Forest Service
U.S. DEPARTMENT OF AGRICULTURE

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Final Environmental Impact Statement for the 2021 Land Management Plan

Helena - Lewis and Clark National Forest

Volume 5

Appendix G. Response to Comments

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Acronyms

In addition to the acronyms used in the FEIS, the following additional acronyms are used in this appendix.

AMP	allotment management plan
AUL	allowable use levels
CARA	Comment Analysis and Response Application
EPA	Environmental Protection Agency
RMO	riparian management objective
SYL	sustained yield limit

Introduction

This appendix describes the process used to analyze the comments received during the public comment period of June 28, 2018 to October 9, 2018 and includes either direct comments or representative comments and subsequent agency responses to the substantive comments received. A variety of methods were used to inform the public about the DEIS and Draft Forest Plan. These included direct mailings to interested and potentially affected individuals and organizations, news releases, newsletters, media interviews, open houses, contacts with other federal and local agencies, publication of the Notice of Availability in the Federal Register, and website posting at www.fs.usda.gov/goto/hlc/forestplanrevision.

The HLC NF received 1,191 letters; of which there were 1,009 unique letters, 161 form letters, and 21 duplicates. Comments were received from 98 agencies/organizations.

Some comments included literature for the agency to consider. The responses to the literature can be found in a table at the end of this appendix.

Prior to final release of the FEIS in 2021, editorial changes were made to this document in response to the reviewing officers' letter to the objectors. These changes were to clarify some responses. Please note that the responses now primarily refer to the 2021 Land Management Plan, the updated version, which is also referred to as "the Plan" throughout the responses in this document.

Content Analysis Process

Content analysis is a method commonly used by the Forest Service to gather information about comment letters. The content analysis process ensured that every comment was read, analyzed, and considered. Each unique letter was read, and substantive comments were identified and coded by major topic. The substantive comments and their coding were entered into the Content Analysis and Response Application (CARA) database, which enabled reports to be run listing all substantive comments by topic. Once the unique and substantially different comments had been coded, the concerns raised by different commenters on the same subject and with the same intent were grouped by topic. Resource specialists combined similar comments into statements that captured the intent of the commenter(s). These statements are the "comments" in the response to comments section. Thus, even though not every comment is displayed in this appendix exactly as written by each respondent, each comment was considered individually. Comments specific to the identification of SCC have been forwarded to the Regional Forester for consideration.

The comment statements are followed by the responses prepared by the team. The interdisciplinary team prepared responses for each comment based on its merits, regardless of the source or whether the comment was expressed by one person or by many.

In considering the comments, it is important for readers and decision makers to understand this process makes no attempt to treat input as if it were a vote. Instead, the content analysis process focuses on the content of the comments and ensures that every comment is considered in the decision process.

Individual letters are not included in this report but can be viewed online in the Content Analysis and Response Application (CARA) public reading room for this project. Go to https://cara.ecosystem-management.org/Public//ReadingRoom?Project=44589.

This appendix documents the Forest Service responses to the substantive comments. The agency responded by:

- modifying the Plan and/or the EIS alternatives;
- developing or analyzing alternatives not given detailed consideration in the draft EIS;
- supplementing, improving, or modifying the analysis that the draft EIS documented;

- making factual corrections; and/or
- explaining why the comments need no further agency response.

Considering Different Types of Comments (substantive/non-substantive)

Agencies have a responsibility under the NEPA to first "assess and consider comments both individually and collectively" and then to "respond… stating its response in the final statement." The content analysis process considers comments received "individually and collectively" and equally, not weighting them by the number received or by organizational affiliation or other status of the commenter. Public comment statements and supporting quotes from public input form the basic summary of public comment and were the primary focus of the interdisciplinary team in considering comments.

In completing the content analysis, comments were identified that fell outside the scope of the forest plan revision. Comments outside the scope do not require a response. Generally, the types of comments that were considered outside the scope include those that:

- Do not address the purpose, need, or goals of the Plan;
- Address concerns that are already decided by federal law or national policy;
- Suggest an action not appropriate for the forest plan decision (such as site-specific decisions to construct new roads, campgrounds or facilities, to offer special use permits, or the sale of timber resources);
- Propose untenable restrictions on management of the Forest or conflict with approved plans not being revised in the forest plan revision process; and/or
- Did not consider reasonable and foreseeable negative consequences.

Once comments were identified as being within the scope, they were identified as being substantive or not. Based on the Council of Environmental Quality's regulations, a substantive comment is one that:

- Questions, with a reasonable basis, the accuracy of the information in the environmental impact statement;
- Questions, with a reasonable basis, the adequacy of environmental analysis as presented;
- Presents reasonable alternatives other than those presented in the DEIS that meet the purpose and need of the proposed action and address significant issues; and
- Causes changes or revisions in the proposal.

Nonsubstantive comments, or concerns identified from them, include those that simply state a position in favor of or against an alternative, merely agree or disagree with Forest Service policy, or otherwise express an unsupported personal preference or opinion.

A response is only required for substantive comments or the concerns identified from them. Responses to substantive concerns are typically more extensive, complete, and most importantly, offer an explanation of why or why not and where the concern may have resulted in changes to the Plan or analysis. If several concerns are very similar, they have been grouped for response purposes. Public comments that identified editorial or other errors in the presentation of information in the DEIS were used to revise text and make corrections for the FEIS.

Commenters and Coding Numbers

Letters received from commenters were numbered. Comments within each letter were then assigned to a comment category. Table 1 includes the individuals and organizations that submitted letters and the categories associated with each letter. Commenters can look for their name and then find the comment categories to refer to see the FS response. Some categories (marked with an asterisk) also have more detailed answers, which can be found in the supplemental appendix G in the project record. The supplemental response to comments in the planning record was meant to be an iterative draft that informed the development of the final response to comments. Not every comment or concern/response category has a detailed response, as they were not necessary, but the level of detail that was captured by some specialists for the more detailed and complex comments could be helpful in the understanding of the final response, so it was preserved in the record.

Table 1. Commenters and comment categories

Last name	First name	Organization name	Letter number	Comment category number(s)
Abelin	Doug		1177	30, 68, 78, 120, 135, 138
Action Committee	CTVA	Capital Trail Vehicle Association	719	30, 66, 67*, 68, 74, 75, 104, 107, 120, 135, 140, 188*, 201, 266
Adair	Robert		34	76, 140
Adams	Stephanie	National Parks Conservation Association	1028	2, 7, 12, 15, 52*, 84, 102, 119*, 138, 192, 275*
Ahrens	James		188	78
Albrecht	Quincie		1119	3, 21
Alford	David		129	83
Allen	Bob	Montana Mountain Bike Alliance	547, 1136	3, 21, 31, 138, 187
Allen	Bob		1139	3, 28, 76, 138, 187
Alley	Katherine		320	3, 76
Allison	Emily Anne		233	2, 5, 16, 34, 93, 102
Allison	John		364	76
Altobelli	Rocco		594	3, 138
Altshuld	Bonnie		856	2, 5, 16, 34, 102
Andersen	Chamois	Defenders of Wildlife	1037	14, 15, 52*, 78, 104
Anderson	Rick		87	82
Anderson	David		357	2, 21, 201
Anderson	Sherman	Sun Mountain Lumber	606	6
Anderson	Ted		728	5, 78
Anderson	Ryan		807	3, 143
Anderson	Kelsey		821	5
Anderson	Heidi		892	18, 2, 5, 16, 34, 102
Anderson	Jennings		955	3
Anderson	Eric		956	3, 28, 31, 38, 76, 138
Anderson	Taylor		1036	31, 138
Anderson	John		1183	23
Angstead	Zach		795, 866	7, 12, 21, 23, 52*, 67*, 175
Angstead	Zach	Northern Rocky Mountain Grotto	1032	107, 122
Ankofski	Greg		383, 596	31, 34, 68, 76, 187

Last name	First name	Organization name	Letter number	Comment category number(s)
Anon	Anon		1, 2, 3, 96, 389, 530, 578, 813, 820	1, 6, 16, 30, 49*, 83, 76, 78, 138
Anon	Jack		35	30
Anon	Anonymous		381	3, 31
Anon	Luke Gorst		440	92, 143
Anon	Leonard		1024	5, 17*, 39, 41, 43, 70, 71, 91*, 96*, 108, 116, 119*, 121, 134*, 161, 162, 177, 180, 184*, 189*, 192, 203*, 239, 260*, 272*
Arlinghaus	Paul	Allegion	365	3, 30, 31, 76, 92
Arndt	Matthew		893	78
Arndt	Michael		1151	21
Arno	Gary		1097	28, 31, 138
Arno	Matt	Montana Department of Natural Resources Conservation	1185	68, 78, 104, 120, 171, 205, 222*, 223, 224, 231, 236*, 258*
Arnold	Anthony		612	3, 31
Ascheman	John		327	1, 30, 78, 135, 201
Ashwood	Lester		201	30
Atchison	Tenlee	Cascade Conservation District	543	183, 237
Aumann	Philip Fulton		649	78
Axhelm	Zoe		1126	2, 5, 23, 33, 34, 102
Babat	Alexander		368	3
Backstrom	James		799	30
Bailey	Jerry		645	78
Baillie	Rusty		399	68, 107
Baker	August		1190	3, 68, 104
Balasky	Cathy		902	7, 23
Ballard	Rebecca		654	7, 34, 102
Barabe	Russell		941	31, 68, 187
Barber	Jack		58	3, 66, 135, 143
Bardwell	Dean		165, 652	30, 68
Barnard	Larry M.		912	78
Barnard	Grant		976	21, 34, 76, 150
Barnes	Jim		469	3
Barnes	Matt		930	28, 31, 76, 78, 138
Barnett	Ann		335	14
Barry	Daniel		1156	67*

Last name	First name	Organization name	Letter number	Comment category number(s)
Barta	Randy		477	207
Bartel	Dan		275	205
Bartlett	Lee		1150	2, 5, 12, 16, 23, 34, 102, 175
Barton	Alex A		661	2, 16, 23, 102
Baskett	Sally		1003	30, 176
Bates	Sarah	National Wildlife Federation	804	15, 59, 72, 119*, 120, 153, 163, 178*, 184*
Baughan	Kalon C		1023, 1118	2, 5, 16, 34, 73*, 102
Baxter	Larry		840	78
Bay	Lisa		591	5, 23, 30, 44*, 150
Bay	Mike		1132	5
Bayer	Joane		184	7
Beardslee	Greg	Montana Mountain Bike Alliance	547	3, 31, 138, 187
Beardslee	Greg		549, 982	3, 78
Beatty	Marvin		678	2, 151
Beck	Scott		446	135, 143
Beckert	Stephanie		91	135
Beckes	Arthur		1110	78
Begler	Henry		191	78
Beier	Dave		429	143
Beischel	Linda		562	5, 14, 15, 150
Bell	Priscilla		161	21
Bender	Bruce		154	2, 3, 5, 16, 34, 102
Benes	Michelle		899	2, 5, 16, 34, 102
Bergan	Faye		1059	5, 23
Bergroos	Raymond		186	78
Bergstrom	Annika		1189	3, 104
Bernhardt	Joseph		390	3, 76
Bertram	Sue		230	2, 3, 5, 16, 34, 102
Bertram	Aubrey R		644	7, 14, 21, 23, 115, 147
Bierly	Craig		452	76
Biggers	Corey		1030	3, 67, 138
Birkes	Lara		182	2, 5, 16, 34, 102
Bishop	Matthew	Helena Hunters & Anglers Association	527	44*, 104, 272*
Bishop	Jodi		676	2, 5, 16, 34, 102
Bishop	Norman A.		688	2, 5, 16, 34, 102
Bishop	Margareta		715	5, 23, 30, 76, 150

Last name	First name	Organization name	Letter number	Comment category number(s)
Blank	D. L.		248	5, 21, 102
Bloomquist	Dean	Golden Valley County Commissioners	408	28, 44*, 135, 184*, 246
Blum	Scott		985	21, 23
Blumenthal	Casey		1105	30
Bodman	Noah	Flathead Area Mountain Bikers	723	3, 76, 138, 208
Bodner	Jay	Montana Stockgrowers Association	1004	1, 18, 108, 116, 163, 219, 228
Boland	Bob		923	5, 23, 102
Bond	Sarah		4	5
Boschert	John		639	68
Bouchard	Kathryn		856	2, 5
Bove	Cliff and Pearl		88	18, 82, 132, 151
Bovingdon	Mark		260	28, 84, 138
Bovington	Tere		159	7, 16, 34, 102
Bowers	Pat		854	17*
Bowman	Jane		223	144
Boyer	Nicholas		102, 952	3, 76, 135
Boyer	Elizabeth		143	28, 31, 138
Boyle	Rich	Fort Shaw Irrigation District	529	67*, 78, 183
Brad	McBratney	Sun River Rental	796	226
Bradford	Sandra		379	76
Bradley	Stacey		104	28, 31, 76, 93, 138, 140
Bradley	Evlyn		891	78
Bradley	James		913	28, 31, 66, 67*, 76, 135, 138
Brake	Matthew		963	3, 31
Brasher	Daniel		895	16, 33, 34
Bray	Tom		231	16, 102
Brewer	Rod	Meagher County Commissioners	471	104, 125, 135, 165, 223, 226, 230
Brooks	David	Trout Unlimited	580	198
Broste	Anders		29	76
Broughton	Kayla	Mountain Bike Guild	602	138
Brown	Lloyd		284	3, 6, 40*, 258*
Brown	David	Elkhorn Working Group	285, 1180	17*, 18, 30, 34, 40*, 44*, 51*, 53, 55, 56, 57, 58*, 59, 60, 67*, 68, 75, 76, 78, 79, 86, 87, 90*, 98, 107, 110, 113*, 119*, 123, 137*, 138, 154,

Last name	First name	Organization name	Letter number	Comment category number(s)
				156, 161, 164, 166, 174, 175, 177, 178*, 184*, 189*, 196, 204, 209, 210*, 213*, 223, 226, 238, 243*, 244, 245, 253, 260*, 279, 287
Brown	Rhett		908	3, 31, 138, 146*, 208
Bruner	Erik		551	92, 138
Bruno	Louis		1171	5, 14, 15, 102
Bucher	William		539	7
Buhl	Timothy		337	34, 138
Buhman	Mike		388	28
Buley	Sara		700	7, 14, 16, 21, 23, 102
Bullis	Rod		316	7, 44*, 63, 90*, 209, 222*, 232*, 287
Burbidge	John		118	31
Burch	Theron		1083	6, 135, 138
Burgess	Aevind		670	2, 5, 16, 21, 34, 102
Burk	Rachel Louise		677	78
Burnham	Bryn L		841	1, 34
Burningham	Dave		1094	76
Bushnell	Jessica	Broadwater County Weed District	523	18, 68
Busse	Ryan		332	14, 76, 102
Butcher	Ross	Fergus County	1063	30, 68, 78
Butterworth	David		524, 525	5, 14, 15, 102, 150
Byerly	Dave	City of Lewistown	552	152*
Byerly	Dave		975	7, 21, 68, 152*
Byrne	Amanda		682	138
Calder	Serena		387	3
Callaghan	Ed		114	21, 67*
Callaghan	E		115	21, 86
Callaghan	Marc		311	78
Callaghan	Noah		319, 359	5, 78
Callaghan	Amelia		323	21
Callaghan	Gabe		360	5
Calvao	Jody		435	28, 135
Calvert	Dale		427	135
Calvert	Wayne		449	135
Campbell	Casey		425	135

Last name	First name	Organization name	Letter number	Comment category number(s)
Canfield	Arthur Gary		1134	2, 5, 16, 34, 102
Cardin	William		1182	5, 14, 15, 102, 150
Carl	Rich		724	2, 5, 16, 21, 26, 34, 66, 78, 90*, 91*, 93, 102, 113*, 131, 147, 152*, 201
Carnahan III	John	Cutthroat Ranch on the Landers Fork, LLC	315	21
Carr	David		1020	5, 23, 76, 150, 267
Carreon	Benjamin		37	31
Carroll	Linda		685, 1099	2, 5, 16, 34, 102
Carson	G. B.		173	2, 21
Caruso-Hirst	Donna		774	5, 14, 52*
Casile	Almer		860	117*, 138
Cassidy	Duane		46, 65, 988	1, 30, 205, 226, 230
Castillo	John		415	138
Cates	Menolly		367	76
Caughron	Clif	Backcountry Horsemen of America	454	34, 76, 154
Chamarro	George		432	201
Chapman	Cheryl		1122	138
Chase	John	Sun River Watershed Group	557	48*, 51*, 53, 67*, 135, 183, 229, 235*, 237, 257
Chenault	David		21	1, 138
Chester	Maryalice		1018	7, 23, 31, 102, 115
Chilson	James A		865	3, 76
Christensen	Kjeld		1000	3
Christensen	Kim		1001	3
Christensen	Hanna		1002	3
Christian	Mark		462	6
Christophersen	Al		285	17*, 18, 30, 34, 40*, 44*, 51*, 53, 55, 56, 57, 58*, 59, 60, 67*, 68, 75, 76, 78, 79, 86, 87, 90*, 98, 107, 110, 113*, 119*, 123, 137*, 138, 154, 156, 161, 164, 166, 174, 175, 177, 178*, 184*, 189*, 196, 204, 209, 210*, 213*, 223, 226, 238, 243*, 244, 245, 253, 260*, 279, 287
Cicon	Kyle		714	3

Last name	First name	Organization name	Letter number	Comment category number(s)
Clark	Cody		294	78, 230
Clark	Bill M		888	78
Clark	Kelsey		929	3, 66, 76
Clarke	Bob		725	71, 174, 175, 176, 177
Clarke	Nick	Yellowstone to Yukon Conservation Initiative	791	14, 18, 21, 67*, 70, 73*, 75, 78, 119*, 149*, 174, 282
Clausen	Leigh		850	2, 5, 16, 23, 34, 38, 102
Clawson	William		174	2, 5, 16, 34, 93, 102, 113*
Cleary	Alan Michael		184	2, 5, 16, 34, 102
Clemens	Phillip		962	30, 78
Cleveland	Emily		1143	2, 5, 16, 21, 34, 102
Clifford	Claudia		812	5, 23, 78
Cohenour	joe	10 Mile/South Helena Forest Collaborative	346, 347	66, 68, 71, 94, 113*, 123, 149*, 152*, 210*, 235*, 243*
Colella	Casey		867	76, 208
Collins	Kyle		23	5, 21, 132
Collins	Wilmot	City of Helena	409	21, 68, 107, 152*, 175, 177
Condit	Kevin		550	3, 76, 78
Connell	Steve		863	78
Conroy	Faith		152, 226	2, 3, 5, 16, 34, 102
Consolvo	Camille Ann		631	5, 21, 38, 151
Contreras	Lisa		380	138, 201, 208
Cook	Christopher		100	3
Cook	Chris		1088	76, 135
Cook	Deborah and Jerry	BHA	1168	5, 23, 78, 197
Cooney	Colin	Trout Unlimited	579, 581	17*, 30, 91*, 112*, 116, 198, 283
Copenhaver	Steve		560	135
Corse	Sarah		516	5, 14
Corzine	Darik		1178	82, 154
Cove	John		453	76
cowdick	bob		192	21
Cox	Keenan		1056	30, 31, 92, 208
Crase	Claudia		693	34, 102
Crawford	Chris		615	30
Crawford	William		683	78

Last name	First name	Organization name	Letter number	Comment category number(s)
Crawford	Jackson		739	2, 5, 16, 34, 102
Cree	Anthony		1074	3, 31, 187
Crissman	Emma		741	78
Crocifisso	Jack		830	78
Cronin	Melissa		1049	3, 76, 138
Cronin	Paul		1080	3, 31, 187
Culpo	Matthew		472	30, 76
Cummings	Amber		1188	3
Cunningham	Bill		362, 370	7, 14, 23, 67*, 175, 187
Cunningham	Bill & Polly		585	5, 14, 15, 102, 150
Curd	Melissa		171	16, 30
Curry	Edwin		218	21
Curtis	Pamala		614	135
Da	David		722	30
Dabler	Dustin		431	6, 92, 135, 138
Daniel	Aaron		53, 54	135
Daniels	Jody		744	78
Danley	Tom		405	76
Dannells	Michael Lynn		632	7, 21, 23, 34
Darling	Scott		127	66
Daugaard	Patricia		1176	78, 138
Davenport	JR		45	5
Davidson	Karen		738	2, 5
Davis	Darlene		468	76
Davis	Cory	Southwest Crown Collaborative	793	51*, 246, 247*, 249*
Dawes	Carol		626	14
De meij	Ann		883	78
Dean	Daniel		483	3, 154
DeBoer	Natalie and Jon		1129	2, 5, 16, 34, 102
Deemer	Mike		404	138, 208
DeGroot	Richard		219	21, 23, 102
Deikman	Steve Edward		760	78
Delger	Mike	Broadwater County Commissioners	376	18, 108
Delmue	Jason	Self	1161	3, 31, 78, 138, 187
Demarais	Julie		643	2, 5, 16, 34, 102, 209
Dendy	John		268	21, 23, 76, 115
Denney	Teresa S		885	5, 23

Last name	First name	Organization name	Letter number	Comment category number(s)
DeVall	Chad		40	3
Deveny	Christine		801	21, 30, 40*, 44*, 63, 78, 160, 176, 209
dias	domingos		496	31, 68, 187
Dickinson	Christine		990	2, 5, 12, 14, 21, 23, 34, 141, 175
Dillenbeck	Beth		846	5, 16, 33, 34, 76, 102, 123, 154
Divoky	Dennis		228, 229	2, 5, 16, 34, 102
Donahue	Larissa		1149	21, 131, 192
Donohoe	Joe		1162	30, 104, 224
Donovan	Nicholas		43	1, 30, 138, 143
Douglas	Aaron		457	76
Downing	Emily		925	2, 5, 16, 34, 102
du mont	lyn		660	5
Duel	Dave		510	30
Duellette	Ken		506	6, 16
Duley	Amanda		953	3, 28, 31, 76
Dundas	Jim		624	6, 78
Dunnington	Alexandra	City of Lewistown	552	152*
Durham	Rebecca		216	78
Eckhardt	Lori		1033	76
Edmo	Kendall	Blackfeet Nation	1193	14, 15, 52*, 54, 102, 123
Edwards	Mike		1052	3, 187
Ehnes	Cory		426	135
Ehnes	Ramona		442, 1047	23, 135, 138, 283
Ehnes	Will		1164, 1166	6, 78, 135, 138
Ehnes	Russ	Great Falls Trail Bike Riders Association	1175	16, 49*, 135, 138, 201
Eisen	Hilary	Winter Wildlands Alliance	128	16, 21, 23, 34, 44*, 45, 61, 66, 67*, 68, 78, 86, 89, 113*, 139, 199, 201, 213*
Eldredge	Bonnie		828	7, 34
Elison	Glenn		627	21, 38, 76, 147
Elliot	Alan		277	135
Ellison	Julie B		633	102
Elsby	Rob		375	138
Emerson	Lauran		926	2, 5, 23
Engle	Donelle		324	21

Last name	First name	Organization name	Letter number	Comment category number(s)
Enk	Michael		476, 587	5, 7, 14, 21, 26, 34, 91*, 96*, 97*, 102, 106, 116, 138, 160, 161, 162, 180, 184*, 189*, 203*, 204, 221, 260*
Ensign	Diane		211	21, 34, 102
Erbach	Kurt		214	2, 5, 16, 34, 102
Erickson	Cody		417	3
Erickson	David R		653	7, 68
Erickson	Pamela		900	5
Erwin	Jaden		777	5, 21, 23, 38, 43, 44*, 71, 72, 75, 76, 90*, 97*, 112*, 175, 176, 222*
Estes	David		475	3, 208
Evavold	Chris		759	21
Faber	Timothy		732, 750	5, 21, 49*, 67*
Faber	Dave		811	3, 6, 28, 31, 76, 135, 138
Fauth	David		64	30
Feckanin	John		217	21
Feinberg	Jackie	The Pew Charitable Trusts	1026	21, 23, 68, 75, 78, 257
Felstet	Brian		423	135
Ferrell	Peter A		681	2, 5, 16, 34, 102
Ferren	Glenn		145	44*, 78, 91*, 112*, 237
Fiaschetti	Aaron		146	3, 31, 92, 135, 138
Fiaschetti	Elisa		1077	16, 28, 31, 76, 138
Fiebig	Michael	American Rivers	24	38
Finch	John		382	3, 31
Fiorita	Richard		698	78
Fisher	Joanne		307	2, 30
Fleckman	Adrienne		829	68, 78
Flint	Kendall	Glacier-Two Medicine Alliance	617	5, 14, 15, 38, 52*, 54, 99*, 102, 150
Fluge	Nick		189	78
Ford	Michael J.		702	7, 26, 186*
Forehand	Dick		861	2, 5, 16, 34, 102
Fortenbery	Luann K.		823	21
Foster	George		274	5, 78
Fox	Robert L.		634	2
Fox	Marla	WildEarth Guardians	1048	40*, 51*, 66, 69*, 75, 78, 81, 87, 89, 99*, 110,

Last name	First name	Organization name	Letter number	Comment category number(s)
				113*, 118, 120, 178*, 182, 189*, 201, 203*, 271*, 275*, 286
Franklin	Richmond W		628	23, 197
Franzen	Joice		75	5
Franzen	Jesse		77	5
Frazer	Eliza		622	5, 67*, 76, 209
Fredrickson	Michael J.		712	2, 30, 68
French	Blaire		534	5, 14, 15, 102, 150
Friedmann	Michael		691	2, 16, 34, 93, 102
Frieze	Mary		640	21
Frost	Rachel	Missouri River Conservation Districts Council	1031	183, 224
Funke	Kyle		450	3, 28, 31, 68, 76
Furlong	Roger		353	5, 21, 23, 38, 43, 44*, 71, 72, 75, 76, 78, 90*, 97*, 112*, 175, 176, 222*
G	Chris		80	30
Gage	Josh		139	3, 31
Gale	Janet Marie		234	2, 5, 16, 34, 102
Galen	Andrew		48	1, 3, 28, 41, 66, 143
Gallagher	Amy Lynn		876	5, 34, 102
Gamon	Aislin		1187	2
Gann	Leah		607	3, 135
Gansauer	Grete		1073	21, 76, 102, 187
Gardella	Lu		340	1, 77, 201, 205
Garrity	Michael	Alliance for the Wild Rockies	410, 411	39, 41, 43, 44*, 58*, 70, 71, 81, 99*, 106, 119*, 121, 127, 134*, 136, 177, 192, 194, 195, 222*, 223, 237, 239, 244, 247*, 248*, 249*, 250, 261*, 262*, 270, 271*, 274*, 275*
Garvey	Lydia		627	2, 5, 16, 34, 102
Gatchell	John	Montana High Divide Trails Partners	790	21, 67*, 68, 78, 152*, 175, 177
Gates	Bob		133	5
Gebo	Keith		783	30
George	Bob		608	30
George	Bret		834	3, 78, 138, 146*, 187, 208

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Gessaman	Kathleen Z		636	2, 5, 16, 34, 102
Getman	Mike		135	21, 30, 68
Gewirtz	Joshua		398	76
Gidley	Alli		22	3
Gidley	Quint		486	31
Gingras	Brian R.		198, 675	2, 5, 16, 34, 102
Glow	Steven		148	5, 23
Goebel	Tia		1116	7, 78
Golb	Richard		782	76
Good	Karyn	Upper Blackfoot Working Group	600	16, 21, 30, 49*, 139, 222*
Good	Margaret Carlin		763	2, 5, 16, 34, 102
Good	Mark		1016	2, 3, 5, 16, 21, 26, 34, 38, 49*, 67*, 73*, 76, 78, 102, 113*, 131, 138, 147, 152*, 210*
Goodhue	Jacob		418	31, 201
Goodman5430	Shelby		103	135, 200, 230
Goodrum	Greg		333	21
Gores	Joanne		886	78
Grace	Patrick		787	5, 14, 21, 34
Granger	Bruce L		752	23
Gravance	Rochelle		141, 870	2, 5, 16, 34, 75, 91*, 102, 112*, 237, 283
Gray	Jeff		868	7, 26, 135, 144
Gray	Randy		922	7, 48*, 69*, 78, 90*, 97*, 151, 201, 225
Greer	Helen		265	78
Gregovich	Gayle		690	21
Gregovich	Barbara		1109	2, 5, 16, 34, 102
Grenz	Susan		256	76
Griffen	Richard		890	3, 68
Grigsby	Dave		570	1, 17*, 77, 81, 135, 138
Grosfield	Janice		931	6
Grosnick	Timothy		391	3
Gullings	Kree		914	2, 5, 16, 34, 102
Gunderson	Kari		657	21, 102
Gunther	Jake		957, 989, 994	16, 28, 31, 34, 45, 67*, 68, 76, 92, 138, 177, 181

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Gunther	Kelsey		1022	16, 28, 31, 45, 66, 68, 135, 138, 177, 181, 187
Guynn	Dr. Dwight Evans		167, 575	30, 78, 119*, 151, 272*
Guynn	Peter		1113	7, 14, 21, 34
Haagen-Smit	Cathy		619	3
Haanstad	Tina		322	21, 68
Habel	Pat		441	6, 135, 138
Hagen	Pat		508	6, 49*, 135, 143
Hagen	Mike		514	135, 201
Haggerty	Jim		42, 767	2, 5, 78, 115
Haggerty	Donna		63	2
Hajenga	Don		276	6, 201
Hale	Dexter		873	21
Hall-Skank	Nick		242	2, 5
Hallinan	Bill		950	78
Hamann	John		317,1170	17*, 43, 75, 84, 164, 170*, 262*
Handelsman	Robert		85, 213	21, 68
Handl	Steven		57, 447	6, 135
Hansing	Scott		1014	68, 208
Hanson	Jay		194	21, 78, 93, 201
Hanson	Mark		747	2, 5, 16, 34, 102
Harber	Will		858	30
Harder	James		521	5, 150
Hardin	Rush		684	2, 5, 16, 34, 102
Hargrave	David		38	16, 68, 209
Harris	Barbara		781	23
Harris	Jennifer		1065, 1089	3, 16, 31, 34, 67*, 138, 187
Hart	Eric		292	28, 31, 76
Hasenauer	Jim		609	3, 31, 76, 187
Hasson	Alex		966	2, 5, 16, 34, 102
Haufler	Jonathan		519	246, 249*, 251, 252*
Haverlandt	Carol		1045	21, 26
Hawke	Tim		287	3, 28
Hazel	Joe		482	31, 138, 187
Heaton	Russ		386	102
Heckel	Jim J		635	5, 21

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Hedquist	Valerie		314	21
Heffern	Roy		224	78
Heidle	Eric		928	2, 5, 34, 154
Heierman	William		98	17*, 78, 201, 230
Heinitz	Nathan		36	66, 143
Heinzig	Dennis Earl		847	2, 5, 16, 34, 102
Heinzmann	Holly		212	7, 16, 102
Helgeson	William		97	30
HELLEKSON	DOUGLAS		940	30, 227*
Hendershot	James		433	135
Henning	Blake	Rocky Mountain Elk Foundation	451	18, 44*, 66, 78, 104, 107, 108, 112*, 135, 237
Henry	Dr. Shani Lee		169	68
Heuwinkel	Ryan		249	3, 76, 138
Hewitt	Diana	City of Lewistown	552	152*
Hibbs	Luc		361	34, 138
Hillstrom	Susan		942	21, 26, 68, 79, 147
Hillyer	Christina		113	30
Hindoien	Chris		90	6
Hinshaw	Michael		498	6, 16, 49*, 135, 138
Hobson	Caroline		1192	3
Hodge	Brad		369	3, 68, 76
Hoffman	Andrew	Great Divide Cyclery	1050	16, 23, 68, 287
Hoisted	Dean		973	7
Holder	Betty		9, 839	21, 147
Holdhusen	Chris J.		689	102
Holeman	Michele		1137	23, 38, 78
Holien	Dave		416	3, 31, 76, 135
Holkup	Patricia A.		857	2, 5, 16, 34, 102
Holmes	Branton		792	76
Holter	Lance		844	7, 23, 68
Holtz	sherie		131	28, 31, 138
Horan	Jan		915	7
Horan	Ben	MTB Missoula	1009	3, 68, 76, 138, 187
Horn	Jack		295	83
Hotovy	Justin Charles		235	7
House	Tim		194	2, 3, 5, 16, 34, 102
Hover	Patrick		601	3
Howard	Loretta		155	21

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Huber	Peggy		882	78
Hudson	Jon	Montana Pilots Assn., Recreational Aviation Foundation	1072	1, 83
Hudson	Hank		1169	21, 31, 78
Humes	Loren		106	112*
Hunner	Bruce		736	23, 68, 113*
Hunthausen	Samuel		537	3, 31
Huntington	Ciarra		646	7, 16, 23, 34, 102, 131
Hyyppa	Craig		1087	3, 16, 31, 34, 138
Infanger	Rocky	TriCounty-Fire Safe Working Group	589	30, 78, 205, 245
Ingalls	Kelly		342	6, 135, 145, 230
Ingman	Gary		488	73*, 97*
Irby	Dustin		79	30
Irvine	Brian		903	7
Ivers	Kevin		301	3, 76
Jabaut	Nicole		290	3, 31, 68, 138, 208
Jacobson	Ken		282	30
James	Lynn		197	154
James	Casey		200	2, 5, 16, 34, 93, 102
Jantos	Jeff		611	3
Jarecki	Chuck		321	83
Jeffries	Tim		203, 204	144
Jenkins	Florence		909	30
Jennings	Charles D		175	2, 5, 93, 102
Jennings	Gerry		210	5, 7, 16, 21, 23, 115, 186*
Jester	Lee		377	151
Jewett	Matt		1055	3, 31, 68, 138, 177, 187, 208
Johnson	Sara Jane	Native Ecosystems Council	410, 411	39, 41, 43, 44*, 58*, 70, 71, 81, 99*, 119*, 121, 127, 134*, 136, 177, 192, 194, 195, 222*, 233*, 237, 239, 244, 247*, 248*, 249*, 250, 261*, 262*, 270, 271*, 274*, 275*
Johnson	Brody		916	78
Johnson	EA Andy		995	17*, 135
Johnson	Cole		1043	28, 31, 45, 138

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Johnson	Peter		1068	2, 5, 7, 16, 34, 102
Johnston	Joan		878	23
Johnston	Jessica		879	2, 5, 21, 23, 34, 43, 45
Jones	Gary B.		140	2, 5, 16, 34, 75, 91*, 102, 112*, 237, 283
Jones	Steven		384, 818	3, 30, 31, 68, 138
Jones P.E.	David J.		710, 1098	7, 23
Joslin	Gayle		625	12, 21, 44*, 48*, 55, 58*, 66, 71, 73*, 75, 77, 78, 84, 86, 90*, 96*, 113*, 119*, 120, 123, 124*, 132, 147, 149*, 154, 156, 161, 184*, 197, 203*, 227*, 232*, 233*, 236*, 246, 247*, 248*, 249*, 272*, 274*, 276, 277*
Juel	Jeffrey	Alliance for the Wild Rockies	1061, 1159	23, 38, 44*, 48*, 51*, 59, 68, 69*, 73*, 74, 75, 78, 81, 84, 86, 87, 91*, 94, 96*, 97*, 99*, 106, 107, 108, 112*, 116, 119*, 120, 125, 126, 127, 137*, 146*, 155, 156, 158, 160, 161, 163, 164, 165, 168, 169, 170*, 171, 172, 180, 182, 184*, 185, 189*, 190*, 203*, 204, 208, 221, 222*, 224, 225, 226, 229, 232*, 235*, 237, 246, 247*, 248*, 249*, 250, 252*, 258*, 260*, 261*, 263, 271*, 272*, 274*, 277*
Juras	Luke		533	138
Juras	John	Great Falls Bicycle Club	568	28, 31, 76, 135, 138
Juras	Evan		934	3, 6, 21, 31, 135
Juras	John		935	81
Kahle	Cora		84	68
Kajkowski	Thad		637	2
Kaler	Matthew		166	2, 5, 16, 34, 102
Kamela	Robert		158	78
Kamm	Wendy		701	5, 7, 23
Kampf	Hannah		832	21
Kantor	Isaac		227	21, 23

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Kantor	Mike and Aleta		629	5, 23
Karinen	Charley		596	5, 21, 67*
Kegley	Brittany		1191	2, 104
Kelley	Aimee		862	2, 5, 16, 34, 102
Kelly	Kyle		363	3, 76, 92, 208
Kent	Paul		968, 1174	1, 5, 21, 23, 44*, 73*, 78, 234, 257
Kent	Vicki		1174	1, 5, 21, 23, 44*, 73*, 78, 234
Kenyon	Sue	Jefferson County Parks, Trails, Recreation Commission	473	68, 107
Kerr	Rick		518, 810	7, 12, 14, 15, 21, 23, 78, 175
Kiehn	Don		565	5, 14, 15, 102, 150
Killen	Sandy		180	200
King	Michael		977	7, 76
Kirsch	Scott		414	3, 138
Kirsch	Cory	Jefferson County Montana	559	68, 107, 108, 225, 230
Klein	Ed		68, 70, 71, 72	17*, 30, 77, 125, 135, 146*, 205
Kligerman	Jack Mark		680	234
Kligerman	Jack		754	78
Kline	Patrick		788	3, 6, 28, 31, 68, 76, 135, 187
Knowles	Randall		11, 49, 123, 124, 262, 312, 325, 338, 339, 341, 461, 621, 797, 1091	30, 46, 67*, 68, 230
Knudsen	B.D.		918	78
Knudson	Ken		1051	5, 21, 23
Kobrin	Benjamin		947	3, 138
Koehnke	Bill F.		1121	23, 66
Konesky	Kelly		437	135
Konsella	Frank		595	3
Kopec	Len		798	14, 21, 68, 102
Kotick	Stephen		826	2, 78
Kotynski	Tom		47	2, 7, 12, 14, 16, 21, 23, 34, 49*, 93, 102, 138, 154, 200
Kovalicky	Tom		241	5
Krause	Ken		509	16, 49*

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Kreidler	Jeffrey S		343, 669, 1120	2, 5, 14, 16, 34, 102
Krier	Rodney		577	1, 6, 16
Krone	Kent & Charlene		199	78
Kronfuss	Brent		39	30, 78, 230
Krueger	James and Margaret		193	2, 3, 5, 16, 34, 102
Krueger	Ryan		936	3, 78, 138, 146*, 187, 208
Krueger	Casey		939	3, 31, 138, 146*, 208
Kubas	Michael		101	3, 5, 66, 138
Kuehn	John C		845	7
Kulesa	Evan	Prickly Pear Land Trust	970	17*, 30, 45, 68, 76, 78, 104, 113*, 152*, 197
Kunen	Julie	Wildlife Conservation Society	1006	15, 104
Kurnick	Rebecca		937	3, 78, 138, 146*, 187, 208
Kurnick	Janna		938	3, 31, 138, 146*, 208
Kurtz	Peter		987, 1152	7, 78, 102
LaGarde	Jerry		163	7, 144
Laird	Scott	Theodore Roosevelt Conservation Partnership	561, 582, 1044	17*, 30, 44*, 65, 67*, 73*, 78, 91*, 104, 107, 112*, 116, 119*, 125, 135, 163, 198, 204, 237, 260*, 274*, 283, 287
LaLiberty	Frank		269	6, 28, 31, 135
Langlois	Ed	Back Country Horsemen of the Flathead	422	102
Langstaff	Larry		695	2, 5, 16, 23, 33, 34, 76, 102, 154
Larsen	Curtis		730	5, 23, 30, 34, 76, 208
Larson	Nancy		969	78
Lassila	Chris		1167	6, 135, 138
Lauer	Ann		791	2, 5, 21
Lawler	Kate		1195	68
Lawley	Gregg		816	3, 31, 138
Layman	Karen		1111	21, 30, 78, 108, 230, 234
Leatham	John		318	28
Leatham	Chris		924	3, 28, 31, 135, 138, 187
Leathers	Megan		894	30
LeBaron	Anthony		590	3

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Lee	Jeffrey		30	76
Lee	Sean		366	76
Lee	James		392	76
Lee	Kenneth		699	7
Leffingwell	Margery Ann		238	78
Lehfeldt	William	Golden Valley County Commissioners	408	28, 44*, 135, 184*, 246
Lehl	Brian		1085	76, 78
Lehman	Aubree		1008	16, 28, 31, 45, 76, 78, 138
Lehman	Lindsey		1008	16, 28, 31, 45, 76, 78, 138
Lehman	Tyler		1008	16, 28, 31, 45, 76, 78, 138
Lehman	Vaidee		1008	16, 28, 31, 45, 76, 78, 138
Lemler	Dan		428	6, 120, 135, 138
Lenard	Susan		1046	5, 23, 76, 150
Lepinski	Devan		297	30
Lepinski	Tyson		563	70
Lewin	Stuart		538	132
Lewis	John	Golden Valley County Commissioners	408	28, 44*, 135, 184*, 246
Lewis	Philip and Barbara J		656	7, 102
Lian	Bret		420	23, 30, 31, 66, 76, 78, 138
Lionberger	Sherri		1181	23
Lipes	Charles		66	30
Lish	Christopher		770	38, 198
Litostansky	Ron	Russell Country Sportsmen's Association	802	6, 51*, 66, 79, 113*, 119*, 135, 201, 210*
Little	Jed		817	3, 135, 138
Littlepage	Dean		855	21
Lloyd	Joseph		419	28, 31, 67*, 68, 76, 138
Lloyd	Allen		991	67*, 138
Lock	Mark		505	16, 49*, 138
Locke	Jacqueline		655	7, 34, 68
Lohrer	Laurie		593	7, 152*
Lojo	Rosemary		874	78
Lonn	Jeff		571	2, 5, 16, 34, 102

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loomis	Clint		122	21, 66, 76, 78, 152*
Loomis	Clint	Big Spring Watershed Council	520	224
Loomis	Clint	City of Lewistown	552	152*
Loomis	Jody		731	30
Loomis	Jennifer		768	30
Loomis	Ashton		769	30
Lowenstein	Roy		1127	2, 5, 16, 34, 102
Lucero	Heather L		641	7, 12, 14, 21, 23, 52*, 67*, 175
Lundstrum	Sarah	National Parks Conservation Association	1028	2, 7, 12, 15, 52*, 84, 102, 119*, 138, 192, 275*
Mabry	Kate		207	2, 5, 16, 34, 102
MacCartney	Douglas L.		884	7
Madden	Brandon		658	76
Madden	William		1038	2, 5, 16, 34, 102
Maddock	Brad	Montana Backcountry Yurts LLC	944	3, 34, 138
Maddock	Brad		948	31, 34
Magley	Beverly		1076	5, 150, 212
Maldonado	Alejandra		264	2, 5, 16, 34, 102
Malek	Frank		492	6, 16, 49*, 135, 138
Malek	Andrew		493	6, 16, 49*, 135, 138
Malek	Gerry		279, 503	6, 16, 49*, 135, 138
Malek	Joyce		522	6, 16, 49*, 135, 138
Malek	Frank	Blackfoot Valley OHV Association	603	16, 49*, 135
Malek	Frank	Upper Blackfoot Working Group	1184	16, 21, 30, 49*, 78, 107
Mangels	Angela		815	3, 31, 138
Manley	Teri		707	5, 16, 33, 34, 102, 154
Mann	Katherine		502	6, 16, 49*, 135, 138
Marckley	Steve		401	76
Mari	David		283	7, 21, 26, 49*
Marks	Gary	Marks-Miller Post and Pole Inc	573	6, 44*
Marks	Kail		616	31, 205
Marks	Steve		981	18, 68, 135, 230
Marolf	Megan		751	2, 5, 16, 34, 102
Maronick	Dan		178	2, 5, 16, 34, 102
Marsh	Wendy		246	2, 5, 16, 34, 76, 102
Martinez	Teresa	Continental Divide Trail Coalition	1160	5, 67, 186*, 188*

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Marty	Debian		648	7
Massick	Kyle		1017	30, 92
Massouh	Donna		1064	14
Matthews	Jonathan		696	2, 5, 16, 34, 102
Matz	Matthew		309	28, 31, 76, 138
Matz	M.J.		310	1
Maxwell	Laramie	Center for Large Landscape Conservation	1062	5, 38, 48*, 58*, 69*, 73*, 75, 99*, 119*, 132, 253, 267
Mazer	Jeff		395	3, 138
Mazuji	Nasrin		330	14, 102
Mazzullo	Sonny		28, 746	2, 5, 16, 21, 34, 102
McArdle	Dan		592	30, 76, 82, 187, 208
McCarthy	Mindy		1104	68, 76, 78
McCarty	Helen Downman		672	2, 5, 16, 102, 154, 208
McCollum	James		270	6, 138
McConnell	Nate		254	5
Mccuen	Dan		55	1, 30
McEvoy	Stephen		555, 1005	23, 78
McGuffin	Patrick		137, 766	5, 33, 34, 78, 102
McIntosh	Ian		421	76
McKelvey	Patrick		1078	78, 223
McKnight	Deva		564	5, 14, 150
McMillion	Geoff		183, 843	21, 102
McOmber	Christie		1066	78
Meagher	Todd		50	30
Meis	Clifford		558	68, 222*, 225
Meloy	Tim		889	7, 176
Melson	Eric		371	3, 76, 138
Mercenier	Jacqueline		358	17*, 21, 28
Mercill	Forest		110	138, 140
Mergler	Jeffrey		344	3, 76
Merrell	Scott		974	76, 78
Merriot	Ivy		848	78
Mertes	Calvin		551	16, 135
Meyer	Eric		185	2, 5, 16, 34, 102
Meyer	Carolyn		880	7, 34, 102
Michael	Ken		438	6, 135

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Michaletz	Jake		393	76
Mickelsen	Brock		138	21
Milhon	Karl		352	23, 76, 83, 154
Miller	Travis		331	102
Miller	Kevin		764	30, 68
Miller	Robert R		838	16, 21, 33, 34, 102
Miller	Ira		1133	31, 78, 138, 208
Mills	Dean		967	38, 76
Mills	Ashea		1102	2, 5, 33, 34, 102
Minow	Terry		1019	76
Minyard	Liz		835	2, 5, 16, 34, 102
Mitchell	Lea		345	68, 78
Mitic	Alex		713	78
Mobley	Bryson		41	1, 3, 41, 143
Moe	Laurie		907	78
Moen	Phillip		144	230
Moon	Sophie		875	2, 5, 16, 34, 102
Moore	Jim		99	140
Moore	Vicki		215	5
Moore	Kevin	Montana Wilderness Association	620	21, 154, 177
More	Robert		266	5, 21, 34
Morgus	Gregory		1114	2, 5, 23, 30, 34
Morton	Scott		1069	76
Mueller	Lisa		822	2, 5, 16, 34, 102
Mulcare	Lindsey		497	6, 16, 49*, 135, 138
Mulcare	Tim		499	6, 16, 49*, 78, 135, 138
Mulcare	Maggie		526	6, 16, 49*, 135, 138
Murnion	David		358, 544	14, 17*, 21, 28
Murnion	David & Jacqueline		545	194
Murphy	Sean		412	76
Murray	Chris		125	5
Muse	Zach		56	135, 205, 230
Myers	Karen		1141, 1146	14, 21, 23
Nawrocki	Joe		554	76, 78
Nedom	Woody		240	21, 78
Neher	Dan		911	78
Nelson	Jerry Nelson		308	76
Nelson	L		334	14, 102

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Nelson	Raymond		905	3, 138
Nelson	Peter	Defenders of Wildlife	1081	17*, 44*, 48*, 66, 67*, 69*, 73*, 76, 77, 78, 87, 90*, 91*, 94, 96*, 97*, 99*, 101, 105, 112*, 116, 119*, 120, 157, 161, 162, 163, 165, 178*, 184*, 189*, 190*, 191*, 203*, 204, 221, 222*, 225, 229, 232*, 235*, 236*, 241, 242, 246, 248*, 249*, 252*, 262*, 263, 271*, 272*, 274*, 275*, 280
Nelson	Danica		1093, 1144	6, 31, 68, 76, 104, 146*
Nelson	Catherine I.		1155	7, 17*, 23
Newman	Richard		243, 704	2, 5, 12, 14, 16, 21, 23, 34, 90*, 102, 197
Newpower	Scott	Recreational Aviation Foundation	303	83
Nicholls	S		491	6
Nirgenau	Paul		1130	31, 187
Nixon	Brian		494	31, 68, 76, 108, 138
Nolte	Miles	Tributaries Digital Cinema	136	5, 44*, 78, 90*, 131
Norderud	Brian		638	21, 28, 31, 45, 78, 138
Norland	Brady		1135, 1158	5, 76, 78
Northy	Paul		1131	21
Nyberg	Harvey		463	66, 108, 112*, 147, 152*, 201, 204, 231
O'Brien	Mary		711	7, 102
O'Connor	Connie K.		1123	5, 23
O'Hara	Tim		142	28, 31, 138
Oates	David		507	16, 30, 49*
Obert	Laura	Broadwater County Commissioners	376	18, 108
Odell	David		244	5
Oldenburg	Diane	City of Lewistown	552	152*
Oliver	Adam	Southwest MT Mountain Bike Assn.	814	31, 34, 45, 76, 138
Olsen	Lance		5, 13, 14, 15, 16, 17, 19, 20, 25, 26, 27, 33, 44, 51, 52, 59, 60, 61, 62, 76, 78, 89, 92, 95, 117, 121, 126,	47, 48*, 261*

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			250, 251, 252, 253, 255, 256, 257, 258, 271, 288, 289, 298, 299, 302, 306, 313, 487, 528, 535, 536, 584, 599, 717, 779, 780, 785	
Olsen	Lois		485, 553	17*, 21, 30, 34, 39, 40*, 44*, 51*, 53, 56, 57, 59, 60, 70, 71, 75, 84, 86, 90*, 98, 107, 108, 110, 113*, 137*, 154, 156, 166, 174, 177, 178*, 182, 184*, 189*, 196, 209, 213*, 226, 243*, 253, 260*
Olson	Curtis		720	3, 68, 208
Olson	Karen		998	3
Olson	Erica		1138	28, 78, 138, 208
Opperman	Fred		232	5, 17*, 21, 23, 93
O'Neil	Devon		808	3
O'Neil	Jason		1163	45, 187
Ormseth	Douglas		497	3
Orr	Jim		515	30
Orr	Taylor		1107	7, 21, 23, 33, 34
Orsello	William		1015	5, 49*, 78, 119*, 120, 135, 138, 154
Ortega	Jolyn		202	2, 5, 16, 34, 102
Osher	Josh	Western Watersheds Project	1090	18, 66, 78, 90*, 91*, 95, 106, 108, 119*, 120, 145, 158, 160, 161, 163, 164, 180, 184*, 185, 238, 277*
Osiecki	Joseph		705	78
Ostlie	Nancy	Great Old Broads for Wilderness, Bozeman Broadband	18	5, 23, 78
Ousley	Dalton		663	78
Overfelt	Kent		439	135, 143
Oviatt	Ms. Brenda G		181	2, 16, 30, 78
Palmer	Denny	Montana Bicycle Guild, Inc.	993	2, 16, 21, 28, 31, 34, 45, 66, 76, 104, 138, 177
Palmer	Denny		1027	16, 28, 31, 34, 45, 68, 76, 138, 177, 181

Last name	First name	Organization name	Letter number	Comment category number(s)
Pannell	Kenny Z		833	21
Parke	Jason		12	2, 76
Parker	Michael		827	2, 78, 102
Parson	Harley		773	68, 138
Patterson	Scott		727	21, 23, 34, 45, 61, 66, 78, 86, 93, 139, 199, 213*
Patterson	Don		1060	78
Patton-Griffin	Sharon		208	78
Paul	Don		385	28
Paulin	Robin		733	68
Paulson	Kyle		94	2, 5, 82
Pavkovich	Anthony Stephen		686	2, 5, 16, 21, 23, 33, 34, 102
Pearson	William		566	5, 150
Peaslee	Rick		83	30
Perkins	Kyle		946	138
Perkins Drishinski	Casey	Montana Wilderness Association	1054	2, 5, 12, 14, 16, 21, 23, 26, 30, 34, 49*, 66, 67*, 68, 76, 77, 78, 93, 102, 131, 174, 201, 207, 214, 237
Pester	Skyler		1115	67*, 68, 78
Peterson	Collin Jeffrey		172, 851	2, 5, 16, 33, 34, 74, 78, 102
Peterson	Preston		336	68, 135
Peterson	Tami	Bch Flathead member	378	76
Peterson	Joel		574	5, 15, 102, 150
Pfaff	Beth		245	2
Phelps	Holly	City of Lewistown	552	152*
Philips	David		540	5, 14, 15, 73*, 76, 150
Phillips	Harold		964	5, 21
Pierce	George		455	30, 68, 135, 205
Platt	Steve	Montana Backcountry Hunters and Anglers	489	5, 21, 38, 43, 44*, 71, 75, 76, 78, 90*, 97*, 102, 177, 222*, 225
Platt	Steve		959	5, 21, 40*, 44*, 49*, 76, 78, 82, 90*, 102, 138, 146*, 154, 201
Ployhar	James	Blackfoot Chapter of Gold Prospectors Assn of America	281	201
Plummer	Michael		618	76

Last name	First name	Organization name	Letter number	Comment category number(s)
Poncelet	Cameron		424, 960	6, 30, 34, 135, 138, 179
Porte	Sanna		729	5, 23, 76, 150
Porter	Dotty		500	30
Porter	Rick		501	16, 30
Porter	Karen W.		1142	7, 78, 115
Powell	Douglas		997	5, 21, 78, 146*
Powell	Maisie		1012	14, 102
Powers	Debo		1172	5, 14, 15, 102, 150
Pozgar	Christopher		758	68
Prange	Chris		679	21
Prather	Steve		869	2, 5, 16, 34, 102
Pratt Jr.	Peter		697	7, 147
Prison	Reid		1103	76
Prissel	Mitch		943	76
Publieee	Jean		86	81
Purcell	John		837	68
Pysher	Lance	Bitterroot Backcountry Cyclists	546	23, 31, 104, 208
Quigley	William		984	68, 208
R	Annmarie		466	138
Radlowski	Matt		349	3, 76, 92, 138
Raleigh	Kenneth		305	3, 31, 76
Ramirez	Dr. Jorge		239	30
Ramos	Peter		789	68, 76
Rasmussen	Robert		7, 1039	7, 12, 14, 21, 38, 39, 78, 82, 177
Rau	Thomas		394	76, 208
Rausch	Nancy		735, 743	2, 5, 16, 34, 68, 102
Ray	Robert	Helena United Cycling	261	34, 76, 138
Read	Donald		972	2, 5, 16, 34, 102
Reed	Anthony		737	34, 68
Reeves	Jordan	The Wilderness Society	1035	5, 12, 23, 52*, 62, 65, 66, 67*, 72, 73*, 74, 75, 78, 104, 110, 130*, 138, 146*, 153, 160, 174, 177, 178*, 275*
Reeves	Linda		1112	2, 5, 16, 34, 102
Renander	Zara		176	144
Ressberg	Richard		443	6, 143
Reynolds	Josie	Broadwater Conservation District	1010	38, 108, 119*, 135, 156, 230

Last name	First name	Organization name	Letter number	Comment category number(s)
Rhoades	Gerry		901	2, 5, 138
Rice	Bonnie	Sierra Club	1084	5, 7, 14, 21, 38, 66, 73*, 96*, 119*, 175, 275*
Richards	Laurie		1066	68, 78
Richards	Doug		1067	78
Richardson	Gail and John		776, 920	7, 14, 16, 21, 23, 34, 45, 102, 200
Riemer	Jeff		877	2
Riley	Brendan		1086	31, 76, 177
Robertson	Kent		396	76
Robinson	Brett		481	3, 31, 68, 187
Robinson	Amy		1007	21, 23, 41, 177, 187, 200
Rodabaugh	Owen		805	31, 76
Roe	Laura		849	2, 5, 16, 34, 102
Romine	Mike		82	30
Ronan	Bob		906	2, 5, 16, 23, 33, 34, 78, 102
Roper	Dan		695	2, 5, 16, 34, 102
Roppo	Joshua		919	78
Rosario	Jill		819	78
Rosin	Cindy		665	2, 5, 16, 34, 102
Ross	Tom Bradley		755	2, 16, 34, 93, 102
Rostect	Bob	Blackfoot Ch. of Gold Prospectors Assn. of America	281	201
Rotar	Mark		852	5
Roubik	Sarah and Andy		1140	23, 78
Routa	Robert	Elk Creek Minerals LLC	280	17*
Rowan	Lynda		272	78
Royer	Fritz and Amy		898	7, 197
Rupp	Gretchen		1173	78, 86, 101, 116, 155, 158, 184*, 202, 203*, 222*, 232*, 248*, 281
Russell	Alex		190	144
Ryan	Terry		397	76
Ryter	John Wesley		825	7
Salisbury	Russell		921	21
Salmon	Marni	The Pew Charitable Trusts	263	2, 3, 21, 38, 67*, 78, 104
Sammons	Dave	Lewis and Clark County Rural Fire Council	775	75, 78, 138, 245

Last name	First name	Organization name	Letter number	Comment category number(s)
Samuels	A. K.		293	76
Sanchez	John		436	135
Sanders	Clarence Raymond		765	2, 5, 16, 34, 102
Sanders	Nathan		1082	16, 45, 138
Sauer	Greg		31	2, 21, 23, 132, 147
Schara	Trent		109	135
Schatz	Deborah		356	14, 102
Scheunemann	Anita		757	2, 5, 16, 34, 102
Schilling	John		479	31, 68, 187
Schmid	John		671	78
Schmid	Katherine P		1154	151
Schmidt	Matt		1092	28, 31, 68, 76, 82, 92, 138, 208
Schmitt	Anna		749	7
Schoen	Laurie		650	78
Schoenfeld	Mark		470	31
Schott	Ms. Sandy L		170	2, 16, 34, 93, 102
Schroeder	David		1125	16, 28, 31, 34, 45, 66, 76, 138
Schultz	Pete		961	30
Schwanke	Corbin		1079	76
Schwarz	Kurt	Maryland Ornithological Society	132	2, 5, 16, 23, 34, 102, 104
Schwyn	Penelope		400	31, 68, 138
Schwyn	Craig		413	3, 31
Scown	Pat		971	76, 192
Scraggs	David		610	30
Secrest	Jess		588	78, 126, 135, 165, 224, 225, 226, 228
Sedgwick	Meg M		642	2, 5, 16, 34, 102
Sedlack	Elaine		1029	14, 15, 21, 23, 73*
Sedlack	Jaye Marie		1145	2, 5, 16, 34, 93, 102, 113*
Sedlock	Michael		1034	30, 78, 135, 146*
Sedlock	David		1106	16, 30
Sem	Steve		567, 992	6, 30, 84, 112*, 135, 201, 210*
Sem	Christy		729	6
Senecal	Cortney		1128	16, 28, 31, 45, 76, 138, 181

Last name	First name	Organization name	Letter number	Comment category number(s)
Seninger	Steve		709	7, 23, 102
Sentz	Gene and Linda		10, 326, 666	2, 5, 14, 21, 34, 48*, 55, 102
Severtson	Eric		784	78, 138
Shabbott	Mary		756	2
Shank	Jana		434	28, 135, 138
Sheets	David		932	6
Sheets	Trygg		933	6
Shefelbine	Paul A		706	68
Shelden	Jeff		116	21, 138, 152*
Shifrin	Brooke	Greater Yellowstone Coalition	1057	21, 74, 99*, 119*, 275*, 277*
Shockley	Richard		8	21
Short	Robert		120, 44, 445	6, 7, 16, 49*, 135, 138
Shotnokoff	Tiffany		108	30
Shovers	Brian		996	2
Shryer	Jeff		703	2, 5, 16, 34, 102
Shuler	Elizabeth		958	6
Shull	Donna		556	5, 14, 15, 102, 150
Sisk	Cory		734	78
Sisk	Carol		864	16, 17*, 34, 102
Sivers	Eric		721	31, 34, 44*, 45, 76, 135
Slabaugh	Bucko and Amy		407	3, 31
Slawson	Cassie		604	6, 135, 138
Slifka	Frank	Boadwater County Commissioners	376	18, 108
Smith	Steven		156	21
Smith	Tony		459	28, 31
Smith	Charles		531	6, 16, 49*, 68, 135, 138
Smith	Shannon		532	6, 16, 49*, 135, 138
Smith	Rhett		651	2, 5, 16, 34, 102
Smith	Garrett		692	2, 5, 16, 34, 102
Smith	Susan G.		1101	68, 78
Sophia	Tristan		662	7
Sovner	Nick		1025	5, 23, 76
Spence	Ryan		576	135
Spence	David		718	3, 76
St. Lawrence	Abigail	Rocky Mtn. Stockgrowers Assn.	1147	108, 138, 219

Last name	First name	Organization name	Letter number	Comment category number(s)
Stam	Wendell		348	68, 76, 92
Stansberry	Scott		541	5, 76, 147
Stark	Tom		73, 598	30
Starshine	Dorothy		196	78
Steffen	Jared		896	3, 41, 135
Steinmuller	Patti		613	2, 5, 14, 21, 23, 175
Stephenson	Elizabeth		247	5, 21, 78
Sterinmuller	David		742	14, 102
Steuer	Daniel		374	3, 31
Stevens	Timothy		134	5
Stevens	Shannon		897	31, 45, 76, 138
Stewart	Sarah		149, 354	7, 12, 14, 21, 23, 102, 147, 175
Stewart	Frances		236	78
Stiffler	Loretta J		753	7, 23
Stimpson	Robert		1157	31, 68, 138
Stone	Scott		597	135
Stoops	Hugh		220	2, 16, 34
Strange	Marcus	Montana Wildlife Federation	586	12, 14, 16, 21, 23, 30, 34, 40*, 44*, 49*, 54, 78, 90*, 93, 102, 107, 119*, 175, 197
Straughn	Jon		69	30
Street	Alex		771	2, 3, 5, 21, 23, 30, 66, 68, 78, 104, 138
Strobel	Philip	EPA, Region 8	406	51*, 63, 87, 96*, 120, 137*, 152*
Stroll	Ted	Sustainable Trails Coalition	291	31
Struble	Dan		842	2, 5, 16, 34, 102
Sullivan	Susan		150	21, 23, 200
Sullivan	Derek		1011	1, 16, 28, 31, 45, 68, 76, 138
Summerscales	Rodney		372	138
Summerscales	Tiffany		373	3, 76
Sundy	Ben		495	3, 31, 67*
Surgenor	Chris		1040	68, 76
sutej	chad		107, 513	6, 16, 135, 257
Sutherland	Shari Weston		694	147
Swan	Greg		474	135
Sweeney	Scott		350	21, 23

Last name	First name	Organization name	Letter number	Comment category number(s)
Swenson	Gigi Dundas		872	5, 12, 16, 21, 78, 138
Swenson	Chuck		917	2, 5, 16, 34, 102
Taber	David		583	16, 49*
Tew	Craig		81	1
Thibaudeau	Mary		667	78
Thomas	Jim		74	5
Thomas	Shannon Kinsella		157	2, 5, 14,16, 34, 93, 102
Thompson	Brian		6	2
Thompson	Cameron		402	30, 31, 68
Thompson	David		623	30
Thompson	Vince and Denise		1013	78, 107, 108, 120, 135, 155
Thornton	Cheri		1070, 1075	76, 104
Thums	Daniel		1108	3, 76
Thums	Patricia		1117	3
Tighe	Dennis		716	5, 7, 14, 21, 23, 34, 147, 176
Tjaden	Steve		512	6, 16, 49*
Todhunter	Jason	Montana Logging Association	548	6, 135, 143, 231
Tompkins	Ed		904	7, 78
Townsley	Lea		67	68
Trenfield	Gail		153	12, 21, 90*, 147, 151, 175
Trujillo	Ric		403	76
Tureck	Hugo		1124	76
Turk	Patty	City of Lewistown	552	152*
Turnquest	Joshua		740	2, 5, 16, 34, 102
Tuss	Darrell		1179	1, 205
Tyler	Jack		304	83
Updike	Jonathan		109, 1148	6, 30, 31
Van Tine	Jeff		673, 772	2, 16, 23, 34, 76, 115
VanOverbeke	Bryce		130	138
VANTINE	Jeff		949, 1042	5, 14, 15, 67*, 75, 102, 150, 154
Vejnoska	Andy		480	31, 68, 187
Vignere	Joel		853	78
Villasenor	Estela	Montana Mountain Bike Alliance	547	3, 31, 138, 187
Villasenor	Estela		1153	3
Vitale	Frank		748	5, 14, 102

Last name	First name	Organization name	Letter number	Comment category number(s)
Vitoff	Micah		806	30, 76
Vogl	Zach		179	78
Vogler	Robin		160	2, 5, 16, 34, 102
Von Bergen	Bing		328	6, 135
Wagner	Jess		460	2, 18, 108, 274*
Walden	John		300	28
Wales	Rob		273	3, 28, 31, 138
Walker	Molly		205	93
Walker	Mike		296	3, 28, 31, 68
Wall	Raylene		668	2, 5, 16, 34, 102
Wallace	Shirley	Montana Wilderness Association	1165	2
Walsh	Dr. Steve J.		209, 674	7, 16, 21
Wantink	Courtney		745	14, 102
Ward	Pete		177	16, 102
Warford	Billie		647, 836	7, 34, 76, 102
Warhank	Murry		979	68, 76
Warr	Thomas		448	135, 138, 201
Warren	Sean		111	30
Warren	Bonnie		237	5, 41
Warren	Greg		664	5, 12, 66, 67*, 77, 78, 90*, 113*, 117*, 124*, 186*, 188*, 205
Wasser	Brandon		800	3, 76
Watson	Mikie	imtbtrails.com	478	31, 68, 187
Watson	Vicki		927	2, 5, 16, 34, 102
Watson	Ryan		945	76
Wear	Emma		168	7, 12, 21
Weber	Cristy		456	76
Weinstein	Lawrence		630	2
Weiser	Jill		187, 659	21, 78
Welch	Jeff		803	3, 138
Wellner	Rich		93	83
Wells	Jerry		980	5, 23, 44*, 76
Weltzien	Dr. O. Alan		167	2, 5, 34
Westphal	Bruce		809	6
Wheeler	Gregg and Wendy		1053	2, 5, 16, 34, 102
Whetzel	Jane		221, 222	2, 5, 16, 34, 93, 102
Whirry	Gordon		119, 542	2, 5, 14, 21, 34

Last name	First name	Organization name	Letter number	Comment category number(s)
White	Kerry	Citizens for Balanced Use	1186	30, 49*, 66, 67*, 68, 78, 112*, 120, 135, 138, 201, 266
Whitnah	Garrick		495	3, 31
Wilhelms	Don		430	135
Wilkins	Cameron		986, 987	66, 135, 143
Willett	George		286	90*, 199
Williams	Tom	Elkhorn Restoration Committee	285	17*, 18, 30, 34, 40*, 44*, 51*, 53, 55, 56, 57, 58*, 59, 60, 67*, 68, 75, 76, 78, 79, 86, 87, 90*, 98, 107, 110, 113*, 119*, 123, 137*, 138, 154, 156, 161, 164, 166, 174, 175, 177, 178*, 184*, 189*, 196, 204, 209, 210*, 213*, 223, 226, 238, 243*, 244, 245, 253, 260*, 279, 287
Williams	David		786	30
Williams	Martha	Montana Fish, Wildlife & Parks	1041	17*, 21, 41, 43, 44*, 51*, 58*, 62, 63, 68, 69*, 71, 72, 73*, 74, 75, 77, 78, 84, 86, 91*, 97*, 104, 106, 107, 108, 110, 112*, 116, 119*, 120, 121, 124*, 134*, 146*, 149*, 156, 161, 162, 163, 174, 177, 180, 184*, 189*, 192, 194, 201, 203*, 204, 227*, 228, 243*, 244, 247*, 252*, 255, 269, 271*, 272*, 287
Williamson	Mike		951	16, 21, 31, 135
Wilsey	David L.		708	2, 5, 16, 21, 34, 102
Wilson	David		151	2, 5
Winberry	Alma		954	17*, 67*, 78
Winestine	Zack		910	2, 5, 16, 34, 102
Witschard	Moe		658	2, 5, 16, 34, 102
Wolar	Glynn		32	7, 21, 23
Wold	Norman		978	6, 138
Wolf	James	Continental Divide Trail Society	517	5, 40*, 66, 76, 78, 110, 113*, 117*, 130*, 138, 146*, 186*, 188*

Last name	First name	Organization name	Letter number	Comment category number(s)
Wolfe	Lynne		794	3, 78, 138, 146*, 187, 208
Wollenzien	Barry		206	44*
Wood	Brian		1071	76
Woodrow	Erin		999	31, 45, 209
Wool	Bobby	Motorcycles of Atlanta	605	68
Woolley	John		871	7
Woolsey	Brad		484	3, 76
Workman	Garrett		329	6, 7
Wright	Jo Ann		983	21
Wuerthner	George		112	21, 23, 67*
Wyberg	Bryan		762	5, 23, 33, 34, 102, 151
Wyntjes	Cassidy		490	3, 31, 68, 187
Xanthopoulos	Susan E.		831	78
Yack	Vince		778	68, 78
Zakheim	Hugh S.		1100	7, 230
Zale	Geary		225	21
Zammit	Tony		1021	16, 28, 31, 34, 45, 66, 78, 104, 138
Zarr	Ron		105, 504	1, 6, 16, 49*, 68, 78, 138
Zarr	Julie	Ponderosa Snow Warriors Snowmobile Club	464	6, 143
Zelasko	Sandy		351	14, 102
Zimmerman	Mark Andrew		1058	14, 21
Zink	Terry		887	78
Zrimsek	Alanna		881	7, 34

Responses to Comments

The following is arranged by resource, in the same order as they are presented in the FEIS. In addition, two other categories (General and Geographic Areas) were added at the beginning to capture the comments that were not necessarily resource related (such as editorial and others).

Alternatives – General support/opposition

CR1 Alternatives A – Support

Concern: Commenters in support of alternative A.

Response: Thank you for your comment.

CR2 Alternatives B – Support

Concern: Commenters in support of alternative B.

Response: Thank you for your comment.

CR3 Alternatives C – Support

Concern: Commenters in support of alternative C.

Response: Thank you for your comment.

CR5 Alternatives D – Support

Concern: Commenters in support of alternative D.

Response: Thank you for your comment.

CR6 Alternatives E – Support

Concern: Commenters in support of alternative E.

Response: Thank you for your comment.

CR140 Alternatives A and E – Support

Concern: Commenters in support of alternatives A and E.

Response: Thank you for your comment.

CR143 Alternative D – Oppose

Concern: Commenters oppose alternative D.

Response: Thank you for your comment.

CR269 Alternatives A and E – Oppose

Concern: Commenter does not support alternative A or E.

Response: Thank you for your comment.

General

CR12 CDNST – General Support

Concern: Commenters support the plan components which provide protection for the Continental Divide National Scenic Trail.

Response: Thank you for your comment.

CR51 Monitoring - General

Concern: Multiple commenters had concerns about the HLC NF monitoring plan, including that the Plan is inadequate, not detailed enough, not likely to be funded and/or completed, lacks treatment effectiveness monitoring, lacks sustainable recreation monitoring, and does not meet adaptive management requirements. There were also requests for the FS to add a monitoring guide for public review and comment.

Response: The Plan monitoring program (appendix B of the Plan) addresses the most critical components for informed management of the Forest's resources within the financial and technical capability of the agency. Every monitoring question links to one or more desired conditions, objectives, standards, or guidelines. However, not every plan component has a corresponding monitoring question.

The Forest used the best available scientific information in the development of the monitoring plan, considering expected budgets and agency protocols. In the implementation stage of the 2021 Land Management Plan, if a monitoring guide is needed, it would be developed then. The monitoring guide is not required forest plan content.

CR66 New/combined Alternatives

Concern: Commenters suggested additional alternatives, modifications to alternatives, or combinations of alternatives.

Response: Thank you for your comments and suggestions. We have considered this additional information and have made some minor changes to the alternatives, as well as developed the preferred alternative based on public comment on the DEIS - all still meeting the purpose and need. Please refer to the "Comparison of Issues by Alternative" "Comparison of Issues by Resource" tables in Chapter 2 of the DEIS and FEIS. The tables cover the different resources in the planning area. Also included in Chapter 2 is a list of “Alternatives Not Considered in Detail” which includes many of the commenters’ suggestions and the FS’s rationale for not considering the suggested alternatives in analysis.

CR67 Attachments – No Further Response Required

Concern: Commenters provided attachments in support of their statements.

Response: Thank you for your comments and submissions. All of them were reviewed and many of the ideas and suggestions were incorporated into the Plan, the preferred alternative, or the FEIS. Please see the corresponding sections of those documents.

CR77 Maps and Data

Concern: Commenters sought additional maps or clarification on existing maps, including:

a. Question on why there was no map for alternative E.

b. Request for existing roads and new wilderness to be included on map UB15_DesArea8x11AltBC.pdf.

c. Concern that the maps did not have enough detailed information/features.

d. Request for the Elkhorns GA IRAs to be included on maps.

e. Request for geospatial data to be provided on our website.

f. Request for more detail to be added to the maps, roads, rivers, creeks, continental divide, etc. make available on-line.

g. It is hard to compare ROS alts B and C as the maps are the same.

h. Request for a map of lynx habitat, including areas where habitat has been added or reduced.

Response:

a. All maps can be found in appendix A (of both the Plan and the FEIS), including maps for alternative E.

b. Map UB15_DesArea8x11AltBC.pdf is designated areas for the Upper Blackfoot GA. This map is limited by size and scale, therefore adding all the open roads would make the intent of this map difficult to read. The first map in each GA grouping shows more detailed roads, streams, and land ownership for reference.

c. The maps are limited by size and scale, therefore adding all the open roads, streams, and land ownership would make these maps difficult to read. The first map in each GA grouping shows more detailed ownership, roads, streams for reference.

d. E19_IRA8x11.pdf that is found in appendix A of the DEIS did have the IRA listed in the legend and on the map. Unfortunately, the name of this IRA was confusing. It was labeled "Elkhorns Wilderness Study Area Plus Additions". Between the DEIS and FEIS the FS went through the formal process to change the name to "Elkhorns".

e. Geospatial data is available by request.

f. The maps are limited by size and scale, therefore adding all the open roads, streams, and land ownership would make these maps difficult to read. The first map in each geographic area grouping shows more detailed ownership, roads, streams for reference. In chapter 1 of FEIS, as well as in the Plan you will find a vicinity map and a forest geographic areas map for reference. Geospatial data is available by request.

g. The maps do not vary between alternatives B and C for ROS summer, but they do for ROS winter. Please refer to the comparison of alternatives in chapter 2 of the FEIS and in the individual resource analysis sections.

h. The maps are limited by size and scale, therefore adding both the previous lynx habitat and the revised lynx habitat to the same map would make these maps difficult to read and understand.

CR78 Comment Noted

Concern: Comment letters included introductory narrative and other information that was reviewed and noted with no further response required.

Response: Thank you for your comments. No further response will be provided for those comments that were:

- unrelated to the decision being made,
- already decided by law, regulation or policy,
- beyond the scope of the proposal,
- conjectural in nature or not supported by scientific evidence, or
- general in nature or without position statements.

CR81 Public Involvement

Concern: Commenters expressed concern over the public involvement process, including the use of GovDelivery to distribute information, the format of meetings, the complexity of documents, the notice given for public meetings, and the use of the comments.

Response: The FS used an email delivery system called GovDelivery. This system enables the agency to efficiently reach thousands of interested publics (in excess of 12,000 people signed up to receive information via this system). Interested publics had numerous ways to interact with the Revision Team - via telephone, postal mail, meeting attendance, in person, and emails. Meeting announcements and other updates were sent through this system, as well as through postal mailings, newspaper announcements, posters, website postings, and the Federal Register.

All of the public meetings involved information sharing and feedback retrieval. Some of the public meetings were workshops, where the attendees were tasked with creative problem solving and listening to concerns of others. Attendees were encouraged to visit with other attendees and Forest personnel. It was deemed important for attendees to hear viewpoints of others, recognizing that there are many opinions and interests across the Forest.

The documents created as a result of the analysis are large; they contain years of information and analysis which will be used to guide the Forest for many years. The large documents were broken into chapters and appendices - complete with a table of contents and an index. With the release of the DEIS, a summary was made available. This summary is a 21-page document which summarizes the alternatives and their effects.

The comment content analysis process ensured that every comment was read, analyzed, and considered. Each submission was assigned a letter number and each unique comment was numbered and coded by topic in a database. The comment analysis process makes no attempt to treat comments as if they were votes and therefore give more weight to similar comments made many different people. Instead, the comment content analysis process focuses on the content of the comments and ensures that every substantive comment is considered in the decision process. Previously submitted comments were used to draft alternatives and to consider during analysis.

CR84 Editorial

Concern: Commenters provided editorial input on the documents that ranged from very general comments to specific edits, including

- Edits to appendix C;
- Edits to the Draft Forest Plan;
- Questions about the alternatives;
- Questions about the GAs; and
- Comments about the length of the Plan and supporting documents.

Response: Thank you for your comments. Where appropriate, edits were made to the documents, please see the appropriate sections in the Plan and appendices.

The description of the alternatives as well as a comparison of the alternatives can be found in Chapter 2 of the EIS.

General descriptions of GAs have been adjusted as appropriate. GAs were chosen because they have their own unique characteristics and conditions. They are landscapes that people associate with on the Forest. By using GAs, we are able to fine tune our management to better respond to more local conditions and situations. GAs provide a means for describing conditions and trends at a more local scale if appropriate. They are ecological areas that are synonymous with basin and watershed. Please see Chapter 3 of the Plan for more information.

We recognize that the size of the Plan, its appendices, the EIS, and its appendices is lengthy. However, years of public interaction and analyses have gone into the creation of these documents. Therefore, we have included much of this information in them. Since they will be used for future management, we wanted to provide a consolidated location of information for forest land managers.

CR104 References

Concern: Commenters provided links and citations for reference.

Response: FS specialists reviewed and responded to references provided by the public. The responses can be found in the table included in this appendix.

CR107 Collaboration and Intergovernmental Coordination

Concern: Multiple comments requesting more FS collaboration with local user groups as well as counties and State agencies.

Response: Collaboration with the public, state and local governments, tribes, and other interest groups is a requirement of the 2012 Planning Rule. Youth involvement has also been a focus for the Forest.

The Forest has facilitated an inter-agency working group consisting of county, state, tribal and federal government representatives since the beginning of the forest plan revision process. This group has met semiannually since 2014 and a focus of these meetings was to discuss issues of mutual concern with respect to each agency's policies and/or plans. The FEIS section 2.4 discusses the process of involving the various government agencies as well as consistency of the Plan with the various agencies policies and/or plans.

Public engagement on the forest plan revision process began in 2014 and included four rounds of public meetings in ten communities across the planning area. The first round was an open house introduction to the process, the second was centered around gathering input on the need to change, the third focused on desired future conditions, and the fourth centered on mapping management areas, timber suitability, and recommended wilderness areas. The primary purpose of all these meetings was go gather input from the communities and stakeholders across the planning area. Comments were taken from the public at all the meetings. The Forest also solicited public input via an online mapping tool, the "Talking Points Collaborative Mapping Tool".

Following the release of the Proposed Action and then again after the release of the 2018 Draft Forest Plan and DEIS, two more rounds of public meetings were held across the planning area communities. The primary purpose of these was to provide an introduction to the documents and to the comment process. During both the comment periods (for the Proposed Action and Draft Forest Plan/DEIS), the Forest utilized the online comment database (CARA) to gather comments. The CARA database was also used in coding and responding to the Draft Forest Plan/DEIS comments to assist in the preparation of the FEIS appendix G: Response to Comments. Over 800 original comments were received during the Proposed Action comment period and over 1000 were received during the Draft Forest Plan/DEIS comment period.

Another key component of the involvement and transparency of the public involvement efforts associated with this planning effort has been the information made available to the public through the use of the forest plan revision website. The forest greatly benefited from the use of collaborative mapping tools in receiving input on its wilderness inventory and evaluation process. The availability to provide equal opportunities to anyone who wanted to participate in the planning process was greatly enhanced through our ability to provide web-based information for the public to comment on the process as well as plan components. The forest plan revision website is an excellent source of information of both the current information but also includes record of all the previous public involvement efforts as well.

CR120 Planning/Process/Methodology – No Further Response Needed

Concern: Commenters expressed concern on whether or not the planning rule was implemented properly, including the use/lack of best available scientific information, methodology, analysis, data set and processes; adaptive management; analysis of effects; realistic and measurable goals, and availability for consultation results for comment.

Response: Thank you for your comments.

The FS is required to follow all existing laws, regulations, and policies relating to the management of NFS lands. The 2021 Land Management Plan is consistent with the National Forest Management Act (NFMA), NEPA, and other required guidelines and laws.

The 2021 Land Management Plan and FEIS are being completed under the 2012 Planning Rule. The FS is required to follow all the direction it provides. All suggested references and other scientific information were reviewed. The summary of this review is included in the response to comments section of the FEIS. The results of the FWS consultation will also be included in the FEIS.

CR125 Funding

Concern: Commenters had several concerns regarding funding and the ability of the USFS to meet its requirements with its current or future funding. These questions/concerns included:

- Requests for direction or guidance within the Plan in relation to budget, capability to achieve the goals;
- Request for increasing funding for actions that include active management on the landscape that benefit big game and other upland wildlife species;
- Whether or not the proposed forest plan monitoring program in Draft Forest Plan appendix A is also based on reasonably foreseeable budgets; and
- How budget and staffing increases/decreases, increased/decreased planning efficiencies, unanticipated resource constraints factor into implementation of the Plan.

Response: The 2012 Planning Rule requires the Plan and alternatives to be based on the fiscal capability of the unit. This includes the objectives and the monitoring program. As described in Forest Service Handbook 1909.12 Chapter 22.12, objectives in the Plan were identified through a trend analysis of the recent past budget obligations for the unit (3 to 5 years). In addition, the Plan includes goals or management approaches to use additional statutory authorities for shared stewardship, partnerships, and volunteers to increase capacity to achieve desired conditions and/or conduct monitoring.

The purpose of the Plan is to guide future project and activity decision making. Although some commenters requested an identification of the "cost of the Plan" or portions of the Plan, it would be highly speculative to estimate the cost of plan implementation as specific locations, timing, and activities associated with implementation are unknown at this time. In addition, forest plans do not make budget decisions. Should Congress emphasize specific programs by appropriation, a redistribution of priorities would follow, regardless of the alternative implemented. In all management activities, the Forest would still be required to either be making progress toward, or not be precluding achievement of the desired conditions. Reduced budgets or changed priorities may change the speed at which this occurs but does not change our obligation to meeting them.

CR127 Suggested Alternatives

Concern: Commenters felt that the range of alternatives analyzed was insufficient. Several commenters specifically asked for the HLC NF to consider an alternative that they proposed, including:

- An alternative that maintains 50% of all watersheds as wildlife habitat with no roads or management activities, and the remaining 50% would be managed for timber production; and
- Including an ecocentric/biocentric alternative, which was previously submitted during scoping and was addressed in alternatives not considered in detail in the DEIS. The commenter seeks clarification on why this alternative would meet the laws, regulation, and policies that guide the multiple use management of NFS lands.

Response: Elements of both of these suggested alternatives are included in the range of alternatives. Each of these alternatives is discussed in further detail in the FEIS, in the alternatives considered but not in detail section of chapter 2. The rationale for not analyzing these alternatives in detail include, but are not limited to, inconsistencies with the 2012 Planning Rule and associated directives.

CR196 Law, Regulation, and Policy

Concern: Commenters ask for repeat of Law, Regulation and Policy, as inspections are required by law.

Response: Per the 2012 Planning Rule, the Plan does not repeat law, regulation and policy. All laws, regulations and policies are applicable and will be followed.

Geographic Areas

CR39 Big Belts GA

Concern: Commenters requesting additional information be included to describe the Big Belts GA, including information on cover types and winter ranges, connectivity, additional species in terrestrial vegetation, and additional cultural sites.

Response: Various GA plan component and other editorial suggestions were provided. Changes were made where applicable; please see the Big Belts GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Desired conditions for cover types were added to each GA. Winter range is covered in the forestwide plan components (see FW-WL-DC-06, FW-WL-GDL-05, 06). Please refer to the forestwide plan components for wildlife and fisheries. The GA sections do not repeat forestwide direction, and it was determined that no GA-specific wildlife/fisheries components were needed in the Big Belts GA.

Connectivity was considered in the wilderness recommendation process, as well as in the mapping of ROS areas across the forest, including the Big Belts.

CR41 Highwoods GA

Concern: Commenters provide general support for the protections of the roadless nature of the Highwood Mountains and requests for specific corrections/additions to the GA description, including:

a. Request for standards and guidelines for wildlife;
b. Request for and against primitive for roadless areas in the Highwoods;
c. Request for edits to the information about westslope cutthroat trout;
d. Edits to the Highwoods GA description; and
e. Request for control of noxious weed expansion.

Response: Various GA plan component and other editorial suggestions were provided. Changes were made where applicable. Please see the Highwoods GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

a. Please refer to the forestwide plan components for wildlife. The GA sections do not repeat forestwide direction, and it was determined that no GA-specific wildlife components were needed in the Highwoods.
b. Primitive ROS areas were considered for the Highwoods GA in alternative D but were not included in the preferred alternative.
c. Please see Highwoods GA Ecological Characteristics and westslope cutthroat trout viability. Wording was changed from "restored" to "relatively secure" to reflect that non-native fish have ascended barriers in the planning area in the past. A sentence describing the North Fork Highwood Creek westslope cutthroat trout project was added as was a sentence addressing the need for retention of all westslope cutthroat trout core and conservation in the Upper Missouri River drainage to maintain westslope cutthroat trout viability.
d. Please see Highwoods GA introduction.
e. Noxious weeds are a concern in the Highwoods GA, as well as the other GAs on the Forest. Please refer to the forestwide plan components for invasive plant species. The GA sections do not repeat forestwide direction, and it was determined that no GA-specific invasives components were needed in the Highwoods.

CR43 Little Belts GA

Concern: Commenters recommend a number of edits to the GA description and plan components.

Response: Various GA plan component and other editorial suggestions were provided, thank you. Changes were made where applicable, please see the Little Belts GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Please refer to the forestwide plan components for wildlife. The GA sections do not repeat forestwide direction, and it was determined that no GA-specific wildlife components were needed in the Little Belts.

Commercial hunting permits are not detailed in the Plan.

CR60 Monitoring – GA Level

Concern: Commenters had requests for more specific information or finer scales for monitoring (appendix B of the Plan). Specifically, commenters suggested monitoring some attributes at the GA-scale, such as vegetation attributes, wildlife, recreation, and pollinators. They also suggest the use of the intensified FIA grid for monitoring.

In addition, they suggested that the best monitoring method for elk needs to be determined with MFWP; hunter days alone seem inadequate.

Response: Where appropriate, the suggestions to improve the monitoring plan were incorporated. For example, the 2021 Land Management Plan (appendix B) now contains detailed desired conditions at the GA level for more vegetation attributes. Other factors are better monitored at broader scales. As described in appendix B of the Plan, monitoring for pollinators would occur in conjunction with vegetation monitoring associated with grazing allotments, because grazing would be the primary activity that may influence pollinator habitat. During the implementation of the Plan, a monitoring guide may be created as needed to refine the best scale for monitoring.

The HLC NF installed a 4x intensification of the FIA grid, and this data has been integral in the planning and analysis for the Plan. However, the budget to re-read this data source is uncertain and the Forest is unable to commit to maintain this plot grid over time as a monitoring tool. For this reason, the monitoring plan is designed so that the monitoring can be accomplished using other data sources, such as the base (National) FIA grid and/or VMap, if necessary.

CR70 Upper Blackfoot GA

Concern: Commenters provide recommendations for the Upper Blackfoot GA description and plan components associated specifically with the Upper Blackfoot GA.

Response: Various GA plan component and other editorial suggestions were provided. Changes were made where applicable, please see the Upper Blackfoot GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

In addition to the GA plan components, please refer to the forestwide plan components for wildlife and other resources. The GA sections do not repeat forestwide direction, and only GA specific plan components are included in the GA sections.

CR71 Divide GA

Concern: Commenters recommended edits to the Divide GA description and plan components.

Response: Various GA plan component and other editorial suggestions were provided. Changes were made where applicable, please see the Divide GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR121 Castles GA

Concern: Commenters recommend edits to the Castles GA description and plan components.

Response: Changes to plan components were made where applicable, please see the forestwide Wildlife section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule. Please note that the GA sections do not repeat forestwide direction, and it was determined that no GA specific wildlife components were needed in the Castles.

CR134 Rocky Mountain Range GA

Concern: Commenters offer recommendations for the Rocky Mountain Range GA description and plan components.

Response: Various GA plan component and other editorial suggestions were provided. Changes were made where applicable. Please see the Rocky Mountain GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR174 Elkhorns – Plan Components

Concern: Various GA plan component and other editorial suggestions were provided.

Response: Changes were made where applicable. Please see the Elkhorns GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR192 Crazies GA

Concern: Commenters had specific comments related to the Crazies GA.

Response: Various GA plan component and other editorial suggestions were provided. Changes were made where applicable, please see the Crazies GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Please refer to the forestwide plan components for wildlife and other resource plan components. The GA sections do not repeat forestwide direction, and it was determined that no GA specific wildlife components were needed in the Crazies.

CR194 Snowies GA

Concern: Commenters shared a number of suggestions/recommendations regarding the Big and Little Snowies, including:

a. A request for GA specific wildlife plan components;
b. Questions about timber suitability in the Little Snowies, especially the effects to wildlife;
c. Additional information for the GA description about westslope cutthroat trout; and
d. A request for continued motorized access into the south side of the Big Snowies.

Response: Thank you for your comments, changes were made where applicable; please see the Snowies GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

a. Please refer to the forestwide plan components for wildlife and other resource plan components as the GA sections do not repeat forestwide direction.
b. The FS appreciates your interest in the ecological integrity of the Little Snowies landscape. Several alternatives, including the preferred alternative, do identify the Little Snowies portion of the Snowies GA as suitable for timber production, based on the topography, access, and vegetation conditions of the area. Plan component SN-TIM-GDL-01 underscores the important features of this area by stating that timber harvest and other vegetation management activities should "emphasize ponderosa pine habitat restoration, wildlife habitat, reducing hazardous fuels, protecting communities and values at risk, and providing for public safety." The desired conditions for the vegetation in the Snowies GA are based on a natural range of variation (NRV) analysis, which established the likely range of natural conditions. The Plan does not authorize any site-specific projects. Prior to logging or other treatments, additional NEPA analysis would be conducted. Any future projects planned in this area would adhere to these as well as the full suite of applicable forestwide and Snowies GA plan components, including those that provide for all terrestrial and aquatic species. The FW-TIM plan components also provide additional guidelines and standards designed to ensure that harvest would be conducted in a sustainable manner.
c. The westslope cutthroat trout information has been added.
d. To accommodate established motorized over-snow use and to provide access to the more popular trails for mountain bike use (mechanized means of transport), the RWA boundary in the preferred alternative (alternative F) has been adjusted. The RWA boundary would exclude those trails that access the Ice Caves (Trails #403, #490, and #493) and provide a loop trail riding experience based out of the Crystal Lake Campground complex. The area outside of the RWA would still provide a primitive recreation experience and would be managed for primitive ROS, except in those locations where motorized over-snow use would be allowed under the current winter travel plan. Trails within the RWA boundary would prohibit motorized and mechanized means of transportation in the preferred alternative (alternative F).

CR195 Elkhorns GA

Concern: Comments on the Elkhorns GA plan components.

Response: Please refer to the forestwide plan components for wildlife. The GA sections do not repeat forestwide direction, and it was determined that no GA specific wildlife components were needed in the Elkhorns. Also see Elkhorns GA WMU plan components.

Aquatic Ecosystems and Soils

CR62 Monitoring - Water

Concern: Commenters had concerns with the monitoring plan and appendix B of the Draft Forest Plan related to:

a. Asking for additional tracking of measures of ecological and fiscal sustainability, with respect to roads and trails within subwatersheds, as well as aquatic organism passage; and
b. Requesting more detail about staffing/budgeting to accomplish monitoring goals related to watershed management.

Response: Thank you for your concerns and suggestions dealing with monitoring.

a. MON-WTR-04 through 07 (appendix B) would track and report on the requested data for priority watersheds.
b. The HLC NF realizes staffing, and the completion of required monitoring, would continue to be difficult under today's budgets allocations. The completed monitoring plan (appendix B of the 2021 Land Management Plan) will be released with the FEIS. It has been edited and provides

additional indicators to aid in prescribing adaptive management tools. Staffing considerations and budgeting numbers are outside the consideration of the 2021 Land Management Plan.

CR65 Conservation Watershed Network

Concern: Commenters were generally supportive of the Conservation Watershed Network (CWN), and there were requests for additional information in the FEIS.

Response: Thank you for your comments. The HLC NF agrees that the use of the CWN to prioritize watersheds will support the recovery of these important watersheds. More information was added to App E, please see the Plan.

CR87 Water Quality

Concern: Commenters had concerns with water quality and project best management practices (BMPs) in respect to the Clean Water Act. These included requests for:

a. Additional DC to include highly altered systems;
b. Protections to be included to protect resources from future actions;
c. Editorial corrections;
d. Addition of RMZ plan components to include winter recreation in RMZs east side of the divide;
e. Plan components for new trail construction sediment and compliance with the Clean Water Act; and
f. Road related BMPs to comply with Clean Water Act.

Response:

a. The Forest realizes the difficulty of moving highly altered stream systems to desired conditions. Additions were made to DC-3 to include highly altered systems to move towards stable or improved function towards desired conditions.
b. The Plan includes protections for water quality and quantity as required by the Clean Water Act. The use of BMPs and other mitigations to protect water quality would be implemented at the project level. We agree with your comments that roads affect many processes that in turn affect aquatic systems. The Plan provides plan components to address, minimize, and mitigate the impacts of roads. The EIS may not directly address all the impacts from roads, it does analyze and disclose the effects of the Plan on implementation of forest activities. The 2012 Planning Rule requires the FS to comply with the Clean Water Act, to implement national BMPs on all forest management activities, and to have specific plan components stating if or when individual national BMPs are not required. FW-WTR-DC-04 and 05, FW-WTR-STD-02, FW-RMZ-GDL-04 all provide protections under the Clean Water Act.
c. Corrected in FEIS. FW-WTR-STD-02 requires the use of BMPs to control sediment delivery to streams. The component has been reworded to include road infrastructure BMPs.
d. The adoption of RMZs would increase the area protected on the east side of the divide and would be similar to alternative A on the west side of the divide.
e. Any identification of or new trail construction is beyond the scope of this document. The Plan requires the use of BMPs during planning and construction to mitigate and limit impacts to streams and water resources by new or existing trail system construction/maintenance.
f. This is covered in FW-WTR-STD-02.

CR91 Fish/Aquatic Habitat

Concern: Commenters had concerns about fisheries and aquatic habitat, including: sediment in streams; funding for fisheries management, including removal of barriers, mitigation of mine pollution, and restoration/reintroduction of native westslope cutthroat and bull trout; road density; livestock impacts and setting allowable use standards; consideration of westslope cutthroat trout; and monitoring.

Response: The Plan was developed following the 2012 Planning Rule and is intended to protect aquatic resources. The Plan contains standards, guidelines and objectives to meet obligations under the Clean Water Act, Endangered Species Act (ESA), NFMA, and Federal Land Policy and Management Act. While any management or development carries risk to aquatic resources, the standards and guidelines in the Plan as well as National BMPs and State of Montana SMZ rules were developed to mitigate potential impacts to aquatic ecosystems. The Forest agrees that native trout species that inhabit the planning area are important to protect and that roadless areas provide important refugia that minimize sediment and maintain temperatures and habitats in the face of climate change.

CR96 RMZs

Concern: Commenters had concerns related to the proposed Riparian Management Zones (RMZs). These concerns include RMZ width, management within RMZs, riparian and terrestrial connectivity, and the analysis of RMZs within the EIS.

Response: RMZs, and management within these zones, are critical to overall forest and ecosystem health. Based on best available scientific information, the RMZ width would be adequate to protect aquatic resources, riparian and terrestrial connectivity (FW-RMZ-DC-02) and management activities that occur within the RMZ would restore or enhance aquatic and riparian-associated resources.

CR97 Watershed

Concern: Commenters had a general concern for impacts to watersheds and/or the way the effects analysis for watersheds was conducted. The main concerns were watershed resilience with climate change, concerns with a specific watershed, the watershed analysis used, and forest plan editorial changes.

Response: Watersheds, and management within these areas, are critical to overall forest and ecosystem health. The Plan provides direction to improve and protect riparian areas, as well as whole watersheds, to become resilient into the future from multiple potential impacts including changing climate (FW-WTR-DC-01). Forest management, through the plan components, would work toward the goals, objectives, and desired conditions for all resources. Project level decisions, including travel planning, are outside the scope of the forest plan revision process.

Based on the comments received, changes were made where applicable, please see the water resources section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR98 Soil – Nutrient Cycling

Concern: Commenters had concerns about soil nutrient cycling and requested the FS to add ecological site descriptions to the desired conditions in the Plan.

Response: Ecological site descriptions have not been developed for the Forest at this time. The statement regarding ecological site descriptions has been removed as it is not considered a desired condition. Please see changes in the soils section of the Plan.

CR137 303D Listed Streams/TMDL Issues

Concern: Commenters had concerns with 303d listed streams, streams with developed TMDL plans, and overall water quality in these streams. The concerns were centered on priority treatments to 303d listed streams, edits in the plan, baseline data for 303d listed streams, and Forest data discrepancies with 303d listed streams.

Response: The Forest recognizes the significance of having all waters free from pollutants and impairments and would actively work toward that end (FW-WTR-DC-07). The 2012 Planning Rule requires that all watersheds with 303d listed streams within the planning area be included and designated within/as Conservation Watershed Networks (CWN). CWNs have additional plan components that would be required in project management actions within these watersheds. Once MTDEQ has completed TMDLs for a stream segment, they will also include baseline data of that designated watershed. The Clean Water Act stipulates the Forest will work within the parameters of the TMDL to move towards attainment of beneficial uses, and we would accomplish this in partnership with MTDEQ (FW-WTR-GO-03).

Based on the comments received, changes were made where applicable, please see the Water resources section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR152 Watershed – Municipal

Concern: Commenters had concerns with the management actions and protections of water quality in forest designated municipal watersheds.

Response: Municipal watersheds provide water for public consumption and are critical for the citizens that rely on them. The Plan recognizes the importance of these watersheds, and they are included in the CWN. This designation affords municipal watersheds additional protections through the CWN plan components (please see the FW-CWN section), as well as, all other watershed and riparian plan components, and GA municipal watershed plan components. The Plan provides direction to improve and protect all watersheds in an effort to become resilient into the future from multiple potential impacts including changing climate (FW-WTR-DC-01).

CR164 Soil – Detrimental Soil Disturbance/Region 1 Soil Quality Standards

Concern: Commenters had questions/concerns about the detrimental soil disturbance/Region 1 soil quality standards. These included:

a. The standards are difficult to achieve and are flawed; studies are needed to show their effectiveness;
b. Soils standards should apply to livestock grazing;
c. Why does the Draft Forest Plan not incorporate the full Region 1 soil quality standards fully; and
d. Do existing or past disturbance areas count toward the 15% detrimental soil disturbance?

Response:

a. Soil quality standards do have inherent assumptions and flaws; however, they present a consistent approach for assessing and quantifying management activity impacts on soil. It is true that soil quality and soil disturbance may not directly equate with changes to site productivity; the long-term soil productivity experiment was designed to detect productivity changes resulting from soil disturbance and represents the most applicable research on this topic. It has shown mixed productivity responses to soil compaction and organic matter removal 5, 10, and 20 years following treatment, both for above ground arboreal biomass production as well as below-ground properties of soil carbon, nitrogen, and microbial communities (please see long term soil productivity references in the FEIS). However, studies have shown impacts of harvest on other soil properties, including nutrient cycling and microbial communities. But it is exactly because of these variable responses and measurement challenges that soil quality standards represent are valuable; they represent a quantitative tool for consistently representing management impacts on soil on a landscape scale, and incorporate measures of soil function beyond those that directly impact plant productivity (such as depth of organic layer, understory root density, and ground cover estimates). While imperfect, the FS expects that the 15% detrimental soil disturbance threshold derived from Region 1 soil quality standards would provide a conservative baseline for preserving soil functions across a site.

b. Thank you for your comment. Though monitoring grazing is not required under the current Regional Soil Standards, impacts to the resource from grazing are still assessed. Any impacts are addressed through revised allotment management plans (AMPs).
c. Though not stated verbatim, the FS feels that the Region 1 soil quality standards are covered in the soils plan components.
d. Administrative sites/infrastructure (system roads, trailheads, etc.) are excluded from detrimental soil disturbance as per the Region 1 soil quality standards. Also, we do not have any permanent log landings on the forest, and disturbance from log landings is included in detrimental soil disturbance monitoring.

CR165 Soil – Coarse Woody Debris

Concern: Comments were received regarding soil and coarse woody debris, including:

a. The desired conditions and guideline thresholds for coarse woody debris are too high and/or should be removed. It appears that there is a desire for more downed wood than what is present currently, which is not consistent with desired resilience to fire; nor is the concept of adding fuel to a site that does not meet the guideline.
b. The analysis needs to disclose the frequency, magnitude and potential effects of activities that would be excepted from the woody debris guidelines (where fire risk is of concern).
c. There were requests to disclose the scientific basis for the acceptable levels and distribution of downed wood. How was NRV estimated (data source)? What is the scientific basis for stating that 30-50% of a forest area may have little or no woody debris at a given time? The analysis must include information on the distribution of downed wood in "unmanaged" areas as compared to the NRV, in order to assume that sufficient habitat associated with this material is available.
d. The guideline allows for "gerrymandering" of project unit design to avoid leaving downed wood in treated areas.
e. The coarse woody debris guidelines need to be reduced to factor in climate change, because the timespan that woody debris will contribute to fire severity and intensity will increase.

Response:

a. The coarse woody debris plan components are based on the best available scientific information for the HLC NF. These components are necessary to ensure that sufficient wood would be present on the landscape to provide for key ecosystem processes such as nutrient cycling into the soil and wildlife habitat. The levels of downed wood are based in large part upon the natural fire regime of the area; and acknowledge that distribution of the material may vary with some areas containing little to no downed wood. In addition, there are exceptions granted specifically for areas where fire risk is of concern. Coarse woody debris would only be added in areas where the tons/acre are below what would be needed to sustain future productivity and meet multiple management objectives.
b. Additional discussion has been added to the downed woody debris section of the FEIS to address the potential effects of activities that would be excepted from the woody debris guideline due to fire risk. These instances would likely be limited to harvest and prescribed fire activities that occur within wildland urban interface (WUI) areas.
c. The basis for the coarse woody debris plan components is further described in appendix H of the FEIS. The NRV in terms of quantities and distributions is based on forest inventory analysis (FIA) data within unroaded and wilderness areas, because these areas have been influenced to a lesser degree by management intervention. Lacking other quantitative information, this method is consistent with the best available scientific information. The downed wood section of the final EIS includes additional analysis describing the distribution of downed wood in "unmanaged"

areas as compared to the NRV, to inform conclusions on whether sufficient habitat associated with this material would be available.

d. The intent of the coarse woody debris guideline is to guide managers in designing the best placement, distribution, and linkages of down woody material across a treatment area.

e. The FS appreciates the concern related to downed woody debris. Utilizing the best available scientific information cited in the FEIS as the basis for the desired conditions and guideline is the best approach for managing downed wood, especially given future uncertainties. The potential impacts of climate change are more uncertain and complex than the influence on decay rates. Additional discussion was added to the downed woody debris section of the FEIS to address this. While decay of this material may be somewhat slower in warm and dry conditions, conversely an increase in expected fire activity may consume downed wood, thereby emphasizing the importance of retaining it in situations under FS control to contribute to soil nutrient cycling and wildlife habitat.

CR166 Monitoring – Soils

Concern: Commenters are concerned with soil monitoring and the ability to assess soils at the Forest scale. They also asked about GA level monitoring and questioned what the elements in the soil monitoring plan include.

Response: Since the effects to the soil resource are considered site specific, the monitoring would occur inside of management units at the project scale. Post-treatment forest floor conditions would be monitored within the activity units, this includes, detrimental soil disturbance, course woody debris, visual ground cover estimates, soil burn severity, and number/acres and types of road/trail treatment.

CR169 Soil – Nonnative Invasive Plants

Concern: Commenter was concerned with the lack of disclosure of losses of soil productivity due to foreseeable increases in noxious weeds.

Response: Under the Plan, following implementation of all management activities (including road construction and road decommissioning), sites would be monitored for noxious weed invasion, and subsequent weed treatments would be conducted to control and eradicate weeds. With this mitigation, soil cumulative effects from noxious weeds would be minimized.

CR170 Soil – Productivity, Quality, Function

Concern: Commenters had concerns/suggestions for plan components related to soil productivity, quality, and function.

Response: Thank you for your comments. Changes were made where applicable. Please see the soils section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule. Please also see the soils section of appendix C of the Plan as well as the FEIS for more information on the best available scientific information regarding detrimental soil disturbance in the long term.

CR171 Soil – Ground Cover

Concern: Commenters were concerned with ground cover, including: the definition and how to measure it; and the sustainability of the 1cm threshold.

Response: Thank you for your comments. Please see the glossary section of the Plan for the definition of ground cover. Ground cover would be monitored per the monitoring plan, appendix B of the Plan).

CR172 Soil – Sensitive Soils

Concern: Commenter was concerned with sensitive soils, including: the definitions and process for determining which soils are sensitive and what protections they require, especially slump prone soils, ash laden soils, and grazing impacts on mollic soils.

Response: The initial criteria for determining if a soil is slump prone or mass wasting is by using data from the Natural Resource Conservation Service Soil Survey of either the Helena NF or the Lewis and Clark NF or ground truthing by FS soil scientists. In some cases, ground truthing would be required to determine the extent/existence of the slump/mass wasting potential. Please see FW-SOIL-GDL-08.

By aligning primary grazing areas with soils, we can better anticipate where impacts from grazing would occur. This does not necessarily mean there would be an increase in stocking rates. However, once inventoried, it would allow us to mitigate impacts through the AMP revision process.

CR178 Watershed – Plan Components

Concern: Commenters had general concerns and suggested changes, or additions, to watershed plan components. These suggested changes, or additions, were for all the watershed forestwide plan components.

Response: Forestwide plan components were developed to enhance or maintain properly functioning watershed condition on NFS lands. One of the original purposes for establishing the FS was to protect the nation's water resources. The 2012 Planning Rule includes a newly created set of requirements associated with maintaining and restoring watersheds and aquatic ecosystems, water resources, and riparian areas on the national forests. The increased focus on watersheds and water resources in the 2012 planning rule reflects the importance of this natural resource, and the commitment to stewardship of our waters.

The 2012 Planning Rule requires that plans identify watersheds that are a priority for restoration and maintenance. The 2012 Planning Rule requires all plans to include components to maintain or restore the structure, function, composition, and connectivity of aquatic ecosystems and watersheds in the planning area, taking into account potential stressors, including climate change, and how they might affect ecosystem and watershed health and resilience.

Plans are required to include components to maintain or restore water quality and water resources, including public water supplies, groundwater, lakes, streams, wetlands, and other bodies of water. The 2012 Planning Rule requires that the FS establish BMPs for water quality, and that plans ensure implementation of those practices.

Based on the comments received, changes were made where applicable, please see the water resources section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR183 Watershed – Downstream Water Users/Irrigation

Concern: Commenters had concerns about forest management of surface water quality and quantity related to water delivered to downstream users, primarily irrigators.

Response: The HLC NF recognizes the important role the Forest has in supplying adequate clean water to water users downstream of forest managed lands. The Plan includes management strategies to help achieve these goals of maintaining quality and quantity of water into the future in the face of climate change. We also recognize beneficial downstream uses and the Plan provides tools for appropriate fire management in the designated wilderness areas. Timing of runoff along the HLC NF section of the Rocky Mountain front has not been directly linked to wildfires, however, climate shifts (earlier runoff) throughout the entire Rocky Mountains has been studied and early runoff has been attributed to climate change and not wildfires.

The HLC NF works to mitigate the effects of climate change through vegetation management activities within its managed lands. The Plan has standards, desired conditions and guidelines that the FS expects to provide continued delivery of high quality and quantity of water to downstream users. Management within designated wilderness, the forest lands that supply water to the Sun River Watershed Group, is limited due to limited access (Roadless rule) and laws (Wilderness Act). Past management of wildfire within the wilderness areas have been managed in coordination with downstream water users to the extent possible.

CR184 RMZ – Plan Components

Concern: Commenters had concerns for the Riparian Management Zone (RMZ) plan components to include Desired Conditions, Objectives, Standards, and Guidelines.

Response: Various RMZ plan component and other editorial suggestions were provided. Changes were made where applicable, please see the RMZ section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

The Plan RMZ plan components have been expanded to focus on key ecological processes and functions, to highlight the importance of vegetation structure and composition, and provide suitable connected wildlife habitat rather than being fish-centric under the Inland Native Fish Strategy. Vegetation management within RMZs would be allowed but riparian and aquatic conditions must be maintained, restored, or enhanced. Also, many activities that can degrade soil function (compaction or erosion) are restricted or minimized within this zone. RMZs are not "no management zones" since treatment may be necessary to achieve desired conditions. However, guidance is provided for any activities that may occur within RMZs.

CR189 Aquatics/Fish Habitat – Plan Components

Concern: General concerns and suggested edits to plan components for Fisheries and Aquatic Habitat were provided.

Response: Various plan component and other editorial suggestions were provided. Changes were made where applicable, please see the fisheries and aquatic habitat section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR190 Aquatics – Bull Trout Conservation Strategy

Concern: Commenters asked for additional clarification regarding how the Plan would be consistent with the Bull Trout Conservation Strategy.

Response: A desired condition has been added to the Divide and Upper Blackfoot GA sections to demonstrate the intent of contributions to recovery. Please see the Divide and Upper Blackfoot GA Fisheries and Aquatic Habitat sections of the Plan.

Forestwide desired conditions: plan components for fisheries and aquatic habitat provide the guidance to improve habitat conditions where the HLC NF has the ability to manage habitat. Core area populations would be expanded by increasing local populations, which are considered to be the smallest group of fish that are known to represent an interacting reproductive unit. A core area represents the closest approximation of a biologically functioning unit for bull trout. Those portions of the patch size needed to maintain viability on the HLC NF are addressed by plan components.

Current USFS direction requires the Bull Trout Conservation Strategy to be used to inform forest plan revision in core areas, for local populations and in areas of other important populations. The conservation strategy prioritized needs for core areas on the HLC NF to provide the best available information on bull trout restoration opportunities. It is intended to be a document that would be updated and improved over time in light of changing conditions and status of local populations and core area. The Plan provides oversight direction rather than name-specific actions to take for recovery actions. In addition to other plan components, it helps provide guidance originally provided by the INFISH strategy and can increase the effectiveness of plan direction. Plan components address mitigating sediment, recreational use impacts instream flows, improvement of passage and entrainment, restoring instream habitat and improving spawning and rearing habitat, which are actions to address habitat threats in the Columbia Headwaters Recovery Unit Implementation Plan.

The Memorandum of Understanding and Conservation Agreement for westslope cutthroat trout in Montana serves to document Montana's efforts as part of coordinated multi-state, rangewide efforts to conserve cutthroat trout. Plan components address goals of the MOU. Sub-basin plans provide the framework for population enhancement, protection and replication.

CR191 Aquatics – INFISH

Concern: Commenter provide a number of comments related to INFISH, including:

a. Aquatic strategy proposed in the revised forest plan must be an improvement of INFISH;
b. Please include an action alternative that retains and improves INFISH;
c. INFISH was short-term strategy;
d. Support the expansion of an aquatic strategy to areas not covered by INFISH;
e. Monitoring should have been used to develop specific desired conditions and objectives;
f. The revised forest plan should require site specific, interdisciplinary watershed analysis before projects proceed in the RMZ's;
g. The protection measures outlined in INFISH need to be included to comply with ESA; and
h. An action alternative should be included that retains INFISH on the west side and applies it to the east side.

Response:

a. The aquatic strategy plan components in the Plan are an updated synthesis of the two existing aquatic strategies: 1) Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California (PACFISH) and 2) the Inland Native Fish Strategy (INFISH). PACFISH and INFISH were originally expected to only provide direction for a few years while a broader effort, the Interior Columbia Basin Ecosystem Management Project, was completed for the Interior Columbia River Basin. Although that strategy was never completed, science from that effort has been retained in the form of guidance for plan revisions in the Interior Columbia Basin Ecosystem Management Project Framework Memorandum of Understanding (2014). While portions of the HLC NF planning area were not originally subject to these strategies, the underlying principles in these plan components and strategy are relevant and applicable. The Plan addresses new requirements in the 2012 Planning Rule, advances in BASI for such components as riparian management objectives, and standards and guidelines. The Northern Region has also provided guidance for identifying compliance with the goals of a conservation strategy as first outlined by PACFISH and INFISH. Additional guidance addressed aquatic and riparian ecosystem integrity and connectivity. Some components, such as desired conditions, have been added or altered to provide more clarity in project development under the Plan.
b. Plan components related to INSFISH protections are located in the RMZ, WTR, FAH, and CWN sections.
c. Thank you for your comment. The intent of the Plan is to replace the Interim INFISH Direction with plan components that provide the same result and would utilize PIBO monitoring to

determine if habitat conditions are trending towards desired conditions using a science-based methodology.

d. Regional guidance provided oversight to ensure compliance with the aquatic strategy replacing INFISH. In all alternatives, the aquatic strategy has been extended to the Missouri River Basin.
e. PIBO monitoring would demonstrate whether habitat trends are degrading or improving towards desired conditions based on the physical stream habitat metrics at each site that are appropriate for the stream rather than the interim RMOs that were not site specific. BASI and PIBO data will also be used to develop desired conditions and objectives for stream habitat.
f. NEPA analysis would occur on all proposed projects and BMPs would be implemented as required by law. Also, INFISH requires a science-based watershed analysis which was performed on numerous watersheds west of the continental divide. That analysis would be incorporated into all future actions. INFISH provided for a network of priority bull trout watersheds within the planning area, based on metapopulation needs of bull trout. Ongoing projects within the priority watersheds would be screened to determine their potential habitat effects and whether they would need to be modified. Watershed analysis would also be required for some management activities within the riparian habitat conservation areas in priority watersheds." INFISH watershed analysis has occurred on priority watersheds.
g. The INFISH Direction was amended to the 1986 Helena Forest Plan as Amendment 14 in May 1996 and as a result continues to be part of the no-action alternative. The aquatic strategy's plan components that replaced this direction in the 2021 Land Management Plan would be required to comply with ESA, and the programmatic biological assessment addressed the effects of implementing the Plan on bull trout and designated bull trout habitat on the HLC NF.
h. Thank you for your comment. The intent of the aquatic plan components in the 2021 Land Management Plan is to replace the Interim INFISH Direction with plan components that provide the same result and would utilize PIBO monitoring to determine if habitat conditions are trending towards desired conditions using a science-based methodology.

CR203 Monitoring- Aquatics

Concern: Commenters were primarily concerned with different aspects of the monitoring needed to track the progress towards meeting desired conditions included in the forest plan. There were also comments regarding the removal of INFISH protections and the use of riparian management objectives, which were part of INFISH. These also included comments on restoration, effects of grazing, roads, and noxious weeds.

Response: PIBO data would be used to evaluate aquatic habitat status and trend across the planning area and would guide adaptive management strategies, to meet aquatic desired conditions. Desired conditions and objectives are not determined for future projects they are determined for a specific resource such as watersheds, RMZ or riparian area. For aquatic plan components, NRV means the expected range of variation for a condition or process as described by monitoring that condition or processes in a similar biophysical setting, in relatively unmanaged landscape. The Plan was written following the guidance given in the 2012 Planning Rule. The use of one-size-fits-all riparian management objectives has been shown to not represent the best available scientific information. Please see the monitoring plan in appendix B of the Plan. The interim INFISH riparian management objectives would be replaced by the plan components in the 2021 Land Forest Plan.

The standards and guidelines contained in the Plan are designed to minimize the impacts of grazing, noxious weeds, and the road and trail system on wetlands and aquatic resources of the HLC NF. The 2012 Planning Rule gives direction on how forest plans are developed and implemented. We agree that limiting development and motorized use would help movement of aquatic systems toward desired conditions. However, it is important to remember the FS mandate is to facilitate multiple use, so not all areas can be maintained in limited use. The impacts to aquatic resources would be minimized by implementation of the plan components.

Based on the comments received, changes were made where applicable, please see the Water resources section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR204 Aquatics – Roads

Concern: Commenters had concerns with potential road impacts to streams and their interactions with habitat quality. The concerns were centered on the EIS analysis, suggested additions to plan components, RMZs, roadless areas, and fish habitat.

Response: Based on the comments received, changes were made where applicable, please see the 2021 Land Management Plan and specific sections that relate to the concern. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Since the building of roads into the forest began, they have always divided opinions, potential impacts, and personal beliefs. The FS provides access for all Americans into their natural lands, and at the same time, minimizing the impacts to the native habitat. The majority of FS lands are wilderness and IRA, so there are very little roads to begin with (on a national scale). The goals of access and preservation are sometimes competing, but with the use of BMPs, travel analysis, road decommissioning, road maintenance, and aquatic organism passage improvements, we are actively working so they will become mutually inclusive into the future.

CR221 Watershed – FEIS

Concern: Commenters had concerns with or suggestions for some aspects of the analysis in the EIS, including:

a. Requests to consider limiting development and motorized travel to benefit watershed resources;
b. The conclusion that watershed effects are comparable between alternatives because of RWA, WSA and IRA designations may not be correct, given changes in direction from congress and the administration. Not all of these designations can be relied on to be permanent;
c. Request to clarify that under the 1986 Forest Plans, the areas west of the continental divide do have existing fixed riparian zones, as opposed to east of the divide; and
d. Concern that RMZs would allow for widespread logging in riparian areas.

Response:

a. The FS manages lands for multiple uses. There are many areas that limit development and motorized travel, as well as areas where other types of recreation and uses are emphasized.
b. The 2012 Planning Rule requires the Forest to analyze RWA. The analyzed RWAs were mostly in IRAs where there are limited impacts to aquatic habitat from roads and infrastructure. Designation of wilderness areas is not at the discretion of the FS; Congress is the only entity that can do that. Similarly, the designation or undesignation of IRAs or WSAs is also not at the discretion of the HLC NF. Should those protections be removed, the Plan would need to be amended and the effects disclosed.
c. The suggested edits were made in the FEIS; please refer to the RMZ section.
d. The RMZ plan components would not allow for increased and widespread logging in riparian areas, please see FW-RMZ-STD-02 and 03.

CR260 Conservation Watershed Network – Plan Components

Concern: Commenters had concerns related to the Draft Forest Plan Conservation Watershed Network (CWN) plan components.

Response: The 2012 Planning Rule includes a newly created set of requirements associated with maintaining and restoring watersheds and aquatic ecosystems, water resources, and riparian areas on the national forests. The 2021 Land Management Plan includes these additional requirements and are described as CWN standards and guidelines to maintain, or improve, watersheds towards desired conditions. CWN and RMZ-specific plan components would provide strong conservation measures in support of riparian and terrestrial habitat connectivity. It is beyond the scope of the forest plan revision process to address road maintenance, or travel planning, at a project level scale.

Based on the comments received, changes were made where applicable, please see the Water resources section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Air quality

CR63 Air Quality and Smoke

Concern: Several comments were received regarding air quality and smoke, including requests for:

a. More language about the forest fires generating poor and unhealthy air quality;
b. Brief discussion of the existing Clean Air Act airshed classifications (e.g., attainment, non-attainment, maintenance) in and near the planning area;
c. Inclusion of air quality objectives, standards and guidelines to identify planning horizon activities;
d. Estimates, by alternative, of predicted emissions that may result from future burn-related treatments;
e. Recognition that effects of off-road vehicle use will impact air quality; and
f. Corrections to tables in the DEIS.

Response:

a. Detailed information about air quality conditions and monitoring, the effects of wildfires and wintertime wood burning smoke, and airshed classifications is available in the air quality section of the FEIS.
b. The Plan air quality desired conditions and goals addresses planning horizon activities. Forest air pollution emissions are regulated by the state and this will continue into the foreseeable future.
c. Applicable plan components have been included in the Plan, please see the air quality section.
d. A rough estimate range of emissions from forecasted forest prescribed burning and wildfire emissions under each of the alternatives can be done. However, the resulting range of emissions would be very wide and potentially misleading and confusing given the number of variables that drive emissions on a forestwide scale. Project level emissions estimates would be more refined and provide closer to accurate emissions ranges.
e. We acknowledge that if there is an increase in fossil-fuel-burning off-road vehicles and snowmobiles there would be an increase in air pollution and greenhouse gas emissions.
f. The tables have been updated to show the acreages for decades 1-5.

Fire and fuels

CR53 Monitoring - Fire

Concern: Several commenters had concerns/requests regarding fire monitoring, including:

- Fire monitoring should measure something about the vegetation composition; and
- The FS should include more monitoring of the cause and effects of fire/fuels to evaluate impacts for all beneficial uses.

Response: In the monitoring plan, disturbance to vegetation would be monitored using monitoring trends in burn severity, which indicates effects to vegetation. Additionally, vegetation monitoring includes effects fire has on vegetation composition. See MON-FIRE-01, MON-VEGT-01, MON-VEGF-07, MON-POLL-02.

CR222 Fire – Silviculture

Concern: Comments were received regarding fire and vegetation/ecosystem function, including:

a. A more detailed description of existing condition is needed. The DEIS does not provide scientific support that disturbance regimes have been altered. Change FW-FIRE-OBJ-01 to a range from 15,000 to 25,000;
b. Table 34 (fire regimes on the HLC NF) in the DEIS has outdated information on fire regimes. Review available scientific information on fire regime and update table as needed;
c. Need to detail how wildfire and prescribed fire can be managed to help restore/maintain ecosystem function. Prescribed fire can be used in old growth. Forest health is poor, and the forest needs to be proactively managed to address fire risk and to benefit recreation and wildlife. Ogden Mountain, Dalton Mountain and Lincoln Gulch areas need active management to address fire risk and restore forest health;
d. Need to identify which vegetation types are maintained by fire and have fire as a means to maintain/restore ecosystems;
e. DEIS nullifies many statements in the Draft Forest Plan in stating that fire regimes do not vary much between alternatives because projected future treatments are generally the same; and
f. Follow the National Cohesive Wildland Fire Management Strategy goals and use forest products to generate funds for restoration efforts.

Response:

a. A detailed discussion on existing condition can be found in the project record, specifically the Forest Assessment. FW-FIRE-OBJ-01 is designed to set the minimum expectation of treating 15,000 acres in the WUI. FW-VEGT-OBJ-01 specifies treating at least 130,000 acres per decade which includes all fuels treatments.
b. The FEIS uses the best available scientific information which supports the information in Table 34 in the DEIS (Table 35 in the FEIS). Additionally, no opposing references were provided to support the claim made that we are using outdated science.
c. Throughout the FEIS and the Plan, fire is identified as an essential function in the ecosystem. FW-FIRE-DC-01, 02 and 03 encourage fire across the landscape. Additionally, FW-FIRE-GDL-01 addresses that vegetation treatments should allow opportunities for naturally ignited wildfire to occur. The use of prescribed fire would be acceptable across the landscape, including old growth stands, as described in the old growth section. See FEIS for more detail on the role of wildfire and prescribed fire in managing and restoring ecosystems.
d. Vegetation types that have frequent fire and where fire is needed to maintain/restore ecosystem function are described in FW-VEGT-DC-01. Additionally, FW-VEGNF-DC-03 identifies vegetation conditions where fire maintains nonforested vegetation.
e. The reason fire regimes and wildfire occurrence are generally the same is due to projected treatments. In addition, wildfire estimates are similar across alternatives. This is discussed in FEIS (Please see Tables 36, 37, and 38 in the fire and fuels section).

f. The National Cohesive Wildland Fire Management Strategy is part of the regulatory framework and would be followed. The 2021 Land Management Plan has been developed to achieve this strategy. Forest products are factored in the Plan and FEIS. See the terrestrial vegetation section of the Plan and FEIS. Funds from commercial harvest are put back into land management activities within existing laws and regulations.

CR223 Fire – Desired Conditions

Concern: Commenters stated that the plan desired conditions do not adequately address the following:

a. Fuel treatment lessen negative effects to high value resources. Strategically locate treatments in relation to the WUI. Minimize any risk to loss of life and property. Prevent fire spread onto private lands;
b. Treated areas need to be maintained to provide conditions for benefiting fire management operations and meeting other resource desired conditions;
c. Provide public information on wildfire risk; and
d. Allow for the full range of management options to meet ecological desired conditions and create resilient systems.

Response:

a. FW-FIRE-DC-02 provides for minimizing threats to values and reducing fire severity. This DC also addresses treating in and around the WUI, municipal watersheds, and other values. Private land is also considered one of the values this DC is designed to minimize threats to. Existing plan components for fire management account for addressing risk to life and property. Additionally, FW-FIRE-DC-01 addresses ecosystem function.
b. FW-FIRE-DC-03 was added to address the desire to maintain treated areas to increase the opportunity to allow naturally ignited fire to play a more natural role.
c. FW-FIRE-GO-02 addresses providing public information on wildfire risk to landowners, permittees and others.
d. FW-FIRE-GDL-01 and 02 provide the basis for using all available tools to manage fire across the forest including mechanical, prescribed fire and naturally ignited wildfire. Additionally, fire is clearly identified as an essential ecological process and is a necessary disturbance. The use of fire as a tool would be allowed as described in the plan. Per the Plan "Fire management strives to balance the natural role of fire while minimizing the impacts from fire on values to be protected, especially in the wildland urban interface."

CR224 Fire Suppression

Concern: Commenters had concerns and suggestions regarding fire suppression, including:

a. Impacts of wildfire to municipal watershed and associated infrastructure. Fire will continue to be suppressed as in the past;
b. Use other fire models to determine fire strategies. Complete a spatial wildfire risk assessment and include in the forest plan revision;
c. Highly valued resources need to be reconsidered to include the value of the land and vegetation as a water capture, storage and release tool;
d. Fire suppression is not adequately analyzed;
e. Inability to mitigate risk from fire creating a chance of landowner complacency;
f. Decreasing road access may increase risk to firefighters and reduce successful initial attack.

Response:

a. Desired conditions FW-FIRE-DC-01 and 02 address minimizing threats to values including watersheds and associated infrastructure. FW-FIRE-DC-01 and 02 provide direction on where and what type of fire would be acceptable. Additionally, the introduction of the fire and fuels management section of the Plan describes where fire would be acceptable. FW-FIRE-DC-01 provides the basis for fire being used in its natural ecological role as much as possible.
b. In the Plan, the introduction to the fire and fuels management section refers to using a "coordinated risk management approach" which includes a fire risk assessment to assist with fire management planning. A fire risk assessment has been completed for the forest and would be used to inform the risk management approach.
c. FW-FIRE-DC-02 addresses high value resources which includes land and vegetation.
d. Fire suppression is analyzed throughout the EIS within many of the specific resource areas including aquatic ecosystems and soils; terrestrial vegetation; old growth, snags and downed wood; and plant species at risk (threatened, endangered, proposed, and candidate plant species, and plant species of conservation concern).
e. Plan components under the fire and fuels section provide direction on managing risk and communicating with the public about wildfire risk to landowners. Additionally, the components describe the desire for natural process to function as nearly as possible.
f. Forest plan revision does not direct decreasing road access. This would be done outside forest plan revision process, generally through the travel management process.

CR225 Fire – WUI

Concern: Comments/suggestions were received regarding fuels treatments and WUI, including:

a. Clarify that mechanical fuel treatments are appropriate to protect WUI structures, however, they are ineffective for structural protection as treatments are located away from structures. Health and well-being of people of Montana, specifically around Helena. FS to proactively manage National Forest lands in and near the WUI. Firewise government facilities;
b. Treatments within WUI and around high value resources may have adverse ecological effects;
c. High value resources should be identified as well as WUI. Describe how WUI is defined and how it can be re-defined;
d. Identify conditions for cool moist forest types outside WUI; and
e. Helping communities adapt to fire prone ecosystems.

Response:

a. FW-FIRE-DC-02 provides direction on fuel conditions within the WUI and around high value resources. This addresses the need to manage lands in and around the WUI and other areas with high value resources including government facilities.
b. Treatments around the WUI and high value resources have been analyzed in the FEIS, specifically in the aquatic ecosystems, terrestrial vegetation, old growth, snags and down wood, terrestrial wildlife diversity, and terrestrial wildlife species sections.
c. “High value resources” is defined in the glossary in the Plan. Additionally, WUI designation is dictated by the Healthy Forest Restoration Act 2003 and WUI maps can be and are updated more frequently than the forest plan. WUI maps are not included in the Plan due to the continual updating that occurs. Current WUI maps are available from the State of Montana and from the FS.
d. FW-VEGT-DC-01 describes desired conditions for cool moist forest outside WUI.
e. FW-FIRE-GO-01 and 02 provide the basis to work with communities on addressing wildfire risk.

CR226 Fire – Plan Components

Concern: Commenters provided suggestions and requests in regard to the FIRE plan components, including:

a. Add goal 03 to prioritize activities in areas where adjacent landowners are doing fuel mitigation work. Plan will limit fuels management in the area which will cause watershed damage;
b. Add objective "Over the life of the Plan manage natural and planned ignitions to meet resource objectives." Plan components do not provide incentive to allow fire to take a more ecological role on the landscape;
c. Address fire management plans for wilderness areas;
d. Add a goal to address coordinating access for initial attack and suppression activities. Add a guideline to work with adjacent landowners on designing fuel treatments on the forest;
e. Add objective to move toward or maintain fuels treatment son 25,000 to 75,000 acres per decade, with emphasis on the WUI;
f. Add desired conditions and objects to address minimizing risk and loss of life, damage to property and ecosystems. The full range of management activities are recognized and used in fire management;
g. Add desired condition to maintain treated areas into the future and treating lands in the WUI;
h. Provide public information on wildfire risk;
i. Address benefits to resources from fuels treatments;
j. Paragraph 3 of the Fire and Fuels section is not correct; and
k. Fire can be managed across all areas of the National Forest.

Response: Various fire plan component and other editorial suggestions were provided. Changes were made where applicable; please see the fire and fuels section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule. Some specifics include:

a. FW-FIRE-GO-01 addresses working with adjacent landowners by meeting goals of community wildfire protection plans. This would include working on access for response to wildfires if part of the plans. Also added FW-FIRE-GO-03.
b. Objectives need to be measurable and based on reasonably foreseeable budgets. Additionally, FW-FIRE-DC-01 sets the desire to have fire both natural and planned across the landscape.
c. FW-FIRE-DC-01 provides direction for fire in wilderness. Additionally, direction for fire management plans for wilderness is found in Forest Service Manual 2320.
d. FW-FIRE-GO-01 and FW-FIRE-GO-03 provide direction on coordinating with partners on implementing community wildfire protection plans and designing fuel treatments. This would include access for fire suppression.
e. FW-VEGT-OBJ-01 sets the minimum of 130,000 acres per decade. Most if not all would be considered a fuel treatment. Additionally, FW-FIRE-OBJ-01 addresses treating a minimum of 15,000 acres of WUI per decade.
f. Risk to fire personnel and the public is addressed in FW-FIRE-STD-01. FW-FIRE-DC-02 sets the desire to manage fuels in the WUI to minimize threats to values.
g. Within the introduction to the fire and fuels section of the Plan it states that fire management would be achieved through prescribed, wildfire, and mechanical methods. FW-FIRE-DC-03 provides guidance on treated fuel management areas being viable into the future for benefiting fire management decisions.

h. FW-FIRE-GO-02 provides direction on communicating with the public on wildfire risk and that fire is an ecological process.
i. Details were added to the benefits of fuels treatments in the introduction of the fire and fuels section of the Plan.
j. Paragraph 3 was reworded to clarify prescribed fire.
k. FW-FIRE-DC-01 sets the desire for fire to occur across the forest in a natural ecological role. FW-FIRE-OBJ-01 states to use any wildland fire management opportunity to reduce fire intensity and severity.

CR228 Fire – Prescribed

Concern: Comments were received about prescribed fire, including:

a. Prescribed fire needs to be part of fuels treatments. Acres in the WUI needs to be increased from the specified 15,000 acres. Ability to manage fire across the entire forest is needed. Need to treat more acres with prescribed burning than shown in the FEIS;
b. Coordinate with grazing permittees on the use of prescribed fire; and
c. Connection between mechanical treatments and prescribed burning is not clear.

Response:

a. The introduction to the fire and fuels section of the Plan explains that fire management would be achieved through the use of prescribed fire and mechanical methods. Additionally, FW-FIRE-GDL-01 identifies mechanical and prescribed fire treatments would allow for naturally ignited fire to occur and benefit fire management operations. FW-FIRE-OBJ-01 specifies a minimum of 15,000 acres of hazardous fuels treatment per decade. FW-FIRE-DC-01 allows for fire to be managed anywhere on the forest under favorable conditions. We agree that more prescribed burning would be preferred. However, due to limited burn windows, funding, and historical accomplishments, the acres are a reasonable estimate of what can be accomplished. While prescribed burning would be limited, wildfire on the landscape is an important part of the Plan. As shown in the FEIS it is anticipated that on average over 12,000 acres of wildfires would burn across the forest yearly. Management actions to treat fuels in strategic locations across the forest would create conditions more favorable for wildfire to take a natural role and help maintain and restore ecosystems. See the FEIS and project record for more detail on the interrelationship between prescribed fire, mechanical fuel treatments, and wildfire.
b. FW-FIRE-GO-03 provides guidance on developing treatments with partners. Additionally, various regulatory framework provides direction on working with the public and interested individual on managing NFS lands.
c. Clarifying language was added to the FEIS fire and fuels introduction section to explain why mechanical treatments are often needed prior to prescribed burning.

CR229 Fire – Analysis

Concern: Commenters expressed concerns and had suggestions regarding fire analysis in the Plan, including requests for:

a. Evaluation of what high valued resources are. Suggest including runoff;
b. Additional analysis regarding fire effects to recreation and agriculture;
c. Additional analysis needed including assumptions made, any differences between alternatives from differences in timber suitability, effects of fire suppression and how fire was modeled;
d. Information on where fuel treatments will occur that would be outside normal ecological conditions;
e. More analysis of mechanical treatments;
f. More scientific basis for uncharacteristic fire;

g. More scientifically defensible analysis of NRV relating to fuel conditions;
h. More analysis to address the variety of different types of fire across the landscape including mixed-severity fire or stand replacing fire;
i. More options for having fire on the landscape;
j. More scientific evidence that intensive tree removal activities reduce the risk of catastrophic fires. Intensive treatment efforts do not provide "fire-proofing". Fires burn through treated and untreated areas. Recognize the temporal gradients in vegetative recovery following fuel treatments. Large fires are weather-driven and cannot be affected by fuels treatments;
k. Disclosure of limitations of using fire regimes;
l. Inclusion of information that treated areas will need follow-up treatments to maintain desired conditions;
m. More disclosure of how past management activities and future activities influence fire behavior;
n. Disclosure of scientific information that contradicts some of the premises of the forest plan. Namely that untreated areas experience "less intensive fire compared with areas that have been logged";
o. More analysis of beneficial effects of wildfire to fish populations due to fire suppression forestwide; and
p. More scientific information that mechanical treatments can replicate natural disturbance is contradicted by science.

Response:

a. High value resources include watersheds, infrastructure, and other; see forest plan glossary.
b. The HLC NF recognizes the important role the Forest has in supplying adequate clean water to water users downstream of NFS lands. The Plan includes management strategies to help achieve these goals of maintaining quality and quantity of water into the future in the face of climate change. We also recognize beneficial downstream uses and the Plan provides tools for appropriate fire management in the designated wilderness areas. Timing of runoff along the HLC NF section of the Rocky Mountain Front has not been directly linked to wildfires. However, climate shifts (earlier runoff) throughout the entire Rocky Mountains has been studied and early runoff has been attributed to climate change, not wildfires. Effects to recreation from wildfire are analyzed throughout the FEIS including sections 3.16 through 3.22. Also see the project record for more detailed analysis of fire effects on recreation.
c. Analysis of fire suppression effects are included in the following sections of the FEIS: 3.5.6 aquatic ecosystems environmental consequences, 3.8.5 terrestrial vegetation affected environment, 3.10.6 old growth, snags and downed wood environmental consequences, 3.10.6 plant species at risk environmental consequences, 3.12.5 invasive plants affected environment, 3.13.6 terrestrial wildlife diversity environmental consequences, 3.14.6 terrestrial wildlife species at risk, grizzly bear, environmental consequences, and 3.26.6 infrastructure environmental consequences. Also see the project record for more details on analysis. Section 3.7-fire and fuels section of the FEIS contains assumptions made relating to fire. Additionally, see Section 3.7 for a discussion on differences between alternatives which includes timber harvest. For information see Section 3.8 and appendix H for details on vegetation and fire modeling. Also see the project record for more details on analysis.
d. “High value resources” is defined in the glossary in the Plan. Additionally, WUI designation is dictated by the Healthy Forest Restoration Act 2003, and as such, WUI designations can and are updated more frequently than the Plan. WUI maps are not included in the Plan due to the continual updating that occurs. Current WUI maps are available from the State of Montana and from the FS. Treatments around the WUI and high value resources have been analyzed in the FEIS within the following sections: 3.5 aquatic ecosystems, 3.8 terrestrial vegetation, 3.9 old growth, snags and down wood, 3.13 terrestrial wildlife diversity, and 3.14 terrestrial wildlife species at risk. Also see the project record for more details on analysis.

e. Analysis of mechanical treatment effects are included in the following sections of the FEIS: 3.5.6 aquatic ecosystems environmental consequences, 3.10.6 plant species at risk environmental consequences, and 3.12.6 invasive plants environmental consequences. Additional analysis would be conducted in adherence to the NEPA prior to any project implementation. Also see the project record for more details on analysis.
f. The FEIS provides citations of published research relating to uncharacteristic fire. See the following sections of the FEIS: 3.7 fire and fuels and 3.8 terrestrial vegetation. Also see the project record for more details on analysis.
g. Historic fuel and vegetation conditions and NRV are discussed in the FEIS sections 3.7 fire and fuels and 3.8 terrestrial vegetation. Also see the project record for more details on analysis.
h. The FEIS discusses the wide variety of different fire types ranging from low-severity to high-severity stand replacing fire in the following sections: 3.5 aquatic ecosystems, 3.7 fire and fuels, 3.8 terrestrial vegetation, 3.9 old growth, 3.14 terrestrial wildlife species at risk. Additionally, see Table 37 in the FEIS that identifies expected acres burned by alternative for different fire types.
i. The Plan provides plan components that encourage fire's natural role on the landscape and supports the full array of fire management decision options. In contrast, the 1986 Helena National Forest Plan includes direction related to suppression of wildfires, with several management areas direct full suppression as the response including A-1, H-1, H-2, T-4 and others. Additionally, the 1986 Lewis and Clark National Forest Plan directs full suppression in the following management areas: A, H, J, K and others.
j. Beneficial effects of fuels treatments relating to changing fire behavior under extreme weather were added to the FEIS in the following section: 3.7 fire and fuels. Also see the project record for more details on analysis.
k. The FEIS section 3.8 discusses in detail various influences on fire regimes. See the project record for more detail including additional citations relating to fire regime condition class.
l. FW-FIRE-DC-01 and 02 provide the guidance for follow-up treatments and creating conditions for natural fire to take its ecological role in maintaining the ecosystem.
m. The influence of past activities is reflected in the current condition of forest vegetation, as shown in the Terrestrial Vegetation section and appendix H of the FEIS. Additionally, effects of potential future treatments are discussed throughout the FEIS under environmental consequences, including the terrestrial vegetation and fire and fuels sections. Also see the project record for more details on analysis.
n. Discussion was added about the effects of fuel treatments on fire severity. See FEIS section 3.7. Also see the project record for more details on analysis.
o. Benefits of wildfire to fish is included in the FEIS as quoted in the comment, section 3.5 of the FEIS. The FEIS also identifies plan components to minimize impacts from fire suppression on aquatic ecosystems. Additionally, FW-FIRE-DC-01 provides direction that fire be allowed to function in its ecological role as much as possible. The Plan and FEIS acknowledge that under certain circumstances and locations fire would be suppressed. However, the desire is to get to a point where the need for suppression would be reduced forestwide.
p. Section 3.7 of the FEIS provides citations that ecological restoration can be achieved through fuel treatments using mechanical methods.

Terrestrial vegetation

CR54 Badger Two Medicine – Timber

Concern: Commenters had concerns about timber harvest in the Badger-Two Medicine area, including:

a. A request to clarify the timber suitability statement in terms of providing desired conditions and constraints for possible timber harvests; and
b. There is too much discretion for "non-commercial harvest" in RM-BTM-SUIT-01. The Plan should include additional components that clarify under what conditions the HLC NF or Blackfeet Nation may undertake harvest. This should include government-to-government consultation as well as a public comment process. There should be a standard requiring harvest to be compatible with protection of the Blackfeet Traditional Cultural District and the area's desired conditions. A specific re-word of this plan component is suggested.

Response:

a. All other plan components in the Plan would apply for possible timber harvests in the Badger Two Medicine area. This includes forestwide standards and guidelines specific to timber harvest (FW-TIM) as well as the desired conditions for all resources specified forestwide, in the Rocky Mountain GA, and in the Badger Two Medicine area.
b. Timber harvest would be constrained in the Badger Two Medicine as per the forestwide timber standards and guidelines, as well as all the plan components for other resources forestwide, in the Rocky Mountain GA, and in the Badger Two Medicine area. Government-to-government consultation is required by law and does not need to be restated in the forest plan. Similarly, any project that includes harvest would be subject to a public process per the NEPA; these requirements should not be restated in the forest plan.

CR56 Monitoring – Pollinators

Concern: Several commenters requested pollinator monitoring using the FIA intensified grid, rather than base FIA grid. They also requested information on where Range 2210/2240 files are located.

Response: The FIA intensified grid is acknowledged as a valuable information source throughout appendix B. However, because funding for the maintenance of this data source is discretionary and uncertain, the monitoring plan includes other potential data sources that may be used.

"Range 2210 and 2240 files" has been corrected to read "Range Trend Monitoring Files" in the pollinators monitoring table. Range trend monitoring includes past vegetation monitoring that has taken place on any NFS lands that are, or once were within a grazing allotment. Data found in range trend monitoring files provides a valuable snapshot in time for vegetation conditions and determining past and potential diversity. Collectively, this information can be used to describe an apparent trend of condition and abundance of various plant species for a site-specific area, including pollinator resources such as floral availability and native species diversity.

CR237 Vegetation – Active Management/Restoration

Concern: Comments/questions regarding vegetation management included:

a. Active forest management at landscape scales is desirable and necessary to benefit multiple resources, including fish and wildlife; scale of restoration must allow for dominant ecosystem processes at appropriate temporal and spatial scales;
b. The EIS and Plan should describe how the FS will work to create healthier forest stands; left unmanaged, catastrophic damage can occur to entire watersheds;
c. The Good Neighbor Authority program should be used to increase pace and scale of restoration; commenters identify specific projects they recommend be brought to completion;
d. How will the FS accomplish the restoration of large burns in the Sun River drainage when most of this area is in the wilderness; and
e. There is concern about the potential for logging, fuels treatments, and prescribed burning in unroaded areas such as wilderness, wilderness study areas, and inventoried roadless areas. Please provide the

data and rationale that support the need to conduct active management in these areas; and how much is expected to occur.

Response:

a. Thank you for your comments regarding the need for active restoration on the HLC NF. All alternatives provide opportunities for forest management at landscape scales to benefit multiple resources.

b. Terrestrial vegetation objective FW-VEGT-OBJ-01 specifies a minimum level of vegetation treatments expected to be implemented for the purposes of achieving desired conditions on the landscape. Projects would be designed to move the landscape toward the desired conditions outlined throughout the plan.

c. The Plan allows for projects to be designed and implemented to move the landscape toward desired conditions. It does not preclude the use of a variety of methods and authorities that may be used to help accomplish the objectives of the plan, which may change over time. The FS appreciates the support for specific project areas on the forest; however, the Plan does not authorize site-specific project areas.

d. The Plan does not address specific post-burn restoration projects. The Plan allows for restoration activities such as tree planting, and includes desired conditions related to healthy watersheds and vegetation. For burns specifically in the wilderness, restoration activities would be limited by the Wilderness Act. In general, natural recovery of these landscapes would occur over time; in some locations where topography and climate are harsh, reforestation may occur over very long timeframes.

e. Under all alternatives, plan components provide direction for unroaded areas allocated specific designations. With the action alternatives, plan components for wilderness, recommended wilderness, and wilderness study areas explicitly prohibit timber harvest (FW-WILD-SUIT-03, FW-RWA-SUIT-04, and FW-WSA-SUIT-01). Restoration activities such as prescribed fire could be done in inventoried roadless areas, recommended wilderness, and wilderness study areas (FW-IRA-SUIT-03, FW-RWA-SUIT-02, and FW-WSA-SUIT-01). Prescribed burning in designated wilderness would be constrained by the Wilderness Act and Forest Service Manual 2324.21 and 5140.31. Harvest and fuels treatments could be allowed in IRAs but would be constrained by the Roadless Area Conservation Rule (RACR) of 2001.

   The need to manage in any landscape would be based upon the desired conditions in the plan, including those to provide for the coarse filter of terrestrial vegetation conditions. The desired vegetation conditions are based in large part upon the NRV, and by default would also provide for the necessary habitat conditions for native wildlife species. The terrestrial vegetation section as well as appendix H of the FEIS provide discussion and best available scientific information regarding these desired conditions. All other plan components would also apply when determining the need for active management, such as those related to fire and fuels as well as wildlife. To the extent possible, resource constraints were incorporated into the vegetation modeling and therefore projected harvest and prescribed burning acres take these factors into account, as discussed in appendix H, as well as the terrestrial vegetation and timber sections of the FEIS. The timber section also discloses the projected acres of harvest and prescribed burning expected to occur to groups of designated areas.

CR238 Vegetation – Nonforested Management

Concern: Comments on vegetation and nonforested management included:

a. A suggestion for a specific objective for treating 5% of grassland/shrublands forestwide annually or 100% every 20 years; and

b. Standards and guidelines are inadequate to prepare nonforested vegetation for the impacts of drought - specifically, modifying livestock grazing practices to ensure the success of revegetation/reforestation as currently outlined in FW-VEGT-GDL-02. Many AMPs will not have drought direction to reduce stocking rates or limit the season of use. These issues need to be addressed with forestwide standards and not left to site-specific prescriptions or AMP revisions.

Response:

a. The FS appreciates the importance of promoting healthy nonforested vegetation types. However, the suggested objective was not incorporated into the Plan, because it does not take into account the potential for natural disturbances and successional processes to maintain some proportion of grassland/shrublands in a desirable state without management intervention. It may not be necessary or realistic to treat 100% of these areas over the next several decades. The desired conditions for these vegetation types would help identify treatment needs in these areas, and vegetation treatment objective (FW-VEGT-OBJ-01) includes acres of treatment in nonforested types.

b. Site-specific prescriptions would be most appropriate to manage livestock grazing following management activities and/or drought conditions. The diversity of rangeland vegetation, climatic conditions, and past and present allotment management would vary across the planning area annually. Allowable use levels found in existing AMPs and annual operating instructions allow managers to adjust for drought conditions according to resource conditions on a case by case basis. When AMPs are revised, the Plan components would be followed to evaluate vegetation conditions and what changes in management may be needed to move towards desired conditions.

CR243 Vegetation - Editorial

Concern: Various vegetation plan component and other editorial suggestions were provided.

Response: Various vegetation management plan component and other editorial suggestions were provided. Changes were made where applicable, please see the vegetation section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR244 Vegetation – GA level Components

Concern: Several commenters requested that quantitative vegetation desired conditions be provided at the GA scale. Others voiced concern about how the changes in forest types by GA would be understood, monitored, and implemented.

Response: To better support project design, analysis, and monitoring, and to reflect the unique condition of each GA, GA-level vegetation desired conditions have been added to the Plan under all alternatives and analyzed in the FEIS. The components that have been added at the GA level include cover type, forested size class, and forested density class, in addition to individual tree species presence. Monitoring for all elements except individual tree species presence is included at the GA level in appendix B of the Plan. The terrestrial vegetation section and appendix H of the FEIS discuss the expected trend of vegetation conditions over time. Changes in vegetation conditions may be a result of management activities but is more often influenced by natural processes and disturbances.

CR245 Vegetation – Juniper

Concern: Several commenters thought that the amount of juniper in the desired conditions and estimated NRV is too high and should be re-visited.

Response: The NRV analysis was redone for the FEIS and is summarized in appendix I of the FEIS. In addition, the desired conditions for juniper were revisited and additional literature was reviewed to determine that the NRV model likely overestimated this component to some extent. The desired conditions were adjusted accordingly as described in appendix H of the FEIS.

CR246 Vegetation – Large Trees

Concern: Commenters had suggestions and questions about the vegetation-large trees plan components and analysis, including:

a. There should not be a GDL that requires leaving certain amounts of large trees; those determinations should be made at the project level;

b. Why are the desired large trees per acre in warm dry less than the existing amount, when these are likely less commonly than they were historically;

c. The only way to increase large and very large trees is to let mature trees grow;

d. The DEIS incorrectly refers to the large tree GDL as a STD. This GDL allows for the removal of large trees which is inconsistent with ecological integrity and the desire to increase the very large size class. The FEIS must explain and analyze this and consider an alternative that would retain more large trees;

e. Firm, clear non-discretionary standards are needed for large-tree retention in the forest plan. FW-VEGF-GDL-01 would promote gerrymandering of treatment units and large clearcuts; and

f. It is unclear what how the large tree indicators are determined or applied in analyses.

Response:

a. FW-VEGF-GDL-01, requiring the minimum retention of large trees, has been kept in the Plan, due to the emphasis on increasing these components on the landscape. The guideline allows for sufficient flexibility to account for the unique conditions that may be encountered at the project level; for example, if insufficient large trees are present or diseased.

b. The desired large trees per acre were derived from best available scientific information, which summarized the large trees per acre found in roadless and wilderness areas as an indicator of the natural range of variability. Other science does indicate that these trees are likely less prevalent than they were historically in the warm dry PVT, consistent with the NRV analysis for the large size class (see appendix H). The trees per acre desired condition for large/very large trees has been removed; rather, large trees are addressed by the desired condition for large tree-structure and the large size class on the landscape.

c. Individual large and very large trees can be promoted by providing additional growing space for mature trees to grow to larger sizes. The large size class can be increased by removing small and medium trees in a stand while retaining the large trees. Additional information regarding the promotion of large and very large trees was added to the terrestrial vegetation section of the FEIS.

d. The error in referring to the guideline as a standard was rectified. FW-VEGF-GDL-01 would allow the removal of some large trees in some cases; however, this would not be inconsistent with the desired condition to increase large/very large size classes. Further explanation of this was added to the Terrestrial Vegetation section of the FEIS.

e. The Plan would promote large trees through several plan components related to the large and very large size classes; large-tree structure; and retention of large trees within treatment units (FW-VEGF-DC-02, FW-VEGF-DC-04, and FW-VEGF-GDL-01). Monitoring of the large size classes and large-tree structure would also occur over time (appendix B of the Plan).

f. In the FEIS, large-tree structure is described in the Terrestrial Vegetation section. This attribute was included in the SIMPPLLE modeling for all alternatives. It ensures that large-tree components are considered even when they do not dominate the stand (and so classified as a large or very large size class).

CR247 Vegetation – NRV and Desired Conditions

Concern: Commenters had concerns related to NRV and vegetation desired conditions, including:

a. A need for more explanation about the use of NRV;

b. The potential for management of NFS lands to compensate for departures from NRV on adjacent lands;

c. The desired conditions are established in a way that requires management, and/or is at conflict with natural processes. Late successional stages and shade tolerant species are important for wildlife habitat;

d. The analysis used to determine DCs has not been peer reviewed for scientific reliability, validity, and limitations and cannot adequately address climate change;

e. Clarify why the NRV is the basis for DCs, when it is acknowledged that the NRV is not necessarily a management target;

f. Concern about the analysis of the reference conditions of landscape pattern using scientific metrics; or analysis that shows treatment effects would mimic these patterns or contribute to wildlife viability;

g. Increases in roads and old growth management are not consistent with the NRV; and

h. The desired conditions and associated management actions do not adequately take into account wildlife habitat needs; and inadequate direction is provided to guide habitat management.

Response:

a. The NRV analysis was updated and the process and results are summarized more thoroughly in appendix I for the FEIS.

b. All lands in the project area were included in the modeling to determine the NRV.

c. The DCs may be achieved through natural processes, such as fire, in addition to management activities. Natural processes were applied to both the NRV modeling (and therefore are integral to the formulation of the desired conditions) as well as the future modeling of all alternatives. While the NRV analysis and desired conditions do indicate a need for an increase in some intolerant species and open forest structures, shade tolerant species and closed forest structures are also reflected as important conditions on the landscape.

d. The process to determine DCs is documented in appendix H of the FEIS.

e. The use of NRV as a basis for DCs is consistent with the direction found in FSH 1909.12. Detailed discussion is available in appendix H of the FEIS.

f. Refer also to CR 233. Landscape pattern, including opening size, amount and relative distribution of cover types and tree species as well as forest structure, was modeled using BASI to establish the estimated NRV (refer to appendix H for details) and to estimate pattern under all alternatives. Also see the terrestrial vegetation section of the FEIS and also CR277 and CR136.

g. The impacts of roads on wildlife, watersheds, and other resources is addressed in the FEIS.

h. The Plan is consistent with the 2012 planning rule and associated directives with respect to ensuring wildlife species viability. Habitat needs of wildlife species or groups of species were assessed in developing the Plan; refer to appendix D for additional information.

CR249 Vegetation – Snags

Concern: Commenters expressed concerns about the guidance in the Plan related to desired snag conditions, and guidelines for retaining snags on the landscape during vegetation treatments. Specifically:

a. Retaining all very large snags is appropriate; especially in the Warm Dry PVT;

b. Please provide the existing condition of snags per acre (Table 9);

c. Explain why the current snag guidance (alternative A) is less clear than the action alternatives, and how the proposed guidelines provide clarity;

d. The snag guideline is not based on BASI and are confusing;

e. The analysis fails to quantify the cumulative snag loss in previously logged areas or other losses such as firewood cutting;

f. The analysis fails to apply BASI to describe the snag habitat needed to sustain the viability of pileated woodpecker and other snag-associated species; and

g. If a higher proportion of large snags are found on lands suitable for timber production, then protecting snags in these areas is critical for wildlife viability. Why are snags in wilderness/IRAs the best indication of NRV? What data source was used to estimate historic snag conditions?

Response:

a. Desired minimum retention for both large and very large snags is provided in FW-VEGF-GDL-02. This guideline has been revised to reflect public and internal comments. It requires that the largest snags available be retained; this would ensure that very large and large snags are the priority for retention in project areas.

b. The existing condition of snags is provided in FW-VEGF-DC-06 as well as in the snag section of the FEIS.

c. The snag section of the FEIS was revised to better describe the differences between alternative A and the action alternatives in terms of snag management; in addition, the guideline was re-written to improve clarity (FW-VEGF-GDL-02). While the 1986 Forest Plans do provide snag retention requirements for harvest projects, they do not point to a quantitative desired condition for snags.

d. The snag desired conditions (FW-VEGF-DC-06) and guideline (FW-VEGF-GDL-02) have been revised in the Plan to improve clarity. The intent of the guideline is to allow managers to design and retain the best linkages of snag habitat throughout the project area.

e. The effects of past logging and firewood activities on snags are taken into account with the existing condition estimates, which are based on the latest available FIA data; additional description was added to the snag section of the FEIS.

f. DCs for snags are based upon the best available information related to the NRV at the forestwide scale. The responsible official expects the plan components related to snag desired conditions, and the guideline that directs how activities that may affect snags and snag habitat must be conducted, to provide for the needs of snag-dependent wildlife species as well as for future downed wood habitat. Plan components allow flexibility to manage for site-specific needs to maintain or enhance wildlife habitat as needed. Additional discussion is provided in the wildlife section of the FEIS.

g. Historic snag conditions were estimated based on the number of snags currently present in wilderness and roadless areas on the HLC NF estimated using Forest Inventory Analysis (FIA) data, as described in the snag section of the final EIS. Retaining snags, especially large snags, within those lands is one of the functions of FW-VEGF-GDL-02.

CR250 Vegetation – Restoration and Resilience

Concern: Commenters had concerns about vegetation restoration and resilience, including:

a. The terms "restoration" and "resilience" are poorly defined, and inappropriately used to justify management intervention, without due consideration for wildlife. There is no definition of "normal function" related to these concepts;

b. The FS does not specify an adequate way to measure degraded ecosystems, resilience, resistance, or measure the change in resilience following management actions;

c. There are no measurable metrics for desired conditions or NRV; no trends are presented; and climate change was not adequately addressed. The desired conditions are not scientifically sound; and

d. The FS is using resilience to justify intensive management to maintain an unnatural stasis that does not allow for natural disturbance. Resilience and resistance would be best achieved by allowing natural processes to occur.

Response:

a. The definitions for resistance and resilience used by the HLC NF are found in the 2012 Planning Rule and associated directives (Forest Service Handbook 1909.12).

b. As per Forest Service Handbook 1909.12, the HLC NF uses a coarse filter approach to define ecosystem diversity in the planning area and compares the existing condition to the NRV to assess ecological integrity. The Plan defines and measures a variety of vegetation attributes at the broad scale to represent ecosystem diversity. The DCs for these attributes are defined in the Plan and would be monitored over time as specified in appendix B of the Plan. During project design and analysis, more localized conditions and possibly degraded conditions would be identified and defined based on specific site conditions.

c. Measurable metrics are specified for an array of vegetation desired conditions, as presented in FW-VEGT, FW-VEGF, FW-VEGNF, and Chapter 3 (Geographic Areas). These metrics include ecosystem components such as cover type, individual tree species presence, forest size class, forest density class, large-tree structure, and snags. Historic trends for these metrics are provided in the NRV analysis, which is summarized in appendix I of the FEIS. Expected future trends are provided in detail in appendix H and summarized in the FEIS. Climate change was incorporated into the modeling process with the SIMPPLLE model, to the degree possible, using expected future fire scenarios and climate parameters, as described in appendix H. The DCs are formulated using the NRV ranges as well as other best available scientific information, as described in appendix H of the FEIS.

d. Resilience may be achieved through natural disturbances; management intervention where needed would mimic the effects of natural disturbances as well as promote resilience to expected future disturbances, as described in the terrestrial vegetation section of the FEIS.

CR251 Vegetation – Ecosystem Diversity

Concern: Commenter believes that the Draft Forest Plan does not adequately represent ecosystem diversity because: 1) the classification and definition of ecosystems is not sufficiently specific; 2) desired conditions do not include non-NFS lands and therefore do not represent an all-lands approach; and 3) ecosystem diversity is not adequately mapped and included in the Plan.

Response: The depiction of ecosystem diversity in the Plan is consistent with the requirements of the directives (Forest Service Handbook 1909.12) as well as other planning efforts in Region 1 and would be sufficient to provide for ecological integrity at the broad scale.

The classification of ecosystem diversity is adequate for programmatic planning purposes, and 'finer scale' (unique combinations of type/size/density) would not be supported by available data or analysis tools. As described in the terrestrial vegetation section of the FEIS, the comparison of NRV and desired conditions are consistent with the findings of an assessment conducted Blackfoot Swan project, which was based on more fine scale classifications of the ecosystem.

The vegetation modeling was conducted across all ownerships in the planning area; therefore, vegetation conditions and disturbance processes expected to occur on non-FS lands were included and appropriately influence the conditions summarized on NFS lands. However, the DCs quantify only the conditions found on NFS lands because those are the lands the FS can directly influence. Future conditions on non-NFS lands would be included in the cumulative effects analysis when projects are proposed under the Plan.

The components of ecosystem diversity are spatially represented in the vegetation model input file, which is based on FIA data and the Region 1 VMap, for analysis purposes in the EIS. However, the current condition of ecosystem components would be subject to constant change as disturbances, successional processes, and management actions occur. Such changes would be monitored as described in appendix B of the Plan. While the existing condition is described numerically in the Plan to provide context for the desired trend on the landscape, these conditions are not included as a map in the Plan. There is no requirement to include such a map as part of the Plan.

CR252 Vegetation Modeling

Concern: Commenters provided a range of concerns and suggestions regarding the vegetation modeling used in the forest plan revision process. Specifically:

a. The vegetation modeling is inadequate or unclear in terms of supporting the analysis and decision;

b. The graphs and charts are unclear; specifically, why the decade 0 of the model is different than the estimated existing condition;

c. Using these models to support wildlife viability conclusions is not valid, given the multiple assumptions used to formulate the models and because the models do not estimate the possible impacts of salvage treatments;

d. The model methodologies and results are not appropriate to support decision making because they have not been validated as the best available scientific information, supported by literature citations, or observations. An independent peer-review process should be conducted. The reliability of the input data has not been disclosed or ensured; the models have not been validated for the way they are used in the EIS;

e. Further explanation is needed as to why the models are not "predictive"; prediction is necessary to ascertain viability. Further, displaying the results as an average of alternatives is inappropriate - the EIS needs to disclose the differences across alternatives whether large or small;

f. The EIS suggests that alternatives A-D are modeled to harvest more warm/dry sites to achieve large size classes; but then suggests projects might not actually do this. This has impacts to wildlife - how are the effects determined if the models do not conform to reality; and

g. The wildlife habitat models specifically should be validated with independent wildlife-use data.

Response: The FS recognizes the complexity and inherent limitations in the use of simulation models to support decision-making. The vegetation modeling was conducted utilizing the best available modeling tools and data sources, and the results were closely reviewed by subject matter experts. The known limitations of the models are disclosed, and other best available scientific information was used to inform the analysis and conclusions (see appendix H of the FEIS).

a. The vegetation modeling processes used represent the best available data and modeling techniques to support the forest plan revision analysis and decision-making. The data and techniques used by the HLC NF align with other efforts in Region 1. Modeling assumptions and limitations are disclosed in appendix H.

b. Decade 0 as reported by the model differs in some cases from the estimated existing condition because two different data sources are used. The existing condition used in the Plan for most attributes is based on the most statistically reliable data, FIA and FIA intensified grid plots. Decade 0 in the model is derived from the spatial input file, which is derived from Region 1 VMap. The spatial input file for the model was refined to be more similar to FIA; however, there are inherent differences in the two products. Both starting conditions are disclosed and shown on the graphs to ensure transparency in the analysis processes. Additional explanation is found in appendix H of the final EIS.

c. The future projections from the model are utilized primarily to compare alternatives; the model is heavily driven by future disturbances, and it is not known specifically when and to what degree disturbances will actually occur. Using these programmatic models to reach conclusions regarding wildlife viability is consistent with other work conducted across Region 1. The model is calibrated to incorporate a broad range of potential future disturbance scenarios, to provide the most likely future trend. The monitoring of actual vegetation conditions on the ground through time, as per the monitoring plan in appendix B of the Plan, would inform habitat analyses and influence the actual management that occurs on the ground, rather than the projected model results. Potential salvage activities are not included in the PRISM (timber scheduling) model, because per the Directives these activities should not be included in potential timber output estimates. Salvage activities would be dependent the timing and location of disturbance events, which is uncertain. The potential effects of salvage are addressed qualitatively in the terrestrial vegetation section of the FEIS.

d. The SIMPPLLE model tool has been peer-reviewed (Chew 2012) and has been used consistently in Region 1 for forest plan revisions and other broad scale vegetation analyses. As a knowledge-based model, there are many calibrations that can be done. The calibrations and assumptions used for the HLC NF build upon other work being conducted in the Region, and included input and extensive reviews from subject matter experts on the planning team, in the Regional Office, and at the Rocky Mountain Research Station to ensure that the assumptions and results were appropriately represented for the ecosystems on the HLC NF. The assumptions in the model are also based on actual data when possible - for example, to emulate the levels of known fire start frequencies and locations, actual acres burned historically, and mapped insect infestations. Even so, the analysis acknowledges and discloses the limitations of the model and utilizes other BASI when needed to reach analysis conclusions. The reliability of the input data is disclosed in appendix H of the FEIS. The accuracy assessment of the Region 1 VMap, along with the statistical reliability of FIA estimates (with 95% confidence intervals) reflect the general accuracy of the input data, because those two products were utilized to create the model input landscape.

e. See also the response for (c), regarding the predictive value of vegetation models. Appendix H of the FEIS discloses the detailed model results by alternative and decade. However, in many cases the results across alternatives were nearly identical, and not compelling for the purposes of display and discussion in the body of the FEIS.

f. Appendix H of the FEIS describes how each alternative was modeled in PRISM related to future timber harvest. In alternatives A-D, the model emphasized attainment of desired conditions. In contrast, alternative E was modeled to maximize timber production as a priority in addition to achieving desired conditions; this was done to provide a range of possible management emphases on the landscape. In this alternative, the model harvested more productive forest types to a greater extent (such as lodgepole pine); this was not inconsistent with desired conditions but did not contribute as greatly to movement toward desired conditions. The timber section of the FEIS clarifies how the model emphasis relate to on -the-ground management.

g. The wildlife habitat model estimates are based on the best available scientific information which inherently incorporate known wildlife use and patterns. The habitat models used are consistent with other broad scale modeling efforts in Region 1, and specifically include the rigorous work conducted by the FS and partners to develop the East Side Assessment for wildlife habitat for a multitude of species.

CR255 Vegetation – Tree Density

Concern: Comments regarding tree density plan components, including:

a. The Plan should represent tree density in a more meaningful way. Canopy cover is not a good surrogate for stand density; trees per acre should be used;

b. Using 1 tree per acre to represent species presence is not useful; a different metric or higher threshold should be used; and

c. High density areas include both small diameter material as well as older multi-storied stands that are beneficial to wildlife; while the NRV indicates a necessary reduction in high density forests, specific conditions such as high density older multi-story stands are below the NRV.

Response:

a. Forest density is an important feature of ecological diversity and plan components are in place to represent this feature based on available data sources. Canopy cover is the best available measure of density in spatial map products such as Region 1 VMap. This is the only metric that can be reliably estimated both from plot data sources and map products to inform programmatic forest plan components and allow for broad-scale monitoring over time. Metrics such as trees per acre are available from plot data (such as FIA) but are not spatially represented. In addition, trees per acre can be a problematic measurement because it does not necessarily describe forest density without an understanding of the tree size. On a more site-specific basis, projects may utilize other metrics such as basal area, trees per acre, average diameter, and canopy cover, as needed to adequately analyze project-level effects for specific species.

b. Tree species presence, as indicated by 1 tree, is the best available metric to represent the extent of a tree species overall; this metric can be consistently mapped and monitored over time. The threshold of species presence that would be meaningful for other analysis purposes would vary, such as the number of trees necessary for seed dispersal, and those needed for various wildlife species habitats. It is not possible to programmatically assess these various thresholds.

c. The FS agrees that density alone does not indicate the size class of the forest, and the utility of high-density forests for wildlife would depend upon other factors as well such as canopy layers and tree species. The NRV is assessed separately for density class, size class, and vertical structure. Some specific wildlife habitats of importance, such as mature multistoried forests in potential lynx habitat, are modeled explicitly due to their importance. The plan components for desired vegetation conditions provide the coarse filter. Other plan components provide specifically for habitats of interest, such as Canada lynx. The terrestrial vegetation and wildlife sections of the FEIS provide interpretation as to how the desired conditions and future projections for vegetation metrics contribute toward wildlife habitat needs.

CR262 Vegetation – Other Species

Concern: Commenters had concerns about aspen decline, especially under the proposed fire management as well as livestock grazing. There were also concerns about the lack of cottonwood DCs, the ability of spruce/fir cover type to be too much, and why there is a desired range for ponderosa pine (which was mentioned to be rare and minor).

Response: Based on the suggestions and comments, the expected trends for aspen have been expanded in the terrestrial vegetation section of the FEIS. Plan components were included in the Plan for protection of aspen from grazing (FW-GRAZ and FW-VEGF DCs). See appendix I of the FEIS for NRV conditions for hardwood species, which include cottonwood. Please see the updated vegetation modeling in the FEIS as well as the terrestrial vegetation sections for discussion of the spruce/fir trends as well as ponderosa pine.

CR280 DEIS Sagebrush Update

Concern: Commenter was concerned that a sagebrush-related guideline that is referenced in wildlife section of the DEIS does not exist.

Response: The wildlife analysis has been updated to reference the appropriate plan components.

Old Growth, snags, and downed wood

CR248 Vegetation – Old Growth

Concern: Commenters had concerns about vegetation, old growth, including:

a. No treatment in old growth should occur. All old growth on the landscape should be protected, and the amount of old growth increased, to provide ecosystem integrity and because of the value it provides for wildlife and plants;

b. Logged old growth stands would no longer remain effective wildlife habitat. Clarify why old growth stands should be treated from a wildlife perspective - particularly cool/moist types that may become more fire-prone after treatment;

c. Old growth should be mapped;

d. The estimated NRV of old growth is too low. An appropriate NRV level of old growth should be included as a DC;

e. The need to sustain old-growth for associated wildlife species;

f. The existing condition of old growth should be provided;

g. The analysis is inconsistent when it states that all old growth is conserved, but some removal of old growth is allowed by plan components;

h. The agency isn't clear on the definition of old growth;

i. The EIS is inconsistent in how it describes the trend in future size classes, such as the effects of fire suppression versus the results of the SIMPPLLE model;

j. The use of remote inventory techniques to determine old growth and other vegetation metrics;

k. The exception to the old growth GDL that allows for the removal of old growth when mortality is imminent;

l. Maintenance of snags in old growth; and

m. A request for more science and analysis of fire refugia for old forests and direction for how to identify or protect it.

Response:

a. The Plan acknowledges the ecological importance of old growth and complies with a USDA policy statement ("USDA Old growth policy statement of 10/11/89). Please see plan components: FW-VEGF-DC-05 and FW-VEGF-GDL-04. Additional discussion has been added to the old growth section of the FEIS on treatment approaches and the supporting science that could support the maintenance or development of old-growth forests.

b. The stated purposes for treating in old growth (FW-VEGF-GDL-04) would result in stand conditions consistent with the natural processes that create old growth, and therefore those stands would likely remain useful for many wildlife species. Additional discussion has been provided in the Wildlife section of the FEIS.

c. There is not a comprehensive map of all of the old growth across the HLC NF that can be used at the programmatic level, because complete field inventory would be required. Existing levels of old growth can be reliably estimated using FIA data, but these points do not necessarily correspond to a stand or patch of old growth. Old growth is subject to continual change - as old stands die, they are replaced by other stands growing older. It would be inappropriate to permanently designate a given stand as old growth into perpetuity. As old growth stands are identified during project development, they would be protected under the old growth guidelines. The intent of the Plan is not to identify permanent designations of old growth, but rather provide for an increasing amount on the landscape overall.

d. Setting a specific target for the amount of old-growth forest is infeasible. The ability to quantify historical amounts of old-growth forest and the NRV is problematic because of the site specificity of the old-growth forest definitions and the need for field inventory to confirm its presence and location, as described in the old growth section of the FEIS. The Plan direction emphasizes the protection of existing old-growth forest and the development of future old-growth forest (to the degree that the Forest is able to do so), understanding that natural disturbance processes and forest succession will continue to be the primary means by which old-growth forest is created and removed on the Forest.

e. The distribution of old growth is not specified in the Plan, due to the uncertainty and variability associated with future disturbance processes. The optimal distribution of old growth from a wildlife perspective would vary by species and landscape, as well as by vegetation type. The Plan provides the flexibility to recognize and adapt management practices to provide for a range of old growth patch sizes, while emphasizing that larger patches are desirable.

f. The existing amount of old growth is disclosed in FW-VEGF-DC-05, as well as in the old growth section of the FEIS. The condition of old growth stands themselves is addressed qualitatively based on general vegetation type, as the specific condition within individual old growth stands is variable and not possible to address at the programmatic scale with available data.

g. The FEIS was updated to clarify that most old growth would be conserved, with some possible exceptions as allowed by the plan components. Stands that are currently old-growth forest may not be treated to the extent that they no longer meet old-growth forest definitions (FW-VEGF-GDL-04). Also see FW-VEGF-DC-05 and FW-VEGF-GDL-01.

h. The old growth components state that old growth is defined based best available scientific information currently available. In addition, FW-VEGF-GDL-04 also notes that if new best available scientific information is developed to update these definitions, the HLC NF would then use the best available definitions. A forest plan amendment would not be needed to incorporate new best available scientific information. Old growth maps are not part of the Forest Plan, and therefore no forest plan amendment would be needed to reflect old growth conditions change across the landscape.

i. The FEIS acknowledges that fire suppression may contribute to overall decreasing size class by allowing small trees to establish and dominate some forests. At the same time, the future SIMPPLLE model results indicate that large size classes will increase on the landscape, even though fire suppression is expected to continue. While the effects of fire suppression will continue to occur, large size classes may also increase overall because of other factors such as predicted increases in fire on the landscape, forest succession in small/medium forests that are abundant in some landscapes, and management practices such as prescribed fire and thinning that favor retaining large trees and removing smaller trees. Additional discussion has been added to the terrestrial vegetation section of the FEIS.

j. As discussed in the old growth section of the FEIS, tree size class can be reliably determined based on the remote sensing techniques used to build the input layer for NRV modeling. Size class is classified in the R1-VMap, with a known accuracy, and tracked with the SIMPPLLE model used to derive the NRV. Old growth cannot be similarly modeled, however, because the definition requires additional information, such as age, that is only available in stand-level field inventory. Such data is not available across the Forest, nor can it be derived with the model used to determine NRV.

k. The FS agrees that dead trees and late-stage forest processes are integral components of old growth. The plan component has been modified and no longer contain an exception to treat old growth when mortality is imminent, because of the potential subjectivity of that determination (FW-VEGF-GDL-04).

l. The old growth guideline has been re-worded, and more specifically guides managers to retain as much of the old growth characteristics as possible in treated areas, including snags (FW-VEGF-GDL-04).

m. Refugia is defined in the glossary of the Plan. The old growth section of the final EIS describes forest remnants that may survive fire located in topographical features such as rock outcrops. When such refugia meet old growth definitions and are identified during project analysis, they would be subject to the management limitations required in FW-VEGF-GDL-04.

CR270 Wildlife – Old Growth and Snags General

Concern: Comments were received that voiced general concerns that the Plan will not conserve wildlife associated with old growth and snags, nor provide adequate monitoring related to those species. See also the summary and responses for CR 248 and 249.

Response: The Plan uses a coarse-filter fine-filter approach to maintain a diversity of plant and animal species, as required by the 2012 Planning Rule. Old growth and snags are important habitat elements for a number of different species, and so the Plan includes components to maintain these key characteristics. These plan components were developed using the best available scientific information. The forest plan assessment describes sources of monitoring data for species associated with snags and old growth, along with data used to estimate the NRV for these characteristics. Maintaining habitat components within the NRV is expected to provide for the needs of associated wildlife species.

For a discussion of the plan components designed to maintain old growth and snags, see CR 248 and 249, vegetation-old growth, and vegetation-snags. These plan components, along with components that promote large trees, will contribute to maintaining wildlife associated with old growth and snags. Section 3.14.5 in the FEIS discusses a number of species that are associated with old growth or with certain components of old growth such as large trees or snags that would be expected to benefit from plan direction under the preferred alternative. As stated in the FEIS, plan direction is expected to maintain old growth and snags, thus conserving species associated with these habitat elements. Table 1 in appendix D of the FEIS notes specific species that are associated with old growth and snags.

See also CR 248 old growth, snags and downed wood, and CR 249 vegetation-snags.

Plant species at risk

CR101 Botany

Concern: Commenters had concerns about the botany analysis in the DEIS, including:

a. The EIS does not adequately address sensitive species and provides inadequate public notice about the change in management for sensitive species. The analysis ignores NEPA requirements for disclosure of effects in a DEIS, relative to sensitive species. Consider the increased risk to species formerly considered sensitive due to plan components because the EIS alternatives would affect those sensitive species that have not been classified as SCC; and

b. An editorial error was identified.

Response:

a. The at-risk plant report analyzes the risks of implementation of the Plan to species that were formerly sensitive species and no longer included as SCC, and also the species that were not previously listed as sensitive species but now would have SCC status. Additional analysis from the botany report was brought into the FEIS to ensure that sensitive species were adequately covered.

The selection of SCC was a separate analysis conducted by the FS Region 1 office; the selection of SCC is a Regional Forester decision. Updated information regarding the evaluation and scientific information used to determine species included and excluded as SCC for the HLC NF can be found on the Northern Region webpage. This includes the evaluation process document, a link within the process document to a supplemental botany report, and the evaluation spreadsheets. Sensitive species not selected as SCC through this process were determined not have to substantial concern regarding their long-term persistence in the planning area.

The Plan components ensure that at-risk species would be considered during project activities. The monitoring plan (appendix B of the Plan) would ensure that the at-risk species are monitored using species-specific protocols to determine that the methods used to implement the plan components are effective and consistent with best available scientific information. Appendix C of the Plan provides more detail on species-specific monitoring to ensure that appropriate data for each species would be collected to support the plan components when necessary.

b. The error has been corrected.

CR202 Monitoring – Botany

Concern: Commenter thought that monitoring for sensitive plants needs to include species-specific information.

Response: The monitoring plan in appendix B of the Plan describes a minimum requirement to monitor threatened, endangered, proposed, candidate, and SCC plants; collectively these are referred to as ‘at risk’ plants in the planning directives and FEIS. The monitoring plan ensures that at-risk plants are reviewed every 6 years for all available trend and status data to determine the status of at-risk plants in the planning area and determine future monitoring needs and effectiveness of plan components. Language was added to ensure that species-specific monitoring protocols would be used as appropriate to document necessary trend data and support the plan components. While species-specific monitoring plans are not included in the monitoring plan for each species, the language of the monitoring plan ensures that species-species techniques would be applied to collect the necessary data to answer the monitoring question: What is the status of SCC species in the planning area?

Additional information on at-risk plant monitoring is described in the at-risk plant section of appendix C of the Plan. This section recommends monitoring known occurrences of at-risk plants within project areas and forestwide to determine trend data of individual occurrences, to contribute to trend data at the species-range level, and to document impacts of project activities. Best available scientific information would be considered and applied to document species and occurrence trends.

CR263 Vegetation – Whitebark Pine

Concern: Commenters had suggestions about whitebark pine, including:

a. The EIS needs to explain inconsistent discussions for whitebark pine: it is estimated to remain static in the future with the modeling, and yet effects analyses note that current and future declines are expected; and

b. The Draft Forest Plan does not include a scientifically based conservation strategy for whitebark pine.

Response:

a. Discussion was added to the terrestrial vegetation and at-risk plants sections of the FEIS to clarify the expected trend of whitebark pine.

b. Whitebark pine is included as a cover type and individual tree presence that would be tracked at the forestwide and GA scales in the desired conditions in the Plan and would be monitored over time as described in appendix B of the Plan. Further, the at-risk plants section of the Plan includes components specific to whitebark pine and includes an objective specific to restoration treatments for this species (FW-PLANT-OBJ-01). These elements together provide the framework to contribute to the conservation of this species.

CR281 Rare Plants – RWA

Concern: Commenter suggested that the presence of rare plants should be considered when choosing which RWAs to designate.

Response: At-risk plant locations were reviewed to determine which species overlapped with various land management areas, including RWAs. The populations that overlap these areas are described in the at-risk plants report. No species' persistence in the planning area was dependent upon populations within the RWAs. A botanist was present at the discussions for some RWAs and provided input in the decision making. Review the at-risk plant report for more information on the species included in the RWAs and the anticipated effects of this designation on the sensitive plants within and outside of these areas.

Pollinators

CR253 Pollinators

Concern: Commenters had suggestions for plan components related to pollinators, including:

a. Pollinator best available scientific information reference needed within the FW-POLL-GDL; and

b. Connectivity needs to be protected/provided for native pollinators. Add plan components to provide connectivity opportunities.

Response:

a. The reference is not needed within FW-POLL-GDL-01. The reference is listed under the pollinators section in appendix C of the Plan.

b. Pollinator habitat is covered by FW-POLL-DC-01: "Plant communities composed of an abundant and diverse mix of native grass, forb, shrub, and tree species are present across the landscape to provide foraging habitat for native pollinators. Pollinator nesting and hiding cover are also provided through graminoid and herbaceous structural diversity in nonforested habitats as well as snags and large downed woody material in forested habitats."

Connectivity is currently available for pollinators along roadsides in the planning area at a higher abundance given the natural character of the landscape when compared to transportation right-of-ways. Transportation right-of-ways represent a more isolated form of pollinator habitat in denser populated areas with fewer natural species. Therefore, transportation right-of-way plan components are not needed in the planning area to achieve the desired condition.

Invasive plants

CR18 Nonnative Invasive Plants – General

Concern: Comments had suggestions for invasive weed management, including:

a. The HLC NF needs to place more emphasis on invasive weed management as the issue affects all forest users. A collaborative approach utilizing early detection rapid response is needed for prompt containment of invasive plants;

b. Weed management is a huge task and expense and should be taken on as a landscape approach with multiple partners through an integrated weed management approach. Wildlife habitat should be prioritized for weed treatments given there is a great area needing treatment tan resources available;

c. Plan components need to consider secondary invasion from winter annuals in weed management strategies;

d. The Plan should consider increases in atmospheric carbon levels and higher temperatures would likely make invasive species more competitive and adaptable, especially annual grasses;

e. Consider the increased threat of invasive plant introductions from disturbance impacts from management activities to increased recreational uses and provide plan components to address these vectors; and

f. RWA and IRAs reduce the ability of county and FS personnel to respond to invasive weed infestations and enable the spread of invasive species by allowing existing infestations to expand.

Response:

a. The HLC NF realizes it would take coordination from all landowners and outside partners within the planning area to establish an effective weed management program. The Plan includes plan components that would direct the Forest to utilize collaborative partnerships to extend weed control efforts to a landscape level. Plan components found under Invasive Plants describe these partnership opportunities and extending efforts for invasive plant management.

b. Plan components for invasive plants provide the guidance to prioritize treatments where intact native plant communities are found and noxious weed populations are currently low. Many priority wildlife habitat areas currently contain these qualities and the plan components encourage these conditions to be maintained into the future. Partnerships opportunities, often with nongovernment organizations, provide project support for critical wildlife habitat improvement projects.

c. FW-INV-STD-01 and FW-INV-GDL-01, and 03 provide guidance to adapt weed treatment strategies to minimize adverse effects from secondary invasion. The HLC NF recognizes that bare ground from misapplication of chemicals or lack of native perennials to repopulate treated acres could lead to secondary weed invasion and risk of plant community conversion. Secondary invaders, such as annual invasive grass species, may present an even less desirable plant community than when noxious weed species were present. Plan components provide guidance for a sustainable treatment approach.

d. The invasive plants section in the FEIS acknowledges that climate change and increases in atmospheric carbon present possible challenges to weed managers. Issues could range from increases in range and distribution of invasive plant species as well as more herbicide resistance, shorter treatment windows, and less time for weeds to senesce and set seed.

e. FW-INV-STD-01 states: For all proposed projects or activities, the risk of noxious weed introduction or spread shall be determined and appropriate mitigation measures shall be implemented. Activities shall be designed to minimize the risk of spreading invasive species and meet multiple use and ecological objectives.

f. RWA and IRAs in general have limited motorized access due to topographic limitations. Where old trail or two-track prisms exist within these allocations, some level of motorized use for administrative purposes may be authorized, especially for invasive plant control. In most cases, Forest weed managers need to account for limited access when planning treatments in these nonmotorized areas. Many of these remote and nonmotorized areas are relatively weed-free or have containable infestations due to limited weed vectors from roads, trails and management activities. The HLC NF has significant investment into backcountry weed control projects, although we recognize much more could be done. Plan components address the need to continue a focus on these remote areas to maintain native plant communities.

CR57 Monitoring – Invasive Plants

Concern: Concerns regarding monitoring of invasive plants included:

a. Effectiveness of treatment for invasive species needs to be monitored and non-target species should be assessed; and

b. FIA intensified grid and non-forest plots should be used along with other data sources to monitor treatment effectiveness.

Response:

a. As part of any integrated pest management approach and early detection, rapid response strategy, monitoring of invasive species populations is a key component. FW-INV-GDL 01 and 03 would direct weed managers to use monitoring information to determine future management actions of invasive species.

b. Where possible, more intensive and quantifiable monitoring information regarding invasive species is needed and desired in order to determine how management strategies are affecting invasive species infestations and populations. FW-INV-GO-02 encourages working with partners, such as MSU extension and county weed departments, to collaboratively treat and monitor invasive plant populations. Both existing rangeland trend study sites as well as new monitoring sites would be used to evaluate the effectiveness of weed management efforts in site specific locations.

CR155 Nonnative Invasive Plants – Management, Treatment, and Reclamation

Concern: Comments were received that asked the HLC NF to manage and treat weeds, including requests to:

a. Treat weeds more aggressively;

b. Limit treatments of broadcast spraying or only allow spot spraying;

c. Describe how an integrated pest management approach will not negatively affect at-risk plant populations;

d. Consider reinvasion of noxious weed species or a secondary invasion of invasive species following treatments; and

e. Have a restoration plan in place following weed treatment activities.

Response:

a. The HLC NF has an active forestwide noxious weed program utilizing an integrated pest management approach to managing invasive species. The Forest fights the spread of weeds as aggressively as budgetary and personnel constraints allow. Plan components provide the support to pursue the latest advancements in technology, herbicides, and treatment options, as well as establish criteria for invasive species management at the project level.

b. The Plan would not limit, restrict, or authorize different treatment options for site-specific application through plan components. Design criteria at the project level would limit treatment options if resource concerns were identified.

c. An integrated pest management strategy would utilize the most appropriate tool for managing invasive species at the site-specific level. The plan components for at-risk or sensitive plant species are designed to look at options that may include hand pulling, mechanical, or precision spot-spraying when invasive species threaten or have invaded sensitive plant populations or habitat. Having a heavy-handed approach or taking no action near these populations of concern could lead to departure from desired conditions. This component was designed to evaluate all the resource values a site contains, and for weed managers to choose the most appropriate tool to move towards desired conditions of maintaining species diversity.

d. The HLC NF recognizes that reinvasion by secondary invasive plant species, such as winter annuals, following treatments of noxious weeds may have severe environmental consequences for range and forest lands. Consequences include increased fire return intervals, new steady vegetation states of communities comprised of entirely non-native plant species, and a loss of forage and wildlife habitat. Plan components for invasive plant management are designed to move plant communities toward desirable native plant species composition.

e. Plan components promote and support reclamation of native vegetation where needs have been identified in order to move towards desired conditions for site-specific projects. At the present time, most areas of the HLC NF have native plant communities that are still intact, even if severely suppressed by invasion on nonnative invasive plant species. Depending on site conditions, timing, and frequency, weed treatments generally result in a beneficial release of native vegetation cover where ground disturbance has been minimal. Options continue to improve to source native seed from plant species and genotypes that are native to the HLC NF.

CR156 Nonnative Invasive Plants – Plan Components

Concern: Various edits and plan component suggestions to the non-native invasive species section were received. These included:

a. An objective should be included to keep weed mapping and treatments up to date. Who will be responsible for weed inventories in the future;

b. An objective should be included to prioritize areas when adjacent landowners are undertaking control actions;

c. A guideline should be included which restricts road or trail construction or placement in areas where noxious weed establishment would occur as a result;

d. Addressing reseeding or weed treatments following projects on forest lands should be addressed in the final plan;

e. Why was a minimum treatment target of 3,000 acres of noxious weed infestations selected, when this level of treatment would not be sufficient to reduce invasive populations, let alone even slow expanse of existing infestation levels? FS weed treatment programs have basically had the same plan direction in the past as what the Plan contains, and invasive species have continued to expand;

f. FW-INV-STD-02 "… maintain effective separation of bighorn sheep from domestic sheep or goats." is a design criteria that just highlights the limited usefulness of using domestic sheep or goats for weed management. This standard does not constrain management actions; and

g. Several comments suggested rewording of invasive species plan components to be clearer management constraints.

Response:

a. Invasive species inventory and treatment data is recorded or updated annually in the FACTS database. Maintaining noxious weed treatment data is already a Federal and state requirement, so additional plan components are unnecessary. The HLC NF is responsible for keeping inventory and treatment records with information updated annually from Forest weed crew, county cooperator, and private contractor daily treatment logs and mapping.

b. Goal FW-INV-GO 03 "Landscape scale weed treatments are coordinated with weed treatments occurring on adjacent lands" addresses this concern.

c. Plan components for invasive species would be followed and considered in project design when road or trail construction is involved. See FW-INV-STD 01.

d. See FW-INV-GDL 05 and FW-VEGT-GDL-04 regarding reseeding and restoration needs. These guidelines would be considered and incorporated at the project level if an interdisciplinary team determined them appropriate.

e. Noxious weed treatments of 3,000 acres is considered to be the absolute minimum acreage the Forest would achieve under the most limiting budgetary constraints and application methods. Objectives in the Plan may be exceeded as funding and capacity allow. The HLC NF has treated up to three times this amount of weed infestations when funding allows. This minimum objective of 3,000 wetted acres could help "hold the line" on past work that has been done with noxious weeds. Plan components for invasive species encourage pursuing more efficient weed control technologies, which could lead to increased weed treatments.

f. Design criteria are constraints. FW-INV-STD-02 requires consideration and analysis at the project level of where wild bighorn sheep occupy habitat prior to authorizing domestic sheep or goats to be used for an integrated pest management option for noxious weed control. The responsible official should also recognize potential adverse interactions between domestic livestock and native species and provide plan components to avoid or mitigate these risks (FSH 1909.12, Land Management Planning Handbook, Chapter 20 - Land Management Plan).

g. Standards and guidelines in the Plan for invasive plant species were reviewed by the revision team and determined to be constraints that would provide guidance for weed management at the project level. These standards and guidelines were developed from past concerns and issues that have occurred or have the potential to occur in the future.

CR157 Nonnative Invasive Plants - Aquatic

Concern: Commenters had concerns about aquatic invasive species and suction dredging and the effects of both on aquatic ecosystems, including:

h. Aquatic Invasive Species Concern: The commenter quoted the DEIS/FEIS that "spread and introduction vector" for aquatic invasive species associated with management activities would be mitigated: "More general or universal objectives and procedures, such as using current best practices for equipment washing before and after entering an area, are recommended for inclusion in the fish and aquatic wildlife sections of the document. This better assures that these components are included as resource protection measures at the project level". The commenter concluded that the recommended standards were not actually included in the plan document as plan components; and

i. Suction Dredging Concern: The commenter's concern was "the DEIS concludes that, "MTDEQ has seasonal restrictions on suction dredging and other in- stream mining activities on many of the forest's bull trout and cutthroat streams, therefore impacts will not be seen in those streams" (p. 96). It does not necessarily follow that there would be no impacts because it is regulated by the state. This must be explained in more detail and supported by BASI."

Response:

j. The following plan components were included in the Plan to address the threat from aquatic invasive species. Please see Forestwide Fisheries and Aquatic Habitat plan components: FW-FAH-DC-06, FW-FAH-GDL-01, and FW-FAH-GDL-02.

k. Montana DEQ requires a General Permit for Portable Suction Dredges that regulates wash water effluent into state waters. Effluent limitations, monitoring requirements, and other conditions are set forth in Parts I, II, III, and IV of the General Permit. Written authorization from DEQ is required before an applicant can discharge under the General Permit. New applicants for the permit must secure the Instream Mining Stream Classification List that identifies restrictions from MFWP. The list of streams provides guidelines for each stream based on stream classification and spawning/incubation periods for fish species that are present. Based on these guidelines, Class 1 and 2 streams are closed, Class 3 and 4 streams are seasonally restricted, and Class 5 streams are open. Reaches of streams that are considered important occupied habitat by bull trout and/or westslope cutthroat trout are closed, while a few reaches have appropriate seasonal restrictions. Both new and renewal applicants must complete a Notice of Intent which is filed with DEQ and all suction dredging proposals must secure a Natural Streambed and Land Preservation Act 310 Permit from the local County Conservation District, which includes a landowner signature line. This is a link that interconnects with the FS' internal permitting process. The potential effects to streams and fish habitat from suction dredging activities requires a Notice of Intent be filed with the District Ranger to determine if a plan of operations is necessary. State permits as well as the NOI or the plan of operations on the HLC NF utilize the restrictions in the Instream Mining Stream Classification List to determine if suction dredging is restricted. The FS approval process would need to comply with FW-EMIN-GDL-01. As a result of the interrelationship of the State, Conservation District and FS permitting processes, any impacts to stream habitat would be avoided, minimized and/or required to be restored in westslope cutthroat and bull trout streams.

CR158 Nonnative Invasive Plants – Livestock Grazing

Concern: Commenters had concerns regarding non-native invasive plants and livestock grazing, including:

a. Livestock are a main vector in spreading invasive plant species as well as degrading the vigor of native plant communities. Plan components do not address this issue, nor managed livestock grazing. Livestock grazing creates favorable conditions to annual grass establishment and dominance;

b. Livestock should be quarantined before entering public lands and be immediately removed should new infestations be discovered. In addition, livestock grazing in suitable acreage that have noxious weeds should be avoided to minimize weed spread; and

c. Scientific literature should be utilized concerning noxious weed spread from livestock.

Response:

a. Livestock are a vector for transporting invasive species, as are wildlife, motorized vehicles, machinery, and forest users. BMPs to mitigate weed spread from livestock grazing would continue to be applied where appropriate. Plan components provide direction for site-specific project design to minimize effects of livestock grazing to native plant communities and maintain healthy rangelands resistant to weed invasion.

b. Quarantine of livestock prior to entering allotments could be an integrated pest management tool used to manage invasive species and already used where appropriate, such as targeted grazing with domestic sheep and goats that come from outside the planning area. Removal of livestock due to new invasive species being discovered may not be the most appropriate action as the cause of many invasive species infestations oftentimes is hard to place on one specific vector alone. However, exclusion, deferment, or herding livestock away from newly discovered infestations of priority 1a and 1b species (Montana State Noxious Weeds List) until eradication of the infestation is complete may be a management approach on affected areas of allotments. Grazing and invasive species management would be closely linked, with site-specific analysis to best address future management approaches.

c. Best available scientific information was considered in the analysis and the HLC NF doesn't dispute that livestock can be a vector for invasive species as well as other forms of multiple uses. Please see literature cited in the Invasive Species section of the FEIS. Invasive species would be a constant factor in land management on the HLC NF landscape, but multiple uses of forest resources would also continue. Plan components combined with BMPs would be used to minimize spread of invasive species directly related to livestock grazing activities.

Terrestrial wildlife diversity

CR44 Wildlife - Big Game Plan Components & Analysis

Comment: Commenters are concerned with the management of and analysis for elk and other big game in the Plan. Concerns fall into several broad categories:

a. Suggested revisions to plan components in the Plan;

b. Concerns about the science used in developing plan components and analysis, and concerns about the quality or completeness of the analysis in the DEIS; and

c. Concerns about winter range and migration corridors for elk and other big game species and the need for clear, strong guidance about motorized travel and other management in those areas.

Response:

a. Changes were made where applicable, please see the wildlife section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule. More detailed analysis on this issue can be found in section 3.15 of the FEIS.

b. The Plan includes direction for management of activities that occur on NFS lands at a broad, programmatic level. Discussion of potential impacts to elk of various management and recreational activities is discussed broadly in the FEIS. That discussion includes, in section 3.15.5 (elk - affected environment), an overview of past and current management issues with respect to elk and other big game species. Refer to the updated information and analysis in the FEIS, specifically section 3.15.6 regarding environmental consequences, conclusions section. See other comments also related to travel planning. Although the Plan does not make site-specific travel management designations, it provides guidance for future decision-making. Future travel planning will need to consider ROS direction, suitability plan components, and the full suite of wildlife-related desired conditions, standards, and guidelines.

The discussion in the FEIS also addresses the changing history of elk management concerns since the 1986 Forest Plans were written. The information there includes discussion of recent research findings regarding the influence of differing levels of hunting pressure, as well as forage, cover, and other factors that influence elk movements and distribution during the hunting season. Recognizing this key issue, the FS worked closely with MFWP biologists and managers to develop a desired condition and guideline that directly address the issue of elk displacement from, and availability on NFS lands during the archery and rifle hunting seasons.

c. The Plan includes components that guide vegetation management to provide for the habitat needs of native wildlife species and their movements, and that establish desired conditions for habitats to provide the life/natural history requirements of native and desired non-native species, and that allow wildlife to move within and between NFS parcels in response to habitat needs and other factors. The Plan also includes desired conditions that key seasonal habitats, including ungulate winter ranges, are relatively free from human disturbance during the period in which those habitats are used by those species. In addition to desired conditions that managers must achieve and/or maintain, the Plan includes components providing additional guidance that would constrain management actions and other activities in key seasonal habitats in order to avoid disturbance and displacement of ungulates, and to ensure that habitat features such as forage and cover are available in those areas.

CR58 Monitoring Wildlife

Comment: There is concern that the proposed monitoring plan for wildlife is inadequate.

Response: The wildlife elements of the monitoring plan have been updated in the Plan (appendix B) in consideration of internal and external comments.

CR69 Wildlife-Wolverine

Comment: Commenters believed that the Plan should include scientifically-based direction to protect wolverine and provide for habitat connectivity. The FEIS should include a more detailed analysis of how forest management and recreation would impact wolverine and should use the most recent available data.

Response: As stated in the FEIS section 3.15.9, the vast majority (>90%) of wolverine habitat is already in a conservation management area, IRA, or designated wilderness. This minimizes human disturbance and means that forest plan direction is unlikely to impact the recovery or persistence of wolverine in the planning area. The largest area of wolverine habitat on the HLC NF is in designated wilderness and provides connectivity to habitat on the Flathead NF and in Glacier National Park. Because of this, all alternatives would contribute to wolverine conservation. The action alternatives also include several desired conditions for specific geographic areas that contribute to wolverine habitat connectivity (DI-WL-DC-01, RM-WL-DC-01, and UB-WL-DC-01; see also the comment and response under connectivity/migration). These plan components contribute to the high level of wolverine protection and habitat connectivity that is already provided by existing land designations.

CR72 Wildlife – Beaver Habitat

Concern: Commenters provided information about the ecological role of beavers and their importance to ecosystem integrity, particularly resilience in the face of climate change. Although comments expressed support for the plan components included in the Draft Forest Plan, there were suggestions for modifications and additions to specifically address beaver re-introduction and the restoration and maintenance of beaver habitat.

Response: The HLF NF agrees with the information provided regarding the beneficial role beavers play as a biotic factor on the landscape. Page 2, Table 3.1, in chapter 3 of the 2015 HLC NF Assessment identifies the key aquatic and riparian ecological characteristics on the Forest and page 26 discusses the role beavers play as a system driver in aquatic habitats forestwide. As disclosed section 3.14.6 of the FEIS, the full suite of aquatic ecosystem plan components are designed to protect watershed integrity, riparian habitats, and hydrologic function and the adoption of riparian management zones forestwide would increase the total acreage of riparian-influenced area in which protections for water and habitat quality apply as compared to the no-action alternative.

Some components included in the Plan already address commenter's concerns and suggestions such as those to address grazing effects in riparian areas (e.g., FW-FAH-GDL-03, FW-GRAZ-DC-03, FW-GRAZ-STD-02, and several of the FW-GRZ guidelines) or to work cooperatively with MFWP (FW-

WTR-GO-04). Some changes were made in response to comment such as a modification to FW-WTR-GDL-03 to adjust the consideration of threats to human infrastructure.

Other comments requested that the Plan more explicitly prioritize habitat restoration to increase beaver distribution and activity throughout unoccupied but suitable habitat. The Plan includes a desired condition (FW-WTR-DC-09) for beaver habitat which direct managers to retain, where possible, beaver presence and complexes to maintain watershed and wetland habitat and resilience (FEIS section 3.14.6). In addition, the outcomes of objectives such as FW-RMZ-OBJ-01 and FW-VEGT-OBJ-01 address riparian habitat improvement and terrestrial vegetation desired conditions, which although do not explicitly highlight beavers, are ecosystem level plan components that would improve beaver habitat and support beaver occupancy over time when applied in suitable habitat. For example, management approaches in appendix C specifically identify the reestablishment of beavers through riparian habitat restoration (in support of FW-RMZ-OBJ-01) and allowing beavers to flood aspen and riparian areas (in support of FW-VEGT-OBJ-01). Although additional objectives could be identified specific to beaver habitat, they would be redundant of the existing plan components and are not necessary.

CR73 Wildlife – Connectivity/migration

Concern: Commenters thought that the Draft Forest Plan should provide specific direction for and recognize the importance of wildlife migration corridors and connectivity needs across the landscape.

Response: Please refer also to CR275: wildlife-grizzly bear connectivity and habitat, and to FEIS section 3.14.5 and 3.14.6 for details about connectivity on the HLC NF. That section of the FEIS, while specifically emphasizing grizzly bear habitat issues, also discusses the existing condition and effects of the Plan and alternatives on habitat connectivity for most wide-ranging species that occur on the HLC NF. The FEIS has been updated to include discussion of plan components that were added as a result of comments, and to provide additional analysis.

CR74 Wildlife – Roads/Road Density

Concern: Some commenters expressed concern that plan components limiting motorized route densities are insufficient to protect wildlife, while others questioned the effect of roads on wildlife and expressed opposition to limiting motorized route densities because it could affect access for recreation.

Response: The Plan includes several components related to motorized route density that are associated with the Northern Continental Divide Ecosystem Grizzly Bear Amendment. Standard Z1-NCDE-STD-01 limits motorized route density in zone 1 (see the Plan glossary for definition) to the baseline level, while standards PCA-NCDE-STD-01 through 04 collectively set limits on open and total motorized route density in the primary conservation area (see the Plan glossary for definition). As noted in section 3.14.5 of the FEIS, motorized route density is a widely used measure of grizzly bear habitat security and numerous studies have found a relationship between open road density and grizzly bear occupancy, mortality risk, and abundance. A more thorough discussion of the scientific basis for these standards and their effects on wildlife can be found in the Final EIS. The impact of road density on elk is described in section 3.15.5 of the FEIS.

Additionally, road density is limited even in areas that are not affected by plan direction related to grizzly bear due to the fact that 20% of the forest is in designated wilderness and 50% is in IRAs. As noted in section 3.14.6 of the FEIS, plan components associated with these designated areas provide large areas of high-quality habitat for a wide variety of wildlife species. Additional plan components such as DI-WL-GDL-01, UB-WL-GDL-01, and RM-CMA-STD-01 limit road construction or motorized access in specific areas to help provide for wildlife habitat and connectivity.

Desired conditions Z1-NCDE-DC-01 and PCA-NCDE-DC-01 both express a desire to continue providing motorized access within zone 1 and the primary conservation area for a variety of public uses.

CR119 Wildlife- Plan Components

Comment: Commenters provided both general and specific recommendations for plan components related to wildlife.

Response: Various wildlife plan component and other editorial suggestions were provided. Changes were made where applicable, please see the wildlife sections of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR136 Wildlife – Coarse/Fine Filter

Concern: A commenter believed that the analysis does not adequately describe NRV or how coarse-filter plan components will maintain a diversity of wildlife species.

Response: The Forest took a coarse-filter and fine-filter approach to provide ecosystem integrity, as required by the 2012 Planning Rule (36 CFR 219.9) and described in the FEIS (terrestrial vegetation and wildlife sections). As the 2012 Planning Rule programmatic EIS disclosed, NFS lands are expected to more consistently provide the ecological conditions necessary to maintain the diversity of plant and animal communities and the persistence of native species using this approach. The Federal Register (volume 77, number 68, p. 21212) states that "The premise behind the coarse-filter approach is that native species evolved and adapted within the limits established by natural landforms, vegetation, and disturbance patterns prior to extensive human alteration. […] These ecological conditions should be sufficient to sustain viable populations of native plant and animal species considered to be common or secure within the planning area. These coarse-filter requirements are also expected to support the persistence of many species currently considered imperiled or vulnerable across their ranges or within the planning area."

The Plan and coarse-filter analysis address key ecosystem characteristics, including composition, structure, function, and connectivity. The NRV analysis for these characteristics is described in appendix I of the FEIS, while the effect of plan direction on maintaining or restoring these conditions is analyzed in section 3.8.6. Section 3.13.6 analyzes how different habitat types would support a wide variety of different wildlife species, and additional details on the habitat needs of specific species can be found in appendix D. The species-specific analyses in section 3.14 of the EIS considered human alterations to the environment such as roads, and plan components placing limits on human alterations were included as needed to conserve at-risk wildlife species.

CR145 Wildlife – Big Horn Sheep

Concern: The Plan and EIS do not adequately address viability of bighorn sheep herds on the forest or the risk of disease transmission from non-FS lands.

Response: Components have been added to and updated in the Plan to address disease threats to bighorn sheep. Section 3.14.5 of the FEIS (Species associated with grass and shrub habitats) discusses threats to bighorn sheep and notes that the primary threat is from respiratory disease. Historic population trends and effects of past disease outbreaks were described in the Assessment. Section 3.14.6 of the FEIS describes how bighorn sheep would benefit from both course-filter plan components designed to maintain or restore key habitat and fine-filter plan components designed to minimize the risk of disease transmission. For example, plan components for the GAs where bighorn sheep herds occur (Rocky Mountain, Big Belts, and Elkhorn) and where sheep have been observed recently (Little Belts) are designed to support healthy bighorn sheep populations by minimizing the risk of disease transmission from domestic animals. While these components target specific areas, the forestwide standard FW-GRAZ-STD-03 would help minimize the risk of disease transmission by requiring use of effective separation techniques before existing sheep and goat allotments would be reauthorized or vacant allotments would be restocked. Further, goal FW-WL-GO encourages coordination with MFWP and other agencies during project planning (such as allotment planning), in order to allow consideration of the goals and objectives of these agencies regarding wildlife and wildlife habitats.

The Plan includes several components guiding managers to work with other agencies regarding wildlife and habitat management issues, and to use BASI and interagency recommendations regarding minimizing risk to bighorn sheep. The current interagency recommendations consideration of sheep grazing on both FS and on BLM lands.

Additional information on the distribution, population trends, and relevant threats to bighorn sheep can be found in the forest's Assessment, and in the rationale spreadsheet for animals evaluated as potential SCC, (available at https://www.fs.usda.gov/detail/r1/landmanagement/planning/?cid=fseprd500402). As noted in this document, there are no active domestic sheep grazing allotments within 10 miles of any bighorn herd in the planning area, which will help minimize the risk of disease transmission.

CR153 Wildlife – Beaver as Focal Species

Concern: Commenters requested that the HLC NF include beaver as a focal species in the Plan. Comments provide background and rationale for the suggestion.

Response: The responsible official agrees that beavers are important to the ecosystems on the HLC NF and acknowledges that beaver presence does provide some understanding of aquatic ecosystem integrity, as indicated by best available scientific information. However, the interdisciplinary team and responsible official chose not to include beaver as a focal species for the Plan. As per the 2012 Planning Rule and associated Directives, Forests are only required to select one focal species. The HLC NF has selected invasive annual grasses as focal species for grass and shrubland systems. Beavers have not been previously monitored on the HLC NF and the Forest does not currently have baseline data on the species. Other indicators will be used to monitor aquatic ecosystem integrity, as specified in appendix B of the Plan; specifically, MON-WTR-01 through 06. Two years after the ROD is signed, the indicators selected for monitoring will be evaluated as part of the biennial monitoring report. At this time, the sufficiency of the selected indicators to assess aquatic ecosystem integrity will also be evaluated.

CR261 Wildlife/Vegetation – Focal Species

Concern: Commenters were concerned about the selection of focal species as well as the tracking of formerly sensitive species under the Plan.

Response: Limber pine was selected as a focal species in the DEIS. However, based on public and internal discussions, limber pine was dropped as a focal species in the FEIS. This is because its presence is not necessarily an indication of ecotone health. The planning rule requires selection a minimum of one focal species, the purpose of which is to "permit inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan… Focal species would be commonly selected on the basis of their functional role in ecosystems." In the FEIS, the HLC NF has selected invasive annual grasses as focal species for grass and shrubland systems, which would provide information regarding the effectiveness of the Plan in providing the ecological conditions necessary to maintain the persistence of native species in the planning area.

In past forest plans, identification of management indicator species was intended to provide information about the ecosystems on which they depend, and management indicator species were to serve as surrogates for the status of a broader suite of species that rely on similar habitats. Use of management indicator species is a concept no longer supported by current science and population trends of identified management indicator species are "difficult and sometimes impossible to determine within the lifespan of a plan." Monitoring of key ecosystem characteristics, focal species, and specific fine-filter components of at-risk species habitat requirements as identified in the monitoring plan (appendix B of the Plan) would provide information regarding the effectiveness of the Plan in providing the ecological conditions necessary to maintain the persistence of native species in the planning area.

CR272 Wildlife – DEIS Analysis

Concern: Commenters had a number of specific comments about the sufficiency of the wildlife analysis.

Response: The FS appreciates the concern associated with the necessity of a thorough and well-rounded analysis for wildlife. Where possible, the wildlife analysis was updated to address these concerns. The wildlife analysis provides the programmatic effects analysis needed to inform the decision-making process for the Plan.

CR274 Wildlife Habitat/Vegetation

Concern: Commenters have concerns about wildlife habitat/vegetation, including:

a. Concerns about the planning rule and whether or not managing habitat will not ensure viability of wildlife species, including promotion of early seral vegetation and forage for elk and other wildlife;

b. Viability of sagebrush associates and moose;

c. A desire to do more to promote forage for elk and other game species; and

d. Request more analysis of the effects of management/timber harvest on wildlife habitat.

Response:

a. The Plan relies on a coarse-filter/fine-filter approach to conserving biodiversity. Maintaining key ecosystem characteristics is expected to support the persistence of most native species, and additional species-specific plan components were added as needed to address specific threats. This approach is consistent with the 2012 Planning Rule.

b. The FEIS describes several different types of ecotones that occur on the Forest and the types of locations where they are typically found. Effects of plan direction on xeric ecotones, where sagebrush is often a component, can be found in the "Nonforested vegetation, forest savannas, and xeric ecotones" section. This section describes how fire would historically have functioned as an important component of these ecosystems by limiting the encroachment of Douglas-fir trees. Wildlife species that rely on sagebrush shrublands and xeric ecotones are described, and fire exclusion is identified as a stressor that affects these types of wildlife habitat. To address this stressor, the Plan includes a guideline (FW-VEGNF-GDL-01) to focus savanna and shrubland restoration treatments in areas historically dominated by nonforested vegetation such as sagebrush. Desired condition FW-VEGT-DC-01 describes a desire for sagebrush communities maintained by a natural disturbance regime within the xeric shrubland/woodland broad potential vegetation type. Additionally, desired conditions for these habitats occur specific to GAs. Numerous plan components are designed to support populations of moose and other native ungulates by protecting key habitat elements such as thermal cover. FW-WL-GDL-05, FW-WL-GDL-06, and FW-WL-DC-01, 02, 03, and 07 are designed to protect winter ranges and thermal cover, and FW-WL-GDL-14 promotes a landscape-scale approach through consistency with other land management agencies. Moose would also benefit from plan components designed to retain beaver complexes and associated wetland habitat. These wildlife-specific plan components complement the full suite of vegetation components designed to maintain vegetation conditions that support all native species.

c. Numerous plan components exist that will provide the direction and guidance the Forest will use to implement management actions that are either aimed directly at benefiting wildlife species, or that will be designed to achieve those goals ancillary to other reasons. These actions will work to allow progress towards achieving the desired conditions for all resources within the NRV.

d. The effects of plan components associated with timber harvest are described under the heading "Effects common to all action alternatives" because the plan components remain the same across alternatives. Potential effects are described generally due to the programmatic nature of this analysis, which examines effects of plan components rather than specific timber harvest activities. The effects of timber harvest are site-specific and will be analyzed at the project scale.

CR276 Wildlife – Travel Plans and Recreation Uses

Concern: Commenter asked for the Plan to provide direction for recreation activities such as motorized uses, mechanized means of transportation, horse users, hikers, drones, and potentially hover crafts, and the effects of these activities on public land wildlife habitat. They feel that human entertainment must be secondary to the survival and life-cycle necessities of wildlife and the landscape.

Response: Thank you for your comment. The National Recreation Opportunity Spectrum (ROS) Inventory Mapping Protocol, April 2018, provides guidance for not only how ROS categories are mapped but also which recreation activities are appropriate in each ROS setting. Adherence to this protocol contributes to the consistent application of ROS settings across NFS lands. Please see forestwide plan components for recreation settings (ROS).

The Plan components work together to meet the needs of native vegetation and wildlife, while providing sustainable recreation across the HLC NF. These plan components are in addition to the requirements of meeting all laws, regulations, and policies concerning land and resource management. Please see forestwide plan components for aquatics, soil, air quality, vegetation, wildlife, and recreation.

CR277 Wildlife – Species Viability

Concern: Some commenters are concerned that the Plan does not provide for species viability. Concerns include:

a. The 2012 Planning Rule and/or the Plan for the HLC NF do not ensure viable populations of wildlife would be maintained or reached, and disagreement that a management focus on habitat (vegetation conditions) would ensure wildlife viability;

b. Monitoring for wildlife is inadequate because no species population trends are to be monitored. Because no terrestrial wildlife focal species are identified, the HLC NF cannot show compliance with NFMA's diversity requirements;

c. Species viability for current Region 1 sensitive species will not be provided, because most are not considered as management indicator species, sensitive, or SCC in the Plan. Viability of current management indicator species cannot be assured because monitoring of populations trends (as per the 1986 Forest Plans) was not conducted; and

d. Viability requirements and/or threats for specific species are not adequately disclosed in the EIS, including marten, black-backed woodpecker, and western toad.

Response:

a. Refer also to CR136- coarse filter. The 2021 Land Management Plan is consistent with the 2012 Planning Rule and associated directives with respect to ensuring wildlife species viability. Issues related to the adequacy of the 2012 Planning Rule are beyond the scope of the HLC NF revision.

   The Plan is an integrated management plan for diverse habitats that support over 300 terrestrial animal species. The FEIS, section 3.13, first discusses the effects of a variety of coarse-filter plan components on ecosystems or key ecosystem characteristics, organized by broad habitat groups, and then discusses the effects on specific species, including but not limited to federally listed species, species listed as sensitive under 1986 Forest Plan, and species of conservation concern as identified by the Regional Forester. Additional details on the habitat needs of particular species can be found in appendix D.

b. Population trend monitoring is not required by the 2012 Planning Rule and associated directives, nor is trend monitoring possible for most wildlife species. The Plan includes a monitoring plan (appendix B of the Plan) that includes comprehensive requirements for monitoring the full array of aquatic and terrestrial ecosystem characteristics that comprise wildlife habitats on the HLC NF. The monitoring plan has also been expanded to include requirements for measuring and reporting key habitat characteristics for grizzly bear, Canada lynx, flammulated owls, connectivity, and habitat security.

c. The terrestrial wildlife diversity section (3.13) and a biological evaluation (see project record) provide evaluation of impacts of the Plan on current Regional Forester Sensitive Species (RFSS). Implementation of the Plan would support persistence of all current RFSS in the planning area and would not result in a trend toward federal listing for any current RFSS.

d. Information regarding the requirements, threats, and stressors for a variety of species considered in the planning process and the FEIS were discussed in the 2015 HLC NF Assessment. That information was supplemented by additional science or other information as available in order to develop plan components and the analysis included in the FEIS (sections 3.13 and 3.14.11). Additional information about terrestrial wildlife species' habitat needs considered in the planning process is in appendix D of the FEIS and in the project record.

Terrestrial wildlife species at risk

CR99 Wildlife – Grizzly Bear Conservation Strategy and Amendment

Concern: Commenters provide specific changes and recommendations to the Grizzly Bear Conservation Strategy and plan amendment. Some felt that plan components associated with the Grizzly Bear Amendment did not provide adequate protection or questioned certain aspects of the associated analysis. Other commenters expressed support for incorporating the NCDE Grizzly Bear Amendment into the Plan. Changes, recommendations, or issues include the following:

a. Concern that the NCDE Grizzly Bear Amendments relied on the Draft NCDE Conservation Strategy rather than on a final product;

b. Lack of clarity regarding management, implementation, and potential effects of motorized route density standards for grizzly bear habitat;

c. The Plan standards for grizzly bears do not rely on the current best available scientific information;

d. Plan components for minimizing the risks to grizzly bears associated with livestock grazing should be added, strengthened, and/or expanded to additional areas on the HLC NF;

e. Plan components for various resource management and recreation activities (e.g., snowmobiling, ski area developments, vegetation management, and others) are not sufficient to protect grizzly bears;

f. The HLC NF should include additional plan components to ensure connectivity between grizzly bear populations;

g. The HLC NF should expand identified management zones, such as the primary conservation area, and/or apply primary conservation area and Zone 1 plan components over larger areas; and

h. Analysis in the DEIS is inadequate to display potential impacts of plan components, and to demonstrate that plan components would contribute to recovery of the grizzly bear population.

Response:

a. The NCDE Grizzly Bear Conservation Strategy is now final. It has been reviewed and there are no significant changes from the draft that formed the basis for the GB Amendments, nor are there inconsistencies with the amendments.

b. Information in the Plan and FEIS has been updated to clarify measures and methodology.

c. The Plan standards for grizzly bears are based on the NCDE Grizzly Bear Conservation Strategy, which relied on the best available scientific information as well as on input from researchers, biologists, and managers from multiple agencies and tribes. The final EIS for the NCDE Grizzly Bear Amendments contains a thorough discussion of the science used in developing plan components related to motorized route density and in analyzing their effects. The FEIS (section 3.14.5) includes a thorough review of the best available scientific information, including recent research and recommendations regarding influences on grizzly bear individuals, population trend, and distribution. The review in the FEIS provides support for plan components and informs analysis of their potential effects.

d. PCAZ1Z2-NCDE-GDL-01 and 02 are designed to minimize the risk of conflict related to activities allowed by permit, including livestock grazing; these guidelines apply in the primary conservation area and Zones 1 and 2. Standard PCAZ1-NCDE-STD-01 requires that livestock grazing permits and plans include measures to reduce the risk of human-grizzly bear conflicts in the primary conservation area and Zone 1, and indicate actions that may be taken if conflicts occur. Standards PCAZ1-NCDE-STD-03 and 04 are designed to minimize conflicts between grizzly bears and livestock by prohibiting an increase in the number of active sheep allotments and ensuring that temporary grazing permits do not increase bear-small livestock conflicts in the primary conservation area and Zone 1. Guidelines PCA-NCDE-GDL-09 and 10 provide further guidance for the primary conservation area on reducing active sheep allotments and protecting key grizzly bear food production areas from conflicting and competing use by livestock. Section 3.15.6 of the FEIS discusses how plan direction related to livestock grazing is likely to affect grizzly bears, and notes that the risk of depredation would be minimal. Unlike the primary conservation area, which is expected to function as a source population with continual occupancy by grizzly bears (refer to the Plan NCDE section and the NCDE Grizzly Bear Conservation Strategy), Zones 2 and 3 are not expected to have continual occupancy by grizzly bears. Therefore, plan components related to grizzly bears are focused on the primary conservation area and Zone 1, with food and attractant storage components extended into Zone 2 in order to facilitate potential movement of bears between the NCDE and GYE grizzly bear ecosystems.

e. The final EIS provides extensive review of and references to peer-reviewed scientific literature that documents the status, habitat relationships and responses to management activities of grizzly bears. The analysis of effects in the final EIS and the biological assessment for the amendments considered the effects of vegetation management on the grizzly bear to the degree possible in a programmatic document. As required by NEPA, additional analysis will occur as site-specific vegetation management projects are proposed. Site-specific analysis at the project level, supported by the necessary science, is the appropriate place to determine whether grizzly bear habitat in a specific location would or would not benefit from treatment. Refer also to response to comments regarding the coarse filter approach required by the 2012 Planning Rule.

Standard PCA-NCDE-STD-09 states that there can be no net increase in the area or trails open for motorized over-snow vehicle use in grizzly bear denning habitat within the primary conservation area. Standard PCA-NCDE-STD-08 requires permits for activities occurring at ski areas during the non-denning season include provisions to limit the risk of grizzly bear-human conflicts. Discussion of the impacts of winter motorized over-snow use has been added to the FEIS (section 3.14.5 and 3.14.6).

f. Many of the connectivity plan components that commenters suggested are already included in the Plan and alternatives as part of habitat management direction in the NCDE Grizzly Bear Amendment, which is retained in full. The goal for zone 2 is to maintain the potential for genetic connectivity between adjacent ecosystems.

The Plan provides additional direction aimed at promoting connectivity in this and other areas on the HLC NF. Forestwide desired conditions FW-WL-DC-03 and 04 address connectivity by directing managers to achieve vegetation conditions that "allow wildlife to move within and between NFS parcels", and large, unroaded areas that are "distributed and connected forestwide, providing for species with large home ranges". Both of these plan components will maintain or enhance connectivity at a forestwide scale. At the scale of GAs, plan components (e.g., UB-WL-GDL-01 and DI-WL-GDL-01) provide additional protection in key areas for connectivity by limiting the effects of recreation and ensuring that vegetation management does not diminish hiding cover. Desired conditions in several GAs guide managers to provide "habitat connectivity for wide-ranging species" such as grizzly bears.

Plan components associated with other resource areas, notably vegetation, will further contribute to habitat conditions that support the movement of grizzly bears. For example, FW-VEGT-DC-02 promotes habitat for threatened and endangered species, while FW-VEGT-DC-03 states a desired condition for vegetation conditions that would contribute to genetic connectivity. Collectively, these plan components promote connectivity for grizzly bear, and additional standards or guidelines are not needed. See also CR73 wildlife - connectivity-migratory linkage.

g. The HLC NF acknowledges that grizzly bears may sometimes be found in zone 3. However, by definition, zone 3 does not have enough suitable habitat to contribute meaningfully to the long-term survival of the NCDE population. Nevertheless, the FS has implemented food storage orders across the entire HLC NF, including Zone 3.

Additional plan components limiting developed recreation in zones 1 and 2 are not needed because grizzly bear occupancy is expected to be lower than in the primary conservation area and these zones do not serve as the source for supporting and maintaining recovery of the NCDE or other grizzly bear populations.

h. The information and analysis in the FEIS have been substantially expanded and updated, in part to include additional information used in the Biological Assessment for ESA section 7 consultation with the US FWS. Refer to section 3.14.5, which includes a list of changes from the Draft EIS, and to section 3.14.6; note also that the Plan has been updated with information regarding the methods to be used to measure and report open and total motorized route density and secure core in the primary conservation area, as well as Grizzly Bear Analysis Unit based measures of secure habitat in Zones 1-3. For additional information regarding motorized route density and secure habitat, refer to Response #2 above.

The effects of implementing plan components in the NCDE Grizzly Bear Amendments were discussed in detail in the EIS associated with the NCDE amendments, would remain the same under the Plan and alternatives, and was therefore incorporated by reference into this FEIS as noted in section 3.14.6. Conclusions from this analysis are summarized, and additional detail on the science used to develop those plan components and support conclusions about their efficacy can be found in the FEIS for the NCDE amendments as well as in this FEIS for the Plan and alternatives (e.g., refer to section 3.15.5, "Key drivers and stressors", "Habitat security", etc.). The amendment FEIS provides extensive review of and references to peer-reviewed scientific literature that documents the status, habitat relationships and responses to management activities of grizzly bears, as does the updated FEIS for the Plan and alternatives. As required by NEPA, the Forest reviewed and discusses scientific consensus as well as opposing scientific information.

CR271 Wildlife – Lynx

Concern: Commenters are concerned with plan components and the analysis for Canada lynx. Specifically:

a. It is not appropriate to use the NRMLD to guide lynx management on the HLC NF, because it is not consistent with best available scientific information regarding the conservation and recovery of lynx; and project-level analysis often determines mapped habitat to not meet habitat requirements. Lynx habitat requirements should only be a consideration in unoccupied habitat; and not preclude managing for other wildlife as well in occupied habitat; and

b. Additional analysis or clarification related to lynx is requested, including clarification of terminology (potential and suitable lynx habitat); disclosure of potential effects to critical habitat PCEs; define, identify, and analyze effects to core areas; description of how fire would be managed (inside and outside the WUI) and the effects of fire to lynx habitat, as compared to the NRV condition; disclose the acreage of prescribed burning and discuss the effects to lynx; more information regarding the potential for timber harvest and associated effects within lynx habitat should be disclosed; present the changes in lynx habitat based on the difference between lynx habitat and potential lynx habitat; include desired conditions based on the NRV amounts of lynx habitat; clarify the trend of available snowshoe hare habitat over time, based on model results; clarify the desired conditions and NRV as compared to the expected trends of the spruce/fir cover type; disclose the amount of grazing expected to occur in lynx habitat; consider the cumulative impacts on lynx from trapping and use of the road and trail networks on the HLC NF.

Response: The FS appreciates and shares in the desire to provide for the needs of Canada lynx. The plan components and EIS analysis are based on the best available scientific information and regulatory guidance for this species.

a. The HLC NF is required to abide by the NRMLD until such time that new direction is issued. Lynx management direction does not preclude the potential to provide for a variety of other wildlife species on the landscape. The NRLMD is to be applied to areas occupied by lynx and to be considered in areas unoccupied by lynx. Presently, only 3 of 10 GAs are considered occupied. In areas where lynx may be present or are resident, the Forest is required by the ESA to work towards recovering lynx, assessing potential impacts to lynx and/or lynx designated critical habitat through the consultation process, and avoiding adverse effects where possible. Hence, projects planned, implemented, analyzed, and assessed through the consultation process need to consider scientific information to manage lynx habitat. The consideration of that science will be done at the project level, where direct effects can result and site-specific information is available to inform those decisions and analyses; however, the best available scientific information was considered or incorporated in the Plan, as directed by the 2012 Planning Rule.

b. Where possible and appropriate, additional analysis and explanation was added to the wildlife section of the FEIS to address these concerns. There is no need for an explicit desired condition for lynx habitat because there are DCs for vegetation composition and structure based on NRV that would encompass those habitat conditions. The vegetation modeling was re-done between the DEIS and FEIS, based on key model improvements as discussed in the Terrestrial Vegetation section and appendix H of the FEIS. The lynx section of the FEIS was updated to incorporate the revised model outputs and clarify the expected trends of the spruce/fir cover type. The modeling has uncertainties, however, in no small part due to the difficulty in predicting if and when natural disturbances will occur. Therefore, there are multiple plan components in place to ensure adequate lynx habitat is maintained over time, as discussed in the lynx section (see lynx FEIS and biological assessment). These plan components have considered the best available scientific information. Since the Plan is a framework programmatic action, it will not result in direct effects to lynx or lynx habitat. Thus, the analysis provides broad, general effects discussions based on programmatic level considerations, rather than effects determinations made with site-specific information that would be generated at the project level. Hence, future projects carried out under the Plan will be planned, assessed, and analyzed using site-specific information.

CR275 Wildlife – Grizzly Bear

Concern: Commenters expressed concern that the plan direction is not adequate to provide viable grizzly bear habitat and connectivity. More specifically, commenters expressed the following concerns:

a. The HLC NF should coordinate with other NFs to the south (Custer-Gallatin NF and Beaverhead-Deerlodge NF) to ensure consistent grizzly bear management in connectivity or linkage areas. The FEIS should include information about potential impacts of the Plan and alternatives on other grizzly bear populations;

b. The HLC NF should do more to protect bears moving through the Blackfoot Divide area;

c. Some plan components from the PCA and Zone 1 should be extended into Zones 2 and 3;

d. Information in the Plan and FEIS should place greater emphasis on the importance of the HLC NF for connectivity, including possibly identifying certain areas as "Genetic Connectivity Areas'; and

e. The HLC NF should limit increases in recreation in order to reduce potential bear-human conflicts.

Response: Please refer also to the response to Concern Statement #99, regarding plan components for grizzly bear retained from the NCDE Grizzly Bear Amendments (USDA FS 2017), and particularly part 6 of that response, regarding habitat connectivity. See also CR73, regarding wildlife connectivity/migration.

Specific responses about grizzly bear habitat and connectivity include:

a. The FEIS for the NCDE Grizzly Bear Amendments contains a discussion of how the plan components would support the grizzly bear metapopulation (section 6.5.5, "Cumulative effects on grizzly bear"). That subsection also discusses how management direction on neighboring forests, including the Beaverhead-Deerlodge and Custer Gallatin NFs, complements the direction in the Helena Lewis and Clark 2021 Land Management Plan and contributes to connectivity across the broader landscape. Plan components to maintain both habitat security and connectivity, as discussed in the FEIS (sections 3.14.5 and 3.14.6) would allow for individual bears to move between the NCDE and GYE populations, potentially increasing genetic variability in both populations (refer also to response to item b, below, and to CR99). In response to received comments, plan components were added to several GAs about providing habitat for and connectivity among populations of wide-ranging species such as grizzly bears. The cumulative effect of these plan components, along with the pattern of designated areas, recreation settings, and management of other resources would be that the HLC NF will continue to support the presence and movements of grizzly bears in and among currently separate grizzly bear populations in Montana.

b. Desired condition Z1-NCDE-DC-02 promotes efforts to reduce connectivity barriers associated with highways, and goal FW-WL-GO-04 guides managers to work with other agencies to identify linkage areas. The Plan identifies the areas near Highway 12 and Highway 200 as important for wildlife connectivity and includes plan components (DI-WL-GDL-01, and UB-WL-GDL-01) designed to manage those lands in a way that promotes connectivity by improving habitat security on NFS land. Some commenters suggested development of crossing structures; those or other means of enhancing connectivity would be developed as site-specific projects. Planning of site-specific projects would include consideration of site-specific needs and opportunities, appropriate interagency and public involvement, and appropriate analysis and consultation. Refer also to item d, below.

c. Please refer to the response to CR99, item g.

d. The Plan section on "Distinctive roles and contributions" notes that portions of the HLC NF may help provide connectivity between the GYE and the NCDE. Discussion of grizzly bear management zone 2 in the Plan and in the FEIS clearly identifies its role in maintaining genetic connectivity between the NCDE and the GYE, per the NCDE Grizzly Bear Conservation Strategy and the NCDE Grizzly Bear Amendments. In response to comments, a guideline (DI-WL-GDL-01) was added regarding management for connectivity in the central portion of the Divide GA, and new desired conditions were added to promote wildlife connectivity in the Elkhorns, Big Belts, and Crazies GAs. New guidelines were also added explicitly stating that wildlife habitat is the management priority (EH-WL-GDL-01) and vegetation management should maintain or improve wildlife habitat (EH-WL-GDL-04). Text was also added in the descriptions of GAs to note when that GA is part of a grizzly bear management zone, as delineated by the FWS.

e. The Plan and alternatives include plan components to reduce human-bear conflict, and human-wildlife conflicts overall. The FEIS sections (3.14.5 and 3.14.6) analyzing impacts to grizzly bears have been updated and expanded to include more thorough discussion regarding potential impacts to grizzly bears of various recreational activities.

CR279 Seed Mix – Attracting Animals

Concern: Commenter felt that FW-REC-GDL-07 would be difficult to achieve, as there are few if any seed mixes that wouldn't attract some species of mammals.

Response: This guideline was adjusted to be specific to bears to attempt to avoid bear/human conflict. Specific species have been identified to be avoided to meet this guideline.

CR286 FWS Consultation

Concern: Commenters are concerned about the consultation process with the FWS related to listed species and species proposed for listing. They request more information regarding consultation documents, and state that specifically for grizzly bear, more detailed analysis should have been included in the DEIS rather than the Biological Assessment.

Response: A biological assessment analyzing effects to threatened, endangered, and proposed species that may result from implementing the framework of programmatic action in the Plan has been prepared in accordance with section 7(a)2 of the ESA. Concurrently, the analysis for those species has been updated in the FEIS. A biological assessment was not prepared for the DEIS since the assessment is to reflect the proposed action, in this case the preferred alternative for the Plan. The preferred alternative was not finalized in the DEIS because the Forest was still receiving public comment at that time and considering or incorporating that comment into the preferred alternative. The biological assessment and subsequent opinion from the US Fish and Wildlife Service will be made available for the public as part of the FEIS. In addition, the analysis for those species will be updated and available for review in the FEIS.

Recreation settings

CR33 ROS – Semi Primitive Nonmotorized for Mechanized Use

Concern: The FS should use the recreation opportunity settings (ROS) to determine where mechanized means of transportation (i.e. mountain bikes) may recreate. Specifically, the FS should state that mechanical uses should remain in semi-primitive nonmotorized ROS settings.

Response: The National Recreation Opportunity Spectrum (ROS) Inventory Mapping Protocol provides guidance for not only how ROS categories are mapped but also what activities are appropriate in each ROS setting. The Plan will follow national direction to contribute to the consistent application of ROS settings across NFS lands.

In accordance with this national protocol, mechanized means of transportation are suitable in all ROS settings, unless those areas are specifically closed due to legislative action, such as congressionally designated wilderness, or by closure order at the Forest or District levels.

CR34 Primitive ROS – Suitable Recreation Uses Within

Concern: Commenters expressed concerns regarding the primitive ROS definition. Many commenters wish to exclude mountain bikes from primitive ROS areas as was outlined in the Proposed Action. Some commenters advocated for mountain bikes to be included within primitive ROS settings.

Response: The National Recreation Opportunity Spectrum (ROS) Inventory Mapping Protocol provides guidance for not only how ROS categories are mapped but also what activities are appropriate in each ROS setting. This mapping protocol is tied closely to existing travel management plan direction on the forest and adherence to this protocol contributes to the consistent application of ROS settings across NFS lands.

In accordance with this national protocol, mechanized means of transportation are suitable in all ROS settings, unless those areas are specifically closed due to legislative action, such as congressionally designated wilderness, or by closure order at the Forest or District levels.

During the formation of the Proposed Action, the HLC NF misinterpreted the national direction for primitive ROS settings and stated that mountain bikes would not be suitable within these primitive ROS settings. This is incorrect and not congruent with the national direction.

The HLC NF corrected this error in both the DEIS and the FEIS. The Plan will follow national direction and all forms of nonmotorized recreation uses within primitive ROS settings will be suitable, including mountain bikes, unless this use is specifically prohibited by Congressional law or a Forest closure order.

Clarifying language was added to the Plan and the FEIS to clearly describe the national direction of nonmotorized recreation in primitive ROS settings.

CR61 ROS – Winter ROS Subcategories

Concern: The FS should adopt the specific winter ROS categories described by the commenter. Those categories are:

- Alpine Solitude;
- Backcountry;
- Alpine Challenge;
- Motorized Social; and
- Nonmotorized Social

Response: The National Recreation Opportunity Spectrum (ROS) Inventory Mapping Protocol provides guidance for not only how ROS categories are mapped but also what activities are appropriate in each ROS setting. In accordance with this national protocol, winter and summer ROS setting categories remain the same. The HLC NF has adhered to this protocol.

CR89 Sustainable Recreation – Plan Components

Concern: Commenters believe that the FS should develop a "full suite of sustainable recreation plan components that are integrated with plan components related to other uses". These plan components would provide for sustainable recreation, including standards or guidelines that maintain or restore ecological stability and contributions to social and economic sustainability.

Response: Recreation is recognized as a critical resource on the HLC NF due to its contributions to the local economy, its influence in connecting people to the land, its impact on public understanding of natural and cultural resources, and its role as a catalyst for public stewardship.

The HLC NF strives to provide a set of recreation settings, opportunities, and benefits that are sustainable over time. Sustainable recreation is defined as the set of recreation settings and opportunities on the NF that are ecologically, economically, and socially sustainable for present and future generations. For best effect, all aspects of recreation should include the principle of sustainability. Therefore, all plan components in the Recreation Opportunity, Recreation Settings, Recreation Special Uses, Recreation Access, and Scenery sections are aimed at providing direction for a sustainable recreation program.

CR113 ROS – Recommended Plan Component Changes

Concern: Various ROS plan component editorial suggestions were provided, along with other editorial questions.

Response: All specific comments to ROS were reviewed and appropriate changes were made where applicable. Please see the ROS section of the Plan.

When developing the ROS maps, the Forest followed the National Recreation Opportunity Spectrum (ROS) Inventory Mapping Protocol which provides guidance for not only how ROS categories are mapped but also what activities are appropriate in each ROS setting. Adherence to this protocol contributes to the consistent application of ROS settings across NFS lands. The desired ROS maps were developed from the national protocol that projected ROS settings using the location and relationship of constructed features such as roads, housing developments, utilities, etc. Please see the ROS section of the Plan, which includes the maps as well.

In accordance with the national protocol, mountain bikes are suitable in all ROS settings, unless those areas are specifically closed due to legislative action, such as Congressionally designated wilderness, or by closure order at the Forest or District levels.

During the formation of the Proposed Action, the HLC NF misinterpreted the national direction for Primitive ROS settings and stated that mountain bikes would not be suitable within these primitive ROS settings. This is incorrect and not congruent with the national direction. The HLC NF corrected this error in the DEIS and the FEIS. The Plan will follow national direction and all forms of nonmotorized recreation uses within primitive ROS settings will be suitable, including mountain bikes, unless this use is specifically prohibited by Congressional law or Forest closure order. Clarifying language was added to the Plan and the FEIS to clearly describe the national direction of nonmotorized recreation in primitive ROS settings.

CR282 ROS – Mapping Changes

Concern: Commenter would like to allocate semi-primitive nonmotorized ROS settings to roadless areas outside of RWAs. Specific examples were provided.

Response: The National Recreation Opportunity Spectrum (ROS) Inventory Mapping Protocol, April 2018, provides guidance for not only how ROS categories are mapped but also what activities are appropriate in each ROS setting. The HLC NF used this protocol to inform the desired ROS settings across the forest. Adherence to this protocol contributes to the consistent application of ROS settings across NFS lands. Except within the RWAs where the ROS setting changes to primitive, ROS settings do not substantially change from the existing condition.

Recreation opportunities

CR212 Recreation Definitions – Electric Bicycles

Concern: The FS should define "mechanically-assisted" devices as motorized use.

Response: "Mechanically-assisted" was added to the definition of motorized equipment in the glossary of the Plan.

CR213 Recreation Plan Components

Concern: Commenters had editorial suggestions for recreation plan components.

Response: Changes were made where applicable; please see the recreation sections of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Recreation special uses

CR90 Permits and Special Uses

Concern: Comments were received regarding plan components for special use permitting, including:

- Requests for plan components to limit the number of outfitting permits on the HLC NF;
- Requests for plan components to limit permits for special events along the CDNST;
- Questions about conflicts between special use permitting and the Plan resource plan components, especially in ski areas; and
- Requests for plan components regarding how to deal with conflicts between special uses and wildlife.

Response: Plan components in the Plan provide direction and guidance for recreation special use permits through forestwide desired conditions, and guidelines. Please see the Recreation Special Uses, Lands, and Land Uses plan components in the Plan. In addition to forest plan direction, all special use permits are required to meet applicable laws, regulations, and policies. Decisions regarding the specific number and kinds of outfitter and guide permits would be determined outside of the forest planning process.

The FS has recognized ski areas as having rural ROS settings. This ROS setting provides for the continual development of these sites, allowing for changes over time. Plan components in the Plan (including those for rural ROS settings) provide direction and guidance for recreation special use permits through forestwide desired conditions and guidelines. Authorization for special uses require that other resource desired conditions are considered. Additionally, the 2012 Planning Rule also requires that other resource desired conditions are met. Beyond forest plan direction, all special use permits are required to meet applicable laws, regulations, and policies.

CR92 Mountain Bike Volunteers and Partners

Concern: The FS should recognize, value, and actively pursue additional partnership and volunteer opportunities with the mountain bike community.

Response: The FS recognizes the tremendous positive impact that the mountain bike community provides to the agency. To encourage and continue these valued relationships, the preferred alternative (alternative F) and the Plan established two additional goals: FW-RT-GO-01 and FW-RT-GO-02. These would encourage partnerships with various interest and user groups as well as the pursuit of grants, cost-sharing, and partnerships.

CR199 Ski Areas and Winter Recreation

Concern: Comments were received in regard to several aspects of winter recreation, including requests for:

- An avalanche forecaster and a Central Montana Avalanche Center;
- Stronger language associated with treating ski areas as unique and developed recreation sites;
- Acknowledgement of backcountry skiing and snowboarding as a recreation activity and provision of services to make it easier to recreate;
- Up to date access information, possibly a smartphone app, showing open and closed roads, gates, and campsites along with special comments such as avalanche danger, fire danger, flooding, etc;
- Establishment of backcountry ski areas that provide easy to intermediate ski ascents and descents with nearby parking lots (such as the former Skidway ski area); and
- Establishment of a nonmotorized backcountry ski area at the site of the former Skidway ski area.

Response: The creation of a Central Montana Avalanche Center and the hiring of an avalanche forecaster is outside the scope of forest plan revision. Similarly, the development of a method for providing up-to-date access information showing open and closed roads, gates, and campsites along with special comments such as avalanche danger, fire danger, flooding, etc, is beyond the scope of the forest plan revision process.

All of the action alternatives recognize developed downhill ski areas as important features in the Little Belts and Rocky Mountain GAs. Plan components were developed to specifically address developed downhill ski area issues and concerns while still meeting all of the required laws, policies, and regulations. The creation of a backcountry ski area near Skidway campground in the Big Belts GA would be a site-specific change that would be beyond the scope of the forest plan revision process.

CR200 Primitive ROS vs. Wilderness

Concern: Commenters asked the FS to consider primitive designations in several areas, including:

- The Highwoods, Elkhorns, and the Badger Two Medicine;
- In areas recommended for wilderness; and

- The nonmotorized areas in Tenderfoot Creek in the Smith River corridor.

Response: A range of alternatives were considered for RWAs in the both the DEIS and FEIS. Based on this analysis as well as public comments, in the Plan, seven (7) recommended wilderness areas are included in the preferred alternative (alternative F). In addition, alternative F includes several primitive ROS areas outside of recommended wilderness, including:

- Badger Two Medicine in the Rocky Mountain Range GA;
- A core area within the Elkhorns GA;
- Deep Creek and the lower portion of Tenderfoot Creek in the Little Belts GA; and
- The west portion of the Big Snowies in the Snowies GA.

CR201 Travel Plan – Recommended Changes

Concern: The FS should consider general and specific concerns regarding current recreation access for motorized and mechanized recreation uses across the forest. Commenters voiced specific concerns related to:

- Blacktail Road on Grassy Mountain;
- Closed roads in the Lincoln area;
- Trails in the South Fork Deep Creek;
- Pilgrim Creek;
- Tillinghast Creek;
- Blackfoot Valley GPAA claims; and
- General road closures

Response: The responsible official chose not to include travel plan changes within the alternatives for forest plan revision process. A range of alternatives were considered for motorized/mechanized means of transportation within RWAs. Based on this analysis as well as public comments, in the Plan, both motorized and mechanized means of transportation would not be suitable within RWAs in the preferred alternative F. These changes in suitability may be reflected in a future site-specific decision and would reduce the amount of motorized and mechanized recreation access in each RWA. Other site-specific changes to existing travel plans should be brought to the District Ranger of the applicable ranger district.

Recreation access

CR16 Specific Trail Changes/Requests

Concern: The Forest should use the forest planning process to make site specific travel planning changes.

Response: The Plan is programmatic in nature, guiding future project and activity decision-making, and does not make site-specific road, trail, or area motor vehicle use designations, or authorize road or trail construction.

Site-specific determinations, such as development of additional trails, or where motorized uses and mechanized means of transportation may and may not occur, would be determined in travel planning decisions outside of the forest plan and forest planning process.

CR28 Big Snowies – Support Mountain Bike Use

Concern: The FS should allow mountain bike use to continue on the trails in the Big Snowy Mountains, particularly on the trails that access the Ice Caves. (Trails #403, #490, and #493).

Response: In the DEIS and FEIS, a range of alternatives was considered for mountain bike use in RWAs. In the preferred alternative, the Grandview Recreation Area would be designated in the western portion of the Big Snowies mountain range. This recreation area would be approximately 32,296 acres and borders the Crystal Lake Campground complex. Outside of the campground complex, the bulk of the recreation area also overlays a portion of the Big Snowies WSA. The Grandview Recreation Area contains numerous trails that provide exceptional hiking and challenging mountain biking opportunities. These trails lead to prominent features and vistas in the area. There are also popular motorized over-snow areas in the north western portion of the recreation area which provide semi-primitive motorized recreation settings and access into portions of the area in the winter. The Grandview Recreation Area abuts the Big Snowies RWA which would be in the eastern portion of the mountain range. Lands within the Big Snowies WSA and would continue to be managed for the wilderness character, as it existed in 1977, and for its potential for inclusion in the National Wilderness Preservation System.

CR30 Motorized Access – Maintain and/or Improve Access

Concern: Commenters wish to maintain and/or increase motorized access to the National Forest.

Response: The HLC NF recently completed travel plans for all locations across the forest; therefore, broad shifts in motorized access were not identified in the need for change. The responsible official chose not to include travel plan changes within the alternatives for 2021 Land Management Plan.

A range of alternatives were considered for motorized/mechanized means of transportation within RWAs. Based on this analysis as well as public comments, in the Plan, both motorized and mechanized means of transportation would not be suitable within RWAs in the preferred alternative F. These changes in suitability may be reflected in a future site-specific decision and would reduce the amount of motorized and mechanized recreation access in each RWA.

Other site-specific changes to existing travel plans are beyond the scope of the forest planning process and should be brought to the District Ranger of the applicable ranger district.

CR31 Core area of the Elkhorns GA – Mechanized Uses

Concern: Commenters oppose the plan component which states that mechanized means of transportation are not suitable within a core area of the Elkhorns GA in alternative C. One commenter opposes designation of the Wildlife Management Unit (WMU).

Response: After reviewing public comment received on the alternatives in the DEIS and the FEIS, the suitability of mechanized means of transportation (mountain bikes) within a core area of the Elkhorns GA was not included in the preferred alternative. Please see Recreation Access, section of the FEIS for more information.

CR46 Tourism/access

Concern: Comments were received regarding tourism and access, including:

- A concern for an appropriate amount of access to be allowed for the public and to prioritize accessibility for all, including those with physical handicaps, to our public lands;
- Tourism from recreation of all kinds and the associated economic activity from both resident and non-resident travel should be capitalized on;
- There is value to maintaining and increasing the road network on public lands;
- Increasing roads, trails, and access for the handicapped will benefit the local economy via tourism; and
- Sufficient wilderness already exists on the Forest.

Response: All action alternatives include plan components designed to enhance recreation opportunities and access and provide safer experiences to recreationists. Recreation monitoring is conducted via the National Visitor Use Monitoring program, and the jobs and income contributed from recreation across alternatives are reported in tabular format in the Environmental Consequences section of the Social and Economics section of the FEIS. The contributions of designated areas (e.g. wilderness) to the quality of life of the public are presented, and the tradeoffs among user groups and their varying perspectives and desires with respect to wilderness have been considered.

Broad shift in motorized suitability were not identified in the need to change because of the recently completed travel plans for the forest. Variations in motorized suitability across alternatives reflect variations in what would be recommended for wilderness, as well as, small adjustments of winter ROS in the Elkhorns GA.

The FEIS does not speculate on potential increases for motorized uses in miles or acres; however, there are approximately 1,090,024 acres on the Forest in motorized settings that could provide opportunities for new site-specific route or area designation that could increase motorized access through future site-specific decision making. Site-specific route or area designations that increase access could be made consistent with the Plan after it is approved.

The Forest completed its wilderness inventory and evaluation according to the 2012 Planning Rule. A range of alternatives for the number of RWAs to include (0-16) was considered. Based on public input and resource analysis, 7 RWAs areas are included in the preferred alternative.

The FS is required to meet all law and policy related to accessibility, particularly within developed recreation sites. Dispersed recreation sites are not required by law to meet accessibility standards. Neither is it policy or law to provide motorized access to areas that are closed to motorized recreation use in order to meet accessibility standards, except in wilderness where motorized wheelchair use is permitted according to the Americans with Disabilities Act of 1990 (Public Law 101-336).

CR76 Mountain Bike Access on Forest

Concern: Regarding mountain bike access on the HLC NF, commenters thought that either:

a. The FS should support, and not limit, mountain bike access within the National Forest; or

b. The FS should prohibit mountain bikes use in National Forests altogether.

Response: Thank you for your comments.

CR83 Aviation Access

Concern: Comments regarding aviation access were received, including:

a. Requests to support or expand aviation access;
b. Requests for airstrips within the Wilderness Preservation System;
c. Requests that aircraft should not be considered a motorized vehicle;
d. Requests for the FS to not increase aircraft landing areas or facilities; and
e. Requests for the FS to address unmanned aerial devices.

Response:

a. The preferred alternative provides specific plan components for aviation recreation. See Plan, access section.
b. The preferred alternative (alternative F) identifies recreation aviation as a motorized recreation use and provides direction for the settings where that use would be most appropriate. See Plan, recreation settings, ROS sections. As a motorized recreation use, aircraft could fly over but would not be permitted to land within primitive or semi-primitive nonmotorized ROS settings. This would include wilderness and RWAs.
c. The preferred alternative clearly describes the ROS settings where motorized and nonmotorized recreation uses are appropriate. Aircraft with motors are considered "motorized" in the Plan, regardless of their perceived impact to the land. Aircraft without motors would not be considered "motorized" and may be appropriate in semi-primitive nonmotorized settings. The Plan would support

internal trailheads so long as they are located within semi-primitive motorized, roaded natural, and rural ROS settings.

d. Determining where landing strips are most appropriate is a site-specific analysis and is outside the scope of the forest plan revision process.

e. The regulation of unmanned aerial devices is controlled by the Federal Aviation Administration. The FS cannot regulate how these devices are used when they are in the air.

CR144 Motorized Access – Limit or Eliminate

Concern: The FS should exclude, or limit motorized uses from "wild" areas on the National Forest. Commenters recommended several specific areas where motorized use should be prohibited:

- Big Snowies;
- Nevada Mountain;
- Badger Two Medicine; and
- Inventoried Roadless Areas

Response: Except within RWAs, the responsible official has decided not to make travel plan changes within the forest plan revision process. Under current travel plans, motorized uses are not allowed in most of the Badger Two Medicine, most of the Big Snowies, and the Nevada Mountain areas. IRAs have been allocated to both semi-primitive motorized and semi-primitive nonmotorized ROS settings.

The HLC NF recently completed travel plans for all locations across the forest; therefore, broad shifts in motorized access were not identified in the need for change. The responsible official chose not to include travel plan changes within the alternatives for Plan.

A range of alternatives were considered for motorized/mechanized uses within RWAs. Based on this analysis as well as public comments, in the Plan, both motorized and mechanized means of transportation would not be suitable within RWAs in the preferred alternative F. These changes in suitability may be reflected in a future site-specific decision(s) and could reduce the amount of motorized and mechanized recreation access in each RWA.

Other site-specific changes to existing travel plans are beyond the scope of the forest planning process and should be brought to the District Ranger of the applicable ranger district.

CR154 Core of the Elkhorns GA and Mechanized Means of Transportation

Concern: The FS should not allow motorized or mechanized recreation uses within the Elkhorns Core area.

Response: Based on the analysis in the DEIS and the public input around this issue, the HLC NF decided mechanized means of transportation (including mountain bikes) would be suitable within the core area of the Elkhorns GA in the preferred alternative. Motorized uses are not allowed in this area as determined by the existing travel plan. Please see the Recreation Access section of the FEIS for more information on the analysis.

CR208 Mountain Bikes – Erosion

Concern: The FS should consider the minimal impact that mountain bike users have on the environment when determining where mountain bikes should and should not be permitted. Commenters assert that mountain bike users create minimal impact to trails and surrounding areas when compared to horses and hikers, and that there is little scientific proof that mountain bikes create soil erosion.

Response: A range of alternatives around this issue was included in the DEIS and FEIS. Following analysis and review of all of the public comments, the preferred alternative for the Plan has the following plan component (FS-RECWILD-SUIT-01) for RWAs: "Motorized and mechanized means of transport are not suitable in recommended wilderness areas. Exceptions may be made for authorized permitted uses, valid existing uses, or in emergencies involving public health and safety that are determined on a case by case basis."

Mechanized means of transportation, including mountain bikes, would be suitable in all areas on the HLC NF outside of wilderness and RWAs.

CR209 Recreation/Trail Conflicts

Concern: Commenters had concerns related to user conflict in several areas.

Response: The responsible official considered all points of view and strived for an appropriate mix of multiple uses for the Forest when making his decision. Conflict resolution between user groups is often a site-specific issue that could be addressed in future site-specific projects and is beyond the scope of the forest plan revision.

CR287 Recreation Access

Concern: Commenters requested that plan components address recreation access issues, especially the acquisition of Right of Way easements through private lands to landlocked parcels of NFS lands. Additionally, these commenters asked to include direction for travel planning and to consider a no-net increase of trails unless adequate maintenance on existing trails can be conducted.

Response: The HLC NF is committed to pursuing right of way easements during the lifetime of the Plan. Please see FW-ACCESS-GO-01, FW-LAND-DC-2, FW-LAND-DC-03, FW-LAND-OBJ-01, and FW-LAND-GDL-01.

Travel plan development and implementation are beyond the scope of the forest plan revision process.

Scenery

CR94 Scenery

Concern: Commenters requested additional clarifying language regarding scenery in each GA. They also asked the FS to clearly explain the effects to timber harvest resulting from high and very high SIO classifications. More clarification on the scenic integrity objectives was also requested.

Response: Additional language was added to each GA in the Plan to provide additional clarity regarding the terms used to describe scenery. Additional language was also added in the FEIS to describe the effects to timber harvest resulting from high and very high SIOs.

Scenic character descriptions provide baseline scenery information for each GA. These character descriptions are found in appendix H of the Plan. FW-SCENERY-DC-02, FW-SCENERY-DC-03, and FW-SCENERY-GDL-01 provide direction for the scenic character in the Plan. Desired conditions describe characteristics towards which management should be directed. Guidelines are established to help achieve or maintain a desired condition.

Scenic character and scenic inventory objectives are described in Landscape Aesthetics: A Handbook for Scenery Management, Agriculture Handbook 701. Handbook 701 describes the most current FS direction for the management of scenery resources on NFS lands, and provides the process used for this analysis. The HLC NF used the guidance of Handbook 701 in the development of scenic integrity objectives for the Plan.

Administratively designated areas

CR21 Recommended Wilderness Areas – General and Specific Support

Concern: The Forest should consider designating RWAs within the Plan. Commenters recommended the following specific areas to be considered for inclusion as RWAs:

- Nevada Mountain;
- Loco Mountain (north Crazies);
- Tenderfoot;
- Big Snowies;
- Middle Fork Judith;
- Deep Creek;
- Baldy Mountain;
- Camas Creek;
- Grassy Mountain; and
- Middleman-Trout Creek.

Response:

RWAs were identified through a detailed wilderness inventory and evaluation process used to identify those areas within the forest which best met the criteria for consideration of their wilderness characteristics. All IRAs were considered in that analysis. There is a range of RWAs included in the alternatives. The preferred alternative, alternative F, includes seven (7) RWAs.

CR23 Recommended Wilderness Areas – Prohibit Motorized/Mechanized Uses

Concern: The Forest should prohibit motorized and mechanized means of transport in RWAs.

Response: A range of alternatives around this issue was included in the DEIS and the FEIS. Following analysis and review of all of the public comments, the preferred alternative includes the following plan component (FS-RECWILD-SUIT-01) for RWAs: "Motorized and mechanized means of transportation are not suitable in recommended wilderness areas. Exceptions may be made for authorized permitted uses, valid existing uses, or in emergencies involving public health and safety that are determined on a case by case basis."

The identification of suitability helps determine whether future projects and activities are consistent with desired conditions. The FEIS also includes an appendix that provides an analysis of the direct effects of potential future restrictions of motorized and mechanized means of transportation within RWAs, which would be used in a subsequent analysis and decision to implement the suitability plan components.

CR26 Tenderfoot/Deep Creek

Concern: The FS should consider a Special Management Area for the Tenderfoot/Deep Creek area along the Smith River corridor.

Response: A range of alternatives was considered for the Tenderfoot and Deep Creek areas in the DEIS, the FEIS, and in the Plan. Based on the preferred alternative, alternative F, the Deep Creek and Tenderfoot Creek drainages would not be managed as RWA. Instead, these areas would be assigned a primitive ROS and would be managed for a primitive recreation setting. Access into these primitive ROS areas (see ROS map) would be nonmotorized and mechanized means of transportation would be suitable on established trails.

CR38 Eligible WSR Study – General Support

Concern: Multiple commenters were generally supportive of the eligible wild and scenic river study. Several offered specific additions to the final listing, including:

- Belt Creek (Monarch to Forest boundary) -recreation and scenery ORVs;
- South Fork Dupuyer Creek (headwaters to Forest boundary) - recreation and geology ORV;
- Tenderfoot Creek; and
- Deep Creek; and
- Permittees and ranchers in the Elkhorns would like the FS to reconsider Staubach Creek in the Elkhorns. These commenters are concerned with the potential negative implication for future grazing and other uses of the area if Staubach Creek is an eligible WSR.

Response: As per direction in FSH 1909.12 Chapter 80, the HLC NF conducted an eligibility study on each free-flowing river/stream on the Forest to determine its potential for inclusion in the National Wild and Scenic Rivers system. Each river was also studied to determine whether it possessed an outstandingly remarkable value. Those streams and rivers which were both free-flowing and had at least one outstandingly remarkable value were identified as eligible for inclusion as a wild and scenic river. The study identified 45 rivers/streams on the HLC NF that were eligible for inclusion.

Rivers/streams brought forward from the public for consideration in this process were also reviewed. Belt Creek, South Fork Dupuyer Creek, and Deep Creek were studied but were not found to have at least one outstandingly remarkable value. Tenderfoot Creek, from the FS boundary to Iron Mines Creek, was found to be eligible and has ORVs of Recreation and Fish. Staubach Creek was identified as an eligible river due to the outstandingly remarkable value as an important fishery. Please see appendix G of the Plan for further information.

CR40 IRAs – Recommended Plan Components

Concern: Commenters provided various recommendations for plan components in the Inventoried Roadless Area (IRA) section of the Plan. These included requests for clear plan components regarding suitability of management activities, including timber, roads and restoration in IRAs.

Response: Where applicable, changes were made in the plan components and suitability for various management activities. Please see the IRA section of the Plan.

CR45 South Hills Recreation Area – Support

Concern: Commenters support the designation of the South Hills Recreation Area. Some suggested that the FS should establish this area as a National Recreation Area.

Response: The creation of the South Hills Recreation Area would allow the FS to better manage recreation activities and provide focused recreation services in this area. The FS has the authority to designate and manage parts of the forest as special recreation areas; however, only Congress may establish an area as a National Recreation Area.

CR49 RWA Boundary Adjustments

Concern: Multiple commenters had suggestions for boundary adjustments for several RWAs, including:

- Middle Fork Judith RWA in alternative D;
- Baldy-Edith RWA;
- Arrastra RWA;
- Silver King RWA;
- Nevada Mountain RWA;

- Red Mountain RWA; and
- Colorado Mountain RWA in alternative D.

Response: A number of changes were made to RWA boundaries in the preferred alternative. All RWA boundaries would be set back 300 feet from open roads or private land boundaries. The Nevada Mountain RWA was adjusted in alternative F so that the Helmville-Gould Trail could remain open. Additional acres were added to the Red Mountain RWA to follow the watershed divide between Red Creek and North Fork Copper Creek. The switchback on Trail 485 is located outside of the Red Mountain RWA boundary. Please see the RWA section of the Plan as well as the analysis in the FEIS for more information.

CR55 Elkhorns GA – Primitive ROS within the core area

Concern: Commenters support allocating a primitive ROS to the core area of the Elkhorns GA.

Response: The core area of the Elkhorns GA was allocated a primitive ROS in the preferred alternative, alternative F.

CR86 Research Natural Areas and Botany Special Areas

Concern: Commenters had suggestions/questions regarding RNAs and botany special areas, including:

a. Support for the designation of specific RNAs (Indian Meadows Creek; Granite Butte);

b. RNAs should be unsuitable for off-trail motor vehicle use year-round;

c. Support the creation of the Poe-Manley RNA if activities to achieve vegetation desired conditions are allowed;

d. The plan documents need to explain RNA designation process;

e. The EIS does not provide information on how Poe-Manley RNA would be managed (the table provided is for the Tenderfoot Experimental Forest);

f. The Plan needs to state which RNAs are appropriate to log and why; and

g. Please include botanical special areas in list of administratively designated areas. The Green Timber Basin/Beaver Creek/Sawmill Flat area should be designated as a botanical special area.

Response:

a. Indian Meadows and Granite Butte RNAs are included in all alternatives. Indian Meadows has already been established. Granite Butte is a proposed RNA, as described in the RNA section of the FEIS.

b. Motorized uses are greatly constrained in RNAs in all alternatives. However, some of these uses would be suitable. In the Plan, FW-RNA-SUIT-02 provides that winter motorized travel (over snow) may be suitable in RNAs so long as those uses do not threaten or interfere with the objectives or purposes for which the RNA is established. FW-RNA-SUIT-03 states that summer motorized travel would not be suitable in RNAs except on routes that existed at the time the RNA was established; and new motorized routes are not suitable. RNAs are generally juxtaposed within other land designations that either prohibit or limit motorized use, such as nonmotorized ROS settings, IRAs, or RWAs.

c. Management in the Poe-Manley RNA would be guided by the establishment record, if and when the area is formally established as a RNA. The plan components in the Plan do not preclude the potential for management activities that would maintain the desired natural conditions. This includes the possible use of prescribed fire, mechanical removal of trees, and other management actions to achieve the desired conditions in the establishment record or management plan of the RNA (FW-RNA-SUIT-01).

d. The RNA section of the FEIS provides additional information regarding how RNAs are designated.

e. Information is available in the specialist report and table references have been corrected. Details on Poe Manley RNA management is available in the designated areas section of the FEIS.

f. All RNAs are unsuitable for timber production. The no-action alternative also prohibits timber harvest. Under the action alternatives, FW-RNA-GDL-01 and FW-RNA-SUIT-01 provide that harvest could occur if it is allowed by the establishment records. The Forest is not required to identify more site-specific guidance for each RNA in the Plan.

g. In the Plan, the Green Timber Basin/Willow Beaver Creek area is designated as an emphasis area in the Rocky Mountain Range GA.

CR93 RWA – Allowing Chainsaws

Concern: Commenters support the use of chainsaws in RWAs and WSAs.

Response: Chainsaw use would be suitable within RWAs and WSAs in the preferred alternative, alternative F.

CR131 Smith River Corridor

Concern: Commenters feel that the Smith is iconic, and should be protected, including protection of stream banks. This area holds special memories for commenters’ family and friends and should be managed as a "special management area".

Response: The HLC NF agrees that the Smith River is a special place. The Smith River Corridor was identified as an emphasis area in all of the action alternatives, including the preferred alternative, alternative F. This recreation river corridor has specific plan components that would support the semi-primitive nonmotorized setting and protect the natural resources for which it is renowned. No travel plan changes would be needed to be consistent with the preferred alternative for this area.

CR132 IRAs – Protection of Roadless Areas

Concern: Commenters asked for all IRAs to be designated as RWAs or some other protected wild area designation.

Response: The HLC NF followed the wilderness evaluation process to determine which lands should be included in the National Wilderness Preservation System. To accomplish this, the Forest used the four steps outlined in the 2012 Forest Service Planning Rule and Chapter 70 of the Forest Service Land Management Planning Handbook 1909.12. All IRAs were considered in this process. There is a range of RWAs included in the alternatives. The preferred alternative, alternative F, includes 7 RWAs.

CR135 RWAs – Opposed to Recommended Wilderness Areas

Concern: The FS should not create RWAs.

Response: During the Forest Planning process, the FS was required to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System (FSH 109.12, chapter 70). Potential RWAs were identified through a detailed wilderness evaluation process used to identify those areas within the forest which best met the criteria for consideration of their wilderness characteristics. Please see appendix E of the FEIS.

Nine (9) RWAs were identified in the Proposed Action, alternative B. After public scoping on the Proposed Action, a range of alternatives, which included from 0 to 16 RWAs, were developed to address concerns brought forward by the public. Alternative E was developed to respond to comments asking the Forest to consider an alternative that did not identify RWAs. All alternatives were analyzed in the FEIS.

The preferred alternative, alternative F, includes seven (7) RWAs.

CR138 RWA – Allow Motorized/Mechanized Uses

Concern: Multiple commenters thought that motorized uses and mechanized means of transportation should be suitable within RWAs. Some did not think that it was within the HLC NF or the Region's authority to make motorized and mechanized means of transportation unsuitable within RWAs.

Response: Suitability of motorized and mechanized means of transportation within RWAs was an issue that drove alternatives development in the DEIS and FEIS. Following the analysis and review of all of the public comments, the preferred alternative, alternative F, includes the following plan component (FS-RECWILD-SUIT-01) for RWAs: "Motorized and mechanized means of transportation are not suitable in recommended wilderness areas. Exceptions may be made for authorized permitted uses, valid existing uses, or in emergencies involving public health and safety that are determined on a case by case basis."

The identification of suitability helps determine whether future projects and activities are consistent with desired conditions. The FEIS also includes an appendix that provides an analysis of the direct effects of potential future restrictions of motorized and mechanized means of transportation within RWAs, which would be used in a subsequent analysis and decision to implement the suitability plan components.

CR146 Wilderness Evaluation Process

Concern: Commenters had concerns about the wilderness evaluation process used by the HLC NF.

Response: During the Forest Planning process, the FS was required to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System (FSH 109.12, chapter 70). Potential RWAs were identified through a detailed wilderness evaluation process used to identify those areas within the forest which best met the criteria for consideration of their wilderness characteristics. Please see appendix E of the FEIS.

Based on public comment to the Proposed Action, both Camas Creek and Colorado Mountain were included as RWAs in alternative D and analyzed in the FEIS. The preferred alternative, alternative F, does not include Camas Creek or Colorado Gulch as RWAs.

CR149 South Hills Recreation Area – Recommended Plan Components

Concern: Various South Hills Recreation Area plan component and other editorial suggestions were provided.

Response: Changes were made where applicable, please see the South Hills Recreation Area section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule. Please see the forestwide plan components, which are also applicable in the SHRA.

CR176 Core area of the Elkhorns Recommended Wilderness Area Designation

Concern: Commenters expressed support for recommending a core area of the Elkhorns for wilderness designation.

Response: Potential RWAs were identified through a detailed wilderness evaluation process used to identify those areas within the forest which best met the criteria for consideration of their wilderness characteristics. Details of the wilderness evaluation process are found in appendix E of the FEIS.

The core area of the Elkhorns was studied in the wilderness inventory and evaluation process but was not brought forward as a RWA under any alternative. Instead the entire Elkhorns GA was maintained as a Wildlife Management Unit. Please see the Elkhorns GA section of the Plan.

CR177 Elkhorns Wildlife Management Unit

Concern: The FS should maintain the Elkhorns Wildlife Management Unit designation and/or pursue a Congressional designation of this area.

Response: The FS agrees that the Elkhorns is a special place and should continue to be managed as a Wildlife Management Unit, similar to how it was managed under the 1986 Helena Forest Plan. The WMU was included in all alternatives in the DEIS and would also be designated as an emphasis area in the Plan and is included in the preferred alternative (alternative F). However, Congressional designation of this area is not within the authorization of the FS.

CR181 Core area of the Elkhorns GA – Boundary Adjustment

Concern: The FS should adjust the northern boundary of the Elkhorns core area. Commenters provided recommendation for the new adjusted boundary.

Response: Based on public input, the overall boundary for the core area of the Elkhorns GA area was adjusted between the draft and final and is included in the preferred alternative, alternative F. To the extent possible, the adjusted boundary follows natural features on the landscape such as ridgelines or creek bottoms. In a few locations, it follows property boundaries or buffers roads or trails. The northern boundary of the core area in the Elkhorns GA in the Willard Creek/McClellan area was adjusted to the south.

CR210 Recommended Wilderness Area Plan Components

Concern: Multiple comments were received regarding RWA plan components. Requests included:

a. Additional desired conditions;
b. Additional FW information included in in GA sections;
c. Information on overlapping designations/plan components;
d. Move RWA/WSR out of congressionally designated areas; and
e. Requests for additional suitability statements in RWAs and WSAs, including the Middle Fork Judith WSA.

Response:

a. Changes to plan components were made where applicable; please see the RECWILD section of the Plan. Where plan components were not changed as per the comments, the Forest determined that the retained plan components were sufficient to meet the obligations of the 2012 Planning Rule.
b. Plan components for RWAs are found in the forestwide plan components section. There is no need to repeat them in the GA section.
c. Where multiple designations overlap, the plan components associated with the most restrictive designation apply.
d. The analysis for both RWAs and eligible WSRs has been relocated into the Administratively Designated section of the FEIS.
e. Suitable recreation activities are determined by the desired ROS settings. See Desired ROS maps, appendix A of the Plan. Desired ROS settings are identified. Forest plan direction and current travel plans establish where motorized uses are suitable. In accordance with national policy, mechanized means of transportation (mountain bikes) are suitable in all ROS settings, unless those areas are specifically closed due to legislative action, such as congressionally designated wilderness, or by closure order at the Forest or District levels. Additional suitability plan components specific to the Middle Fork Judith WSA are not necessary because the suitability of activities within the Middle Fork Judith are addressed by other forestwide plan components and ROS.

CR283 Inventoried Roadless Areas – Conservation

Concern: Commenters support the continued conservation and management of IRAs according to the direction provided in the 2001 Roadless Conservation Management Rule.

Response: The FS must follow all law, regulation, and policy related to natural resources on the HLC NF, and, therefore, must follow the direction provided in the 2001 Roadless Area Conservation Rule.

Congressionally designated areas

CR115 Continental Divide National Scenic Trail – Prohibit Motorized/Mechanized Uses

Concern: The FS should prohibit motorized and mechanized uses along the entire length of the CDNST.

Response: Limiting motorized and mechanized uses along the CDNST is beyond the scope of the forest planning process. Except for wilderness and RWAs, motorized and mechanized means of transportation along the CDNST, have been established by summer and winter travel management plans. Recommended changes to these existing plans are site specific and, therefore, not forest planning issues. These potential changes should be discussed with the District Ranger at the applicable Ranger District.

CR117 Monitoring – Continental Divide National Scenic Trail

Concern: Commenters had questions and suggestions regarding monitoring of the CDNST.

Response: Elements of the CDNST Comprehensive Management Plan are monitored annually. There is no need to repeat this monitoring as a part of the Plan. Additionally, the FS must follow all laws, regulations, and policies that provide direction for the CDNST.

FSM 2353.44b directs the FS to complete a CDNST Unit Plan for those segments of the trail that cross the HLC NF. There is no need to repeat this policy in the Plan.

CR124 Wilderness – Plan Components

Concern: Commenters had a number of suggestions/recommendations for wilderness plan components.

Response: Changes to plan components were made where appropriate. Please see the wilderness section of the Plan. Where plan components were not changed per the comment, the Forest determined that the retained plan components were sufficient to meet obligations under the 2012 Planning Rule.

CR130 Lewis and Clark National Historic Trail – Recommended Alternatives

Concern: Commenters recommended changes to plan components and other editorial suggestions for the Lewis and Clark National Historic Trail section of the Plan.

Response: Various LCNHT plan component and other editorial suggestions were provided. Changes to plan components of the Plan were made where appropriate, please see the LCNHT, wildlife, and ROS sections of the Plan. Where plan components were not changed per the comments, the Forest determined that the retained plan components were sufficient to meet obligations under the 2012 Planning Rule.

CR147 Wilderness Study Areas – Support Wilderness Designation

Concern: The FS should recommend the Middle Fork Judith and/or the Big Snowies WSAs as recommended wilderness areas.

Response: During the Forest Planning process, the FS was required to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System (FSH 109.12, chapter 70). Potential RWAs were identified through a detailed wilderness evaluation process used to identify those areas within the forest which best met the criteria for consideration of their wilderness characteristics. Both the Middle Fork Judith and the Big Snowies WSAs were considered in that analysis. Please see appendix E of the FEIS.

A range of alternatives were considered for the WSA areas in the DEIS and FEIS. Based on this analysis, as well as public comments, the Plan identifies approximately 67,000 acres of the Big Snowies WSA would be RWAs in the preferred alternative (alternative F). The Middle Fork Judith WSA was not chosen for recommended wilderness in the preferred alternative. However, much of the area was allocated to a primitive ROS category that would protect its wilderness characteristics.

CR179 Wilderness Study Areas – Oppose Wilderness Designation

Concern: Since the Big Snowies and Middle Fork Judith WSA are already IRAs and WSAs, the Forest should not consider them for RWAs.

Response: Potential RWAs were identified through a detailed wilderness evaluation process used to identify those areas within the forest which best met the criteria for consideration due to their wilderness characteristics. All lands outside of designated wilderness were included in this process, including both the Middle Fork Judith and the Big Snowies WSAs.

A range of alternatives were considered for the WSA areas in the DEIS. Based on this analysis as well as public comments, in the Plan, approximately 66,894 acres of the Big Snowies WSA would be recommended wilderness area in the preferred alternative, alternative F. The Middle Fork Judith WSA was not chosen for recommended wilderness in the preferred alternative, however, much of the area was allocated to a primitive ROS category that would protect its wilderness characteristics.

CR182 Designated Areas – Plan Components

Concern: Commenters recommended changes and additions to plan components for RWAs, WSAs, and IRAs. These included requests for the FS to:

a. Add the following language to the WILD, RECWILD, and WSA sections of the Plan: "restoration activities (such as management ignited fires, active weed management) are used in wilderness areas to protect and/or enhance the wilderness characteristics of these areas and "Non-native invasive species are nonexistent or in low abundance and do not disrupt ecological functions";

b. Coalesce all Suitability plan components into one location to allow the public to locate and meaningfully understand the proposed Suitability plan components; and

c. Incorporate plan components that state livestock grazing allotments be retired in designated Wilderness and in Wilderness Study Areas, so that such areas have the wild character intended by the Wilderness Act.

Response: Changes to plan components were made where appropriate, please see the Recommended Wilderness section of the Plan. Where plan components were not changed per the comment, the Forest determined that the retained plan components were sufficient to meet obligations under the 2012 Planning Rule. Additionally:

a. Restoration activities are suitable in RWA and WSAs. Please see FW-RECWILD-SUIT-02 and FW-WSA-SUIT-03. Natural ecological process and disturbance should be the primary forces affecting the composition, structure, and pattern of vegetation in designated wilderness areas. Restoration actions would be inappropriate in these areas.

b. Suitability components change depending upon the designated area and, therefore, need to be placed within the plan components established by designated area.

c. Section 4(d)(4)(2) of the Wilderness Act (1964) states "the grazing of livestock, where established prior to the effective date of this Act, shall be permitted to continue subject to such reasonable regulations as are deemed necessary by the Secretary of Agriculture." Wilderness range is to be managed in a manner that utilizes the forage resource in accordance with established wilderness objectives (36 CFR 293.7). The HLC NF would continue to follow guidance under the Wilderness Act (1964) and FSM 2300 regarding pre-existing land uses and livestock grazing permits within designated, recommended, and wilderness study areas. Grazing permits are the sole property of the Federal government and bestow no right or title of interest other than to the United States (CFR 222.3(b)). Allotment closures are not to be carried out at the requests of any third party. In the event of a permit waiver or an allotment becomes vacant, a new grazing authorization may be issued within the wilderness area allotments (FSM

2323.24-Permits). Allotment restoration activities are suitable in recommended wilderness and wilderness study areas. Please see FW-RECWILD-SUIT-02 and FW-WSA-SUIT-03. Natural ecological process and disturbance should be the primary forces affecting the composition, structure, and pattern of vegetation in designated wilderness areas. Restoration processes would be inappropriate in these areas.

CR186 Continental Divide National Scenic Trail – Recommended Plan Components

Concern: Commenters had many suggestions for plan component additions and edits in the Continental Divide National Scenic Trail section of the Plan.

Response: Various CDNST plan component and other editorial suggestions were provided. Changes were made where appropriate. Please see the CDNST section of the Plan. Where plan components were not changed per the comment, the Forest determined that the retained plan components were sufficient to meet obligations under the 2012 Planning Rule.

CR187 Continental Divide National Scenic Trail – Support for Mechanized Means of Transportation

Concern: The FS should support the use and expansion of the CDNST for mechanized recreation (mountain bike) use.

Response: In all alternatives, mechanized means of transportation (including mountain bikes) would be suitable on the CDNST except within designated wilderness and RWAs.

CR188 Continental Divide National Scenic Trail – DEIS Comments

Concern: Multiple commenters had suggestions on the CDNST plan components and analysis.

Response: Plan components were developed for all designated areas on the HLC NF, including those that protect wilderness character and the nature and purposes of the National Scenic and Historic Trails. All action alternatives include plan components for the CDNST, and the preferred alternative, alternative F, establishes a CDNST corridor that extends 1/2 mile either side of the CDNST trail. Plan components for the CDNST provide direction within this corridor. Please see the CDNST section under Designated Areas in the forestwide section of the Plan. The corridor map is displayed in appendix A of the Plan. Analysis for the CDNST trail corridor is included in the FEIS.

CR205 Wilderness Fire

Concern: Commenters hold concerns about the management of fire within recommended and designated wilderness.

Response: Forest Service Manual (FSM) provides direction relating to fire management in designated areas. This direction is referenced in chapter 3 under section 3.3.2 Regulation and Policy in the DEIS. Regarding equipment, fire suppression and prescribed fire in wilderness see FSM 2320 Wilderness Management. Relating specifically to prescribed fire see FSM 2320 Wilderness Management and 5140 Hazardous Fuels Management and Prescribed Fire addresses wilderness.

CR207 Wilderness Study Areas – Legislation

Concern: Comments regarding wilderness study areas included:

a. The FS should support the Senator Daines' Bill to rescind the Wilderness Study Act in the Big Snowy Mountains; and

b. Allowing mechanized means of transportation in WSAs is inconsistent with the Montana Wilderness study act of 1977 and a departure from the Proposed Action.

Response:

a. The potential for Congress to rescind the 1977 Montana Wilderness Study Act is beyond the scope of the forest plan revision process. The FS does not advocate for or against legislation.

b. The Montana Wilderness Study Act of 1977 does not mention the allowance or prohibition of mechanical uses within WSAs. A Northern Region supplement to the Forest Service Manual 2329 was published in 2008 which provided clarification for management of WSA's. The Region 1 Manual Supplement includes guidance for management to maintain wilderness character, management of existing uses, and new uses such as mountain bikes.

There were no restrictions to mechanized means of transportation in WSA areas in 1977. However, under the Northern Region supplement to Forest Service Manual 2339, "Mountain bikes may be allowed on trails that had established motor-bike use in 1977, or on nonmotorized trails as long as the aggregate amount of mountain bike and motorcycle use maintains the wilderness character of the WSA as it existed in 1977 and the area's potential for inclusion in the National Wilderness Preservation System."

CR214 Conservation Management Areas

Concern: The FS should designate additional conservation management areas in the Plan. Specific areas recommended include: Stonewall, Anaconda Hill, Specimen Creek, and Green Mountain.

Response: Conservation Management Areas are established by Congress. The HLC NF does not have the authority to create them.

Cultural, historical, and tribal resources

CR14 Badger Two Medicine

Concern: Commenters had several requests/suggestions for the management of the Badger Two Medicine area of the Rocky Mountain GA, including:

a. The FS should be in close consultation with the Blackfeet Nation to ensure that the Tribal rights and the cultural, historic, and spiritual values of the Badger Two Medicine area are protected;

b. The Badger Two Medicine area should be a RWA;

c. The Badger Two Medicine area should be co-managed with the Blackfeet Nation;

d. The area should not allow motorized or mechanized travel; and

e. The Blackfeet Nation had several suggestions for plan components.

Response:

a. The Badger Two Medicine Traditional Cultural District would be managed per the National Historic Preservation Act, the Archaeological Resource Protection Act, the Indian Sacred Sites Executive Order 13007, the American Indian Religious Freedom Act of 1978 and their implementing regulations, in addition to the forest plan components. All Federal undertakings within the Badger Two Medicine area would follow government to government consultation protocols as defined in the Forest Service Manual 1500, Chapter 1560 and Forest Service Handbook 1509.13, Chapter 10, as well 36 CFR 800.2 and Executive Order 13175.

b. It was the recommendation of the Blackfeet Nation to not make the Badger Two Medicine area into a RWA.

c. Proposed actions in the Badger Two Medicine area would follow all federal laws and regulations for cultural resources and government to government consultation, in addition to any plan components. Co-management of the Badger Two Medicine area between the Blackfeet Nation and the FS is outside of the scope of the forest plan revision process.

d. Under current travel plans, motorized uses are not allowed in the Badger Two Medicine area. Mechanized means of transport (including mountain biking) are suitable in all areas expect for those areas closed by Congressional action (such as wilderness) or specific area closures. Most of the Badger Two Medicine area (97%) would be allocated a primitive ROS setting. The remaining 3% would be located adjacent to open roads in several locations near the boundaries of the Badger Two Medicine area and are allocated roaded natural ROS settings. Mechanized uses would be suitable in both primitive and roaded natural ROS settings within the boundary of the Badger Two Medicine area.

e. Through consultation with the Blackfeet Nation, many of the suggested plan components were included in the Plan, please see the Badger Two Medicine section.

CR15 Badger Two Medicine – Bison

Concern: Commenters had comments about livestock grazing and bison in the Badger-Two Medicine Area, including:

a. The Plan should reduce or eliminate any livestock grazing leases that currently exist within the Badger-Two Medicine Traditional Cultural District. Livestock grazing has demonstrated negative effects on riparian zones and other ecosystem processes and may possibly degrade the natural areas within the Badger-Two Medicine area;
b. Restore bison to the Badger-Two Medicine area during the life of the Plan; and
c. The FS should acknowledge the special place that bison hold in Blackfeet history, culture, and spirituality and should work with the Blackfeet Nation to re-introduce bison in the Badger Two Medicine area.

Response:

a. The Badger-Two Medicine area contains a large, active cattle grazing allotment with multiple permittees. The permits are in good standing, with conservative stocking rates in place and a flexible AMP that can address resource concerns if they are identified. As long as term grazing permits are in good standing in the Badger-Two Medicine area, the HLC NF would continue to work with all parties including grazing permittees and the Blackfeet Nation, with a vested interest in the area. The Plan is not a decision document that would reduce, restrict, or eliminate livestock grazing from the Badger-Two Medicine area.

   Administrative processes, which allow for the transfer of grazing preferences to occur between a willing seller and buyer based on the sale of base property or permitted livestock, may occur at any time. If the purchaser of base property or permitted livestock requests a change in class of livestock, the Forest could consider the request and effects to resources through the appropriate level of environmental review.

b. 36 CFR 222.1 defines Livestock as "animals of any kind kept or raised for use or pleasure." Under this definition, the FS would recognize bison as permitted livestock, requiring authorization by written permit for the owner to graze bison on NFS lands. If bison were proposed to be managed as a free-ranging animal recognized as a public wildlife resource, a larger geographic area level plan would need to be developed between MFWP, the Blackfeet Nation, HLC NF, and local private landowners in the Badger-Two Medicine area. Changes from cattle to bison grazing alone, depending on management, may or may not have a beneficial effect in moving towards desired resource conditions. Many variables would need to be considered for riparian areas and mountain meadows, as any type of unmanaged grazing could result in negative ecological effects to the area.

c. The FS acknowledges the historic and cultural significant of American bison to the indigenous Native American peoples. The Plan includes components to maintain habitat for native wildlife species and support the native flora and fauna on the HLC NF, including habitat that would support American bison and other species of tribal interest. Please see plan components in the vegetation, wildlife, and tribal sections of the Plan.

CR52 Badger Two Medicine – Other Resources

Concern: Various Badger Two Medicine plan component and other editorial suggestions were provided. These included:

a. Suggestions for additional suitability plan components in the Badger Two Medicine section;

b. Requests for additional components regarding the traditional cultural district;

c. Requests for more collaboration with the Blackfeet Nation, including co-management with the FS; and

d. Requests to not allow mechanized means of transportation in the Badger Two Medicine area.

Response: Changes to plan components were made where appropriate. Please see the Badger Two Medicine section of the Plan as well as other applicable forestwide sections of the Plan. Where plan components were not changed per the comment, the Forest determined that the retained plan components were sufficient to meet obligations under the 2012 Planning Rule.

a. Please see the Badger Two Medicine suitability section of the Plan.

b. All actions within the Badger Two Medicine area would follow all federal laws and regulations for cultural resources and government-to-government consultation, in addition to any plan components.

c. Please see response to CR14.

d. Please see response to CR14.

CR102 Badger Two Medicine – Prohibit Motorized/Mechanized Use

Concern: The FS should prohibit motorized and mechanized uses in the Badger Two Medicine area.

Response: The responsible official has decided not to make travel plan changes within the forest plan revision process. Under current travel plans, motorized uses are not allowed in the the majority of the Badger Two Medicine area. Mechanized means of transportation (including mountain biking) are suitable in all areas expect for those areas closed by Congressional action (such as wilderness) or specific area closures.

The preferred alternative (alternative F) allocates a primitive ROS to the Badger Two Medicine area and mechanized uses would be suitable.

CR123 Cultural/Historic/Tribal

Concern: Commenters had suggestions for added content to the cultural and historical characteristics sections of the Plan.

Response: Thank you for your comments. In the Plan, the HLC NF tried to be concise and only provide a brief history of the cultural/historic features of the planning area. Further information can be found in site records which are housed in the Helena Supervisors Office and the State Historic Preservation Office. Historical information can also be found in the Historic Overview of the Helena and Deerlodge National Forests written by Barb Beck in 1989. Also, some of the historic communities can be found on historic maps that can be found online. Other information about historic or cultural features can be provided to the Forest archaeology staff in Helena or Great Falls.

CR139 Badger Two Medicine and CMA

Concern: Commenters support the designation of the Badger Two Medicine area as an emphasis area as well as the larger Rocky Mountain Front Conservation Management Area. Requests for suitability plan components were received, as well as requests for additional Conservation Management Areas.

Response:

- The preferred alternative, alternative F, designates the Badger Two Medicine area as an emphasis area and establishes plan components to protect and/or maintain the special character of the area.

- The Conservation Management Area on the Rocky Mountain Ranger District was signed into law on December 19, 2014 as a part of Public Law 113-291. The preferred alternative, alternative F, further designates these areas as emphasis areas and establishes plan components to protect and/or maintain the special character for which they were designated.
- Plan components were developed for both the Badger Two Medicine area and the Conservation Management Area to provide clear direction for the management and protection of these emphasis areas.
- Conservation management areas are designated by Congress through legislation and designating them is beyond the scope of the forest plan revision process.

CR150 Badger Two Medicine – ROS Primitive

Concern: The Forest should assign a Primitive ROS classification to the Badger Two Medicine area.

Response: Based on the DEIS analysis and public comments on this area, the FS agrees. The majority of the Badger Two Medicine area (97%) would be assigned a primitive ROS classification in the preferred alternative (alternative F) to protect the recreation, environmental, cultural and social values of this area. The remaining 3% would be located adjacent to open roads in several locations near the boundaries of the Badger Two Medicine area and are allocated roaded natural ROS settings. Both primitive and roaded natural ROS settings preferred alternative (alternative F) allocates a primitive ROS to the Badger Two Medicine area and mechanized uses would be suitable within the boundary of the Badger Two Medicine area.

CR151 Badger Two medicine – Wilderness Values

Concern: The Forest should protect the wilderness values of the Badger Two Medicine area.

Response: The majority of the Badger Two Medicine area has been assigned a primitive ROS classification in the preferred alternative (alternative F) to protect the recreation, environmental, cultural and social values of this area. The preferred alternative does not identify it as a RWA.

Lands

CR79 Lands

Concern: There were several comments related to land status, ownership, land use, and access. One commenter requested that the FS add back into the plan "NFS Boundaries are clearly marked to reduce encroachments and trespass" as a plan component. Another suggested that obtaining access to NFS lands must be a top priority.

Response: Handbook and manual direction requires that the FS clearly mark boundaries. Because this is required by FS regulations, it does not need to be included as a plan component. Improving access to NFS lands would be a priority and would be addressed in the Plan through FW-LAND-DC-02, FW-LAND-OBJ-01, and FW-LAND-GDL-01.

CR110 Land Use

Concern: Commenters had concerns regarding land uses, including:

a. Request to add "compatible with other resource desired conditions" and to identify the suitability of areas for the appropriate integration of resource management and uses;
b. National and State recommendations and guidelines should be consulted to minimize the impacts of utility lines and other methods of energy production and delivery on wildlife. Given the great size of the lands to be managed, the objective of acquiring 1 to 5 roads or trail rights-of-way may be too restrictive. Would like to see 1-5 per decade instead;

c. NFS land ownership boundaries are clearly marked to reduce encroachment and trespass; and
d. Are there proposed or pending energy corridors?

Response:

a. Handbook and manual direction require that the FS ensure uses are compatible with the resource management plan prior to authorizing the use. The FS is also required to consult and ensure that uses are not impacting wildlife.
b. These concerns are addressed in FW-LAND-OBJ 01 and 02.
c. In regard to land ownership boundary marking, current FS policy is that all NFS boundary lines shall be located, monumented, marked, and posted to prescribed FS boundary marking standards prior to undertaking land management activities planned near or adjacent to any FS boundary line. This policy is currently documented in FSM 7152.
d. There are no proposed or pending energy corridors.

Infrastructure

CR75 Transportation System/Travel Management Planning

Concern: Many comments were received related to roads, transportation, and travel planning, including:

a. Request for open/closed roads and motorized/nonmotorized trail miles;
b. Requests for more road obliteration of single use, user created, not needed roads. Others commented that the FS does not require enough road maintenance and trail maintenance;
c. Inquiries about the connection between travel management planning and forest plan revision;
d. Comments about not using the Travel Analysis Process to remove identified unneeded roads;
e. Comments on RS2477;
f. Comments on Subpart A; and
g. Request to disclose effects of climate change on the road system.

Response:

a. Please refer to the FEIS recreation access and infrastructure sections for miles of open/closed roads and motorized/nonmotorized trails.
b. Objectives for road and trail maintenance, reconstruction, improvement and decommissioning miles are minimums and additional miles would be accomplished as funding allows.
c. The Plan would guide future travel planning.
d. The Travel Analysis Process was used to develop the Travel Analysis Report which identified "not likely needed for future use" NFS roads. The Travel Analysis Report would guide site-specific projects for road decommissioning in an effort to achieve the desired conditions FW-RT-DC 01 and 02. This process would also support Subpart A in moving the national forest road system in the direction of a safe and cost-effective transportation system.
e. There are no travel plan decisions within the Plan. Therefore, RS2477 would not apply.
f. Desired conditions FW-RT-DC-01 and FW-RT-DC-04 address a travel system that reduces impacts to wildlife and guideline FW-RT-GDL-12 prioritizes road decommissioning to areas that would benefit fish and wildlife habitat as well as create a more cost-efficient transportation system.
g. The EIS addresses the potential risk to infrastructure from future climate conditions using BASI.

CR105 Transportation Management

Concern: Concerns that road and trail maintenance, construction and decommissioning shall minimize adverse effects to the occupied habitat of threatened, endangered species.

Response: Desired conditions FW-RT-DC-01 and FW-RT-DC-04 address a travel system that reduces impacts to wildlife and guideline FW-RT-GDL-12 prioritizes road decommissioning to areas that would benefit wildlife habitat.

CR118 Monitoring Road/Trail

Concern: Questions were raised about monitoring for changes to the transportation system as well as impacts associated with roads and trails and if they comply with the 2012 Planning Rule requirements. There was also a concern that road miles converted but not decommissioned would remain on the system.

Response: Monitoring desired conditions and objectives would identify progress toward requirements of the 2012 Planning Rule. The number of road miles decommissioned through obliteration and conversion would be tracked independently and recorded for accomplishments as such. Monitoring road and trail miles maintained annually would provide data to evaluate overall transportation system condition. Roads converted to trails would reduce the number of system roads and reduce transportation system maintenance costs as a whole, while maintaining desired public access to the forest. Road to trail conversion decisions would be made on a project by project basis and the transportation system would be evaluated for each project area at that time.

Social and economics

CR68 Social and Economic Impacts

Concern: The values associated with ecosystems, resources, and multiple uses on the HLC NF are critical to consider in making a plan decision. There are important values that have not been included, or correctly evaluated, in the DEIS, including but not limited to: recreation and outdoor activities including mountain biking, motorized vehicle use, hiking, and other trail use; resources including timber and forest products; community proximity to WSA's, RWA's, and other primitive management areas; public health benefits from national forests and recreation in healthy ecosystems; and ecosystem services in general.

In addition, the economic analysis does not fully explore the marginal costs of individual project actions, consider the "Trail Usage and Value: A Helena, Montana Case Study" report from the Montana Office of Tourism, or include scientific references on the public health benefits of National Forests.

Response: Not all human values assigned to national forest resources, ecosystems, and multiple uses can be quantitatively, or otherwise fully analyzed, for the purpose of forest planning. In the HLC NF FEIS, the appropriate analysis, relevant to level of decision being made in forest planning, is provided. In the social and economic analyses, key ecosystem services and the provision of natural resources and recreation opportunities are analyzed to the extent necessary, given the uncertainty with future Forest projects and project-level decisions that will have more direct implications for on-the-ground travel, ecosystem and resource management.

Specifically, in the FEIS, ecosystem services are qualitatively analyzed and are limited to a list of "key" ecosystem services, those being relevant to forest planning decisions. Ecosystem services are described qualitatively in the sections entitled "Benefits to People" and the decision implication for each key ecosystem service is provided in the environmental consequence subsection.

Additionally, recreation and other multiple use economic values are considered and analyzed under the national forest jurisdictional perspective. For example, the economic contribution analyses for recreation on a national forest does not include spending associated with durable goods such as off-road vehicles, or mountain bikes. Instead, only spending directly linked to visitation and travel within a 50-mile radius, and for non-durable goods (e.g. gasoline, hotel rooms, fishing bait, etc.) are used in estimation of the economic contribution from recreation related national forest visitation. Understandably, compared to industry or tourism agency studies, which typically include all durable goods spending, the results appear much different in terms of economic valuation. This difference is not reflective of the difference in opinion of the importance of recreation economics, but rather what is being specifically accounted for in each study.

Regarding public health and health benefits associated with national forests, the FEIS analyzes key ecosystem services, or benefits to people, and specifically describes which ecosystem services are linked to providing public health benefits. Public health is highlighted and documented as part of a key benefit in nine subsections within the analysis of benefits to people.

CR82 Enforcement and Education

Concern: Comments included input about existing and needed enforcement of policies, laws and regulations.

Issues included lack of law enforcement including off-road vehicle abuse and non-compliance in the Little Belts and The Big Belts and live Douglas-fir tree poaching on the middle fork area of Warm Springs Creek Road in Clancy. There was also a suggestion to reduce conflicts with education.

Response: Thank you for your comments, but the specifics of law enforcement are not part of the forest planning process and are not regulated by Forest Plans. Please refer questions and concerns to your local Ranger District office.

CR112 Hunting

Concern: Commenters had concerns about hunting in the planning area, including:

a. The FS should not prohibit hunting in wilderness areas;

b. The FS should conserve intact habitats and backcountry hunting and fishing areas, especially elk and mule deer winter range and wildlife corridors;

c. Preservation of hunting and fishing opportunity/habitat security in specific areas, including the Little Belts (specifically for elk hunting area), and the Big Log, Mount Baldy, and Camas Creek;

d. Requests for additional plan components for timing and location of motorized uses during hunting season;

e. Effects to grizzly bears from hunting;

f. Lack of standards for elk habitat security, especially in winter;

g. Recreational hunting opportunities; and

h. Recognition of wildlife/hunting value of unfragmented backcountry areas a well as the Elkhorns core.

Response:

a. The FS does not have authority to establish hunting regulations or policies on federal lands. Hunting regulations and policies are established by MFWP.

b. The Plan includes a number of area designations and plan components that would provide for wildlife movement and security during various times of year, including during hunting seasons. RWAs, along with primitive and semi-primitive nonmotorized ROS settings would add to designations such as designated Wilderness, WSAs, IRAs, and the Conservation Management Area in limiting the type and amount of access and anticipated human uses in those areas. These designations represent a large portion of the HLC NF (see Designated Areas section in the Plan and FEIS). The Plan includes components for maintaining connectivity, particularly in some areas identified as of concern, and it includes plan components to maintain areas of seclusion for wildlife. It also includes plan components to limit disturbance to wildlife on winter range or other key seasonal habitats.

c. The preferred alternative designates the Big Log and Mount Baldy areas as RWAs. These RWAs will be managed to protect their wilderness characteristics. The Camas Creek roadless area is an IRA and is currently managed as a semi-primitive nonmotorized area. The Little Belts GA includes a WSA in the east-central portion of the mountain range, where motorized travel is largely restricted. As such, these areas remain mostly or entirely unroaded and therefore may provide a high degree of habitat security for elk or other wildlife in all seasons, including hunting seasons. The Plan includes components that would provide for wildlife habitat security in key seasonal habitats, and that guide managers to work with MFWP regarding management of wildlife habitat.

d. A guideline has been added as a result of discussion with and comments provided by MFWP.

e. The analysis of impacts to grizzly bears has been substantially updated in the FEIS as compared to the DEIS, and reflects changes made during preparation of the Biological Assessment for ESA section 7 consultation with the USFES. Changes include additional discussion and analysis of habitat security. Analysis in the FEIS now includes discussion of existing blocks of security habitat outside of the recovery zone, and includes updates to the discussion of the potential impacts of recreational activity and of management for human uses of wildlife (such as hunting) in the section addressing key drivers and stressors (affected environment) and in the environmental consequences section.

f. Please refer to the response to CR44, which includes detailed discussion of a number of issues regarding elk and big game habitat management. Standards and guidelines for elk and big game in the 1986 Forest Plans were primarily intended to provide specific hunting opportunities and to increase elk herd numbers. Since that time issues regarding management of elk populations have changed; elk numbers are above established population objectives throughout most of central MT, and elk are increasingly moving to private lands during hunting season largely because of the lack of hunting pressure combined with availability of high-quality forage (e.g., irrigated crops) on those lands, regardless of levels of hunting pressure or amounts of security on adjacent NFS lands (refer to discussion in the FEIS and to literature cited there, and to CR #44 responses). The Plan follows recommendations in BASI and recent interagency guidance to refrain from establishing one-size-fits-all numeric standards, but rather to require that managers consider elk habitat needs, including the need for security during the hunting season or other times of year, based on site-specific and herd-specific needs and issues.

In addition, the Plan includes desired condition FW-FWL-DC-04 regarding balancing motorized access during the hunting season with desired conditions for wildlife habitat security and other habitat needs. The Plan also includes an updated guideline (FW-WL-GDL-01) that was included after discussion with MFWP, regarding management of motorized access during the hunting season to consider the potential for displacement of big game from NFS lands during hunting seasons.

g. The Plan recognizes hunting as a valued and desired activity on national forest system lands. FW-FWL-DC-01 provides direction for Elk and Big game on NFS lands. Recreational shooting, while not specifically named in the Forest Plan, is considered a dispersed recreation activity and could occur anywhere on the Forest, unless specifically prohibited to address safety concerns.

h. The Plan includes a number of components that guide managers to work with MFWP or other entities regarding management of wildlife habitat. Specifically, the Plan includes a goal (FW-FWL-GO-01) and a guideline (FW-FWL-GDL-01) that directs FS biologists to work with MFWP biologists to identify management that would help to achieve desired distribution and hunting opportunity of elk and other big game species during the archery and rifle hunting seasons.

Please refer to the Plan and to the FEIS sections that discuss designated areas and ROS for discussion of management of areas based on designations such as Inventoried Roadless Area, Recommended Wilderness Area, and primitive and semi-primitive ROS. In the preferred alternative the Elkhorns Core area will be managed to as a primitive ROS, and motorized means of transport will not be suitable in this area. Mechanized means of transportation will continue to be suitable. Discussion of the Elkhorns Wildlife Management Unit, including the value of the Elkhorns Core area, has been updated in the FEIS. Management activities throughout the Elkhorns GA are largely constrained by plan components intended to maintain or enhance wildlife habitat and the needs of species that require seclusion.

Livestock grazing

CR59 Monitoring – Livestock Grazing

Concern: Comments and suggestions regarding monitoring of livestock grazing included:

a. Monitoring of rangeland trend in response to livestock grazing and other disturbances should utilize intensified grid and non-forest plots as well as PIBO plots for data source and repeatability;

b. The monitoring plan should include a review of the HLC's compliance and non-compliance, successes and failures with monitoring, consistence with NFMA, and evaluation of commitments made in the 1986 Forest Plans. These should be disclosed in the FEIS any and all adverse environmental impacts from the noncompliance;

c. Livestock grazing monitoring should include the number of commercial livestock grazing allotments on the national forest and the number of permitted domestic sheep animal months. Inside and outside the Primary Conservation Area, monitor and evaluate allotments for recurring conflicts with grizzly bears; and

d. The DEIS stated that financial and personnel limitations have led to a wide variety of riparian conditions and inconsistencies in permittee accountability. This statement asserts the ranching community has done a less than adequate job of managing livestock and the statement should be removed. The FS should utilize cooperative agreements to address shortages of finances or personnel.

Response:

a. Rangeland trend monitoring (effectiveness monitoring) would continue to utilize methodology which provides managers answers on apparent rangeland vegetation trends over time. Existing protocols and monitoring methods would be repeated on previously established sites on a rotational basis as much as budgetary constraints allow. During site-specific project development, existing sites would be prioritized for data collection in order to analyze trend and determine movement towards, or departure from desired conditions. If new methodology is developed that is more efficient and effective during the life of the Forest Plan, those methods may be used in the future as long as the information provided could be used for vegetation trend analysis.

   Implementation monitoring through allowable grazing use levels (AULs) would provide guidance for livestock management on an annual basis. AULs are the triggers upon when to base livestock moves from pasture to pasture or when to leave the allotment. Allotments on the HLC have AUL triggers built into the majority of AMPs. These AULs are generally forage use levels and bank alteration with some stubble height requirements west of the continental divide. Effectiveness monitoring on a project-level scale would determine if site-specific prescriptions and AULs need to be adjusted over time.

b. The Plan is a programmatic document and supporting analysis does not focus on individual allotment compliance history. AMP and grazing permit noncompliance and allotment resource concerns are addressed under direction of FSH 2209.13. Impacts from grazing are generally limited to site-specific locations. When grazing effects, outside the sideboards of the existing AMP or annual operating instructions are encountered, FSH 2209.13 direction is followed and adjustments to annual grazing schemes may be implemented.

c. Actual use on sheep and cattle allotments is annually reported in the FS Infrastructure database. Currently, 6,054 head months are permitted on the HLC NF for sheep grazing. Actual use is generally less than full permitted numbers due to annual climatic conditions and the permittee's overall ranch/grazing plan for the year.

   Active cattle and sheep grazing allotments within the Primary Conservation Area (PCA) reported in 2011 serve as the baseline for allotments within the Northern Continental Divide Ecosystem PCA on Federal lands. Allotments on the HLC NF included 24 cattle allotments permitted for 7,467 Head Months (9,857 AUMs) and one sheep allotment permitted for 270 sheep head months with ewes and lambs (89 AUMs). Grizzly/livestock conflicts on HLC NF allotments have been rare but are periodically noted if and when they occur.

d. This statement has been clarified in the FEIS regarding riparian monitoring and permit compliance accountability. Due to reductions in range staffing over the past 15 years and other limiting factors, every allotment across the Forest is not monitored for implementation of the annual operating instructions and AULs. A review of compliance history would be an inaccurate portrayal of conditions as not every allotment is monitored annually; however, the Forest has prioritized allotments with identified resource values or concerns that are monitored annually. The Forest relies on rangeland trend to determine if conditions are moving towards, departing from, or are within desired conditions.

Cooperative monitoring with permittees and other interested agencies, academia, or organizations is encouraged and would help make future range management decisions stronger and implementable.

CR95 Livestock Grazing – Domestic Sheep

Concern: Commenter had suggestions related to domestic sheep livestock grazing, including:

a. The HLC NF should coordinate with other entities to close high-risk allotments near historic bighorn sheep habitat, eliminate trailing routes, and reduce likelihood of straying domestic sheep;

b. The HLC NF should engage landowners and other entities to eliminate sheep from the landscape and reduce threats from private operations;

c. The Forest needs to be more proactive at educating the public on the threats of domestic/bighorn interaction; and

d. The Plan fails to analyze the risk cattle pose to bighorn sheep populations.

Response:

a. FW-GRAZ-STD 03 and FW-GRAZ-STD-04 were added following public comment on the DEIS and these commit the HLC NF to applying measures to minimize contact between bighorn and domestic sheep through spatial or temporal separation using the best available scientific information and agency and interagency recommendations. These management actions would be taken during AMP revision, sufficiency reviews, or when considering stocking vacant sheep allotments. Desired conditions BB-WL-DC-01, EH-WL-DC-04, and LB/RM-WL-DC-02, along with standards BB/EH/LB/RM-WL-STD-01 for geographic areas address the potential for comingling of domestic sheep and goats and bighorn sheep on NFS lands. Currently, no agency proposals or public requests have been made to restock vacant sheep allotments with domestic sheep or goats on the HLC NF.

Active sheep allotments on the HLC NF currently are over 10 miles in distance from occupied bighorn sheep habitat. Domestic sheep allotments are currently considered low risk for the possibility of commingling with bighorn sheep herds in the planning area based on this distance, as well as no observations of commingling or seasonal overlap have been observed to date. If conditions change, plan components would evaluate the risk of contact and determine and apply management actions to maintain separation. Eliminating these domestic sheep allotments would not reduce the possibility of direct contact between domestic sheep and bighorn herds on private lands within or adjacent to active sheep allotments in the planning area.

b. Working outside the forest boundary to discourage domestic sheep production is outside the scope of the forest plan revision process.

c. Plan components for livestock grazing and invasive plants address maintaining separation and preventing contact of domestic and wild sheep. Plan components would require that consideration and analysis show that adequate separation is present at the project level between active sheep allotments and occupied bighorn sheep habitat. Please see FW-INV-STD 02, FW-GRAZ-STD-03/04. In addition, BB/EK/LB/RM-WL-STDs provide the guidance to apply separation techniques for all sheep and goat grazing and use in geographic areas containing occupied bighorn sheep habitat. FW-CONNECT-DC-

02 emphasizes the Forest to have an education program to inform the public on the forest's various natural resources, which would include livestock grazing and wildlife issues.

d. Additional analysis including updating of the best available scientific information has been completed and can be found in the FEIS. The HLC NF will continue to work with MFWP to follow guidance from the Bighorn Sheep Conservation Strategy (2010).

CR106 Livestock Grazing – Analysis and References

Concern: Commenters had questions/concerns related to the analysis of livestock grazing and associated references/BASI. These included:

a. The FEIS should disclose how many allotments have updated management plans and due dates for the remainder. The FEIS should also disclose a how many are meeting the standards of the existing plans, what the schedule for AMP revision will be, what is the actual use (not just authorized or billed) for each allotment, etc. Without this and additional specific information about the grazing program, it is impossible for the public to determine if the proposed standards and guidelines are capable of ever actually achieving the stated desired conditions;

b. The Forest has a lack of quantitative data in regard to the analysis of the ecological status of rangelands throughout the analysis area. The data is also old and with nothing collected in recent times;

c. The DEIS doesn't analyze or disclose noxious weed spread due to livestock grazing. It doesn't quantitatively estimate soil damage due to livestock grazing. The DEIS doesn't quantitatively estimate riparian habitat damage due to livestock grazing. It doesn't analyze or disclose the interaction between upland vegetation changes due to livestock grazing, fire behavior, and forest composition;

d. "Various analysis from 1995-2004 estimate that livestock grazing may have had an effect on the ecological status on 45 percent of the National Forest System lands and 78 percent of the other ownership acres within the planning area." "May have had an effect on" is not explained;

e. The FS didn't analyze or disclose the expected annual infrastructure maintenance and installation costs paid for by taxpayers for the benefit of livestock grazing; and

f. Commenter questions the use of BASI based on a citation in assumptions section of the livestock grazing section and suggests current, peer reviewed literature be used.

Response:

a. The HLC NF is operating under a schedule to revise and update AMPs that is not driven by forest plan revision. The Rescissions Act of 1995 (Public Law 104-19) Section 504(a) requires each NFS unit to identify all allotments for which NEPA analysis is needed. These allotments must be included in a schedule that sets a due date for the completion of the requisite NEPA analysis. Section 504(a) requires adherence to these established schedules. Since the 1986 Forest Plans were completed, and following the Rescissions Act (1995), 158 allotments out of the HLC NF's 240 allotments have had AMPs updated. The remaining 82 allotments require AMP revisions and would follow the plan components for livestock grazing. Allotments that have had AMPs revised under the Rescissions Act would still be subject to forest plan direction through administrative modification of the term grazing permit (FSH 2209.13, Chapter 10, Section 11).

b. Large-scale data collection efforts, such as Ecodata, were conducted in the 1990s and provided the most complete ecological assessment for rangelands. Other various vegetation monitoring efforts have occurred but did not have summarized data available at the time of this analysis. FIA plots, FIA intensified grid plots, and Region 1 Vegetation Map are on-going data collection efforts that continue to improve to provide information on apparent vegetation trends, including rangeland vegetation. In addition, several AMP revisions and other site-specific projects were done between 1995 and 2015 across the HLC NF which also provided new and existing trend monitoring sites for rangeland vegetation information. Many repeatable rangeland vegetation transects exist across the Forest which should give managers the ability to collect sufficient data to make informed future resource management decisions under the Plan.

c. Livestock impacts to weed spread, soils, riparian areas and upland range vary considerably depending on range sites, plant communities, and management conditions. Therefore, these factors are difficult to quantify, but would be considered at a site-specific planning level. Site-specific monitoring, analysis of that data, and a review of literature specific to the issues identified would all be part of developing a new AMP. This approach would determine appropriate management tools that would be effective to move towards desired condition in the quickest timeframe.

d. Grazing is widespread across the Forest as well as other adjacent lands in the planning area. Approximately 1,419,085 acres of the HLC NF's total 2,846,606 acres are within a grazing allotment. Approximately 1,281,000 capable and suitable acres would be found in active grazing allotments, or 45% of the forest area. An estimate of 78% of other lands outside the Forest boundary are grazed by livestock. The statement simply implies that livestock grazing uses have occurred on these lands and vegetation communities have been influenced over time in the presence of grazing and other grazing management practices.

e. Maintenance and installation of rangeland improvement structures are generally the responsibility of grazing permittees. These costs would vary by permittee. FSM 2200 - Range Management, Chapter 2240 - Range Improvements, provides agency policy for funding and constructing rangeland improvement projects. Please see the Social and Economics section in Chapter 3 of the FEIS for more information regarding livestock grazing economics.

f. The assumption acknowledged that livestock can remove plant material, trample soils, and alter water flow patterns. Additionally, a basic principle taught for years in rangeland management is that properly managed rangelands are resilient and able to maintain or recover healthy plant communities. Holling (1973) was tied to discussions of resilience of ecosystems, and the tie to that discussion in the assumption for analysis is that with proper livestock management, these potential effects from livestock grazing would be minor due to the resiliency of the ecosystems. Current literature was reviewed and Chambers et al, 2019 was incorporated in place of Holling to provide a more recent context for resilience of ecosystems tied to management activities including livestock grazing, and the potential for recovery from those disturbances.

CR108 Livestock Grazing – General

Concern: Commenters have concerns/questions regarding livestock grazing on the HLC NF. Issues included:

a. Livestock grazing is an appropriate use of a renewable resource on NFS lands. Grazing opportunities benefit the economic health and continue the heritage of local agricultural communities. The Forest needs to consider the importance of this multiple use for rural communities. FW-GRAZ-DC) 01 is inappropriate as a desired condition and should be a goal;

b. Balance livestock grazing management with wildlife habitat needs and recreational uses. Grazing should be permitted at levels that keep ranches viable but not affect the health of the land or conflict with the wildlife values NFS lands could provide;

c. Decrease hunting and grazing season overlap, especially for archery hunting opportunities, as much as possible;

d. Decrease livestock and wildlife competition for forage in the Elkhorns GA;

e. Grazing permittees are concerned about conifer encroachment and the loss of suitable rangeland for grazing opportunities. Implementing an alternative with more timber harvest and fuels reduction emphasis will benefit livestock grazing in the lone run. Utilize vacant allotments to manage livestock during years where timber and fuels activities could displace grazing opportunities;

f. The Plan should at the very least contain Goals to increase agency staffing for rangeland administration, collect monitoring data on a timely basis, educate permittees about how to meet allowable use limits, ensure compliance checks on every allotment at least once per grazing season, and to comply with the Rescissions Act schedule for NEPA on grazing allotments;
g. The Plan fails to consider the environmental costs of public lands grazing outweigh the relatively insignificant economic benefits; and
h. Maintain the number and acreages of allotments on the HLC NF.

Response:

a. The Plan provides forage for domestic livestock and grazing opportunities under all alternatives. The Plan recognizes livestock grazing as a sustainable multiple use. FW-GRAZ-DC-01 formalizes the importance of grazing opportunities in the Plan for area livestock operations by stating: sustainable grazing opportunities are available for domestic livestock from lands suitable for forage production. Site-specific project development would determine the scope of grazing activities and where (suitable range) they would occur.
b. The Plan sets goals, objectives, and standards (components) for wildlife habitat needs and livestock grazing. Site-specific analysis identifies issues and areas of conflict for the decision maker to resolve within the sideboards of forest plan components. Wildlife needs are identified during site-specific analysis. If issues are raised and validated through monitoring, adjustments in livestock management are made as necessary.
c. Changes to allotment and livestock management on grazing allotments based on recreational uses of NFS lands are best made at the site-specific level. The HLC NF has made several changes to livestock season of use dates to decrease possible conflicts of use in multiple geographic areas of the Forest through the AMP revision process. Under the Plan, analysis at the site-specific scale would continue to identify issues and propose alternatives to mitigate overlap of multiple uses.
d. Plan components for grazing would not specifically address wildlife habitat needs and livestock grazing in the Elkhorns GA. However, plan components would need to be addressed when Elkhorn grazing AMPs are revised during the lifespan of the Plan. FW-GRAZ-GO-01 encourages coordination with MFWP biologists to ensure habitat and forage needs are met in conjunction with livestock grazing plans on NFS lands.
e. The Plan, under FW-VEGT-OBJ-01, strives to treat at least 130,000 acres per decade to maintain, restore, or move vegetation towards desired conditions in both forested and nonforested vegetation communities via a number of activities (see appendix C). Some of these treatments should be favorable to maintaining, improving, or increasing suitable acres for livestock grazing. Increases in suitable range availability would benefit grazing permittees by providing management flexibility and/or increasing livestock distribution on existing grazing allotments. Vacant allotments are generally managed as forage reserves given access and rangeland improvement infrastructure provide a level of operability. These lands can be made available to permittees when natural disaster strikes, such as wildfire, or be used to manage livestock before, during, and after vegetation management treatments to ensure the best opportunities to move towards desired conditions.
f. Agency funding to administer the rangeland management program is beyond the scope of the forest plan revision process. Meetings with permittees to review conditions on allotments and participate in compliance monitoring already occur. Monitoring for compliance with the annual operating instruction and trend data collection would occur at levels and intervals determined adequate for allotment and site-specific needs or AMP prescription.
g. The Social and Economic section in Chapter 3 of the FEIS provides analysis of grazing for the planning area. Livestock grazing on Federal allotments provide for economic opportunity across many Forest communities and contributes to approximately 250 jobs and $8.2 million in labor income annually. Livestock operations are crucial to the tax base for rural counties within the planning area.

Plan components are designed to mitigate environmental costs and provide a net social and economic benefit at the project level.

h. The size and number of allotments, as well as the number of suitable acres and permitted head months is the same across all alternatives. Any future changes to allotment management would be made through a site-specific analysis and decision.

CR116 Livestock Grazing – RMZs

Concern: Concerns/comments around livestock grazing in RMZs included:

a. In order for new grazing guidelines to be effective, areas already affected by grazing need to be recognized and have a restoration plan in the final plan. Existing grazing practices that are degrading streams need to be ended and grazing within inner RMZs and wetlands needs to be minimized or reduced;

b. RMZ widths have increased in the Plan and will change the way livestock grazing occurs within these areas. Provide a table of how many acres of RMZs are within grazing allotments;

c. The EIS must base projected future effects on the experience of past effects or explain why we should expect the effects to be different in regards relying on AMP revisions to move towards desired conditions;

d. Fencing of riparian areas may or may not be effective for managing RMZs;

e. Livestock grazing should be considered a management activity, just like timber harvest, in RMZs;

f. PACFISH/INFISH grazing standards will be weakened under the Plan;

g. Grazing reduces shade canopy, disrupts beaver activity, and alters width-depth ratios. These same impairment related mechanisms often lead to an increase in water temperatures in the stream. An additional grazing related impairment is increased yields and in-channel storage of fine sediments. Grazing also frequently damages springs and wetlands. These factors were not discussed in the suitability analysis. Please cite quantitative data sources regarding livestock impacts upon riparian habitat and at-risk plant species are based; and

h. Both season-long and deferred grazing systems can have negative effects on riparian systems. Plan components should try and reduce riparian impacts from these grazing systems.

Response:

a. Site-specific issues and needs would be identified, and management prescriptions developed through revisions of individual AMPs. Plan components would set the sideboards for what the desired conditions would be and a strategy to move towards those goals. Project level analysis would best determine management changes such as setting allowable use levels or changing the timing and duration of livestock grazing to move towards desired conditions. Closing a grazing allotment or pasture of an allotment or fencing RMZs to exclude livestock use are adaptive management options that may be chosen for a site-specific project. Generally, these options are proposed when other management tools are limited or not effective to move towards desired conditions.

b. RMZ widths have increased under the Plan based on best available scientific information in order to provide greater protection for riparian function. RMZ widths alone would not trigger more stringent grazing regulations. Site-specific conditions based on monitoring would determine allowable use levels and adjustments to livestock management if departure from desired condition is documented. GIS mapping of RMZs, utilizing the Plan inner and outer widths within active and vacant allotments for NFS lands only totaled the following: RMZ inner 91,233 acres; RMZ outer 138,522 acres. Site-specific analysis could refine or document changes in RMZ acres at the project level.

c. Diversity of rangeland vegetation and soils across the forest presents challenges for a one-size-fits-all interim grazing standard to be effective at a programmatic level. The deciding official would determine the most effective tools to incorporate into revised AMPs for the fastest movement towards desired conditions. Under the Plan, more emphasis would be placed on improving or maintaining riparian management zones than under either of the individual Forest's 1986 Forest Plans. Long-term rangeland trend sites are established in many allotments and key areas on the Forest. If departure from desired conditions is noted, management adjustments may be done to reverse current trends. Once site-specific analysis can be conducted, more prescriptive livestock management adjustments may be implemented that address multiple resource plan components.

d. Fencing of RMZs into enclosures or riparian pastures has been a widely used management tool across the Forest for well over 20 years. Fencing may achieve desired results of improving some riparian reaches, but may have drawbacks including financial cost, maintenance needs, and effects to other resource areas, such as complicating wildlife passage. Plan components stress utilizing adaptive management to best move towards a full array of desired resource conditions. Fencing of RMZs would continue to be a management tool that may be considered at the project level.

e. Livestock grazing is a permitted multiple use, subject to meeting AMP allowable use levels, grazing standards, and following BMPs. If identified, impacts to RMZs from livestock grazing would be identified and mitigated on a case by case basis.

f. Under PACFISH/INFISH, end of season bank alteration and stubble height standards were not specifically established. Instead units were required to establish grazing standards for each pasture and monitor if end of season standards were met. Under the Plan, allotments would continue to be managed under existing AMPs, which generally have allowable forage use levels and/or bank alteration standards consistent with PACFISH/INFISH. Consultation with the US Fish and Wildlife Service on the Plan will determine allowable use levels for allotments containing streams with threatened or endangered aquatic species. FW-GRAZ-GDL 01 acknowledges that current ESA consultation documents would be used if they are based on best available scientific information and monitoring data and meet the purpose of achieving riparian desired conditions over time.

g. Livestock grazing effects to riparian areas and stream channel morphology are not suitability criteria that identify suitable rangeland acres. Grazing effects to streams and wetlands would be addressed through plan components that provide project-level sideboards to maintain or move these areas towards desired conditions. Grazing-related impairments to streams and wetlands can be successfully mitigated with adjustments to livestock management. See standards and guidelines in the livestock grazing section (FW-GRAZ-STD 02, FW-GRAZ-GDL 01, FW-GRAZ-GDL 03, FW-GRAZ-GDL 04, FW-GRAZ-GDL 05, FW-GRAZ-GDL 06 and FW-GRAZ-GDL 07) and the RMZ section (FW-RMZ-GDL 03 and FW-RMZ-GDL 12).

h. Grazing systems are one tool to manage livestock grazing duration, and frequency. Management intensity is the number one factor on whether or not grazing strategies would succeed in maintaining or improving riparian areas. Plan components set the sideboard to guide sound decisions for resource improvement. AMPs carry out the operational direction. FW-GRAZ-STD 01, FW-GRAZ-STD 02, FW-GRAZ-GDL 01, FW-GRAZ-GDL 02, FW-GRAZ-GDL 04, and FW-GRAZ-GDL 05 all provide the guidance to reduce impacts to RMZs within grazing allotments through incorporation of allowable use levels and other management tools, such as grazing systems, on a site-specific level.

CR160 Livestock Grazing – Climate Change

Concern: Several commenters were concerned that the analysis does not adequately address the impacts of livestock grazing to climate change and carbon sequestration. These concerns included:

a. More emphasis should be placed on protecting riparian areas and wetlands from livestock grazing which can increase riparian vegetation structure that could increase stream flow, retention, and maintain cooler water temps to counter the effects of climate change;

b. Adequate baseline conditions of climate are not provided. Climate change that results in warmer weather during the grazing season will put added pressure from livestock on riparian areas and wetlands;

c. The HLC NF failed in using the best available scientific information in the analysis of livestock grazing and climate change in the DEIS. Livestock grazing and grasslands/riparian areas are not analyzed in the context of carbon sequestration; and

d. Permitting livestock grazing to occur on NFS lands is a human activity that leads to increased greenhouse gas emission and should not be considered "suitable".

Response: The carbon and climate analysis was updated to address the impacts of grazing on climate change and carbon sequestration; as well as to analyze the role of nonforested plant communities in the carbon cycle. The methane emissions associated with livestock grazing on the HLC NF are minuscule in the context of global climate change. See the livestock grazing and carbon and climate sections in the FEIS; as well as appendix J of the FEIS.

a. Plan components for livestock grazing and RMZs provide guidance at the project level to increase herbaceous vegetation in riparian areas and move towards desired conditions. Plan components for livestock grazing and RMZs are designed to improve riparian condition by increasing riparian vegetation cover, allowing for natural stream channel morphology, and increasing stream flows where possible.

b. For the DEIS, the carbon baseline report was referenced from the HLC NF assessment. For the FEIS, this work has been updated and included in appendix J. The HLC NF does not dispute that climate change could present challenges to livestock management in the future, with a summary of possible climate change influences on livestock grazing that would occur under any alternative. The impacts to livestock grazing from climate change remain to be fully understood or experienced by permittees on the HLC NF. The FS has administrative tools to adapt to unexpected conditions to short and long-term changes in resource conditions, which could include stocking adjustments and adjusting management practices (FEIS, chapter 3, livestock grazing).

c. Published studies were reviewed and the livestock grazing section of the FEIS updated. Several studies suggest that well-managed rangelands with adaptive management options provide an opportunity to improve ecosystem services and potential carbon sequestration.

d. Livestock grazing is a multiple use provided on portions of the HLC NF in accordance with law. Please see the Suitability/Capability section in the FEIS under livestock grazing. Greenhouse gas emission is not a factor in determining whether or not grazing livestock is an appropriate use of NFS lands for determining rangeland suitability.

CR161 Livestock Grazing – Plan Components

Concern: Various livestock grazing plan component and other editorial suggestions were provided, including:

a. Allowable use levels for managing livestock grazing within riparian management zones are absent. Interim management prescriptions are needed to avoid, minimize, or mitigate impacts associated with livestock grazing to rangeland, riparian areas, and aspen stands. Assumptions that livestock grazing will be managed to meet desired rangeland, and riparian conditions cannot be realized as no enforceable standards or guidelines are present. Plan components fail to constrain management;

b. The HLC NF has limited capacity to manage the grazing program;

c. The Plan does nothing to change impacts of grazing and defers all changes to future decisions;

d. The Plan should have components to address non-compliant allotments and permittees;

e. Several comment letters suggested changes to forest plan component wording for managing livestock grazing, including the addition of more goals or objectives; and

f. The DEIS and Draft Forest Plan did not consider scientific information when designing plan components to have grazing management complement other vegetation and fuels management activities.

Response:

a. The 2012 Planning Rule recognizes that Forests need to provide for integrated resource management for multiple uses in planning areas while providing for ecological sustainability. To focus in on that balance, end of season allowable use levels have generally been used on the context of a site-specific setting. Rangelands and riparian areas are highly variable across the HLC NF due to variations in precipitation, elevation, and vegetation type. Therefore, an AMP revision or other NEPA analysis would be the most appropriate mechanism to prescribed management actions to move towards site-specific desired conditions.

b. HLC NF ranger districts have priority allotments which are inspected several times each year because of on-going projects or activities, areas of resource concerns, cases of permittee non-compliance, or the need for meeting ESA consultation requirements. Plan components in the Plan would help range managers focus on the end goals of desired resource conditions and be more efficient and effective in allotment administration and project implementation for future decisions.

c. The Plan is a programmatic document. Plan components are designed to accommodate the range of site-specific needs of individual areas, wildlife species, allotments, and plant communities. AMPs for livestock grazing provide specific operational guidance and are the appropriate planning level to implement management tools, such as allowable use levels and adjustments in permitted stocking (FSH 1909.12). Plan components will inform future AMP efforts.

d. Forest Service Handbook 2209.13 provides rangeland management specialists and line officers with the guidance to address permit infractions and issues of non-compliance. Allotment compliance standards would be measured on a project by project (AMP by AMP) basis.

e. After interdisciplinary team discussion, some suggestions were added or implemented, while others were not. In most cases, suggestions made by commenters wanted component wording that would either severely constraint or provide very limited constraints to livestock grazing. No significant changes were noted between Draft and Final EIS documents or Draft and Final Forest Plans.

f. Scientific information was reviewed for a variety of livestock grazing related issues, processes, and plan component development. Information that was considered most relevant to the analysis for the planning area was cited by the resource specialist. A review of the literature submitted from the public is found in the project record and this appendix.

CR162 Livestock Grazing – Aquatics

Concern: Comments regarding livestock grazing and aquatic resources were received, including

a. Grazing levels are too high with too many permitted head months to achieve desired riparian conditions. Without significant livestock reductions, riparian areas will not move toward desired conditions;

b. Scientific support for successful grazing management in riparian zones on federal lands in the western US is dated and weak;

c. FW-GDL-GRAZ 01 (riparian stubble height range of 4-6"); A minimum of a 6-inch stubble height for herbaceous vegetation within the greenline adjacent to streams should be a standard. The 4-inch stubble height does not provide enough protection of sensitive stream channels to allow for much movement toward desired aquatic conditions. Additionally, a bank disturbance limit should be included as a plan component;

d. The timeline and prioritization of updating the AMPs are critical to supporting this DC;

e. Grazing is mentioned as a stressor under FS control. The DEIS describes how some plan components would mitigate effects, but it does not describe how other plan components that promote grazing would cause adverse effects, and it does not disclose what those effects would be. Table 62 ignores those plan components;

f. No mention is made of aquatic species that are not listed or not species of conservation concern. Include wording to show adaptive management is also used to reduce impacts to native and desirable nonnative fishes; and

g. The scientific literature referenced provides a solid basis for the conservation watershed network as a strategy to conserve native bull and westslope cutthroat trout on the HLC NF. I strongly support the addition of this important element to the Plan.

Response:

a. Stocking rates and changes in livestock management systems would be made at the project level in order to move towards desired conditions on a specific riparian area or at a watershed scale (FW-GRAZ-GDL 04). Adaptive management would be encouraged (FW-GRAZ-GDL 05) to be incorporated into AMPs which would allow range managers to consider a full suite of livestock and range management tools, including reducing stocking rates, in order to meet desired riparian conditions. The plan components for livestock grazing are designed to be programmatic, with AMPs providing specific operational guidance (FSH 1909.12). If monitoring at a site-specific level indicated departure from desired conditions, some adjustments in annual stocking levels or season of use could be made through the annual operating instructions, which outline the strategy of the AMP.

b. Scientific literature for management of riparian areas and wetlands was reviewed, with the most relevant documents to the planning area considered in the analysis for rangeland management and livestock grazing. Many studies have been done from the mid-1990s to the present regarding livestock grazing and riparian management. Literature cited is based on multiple use management objectives that can maintain or improve riparian areas and wetlands, and relevant to the analysis areas vegetation types and resources. See the literature reviewed section in the FEIS and this appendix for specific documents provided by commenters, which the interdisciplinary team reviewed and considered.

c. FW-GRAZ-GDL 01 encourages the use of greenline stubble height measurements on low gradient stream reaches to evaluate movement towards desired riparian conditions. The 4 to 6-inch range for stubble height was based on site variability within the HLC NF, grazing standards listed under existing ESA consultation, and other Forest grazing standards implemented in Region 1 with similar riparian habitats. The range of stubble heights would give the authorized officer the ability to adapt the target up or down based on the improvement needs of a specific riparian area. Other indicators to measure disturbance from livestock grazing could also be implemented if the measures are effective to determine movement or departure from desired riparian conditions. FS-GRAZ-STD 02 states that annual livestock use indicators within inner RMZs shall be set during the AMP planning process at levels that maintain or move towards desired rangeland vegetation, riparian function, and wildlife habitat specific to rangeland sites.

d. The HLC NF is operating under a schedule to revise and update AMPs that is not driven by the Plan. The Rescissions Act of 1995 (Public Law 104-19) Section 504(a) requires each NFS unit to identify all allotments for which NEPA analysis is needed. These allotments must be included in a schedule that sets a due date for the completion of the requisite NEPA analysis. Section 504(a) requires adherence to these established schedules. Since the 1986 Forest Plans were completed, and following the Rescissions Act (1995), 158 allotments out of the HLC NF's 240 allotments have had management plans updated. The remaining 82 allotments require AMP revisions and would follow plan components for livestock grazing. Allotments that have had AMPs revised under the Rescissions Act would still be subject to Plan direction with the Plan direction added to terms and conditions in new term grazing permits or permit modifications.

e. In the FEIS, Table 70 lists plan components which affect terrestrial wildlife species associated with aquatic, wetland, and shrub habitats. Livestock grazing was listed as a stressor under FS control. While grazing can damage native plant communities and riparian areas if managed improperly, plan components direct grazing management to be implemented that would move towards desired resource conditions. FW-WL-GDL-03 is a forestwide guideline that would protect western toad breeding sites from livestock trampling by allowing emergent vegetation to be retained at those sites. Other riparian-dependent species, such as amphibians, birds, and small mammals should also benefit from improved habitat. Please see the effects of plan components in the aquatics, RMZ, vegetation, livestock grazing and wildlife sections in the FEIS.

f. FW-GRAZ-GDL-04 states that adaptive management should be incorporated into AMPs to allow for range improvement and resource protection, while considering both the needs and impacts of domestic livestock and wildlife. Adaptive management practices used in AMPs include a variety of tools to manage livestock in order to move towards desired resource conditions. Adaptive management could also incorporate conservation measures to protect federally listed plants and animal species and species of conservation concern. If one management strategy did not yield movement towards desired conditions in suitable timeframe, other strategies or tools could be incorporated. Adaptive management would allow for the flexibility to manage livestock for improved wildlife and fisheries needs, including fisheries with desirable introduced fish species.

g. Thank you for your comment. The conservation watershed network is intended to identify important areas needed for conservation and/or restoration, to maintain multi-scale connectivity for at-risk fish and aquatic species, and to ensure ecosystem components needed to sustain long-term high-quality water and persistence of species.

CR163 Livestock Grazing – Wildlife

Concern: Commenters had suggestions or requests relating to livestock grazing and wildlife, including asking the FS to:

a. Restore wildlife habitat through noxious weed control and fence removal on vacant allotments;

b. Consider livestock competition for forage and impacts of range infrastructure on migration routes for wildlife species. AUMs/permitted head months should not be decreased if big game populations grow beyond MFWP objectives;

c. Adopt language similar to Greater Yellowstone Ecosystem National Forests Grizzly Bear Amendments for management of grazing allotments and to be more proactive to reduce or eliminate risk of grizzly/livestock conflicts to ensure habitat connectivity;

d. Minimize conflicts with wolves, including plan components;

e. Consider grazing allotment buyouts where conflicts with wildlife arise;

f. Consider using vacant allotments to give permittees options to avoid grizzly-livestock conflicts;

g. The Plan gives no opportunity to increase AUMs and projects a future decline in grazing; and

h. Threatened, endangered, and SCC and their impact to permitted livestock grazing is a concern for permittees. Grazing permittees also own and regulate private lands that are critical to these species; increased restrictions on federal lands will ultimately cause habitat loss on private lands. This is a trend that needs to be addressed and reversed in the Plan.

Response:

a. Range infrastructure that is no longer needed for livestock management would be removed and identified on a site specific, case by case basis. Fence specifications have evolved over the years, and in general have minimal effects on wildlife. If measurable effects are anticipated for a site-specific project, fence specifications may be modified, or operational requirements made. See FW-WL-GDL 07, 08.

b. The Plan sets goals, objectives, and standards for wildlife and livestock grazing. FW-GRAZ-GO-01 encourages coordination with MFWP biologists during AMP development to ensure that habitat and forage needs are being addressed on grazing allotments. Site specific analysis identifies issues and areas of conflict for the decision maker to resolve, which may or may not involve adjustments to permitted grazing levels.

c. The HLC NF is already following direction from the NCDE Grizzly Bear Conservation Strategy to support a recovered grizzly bear population. Standards and guides for livestock grazing are already being implemented in annual operating instructions and included in the terms and conditions of grazing permits. Plan components carry forward these standards and guidelines. Plan components are similar to many of the Greater Yellowstone Ecosystem Grizzly Bear standards and guidelines. This NCDE strategy covers the entire planning area and incorporates management requirements and recommendations to minimize grizzly/human conflicts.

d. Within the planning area, wolves have recovered and perhaps reached the extent of their current range due to social tolerance limitations. A conservation strategy or plan components similar to the NDCE plan is not being considered for gray wolves as part of the Plan.

e. A permit buyout that includes the permanent closing of an allotment would impose restriction on the FS' management prerogatives and cause the FS to relinquish future management options without knowing beforehand what the long-term effects would be on the resources. Financial arrangements made between third parties purporting to determine the status and management of NFS lands will not be acknowledged, sanctioned, or accepted by the FS. Grazing capacity allocations will be determined through the NEPA process, in consideration of rangeland, soil, wildlife, watershed, fisheries, water quality, and other and resource conditions (36 CFR 222.2(c)). If a permittee waives their grazing privileges back to the FS, there can be no guarantee or agreement, whether written or verbal, regarding waived grazing capacity allocation, based upon buyout agreements between permittees, conservation groups, or other outside parties.

f. Vacant allotments are a good management tool to redistribute permitted grazing use to avoid wildlife conflicts, as well as address other resource concerns. Vacant allotments can also be used as a forage reserve to temporarily move permitted livestock from an allotment affected by a natural disaster such as wildfire. The administrative option to authorize grazing use in existing vacant allotments and allotments that may become vacant in the future would be preserved in the Plan. An allotment would only be closed if a site-specific analysis and decision supported that determination.

g. Under the Plan, the HLC NF anticipates permitted AUMs should remain close to current levels with some annual variation due to climatic conditions. Revisions of AMPs may result in adjustments to permitted head months on some allotments. Current vacant grazing allotments would most likely be used as forage reserves for allotments affected by fire, depredation, threatened and endangered species, or riparian management issues. Therefore, it is unlikely that permitted head months would increase under any alternative (FEIS, 3.28.6 environmental consequences).

h. Providing sustainable grazing opportunities while providing for wildlife habitat and forage needs are desired conditions in the Plan (FW-GRAZ-DC 01, FW-GRAZ-DC 02). The HLC NF acknowledges that ESA listed species may have habitats that span across a landscape scale outside the Forest boundary. A collaborative effort involving all landowners is generally needed to provide the greatest conservation benefit in terms of the amount and quality of habitat. The Plan only focuses on NFS lands within the administration of the HLC NF. Management of habitat for ESA listed species on NFS lands is subject to consultation with the USFWS.

CR168 Soil – Grazing/Range

Concern: Commenter had concerns with soil resources and livestock grazing, including lack of soil damage and soil quality standards.

Response: Thank you for your comment. Though grazing monitoring is not applicable under the current Regional soil standards, impacts to the resource from grazing are still addressed through revised AMPs.

CR180 Livestock Grazing – Allowable Use Levels

Concern: Commenters had concerns or suggestions for livestock allowable use requirements, including:

a. The Plan does not prescribe allowable use levels or quantitative standards for livestock grazing, such as INFISH, that would help achieve desired resource conditions for rangeland or riparian areas. Plan standards and guidelines should prescribe quantitative measures in which to guide livestock management on Forest Allotments in both existing and revised AMPs;

b. The Draft Forest Plan does not discuss in sufficient detail reductions in permitted head months and/or reduced numbers of livestock that will be needed to meet desired resource conditions in the planning area;

c. Management of livestock grazing practices and enforcement of grazing standards are not described in the Plan. No standards, guidelines, goals or objectives provide active direction for achieve desired conditions for upland rangeland or riparian areas within grazing allotments;

d. Given the overwhelming evidence that livestock grazing is having a negative impact on riparian and aquatic ecosystems across the planning area, even in areas where INFISH standards have been in place for two decades, the Forest should develop new and more stringent strategies to improve conditions and implement them as soon as possible. The measurable quantitative objectives of INFISH have been replaced by "descriptive desired conditions" that can only be measured qualitatively. There are no measurable and quantitative allowable use limits and only a single numerical guideline remaining for stubble height that does not identify or require the Forest to apply the standard appropriately using key species. There is no required bank alteration threshold, and no changes will be made to any grazing allotment or authorization until site-specific analysis is completed; and

e. What plan components provide active direction for achieving desired conditions in upland rangeland?

Response:

a. Plan components are designed to accommodate a range of site-specific needs of individual areas, wildlife species, allotments, and plant communities. AMPs provide specific operational guidance and are the most appropriate planning level to implement management tools, such as allowable use levels (FSH 1909.12, Chapter 20). Therefore, allowable use levels and allotment compliance standards would be determined and measured on a project by project (AMP by AMP) basis. Plan components state that AMPs shall provide the site-specific management prescriptions, such as grazing rotations, stocking rates, and use indicators, to move toward applicable desired conditions (See FW-GRAZ-STD-01, FW-GRAZ-STD-02, FW-GRAZ-GDL-01, and FW-GRAZ-GDL-02).

b. Monitoring and analysis determine management prescriptions and would provide the basis to adjust permitted livestock numbers if necessary, to move towards desired conditions on an allotment-scale level (See FW-GRAZ-GDL-04). AMPs provide specific operational guidance, which could include changes in permitted head months.

c. Direction for corrective actions regarding compliance with term grazing permits and AMPs is provided in Forest Service Handbook 2209.13. Direction provided by AMPs fall within the sideboards of forest plan components. Compliance with management direction outlined in AMPs and annual operating instructions is determined on an annual basis through allotment inspections.

d. Existing AMPs would still be in place under the Plan, and multiple disturbance indicators, such as allowable forage use and bank alteration found in those AMPs would be retained. Although the 1986 Forest Plans for both the Helena and Lewis and Clark National Forests were more prescriptive with interim grazing standards listed, allowable use levels (AULs) in AMPs were generally developed at a site-specific level. The Plan has more specific direction for desired resource condition, especially in RMZs, and could include additional impact indicators if warranted through monitoring. The Plan would increase the available metrics at our disposal to measure impacts, not exchanging or removing them.

Plan components that affect the terms and conditions of the grazing authorization can be made administratively through modification of the term permit (FSH 2209.13, Chapter 10, Section 11 Grazing permits with Term Status) or as new permits are issued. Implementation of FW-GRAZ-GDL

01, which is the measurement of riparian stubble height, would be one addition to grazing permit terms and conditions and be a new indicator measured through allotment monitoring. This guideline would also encourage alternative use and disturbance indicators and values, including those in current ESA consultation documents, to be used if they are based on current science and monitoring data and meet the purpose of maintaining or improving riparian condition. Development of new AMPs would continue to be the primary mechanism to implement management changes at a site-specific level to move toward desired conditions. See appendix C, Management Approaches, and FSH 2209 for permit and allotment administration for additional information.

e. Monitoring, data analysis, and management prescriptions to move towards desired upland range condition would be part of the AMP revision process. Adaptive management options built into AMPs can also be used to address upland rangeland condition. See FW-GRAZ-STD-01 and FW-GRAZ-GDL-02 and FW-GRAZ-GDL-04.

CR185 Livestock Grazing – Suitability/Capability

Concern: Commenters asked for more information/disclosure about the FS grazing suitability/capability determination process. Concerns included:

- More criteria-based guidance needs to be provided to determine areas that are suitable and capable for livestock grazing. No direction for undertaking a scientifically based suitability determination for livestock grazing is given; and
- The plan determined suitability without results of forest plan monitoring.

Response: The capability and suitability analysis and determination is not a decision to graze livestock on any specific area of land, nor is it a decision about or estimate of livestock grazing capacity. The capability/suitability analysis and determination may or may not provide supporting information for a decision to graze livestock on a specific area.

All grazing allotments contain areas that are capable and/or suitable as well as areas that are modeled as being not capable and/or suitable. Since the evaluation is based on a modeling process and is dealing with a variety of complex landscapes, it is inevitable that this intermingling would occur on a land base of any significant size. Therefore, these capability/suitability determinations are not intended to imply that livestock would be precluded from occasionally being found on lands that may be modeled as noncapable or nonsuitable. Lands modeled as capable but not suitable for grazing would be identified through site-specific analysis of allotments.

Together, the capability and suitability analyses can provide information for both forest plan level analysis as well as project level analysis and subsequent NEPA decisions. At the forest plan level, capability and suitability analysis provides basic information regarding the potential of the land to produce resources and supply goods and services in a sustainable manner, as well as the appropriateness of using that land in a given manner. This information assists the interdisciplinary team and the line officer in evaluating alternatives and arriving as forest landscape level decisions. It also helps in an analysis of alternative uses foregone. At the project level, rangeland capability and suitability may be reviewed, updated, or made more site-specific, if it is an issue for that project or provides information useful to the decisions being made. Monitoring information collected at the site-specific project level would help improve suitability on an allotment by allotment scale.

The requirement to determine rangeland capability and suitability was detailed in the 1982 Planning Rule. The 2012 Planning Rule makes that determination optional rather than required. A GIS exercise was done to establish a base map for capability and suitability analysis. This mapping exercise determined 1,733,332 NFS acres to be capable for cattle grazing and 2,458,980 acres as capable for sheep grazing. Approximately 483,150 acres of NFS lands within the planning area were mapped as suitable for cattle grazing. Mapping and acreage figures would be refined at the project level scale.

CR219 Livestock Grazing – Recommended Wilderness Area/Roadless Areas

Concern: Commenters suggested the following for administrative motorized uses in RWA allocations:

- Commodity uses should not be curtailed in RWAs or roadless areas;
- The Plan should include clear language that a designation of wilderness or recommended wilderness "will not" prevent the maintenance of existing fence or other livestock improvements; and
- Requiring administration of allotments via no-motorized means is not reasonable, efficient, or effective.

Response: Pre-existing uses prior to RWA designation would continue under the Plan. Motorized and mechanized means of transportation may be authorized to conduct permitted activities, such as grazing permit administration. Grazing allotment infrastructure would be required to be maintained whether the allotment is within RWAs or designated wilderness. However, RWAs in the Plan generally overlap with existing IRAs, WSAs, and have few open motorized roads or trails. Therefore, options to use motorized vehicles or equipment are already limited. Clear communication through a written authorization may be needed to document how and when motorized administrative use would occur within RWAs. Each RWA would vary in the need for, and level of administrative motorized use, but all authorizations would have the same intent; to avoid or minimize potential user conflicts.

The additions of RWAs would not change existing travel plans. Rough and steep terrain generally already limits motorized use within RWAs. RWAs should have little, if any, effect on administration of the Forest's range program.

Timber and other forest products

CR227 Firewood

Concern: Commenters had comments about firewood gathering on the Forest.

Response: Various plan component and other editorial suggestions were provided. Changes were made where applicable, please see the applicable sections of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

CR230 Timber – More Logging, Fire/Insect Mitigation

Concern: Commenters had several suggestions/requests regarding logging, including:

a. The FS should do more logging on the landscape, for reasons including economics, fuel reduction and fire risk reduction, reduction of smoke emissions, removal of insect-killed trees, and/or public health and safety;
b. Logging should be done rather than prescribed fire to manage the forest due to smoke and health concerns (and other benefits such as economics and road access/improvements);
c. Alternative E would be the best because of the timber suitability and projected timber volumes;
d. Logging should keep up with growth and mortality;
e. Timber production should take precedence over wilderness consideration;
f. Harvest should occur in roaded areas; however, it should not be done to provide buffers for homes on the forest edge and it is not an effective method to prevent wildfire;
g. Log bug-killed, but not the living trees; and
h. Logging should maintain a healthy and safe forest; reduce fuels; focus on marketable timber, slash removal and site restoration, and removal of dead trees to improve fire suppression opportunities.

Response:

a. Under the action alternatives, timber harvest would be a tool for moving vegetation towards desired conditions while contributing to social and economic sustainability. Timber harvest is an allowed use on the Forest and would be used to move the Forest towards desired conditions, consistent with geographic area, and forestwide plan components. An analysis was completed to determine the sustainable level of timber harvest in response to desired conditions and management requirements. The results are outlined in the timber section of the final EIS. The preferred alternative, F, reflects a timber harvest level that is sustainable and that contributes to desired conditions.

The Forest recognizes that there are many different ideas and opinions concerning how the Forest should be managed and how the multiple uses of the Forest should be applied across the landscape. The EIS considered a range of alternatives that emphasized different multiple uses, such as one that included more recommended wilderness areas (alternative D) and one that included more lands that are suitable for higher levels of timber production (alternative E). All alternatives recognized that vegetation management, including timber harvest, is an important tool to help achieve the desired conditions in the Plan, including ecological (i.e., wildlife habitat, forest resilience) and social and economic (i.e., providing wood products and employment). The responsible official considers all points of view in making his or her decision, with the intent of providing for an assortment of multiple uses.

The Plan recognizes the importance of wood products and timber harvest in reducing fire hazard and improving forest health. See the timber desired condition FW-TIM-DC-02 in the Plan.

b. Site-specific project development would determine how best to move the forest towards desired conditions and would include smoke emissions as a consideration as well the land allocations identified in the Plan and all resource and social/economic benefits. It is not the role of the Plan to prioritize logging activities over prescribed fire programmatically.

c. Alternative E was not selected as the preferred alternative. However, preferred alternative F includes harvest levels that are less than alternative E, but greater than A, B, C, and D, and provides for a balance of lands suitable for timber production.

d. Other resource considerations preclude the ability of the FS to harvest at levels that match growth and mortality; see the timber section of the final EIS for additional discussion.

e. Alternative E represents the alternative where timber opportunities took priority over recommended wilderness allocations. The preferred alternative F includes some recommended wilderness but less than alternatives B/C and D.

f. The Plan does not determine site-specifically where harvest may occur, but does allow for harvest in many areas, depending on site specific project development and analysis. Mitigating fire risk to private property would be permissible as a project purpose and need, and the types of treatment appropriate to achieve those objectives would be determined based on site-specific analysis.

g. Thank you for your comment; however, to meet multiple use objectives, all alternatives allow for the cutting of live trees when consistent with plan components.

h. The Plan allows for harvest to be used to achieve a variety of resource objectives on both lands suitable and unsuitable for timber production, as described in the benefits to people - timber section of the Plan.

CR231 Timber – Roads and Infrastructure

Concern: Several comments were received regarding timber management and roads/infrastructure, including:

a. Timber industry and infrastructure is important to help achieve forest management goals;
b. An active logging program is needed to maintain timber industry and infrastructure, including roads. Logging projects are important for maintaining and improving the road system;
c. The potential loss of timber infrastructure and the impacts to achieving desired conditions should be evaluated in the analysis; and

d. If road building can be done in a sustainable manner, it should be done to support forest management.

Response:

a. The importance of wood products and timber harvest in providing timber, jobs, and income to local economies is recognized (FW-TIM-DC-03, 04; FW-TIM-GO-01). An analysis was completed to determine the sustainable level of timber harvest in response to desired conditions and management requirements. The results are outlined in the FEIS and Plan as the projected timber sale quantity and the projected wood sale quantity. The projected timber sale quantity is the amount of sawtimber that meets utilization standards, whereas the projected wood sale quantity includes all forest products, including posts and poles. Refer to the timber section of the Plan for the objectives for projected timber sale quantity, projected wood sale quantity, and other direction associated with the production of timber outputs. Sale of stumpage would continue to contribute to the viability of the forest products infrastructure. The social and economic environment section of the final EIS highlights the importance of forest outputs on local economies and communities within the analysis area.

   The preferred alternative (F) reflects the desire for a timber harvest level that provides local jobs and income and generates products for local mills and other forest products businesses to improve forest health within organizational capacity and reasonably foreseeable budgets and while protecting wildlife and other resource values.

b. All alternatives provide for harvest levels that would contribute to maintaining logging industry and infrastructure.

c. Analysis has been added to the timber section of the FEIS addressing the potential losses of timber infrastructure and ramifications to the vegetation desired conditions.

d. The Plan allows for road building and maintenance to support forest management in appropriate land allocations.

CR232 Timber – Salvage and Sanitation

Concern: Commenters provided input about salvage and sanitation harvest practices, including:

a. Concerns regarding the definitions, analysis, and potential application of salvage and sanitation harvest practices;

b. Request for additional components that require salvage to occur in a timely manner to best recover economic value;

c. Requests for additional limitations on salvage logging, including limiting cutting areas to 40 acres or less, with buffers, and retaining some standing dead trees for wildlife habitat considerations. It should only be conducted if it causes minimal disturbance (specific concern about roads);

d. Comments on purpose and exceptions allowed for salvage logging; and

e. Requests for more effects analysis and use of the best available scientific information.

Response:

a. The Plan allows for salvage and sanitation harvest activities, in a manner consistent with the NFMA, the 2012 Planning Rule, and associated directives (FSH 1909.12 chap 60). Salvage and sanitation harvest on the Forest are expected to occur in the future, but since these are opportunistic types of harvest, their location and amount cannot be determined with any certainty. Please see the timber section of the Plan and FEIS as well as the glossary.

b. Plan components are in place that allow for the use of salvage harvest on both lands that are suitable and unsuitable for timber production. It is not appropriate for plan components to compel action.

c. The standards that limit timber harvest activities in the Timber section of the Plan would apply to any type of harvest activity, such as salvage in burned forests or treatments in "green" stands. Salvage logging would follow all Plan direction as well as other law, regulation and policy, including the NFMA and the 2012 Planning Rule and directives.

d. The Plan reflects the direction in the NFMA and the 2012 Planning Rule regarding salvage and sanitation harvest and allows this activity to occur on lands suited for timber production as well as some of the lands not suited for timber production.

e. The timber section of the final EIS discusses the effects of salvage logging in more detail and includes additional BASI. Additional analysis would occur at the project level prior to salvage treatments occurring, and that analysis would incorporate the best available scientific information relevant to the project and site conditions.

CR233 Timber – Openings

Concern: Commenters expressed concern or suggestions related to plan components providing for the maximum size of even-aged regeneration harvest openings.

Response: The limitations and exceptions provided for even-aged regeneration harvest are consistent with direction found in the NFMA, 2012 Planning Rule and associated (Forest Service Handbook 1909.12 chap. 60 sec. 64.1). Northern Region Supplement 2400-2016-1 of the Forest Service Manual 2470-Silvicultural Practices was recently approved (Nov. 21, 2016), and it incorporates the direction of the 2012 Planning Rule for harvest opening size and requirements for public review, which are reflected in standards FW-TIM-STD-08, 09, and 10 in the Plan. The maximum harvest opening size in the standard is based upon an analysis of the NRV in openings created by stand-replacement fire. The NRV analysis is documented in appendix I, and the development of the plan component is documented in appendix H of the final EIS.

CR234 Timber – Harvest Not Beneficial/Desired

Concern: Some commenters had concerns about timber harvest, including the ideas that:

a. Timber harvest is not desirable or appropriate on the landscape;

b. Logging does not prevent future forest fires, due to the slash left behind; and

c. Logging should be minimal due to climate change and protecting clean water sources. Forests should be protected from corporate logging.

Response:

a. Under all alternatives, in accordance with law, regulation, and policy, timber harvest would be an allowable tool to contribute to social and economic sustainability. Timber harvest would be used to move the Forest towards desired conditions, consistent with geographic area and forestwide plan components. An analysis was completed to determine the sustainable level of timber harvest in response to desired conditions and management requirements. The results are outlined in the timber section of the final EIS. The preferred alternative, F, reflects a timber harvest level that would be sustainable and contribute to desired conditions.

The Forest recognizes that there are many different ideas and opinions concerning how the Forest should be managed and how the multiple uses of the Forest should be applied across the landscape. The EIS considered a broad range of alternatives that emphasized different multiple uses, such as one that included more backcountry and recommended wilderness areas (alternative D) and one that included more lands that are suitable for higher levels of timber production (alternative E). All alternatives recognized that vegetation management, including timber harvest, is an important tool to help achieve the desired conditions in the Plan, including ecological (i.e., wildlife habitat, forest resilience) and social and economic (i.e., providing wood products and employment). The responsible official considers all points of view in making his or her decision, with the intent of providing for an assortment of multiple uses.

b. The effects of timber harvest on fire risk depends on how logging is conducted and follow-up treatments including prescribed fire. Harvest using whole tree yarding techniques followed by prescribed burning generally results in removal of much of the slash and reduces fire risk. See the Fire and Fuels section of the final EIS for additional discussion.

c. Prior to conducting logging activities, site specific project development and analysis would incorporate all relevant plan components, including those related to the protection of resources such as clean water and carbon sequestration. Plan components and EIS analysis included the influence of a changing climate.

CR235 Timber – Suitability

Concern: Commenters had various recommendations and requests regarding suitability for timber production.

Response: The identification of lands as suitable for timber production, and plan components that allow for harvest on lands unsuitable for timber production, are consistent with the NFMA, 2012 Planning Rule and associated directives (Forest Service Handbook 1909.12 chap. 60 sec. 61). Appendix H provides a discussion of how lands were determined to be suitable for timber production, and the timber section of the FEIS addresses this in more detail with respect to land allocations such as conservation watersheds, municipal watersheds, IRAs, the Elkhorns WMU, CMA, and developed recreation sites. The Plan allows for harvest on lands unsuitable for timber production based on the direction found in (Forest Service Handbook 1909.12, Chapter 60, section 63). The Plan and FEIS provide full disclosure on the harvest activities that may occur in lands unsuitable for timber production.

CR236 Timber – Volume Projections, Modeling, and Metrics

Concern: Multiple comments were received regarding timber modeling and timber projections, including:

a. The timber modeling was not done appropriately, and new analysis must be done to display and/or clarify volume projections and harvest levels;

b. The project volume metrics (sustained yield limit, projected timber sale quantity, and projected wood sale quantity) do not include potential salvage harvesting; how would these activities affect long-term soil productivity, and how will lands unsuitable for timber production where salvage occurs provide ecosystem services;

c. There is a contradiction in the assumption that site-specific factors wouldn't materially affect timber yield (assumptions, 3.29.3), when the DEIS also states that site-specific data at the project scale would result in changes to timber suitability and volume outputs (3.29.4);

d. The DEIS should have taken into account the effects of the 2017 fires on timber volumes;

e. It is unclear how wildlife plan components would limit harvest, and yet at the same time not alter expected outputs. Appendix H should better describe how various plan components were factored into timber projections; and specify the magnitude of the effects of those plan components;

f. The EIS must discuss how timber projections were affected by the recent mountain pine beetle outbreak;

g. The role of future wildfire, insects, and disease in determining expected timber yields must be explained; and the modeling for alternatives should be tied to what plan components actually say about future fire suppression;

h. Timber volume projections are overestimated, based on the loss of a proportion of the former timber base to inventoried roadless area designation. The conclusion that potential volumes are higher than what has been produced in recent decades is unsupported;

i. Clarify what factors are not under FS control that are not included in the modeled metrics;

j. The way that the sustained yield limit is calculated is not in compliance with NFMA; it is not based on lands suitable for timber production and does not include a requirement for non-declining even flow as required. It is likely too high;

k. The analysis should address harvest from lands suitable for timber production separately from harvest on lands unsuitable for timber production, because harvest on the former is subject to a non-declining even flow criteria, and harvest on the latter would be more uncertain;

l. Clarify the discussion regarding departure from the sustained yield limit versus a departure from non-declining even flow with respect to NFMA. All of the alternatives depart from non-declining even flow because second decade harvest levels are larger than first decade harvest levels. The FS must disclose why this departure is made; and provide an alternative that does not have this departure;

m. Terminology and interpretation of timber volume may not be changed across alternatives; this is a NFMA violation; the action alternatives are incorrectly formulated and must be made comparable to alternative A;

n. The harvest level assumptions in the modeling related to ROS settings must be disclosed and explained;

o. The Plan should allow for timber volumes up to the sustained yield limit, and should not be constrained by budget, because of the potential for partners to increase harvest capacity on the HLC NF;

p. Adjustments should be made to reduce projected harvest in lands unsuitable for timber production; and

q. Effects of timber harvest on specific areas such as conservation watersheds, municipal watersheds; habitat for grizzly bear, lynx, and elk; and wildlife connectivity areas should be included in the timber modeling and reported in the EIS.

Response:

a. The analysis reflects the direction found in the NFMA, the 2012 Planning Rule, and associated directives (Forest Service Handbook 1909.12, Chapter 60).

b. As per FSH 1909.12 Chapter 60, salvage harvest is not included in the sustained yield limit, protected timber sale or wood sale quantities. Additional discussion was added to the timber section of the FEIS to describe potential salvage activities and their effects. Potential salvage projects would be subject to all relevant plan components.

c. Additional text was added in the timber section of the FEIS to clarify these statements.

d. In the analysis for the FEIS, all fire and harvest activity that has occurred through summer 2018 was incorporated.

e. Plan components that could be measured/mapped and that would have an impact on timber outputs were included in the modeling. The effects related to model components are described in the sensitivity analysis in appendix H and the timber section of the FEIS. Other considerations for wildlife plan components would be factored in during site-specific project design and are not expected to alter timber estimates at the broad scale.

f. The effects of the recent mountain pine beetle outbreak are incorporated into the projected timber outputs.

g. Future wildfire and insect outbreaks are reflected in projected timber yields because the expected levels of these disturbances and resulting vegetation conditions are incorporated into the model. The results of fire suppression are represented in the SIMPPLLE model as well. Additional description was added to appendix H and the timber section of the FEIS.

h. The timber modeling reflects potential harvest volumes on the HLC NF based on the most current available data and modeling tools, and incorporates the limitations placed on harvest by IRA designations. Additional clarification was provided in the timber section of the FEIS.

i. The FEIS discussion was clarified; these include factors such as litigation processes, conditions on adjacent private lands, and USFWS direction.

j. The sustained yield limit is calculated per the method described in FSH 1909.12, Chapter 60, Section 64.31, as described in the timber section of the FEIS and appendix H, in a manner consistent with the law and policy. Anticipated sale volume is reflected in the projected timber sale quantity and projected wood sale quantity described in FW-TIM-OBJ-01 and 02, which are considerably lower than the sustained yield limit. Even with an unlimited budget, the anticipated sale volume that could be achieved while still complying with constraints on timber harvest in the Plan is lower than the sustained yield limit.

k. Appendix C of the Plan and the timber section of the FEIS disclose the projected timber volume outputs from lands suitable for timber production, versus lands that are unsuitable. The total timber volume was modeled with a non-declining even flow criterion, although not required by the directives.

l. The FEIS contains clarifying discussion. The 2012 Planning Rule and the directives indicate that a plan may provide for departures from the sustained yield limit as provided by the NFMA when departure would be consistent with the plan's desired conditions and objectives. However, the Plan's projected timber and wood sale quantities are not departed from the sustained yield limit. There is no requirement in the NFMA for a non-declining even flow of timber. Timber volumes may change from decade to decade as long harvest levels are consistent with management for all multiple uses and do not exceed the capability of the land to sustainably produce timber.

m. The metrics as defined in the 1982 Planning Rule would not apply to the Plan action alternatives. The allowable sale quantity and long term sustained yield metrics from the 1986 Forest Plans are disclosed when discussing alternative A. All alternatives are compared using the metrics required in the FSH 1909.12, in a consistent manner to ensure a proper comparison.

n. The timber model includes calibrations for harvest limitations based on ROS classes. Description was added to the timber section of the FEIS and appendix H to clarify.

o. It is possible that harvest could exceed the projected timber and wood sale quantities, so long as it remains below the sustained yield limit. Footnotes were added to FW-TIM-OBJ-01 and 02 that reflect the volumes that could be achieved with unlimited budgets while still consistent with all plan components and resource constraints. No alternative (with or without a budget constraint) results in volume levels that are the same as the sustained yield limit because sustained yield limit includes what could be produced on all lands that may be suitable for timber production, without considering other multiple uses (FSH 1909.12, 64.31). Projected timber and wood sale quantities are based on the lands determined to be suitable for timber production in each alternative, which is a subset of the lands that may be suitable for which sustained yield limit is calculated.

p. As described in appendix H, the PRISM model was formulated to restrict harvest on unsuitable lands to reflect the differences in management emphasis on those lands.

q. Timber harvest constraints for wildlife species other than lynx were not included in the timber modeling. Potential lynx habitat and grizzly bear habitat were included in the modeling, and therefore summaries of the projected harvest activity can be reported. Analysis was added to the timber and wildlife sections of the FEIS with this information. In addition, the lands suitable for timber production can be compared to municipal watersheds and conservation watersheds; this information was added to the FEIS. However, it is not appropriate to apply projected harvest acres or timber volumes to smaller delineations such as conservation watersheds, municipal watersheds, or wildlife connectivity areas because it is not possible to know site-specifically where harvest activities may occur, and it would be highly speculative to do so. Rather, the effects to these areas are described qualitatively in the FEIS. There are plan components in place that would guide potential harvest in these areas in a manner consistent with the other resource desired conditions.

CR239 Timber – Riparian Management Zones

Concern: Commenters asked the FS to analyze the magnitude of potential activities that may occur in RMZs as a function of meeting vegetation desired conditions. Please describe the vegetation existing and desired conditions within RMZs.

Response: The PRISM model was calibrated to reflect potential harvest levels across the landscape. RMZs are grouped with certain ROS classes to represent a "low or very low" potential harvest management emphasis area. The timber section of the FEIS added verbiage to describe the projected levels of harvest in these areas, although they are not exclusively RMZs. Plan components are in place that would ensure that harvest conducted in RMZs would be done to achieve resource desired conditions and not preclude the desired aquatic conditions (see FW-RMZ section).

The existing condition within RMZs could be estimated by overlaying RMZ boundaries with R1-VMap; however, this would not add value to the analysis because of the wide range of conditions that occur, which would be "washed out" by averaging the conditions across all RMZs. Further, it would not be possible to correlate these appropriately to the forestwide or GA-based vegetation desired conditions. For example, RMZs are linear features and would likely contain more species such as aspen and Engelmann spruce than the broader landscape. The desired conditions for these species at the broader scale would not reflect the appropriate conditions specifically within RMZs. Due to the scale of available data sources and modeling, it is not possible to quantify with accuracy the appropriate desired conditions within RMZs, as is done for vegetation at the broader scale. The existing and desired conditions within RMZs are more appropriately addressed site-specifically at the project level.

CR241 Timber – Effects of Future Harvest

Concern: Requests for clarification on the effects of future timber harvest were received, including:

a. The Plan should determine and control limits of harvest within drainages;

b. There should be an analysis of the actual areas likely to be disturbed by timber harvest, based on future projections;

c. The management strategies in appendix C of the Draft Forest Plan should not be included as assumptions in the effects analysis; and

d. Clarify the effects of timber harvest versus the effects on timber harvest.

Response:

a. The timber modeling does include constraints for the level of harvest that can occur in an individual drainage, as described in appendix H; this ensures that the model projected harvest appropriately distributed across the HLC NF and not concentrated in a few drainages. However, this constraint does not necessarily provide for all of the watershed considerations that would be taken into account at the project scale. It is not possible with a programmatic analysis to establish harvest limits for all of the individual watersheds on the HLC NF. The RMZ plan components would be used at the project scale to constrain any harvest activities that may be planned within the RMZs of individual drainages and watersheds.

b. The analysis for forest planning is programmatic in nature. It is not possible to site-specifically disclose the exact location, type, and timing of potential timber harvest projects, except in the broad land classifications described in appendix H. Within the broad land classifications, constraints on harvest are used to represent plan components. The effects of the expected levels of timber harvest are disclosed programmatically throughout the FEIS.

c. The FEIS no longer includes the management strategies in appendix C of the Plan as assumptions for the analysis; this was an error in the DEIS and Draft Forest Plan that has been corrected.

d. The timber section of the FEIS contains sections that disclose the effects of plan components for other resources on potential harvest activities, as well as describing the effects of timber harvest. Other resource sections throughout the FEIS disclose the effects of timber harvest on each resource.

CR242 Timber – Budget and Alternatives

Concern: Commenter asked for additional analysis and explanation of the role of budget in timber projections and how it influences the effects and comparison of alternatives.

Response: The timber modeling included two scenarios related to budget: one in which the budget was constrained at reasonably foreseeable levels, and one where there was no budget constraint. As shown in appendix H, the sensitivity analysis on the timber model concluded that budget was one of the most influential constraints on the model results. The timber section of the FEIS discloses the potential harvest levels and effects of both budget scenarios. The 2012 Planning Rule and directives require that plan components reflect a reasonably foreseeable budget level; therefore, for the timber objectives (FW-TIM-OBJ-01 and 02), the projected timber and wood sale quantities reflect the budget-constrained runs. However, it is possible to exceed objectives; for this reason, a footnote to those objectives provides the estimated timber volumes that could be possible with unlimited budget that are also consistent with all other plan components and resource constraints.

CR257 Timber – Law and Policy, Practices

Concern: Commenters had concerns/suggestions regarding Timber Law, policies and practices, including:

a. Regulations for logging should be relaxed;

b. Sustainable harvest is acceptable, but no cutting of old growth trees and no clearcutting should occur; and

c. Logging operations should consider wildlife activity.

Response:

a. The plan components found in all alternatives adhere to current law, regulation, and policy regarding timber harvest on NFS lands. Alternative E was developed with the intent of being as permissible to timber harvest as possible. The preferred alternative (F) includes less projected harvest than alternative E, but more than the other alternatives. Most of the constraints in the timber section of the Plan are based on laws such as the NFMA; changes to these requirements are outside the scope of forest plan revision. Other constraints are applied based on multiple use objectives for other resources.

b. Plan components are in place to ensure that harvest is conducted in a sustainable manner, as required by NFMA. With some exceptions, old growth stands would be maintained and promoted under all alternatives (FW-VEGF-DC-05 and FW-VEGF-GDL-04). Clearcutting is a silvicultural tool for vegetation management. Clearcutting would be allowed on the Forest only where it is determined to be the method most appropriate to meet the purpose and need of the project (FW-TIM-STD-04). Forest plan direction recognizes the important role that large live trees have in the ecosystem, and a guideline addresses retention of larger-diameter leave trees within harvest units (FW-VEGF-GDL-01). The clearcut harvest method would not be allowed within riparian management zones (FW-RMZ-GDL-11).

c. Prior to conducting any logging activity, projects would consider all plan components including those for wildlife species such as lynx, grizzly bear, and wolverine. During implementation, all prescribed design elements and mitigation measures determined to be necessary to be consistent with these plan components would be followed.

CR258 Timber – Editorial

Concern: Various GA plan component and other editorial suggestions were provided.

Response: Changes were made where applicable, please see the Timber section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

Geology, minerals, and energy

CR17 Minerals and Geology

Concern: Commenters had numerous questions/concerns about mining and minerals, including:

a. Requests for additional mapping or information about mining areas in RWAs;

b. Mining should not be allowed in WSAs;

c. Questions about mining policy in the Forest Plan;

d. Suggestions for additional or other edits to plan components;

e. Suggestions for updates/edits to the FEIS;

f. Questions on public involvement of mineral claimants;

g. Comments/request for more regarding mine cleanup and water quality including bonding and reclamation requirements; and

h. Request for restriction on mining/exploration activities.

Response:

a. The existence of certain minerals is not a criteria for analyzing areas for recommended wilderness purposes. RWAs are not compatible with leasable or salable minerals as the disposal of these minerals is discretionary. Locatable mineral prospecting, exploration, and development is allowable in RWAs as these areas are open to mineral entry until they are congressionally declared wilderness areas.

b. WSAs are not compatible with leasable or salable minerals as the disposal of these minerals is discretionary. Locatable mineral prospecting, exploration, and development is allowable as WSA's are open to mineral entry until these areas are congressionally declared wilderness areas.

c. Please see the Regulatory Framework Section (Chapter 3.30.2) of the FEIS for a discussion of mining policy, regulations, and laws.

d. Various GA plan component and other editorial suggestions were provided. Changes were made where applicable, please see the GA section of the Plan. Where not changed per the comment, the Forest determined that the retained plan components were sufficient to meet our obligations under the 2012 Planning Rule.

e. Please see the Geology, Energy and Minerals section of the FEIS for updates. Where not changed per the comment, the Forest determined that the analysis was sufficient to meet our obligations under the 2012 Planning Rule.

f. As members of the public, minerals claimants had the same opportunities for participation. Please see the Public Involvement Section (Chapter 2.3) of the FEIS that describes the multitude of ways and opportunities to reach out and solicit public participation throughout the planning process.

g. 36 CFR 228 Subpart A is the FS mining regulations for locatable minerals whose purpose is to set forth rules and procedures through which use of the surface of NFS lands in connection with operations authorized by the United States mining laws (30 USC 21-54), which confer a statutory right to enter upon the public lands to search for minerals, shall be conducted so as to minimize adverse environmental impacts on NFS surface resources. Included in these regulations are requirements and procedures for reclamation and bonding.

h. Thank you for the comment. NFS lands on the HLC NF are open for mineral prospecting, exploration, and development unless they are withdrawn from mineral entry.

CR122 Cave and Karst

Concern: Commenters had concerns regarding cave and karst resources on the Forest, including:

a. Concern with White Nose Syndrome and bats and continuing the coordination with interested public and the MT Natural Heritage Program; and

b. Request to have the same protections for cave and Karst in the Plan that were in the 1986 Lewis & Clark Forest Plan.

Response:

a. Please see FW-WL-GO-07.

b. Please see the Federal Cave Resources Protection Act of 1988. This law provides for protection and preservation of caves on Federal Lands. This law is applicable but does not need to be repeated in the Plan.

CR175 Elkhorns – No Oil/Gas Leasing

Concern: Commenters had three separate concerns regarding oil/gas leasing that included:

a. Oil and gas drilling should not occur in the Elkhorns Wildlife Management Unit;

b. This area should be withdrawn from mineral entry; and

c. Road construction limitations and reclamation practices are required for any mining activities.

Response:

a. An oil and gas leasing decision will not be included in the Plan. It is a separate decision and beyond the scope of this analysis. An Oil and Gas Environmental Impact Statement and Record of Decision was released in 1998 for the Helena National Forest and for the Elkhorn Mountains Portion of the Deerlodge National Forest. In 1998 the Helena National Forest Supervisor made the Elkhorn Wildlife Management Unit unavailable for oil and gas leasing. This decision is still in place and the Elkhorns Wildlife Management Unit is still discretionarily unavailable for federal oil and gas leasing.

b. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal for the Elkhorn Wildlife Management Unit area is beyond the scope of this analysis and will not be included in the Plan.

c. 3. 36 CFR 228 Subpart A are the US FS mining regulations for locatable minerals whose purpose is to set forth rules and procedures through which use of the surface of NFS lands in connection with operations authorized by the United States mining laws (30 USC 21-54), which confer a statutory right to enter upon the public lands to search for minerals, shall be conducted so as to minimize adverse environmental impacts on NFS surface resources. Included in these regulations are requirements and procedures for reclamation and bonding.

CR197 Oil and Gas Leasing

Concern: Several comments were received that requested the Plan to specify that there would be no new oil and gas leasing on the forest. Additionally, a request for a mineral withdrawal within the Ten Mile Municipal Watershed was received.

Response: An oil and gas leasing decision is not included in this forest plan revision process. It is a separate decision and beyond the scope of this analysis. An Oil and Gas Environmental Impact Statement and Record of Decision (ROD) was released in 1998 for the Helena National Forest and for the Elkhorn Mountains Portion of the Deerlodge National Forest. An Oil and Gas Environmental Impact Statement and Record of Decision was released in 1997 for the Lewis and Clark National Forest. Both of these decisions are still in place for the HLC NF but may be changed by subsequent new laws and legislation.

A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal for the Ten Mile Municipal Watershed is beyond the scope of this analysis and would not be included in the Plan.

The 1998 ROD for the Helena National Forest referenced above makes the Ten Mile Municipal Watershed legally unavailable for oil and gas leasing.

CR198 Smith River - Mineral Withdrawal

Concern: Several requests for a mineral withdrawal specific to the Smith River watershed were received.

Response: A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and would not be included in the Plan.

Carbon and climate

CR47 Climate Change comment Attachments

Concern: Attachments for CR48.

Response: See responses for CR48 related to the themes of the attachments.

Each attachment is reviewed and documented in the response to literature table/spreadsheet.

CR48 Carbon Climate – Vegetation and General

Concern: Many comments were received regarding carbon and climate and vegetation, including:

a. The Draft Forest Plan and analysis do not adequately take into account the impacts of climate change. The analysis did not include many relevant literature citations important to the topics of climate change, carbon sequestration, and greenhouse gas emissions related to land management activities.

b. The Plan and analysis do not adequately disclose the risk of large-scale forest die-back or ecosystem shifts that may occur due to drought, climate change, and/or megadisturbances.

1. The analysis should further address the risk of limited regeneration potential and reforestation failure; emphasize that monitoring of regeneration will be crucial; and address the potential loss of resilience.
2. The analysis should further address the risk of growth loss and mortality linked to tree size.
3. The DEIS has no scientific basis that treatments will result in sustainable vegetation with climate change. What management strategies could create conditions that are resilient/resistant to disturbances that may be amplified by climate change - irrigation?
4. Please cite the following from Halofsky et al Chapter 5: ""Increasing air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree, shrub, and grass species throughout the Northern Rockies, with drought tolerant species becoming more competitive."

c. The Draft Forest Plan and analysis do not adequately provide for ecological integrity in the context of climate change:

1. The analyses do not adequately consider the risk of departure from the NRV due to climate change and mega disturbances using BASI; potential effects such as novel ecosystems should be disclosed.

2. The desired vegetation conditions are not appropriate or may not be attainable; NRV is not a valid metric to use due to changes/uncertainty in future climate conditions.
3. The Forest needs to conduct alternate scenario planning and consider desired conditions ("plan B") not within NRV. Robust scenario planning should be discussed in the Timber and Carbon sections.
4. The analysis does not sufficiently disclose climate scenarios and effects. Please add figure 2 from Millar and Stephenson (2015); and Northern Rockies Adaptation Partnership Report box 3.4 and 3.5.

d. The analysis does not adequately analyze carbon sequestration.

1. The analysis doesn't consider the potential for soils to shift to a carbon source and downplays the importance of forests in sequestering carbon in that context.
2. The analysis doesn't consider that the capacity of forests to sequester carbon is decreasing.
3. The FS has not modeled the carbon flux over time for all proposed stand management scenarios for each of the forest types on the HLCNF.

e. The Draft Forest Plan and analysis do not adequately predict and respond to potential species distribution changes due to climate change.

1. The analysis should include probable species distribution projections for tree species. Please add figure 5 from Rocky Mountain Forests at Risk.
2. Allow for the introduction of species that currently do not occur on the HLC NF but are likely to be resilient to drought and climate change, such as bur oak.
3. Assisted migration actions should be included in the Plan.
4. A triage approach to conserving species should be considered and discussed. The analysis needs to identify what is "savable".

f. The analysis needs to discuss the positive feedbacks of climate change.

g. The allowable harvest should be adjusted downward to account for climate change.

h. The EIS should disclose the amount of carbon dioxide and other greenhouse gas emissions such as methane and nitrous oxide created by Plan implementation (such as from logging, livestock grazing, recreational motor vehicles). A cumulative emissions analysis should be done taking into account activities on non-NFS lands and other national forests. Global warming and its consequences may be irreversible, which implicates legal consequences under the NEPA, the NFMA, and the ESA which must be disclosed.

i. The DEIS fails to provide any detailed description of what "warm and dry" means in terms of the climate assumptions used in modeling.

j. The FS misinterprets or ignores best available scientific information on the topics of carbon sequestration and climate change. The FS must undertake the peer review process the agency designed (Guldin et al., 2003).

k. Forest policies must shift away from logging because publicly owned forests should be managed to maintain and increase carbon storage. The impacts to carbon from logging is not adequately analyzed.

1. All old-growth, other forests, and grasslands must be protected and expanded for their carbon storage value. Forests that have been logged should allowed to revert to old-growth condition. National forest should not be considered "suitable" for activities that contribute to climate change.
2. Future regrowth cannot make up for the effects of logging, because carbon storage will lag behind for decades or centuries. In addition, forest recovery (regeneration) is no longer a given.

3. Thinning to reduce potential carbon losses due to wildfire is in conflict with carbon sequestration, and would result in a net emission of CO2 because the amount of carbon removed to change fire behavior is often larger than that saved by changing fire behavior, and more area has to be harvested than will ultimately burn over the period of effectiveness of the treatment. The analysis needs to acknowledge that even intense fires emit only a fraction of the carbon emitted by fossil fuels.
4. The analysis should consider science that describes the adverse impacts that land management practices have on carbon sequestration. The analysis should acknowledge that removing trees and other biomass is a net source of atmospheric CO2; and disclose that when wood losses and fossil fuels for processing and transportation are accounted for, carbon emissions can exceed carbon stored in wood products. Clarification is needed as to how harvesting and regenerating forests can result in net carbon sequestration. Carbon emissions from soil due to logging are significant, yet under-reported.
5. The potential to create warmer conditions through forest removal must be considered.

l. Cattle grazing produces greenhouse gas emissions and reduces soil carbon; this should be analyzed/disclosed; and this use should be minimized or discontinued.

m. The FS provided the public with an unreasonably optimistic outlook on forest persistence; it does not adequately address the economic risk related to our ability to grow and harvest economically important conifers.

n. The FS should maintain vegetation types that will become less tolerant of warm conditions.

1. Mixed mesic conifer and spruce/fir are important given climate change; why is the DC to reduce this?
2. Given climate change, Douglas-fir will be reduced; it is very important for habitat so why do the DCs call for reducing this component?

o. There is concern for funding necessary monitoring, especially related to climate change; please leverage partnerships and citizens in this effort.

p. Drought monitoring tools such as the landscape evaporative response index should be used to provide early warning of droughts.

q. The FS needs to increase its own efficiency of fossil fuel use, use of solar and wind, and carbon sequestration practices.

r. Climate change and carbon sequestration considerations are important for maintaining water quality and quantity; please include the Upper Missouri River Basin Climate Impacts Assessment in the process to address issues of drought, early runoff, and warming temperatures.

s. Commenters asked the FS to build climate change adaptations into the Plan, especially for vegetation and wildlife habitat.

Response:

a. The Plan and FEIS have taken into account the potential impacts of climate change to the degree that programmatic plan components and management approaches can or should incorporate concepts related to the issue. Vegetation and wildlife plan components in the Plan address future uncertainties by focusing on the development of landscapes and forests that are resilient and resistant to disturbances and drought. Vegetation modeling incorporated future climate scenarios. Appendix C of the Plan and appendix J of the FEIS provides a summary of possible management approaches and climate change adaptation strategies supported by the Plan.

b. These risks are incorporated into the analysis.

1. The terrestrial vegetation section of the FEIS contains information related to the risks of forest die-back, regeneration failures, and loss of resilience, using many of the references suggested. Reforestation success is included in the monitoring plan (Plan appendix B).

Several plan components help ensure reforestation can be assured (FW-VEGT-GDL-02, FW-VEGT-GDL-03, and FW-TIM-STD-02). Regeneration potential was taken into account when identifying the lands suitable for timber production (appendix H); and incorporated in the vegetation modeling.

2. The Plan calls for managing an array of size classes. While medium-sized trees may be impacted less by drought, it would be inappropriate to adjust the desired abundance of this size class, due to the ecological importance of all classes. The studies provided were not conducted on sites similar to the HLC NF.
3. The Plan includes plan components related to promoting resilience (including but not limited to FW-VEGT-DC-01, FW-VEGF-GDL-01, FW-TIM-DC-02, FW-TIM-GDL-01, and FW-TIM-GDL-02). The FS does not propose to change moisture regimes through actions such as irrigation. Rather, strategies that could create resilient conditions include thinning to lower tree densities so that there is more water available to remaining trees, and creating stand conditions less susceptible to insects, disease, and stand replacing fire behavior. Management activities can also favor species that are more tolerant of drought and wildfire events which can provide seed post-disturbance. These actions are described in the terrestrial vegetation section of the FEIS.
4. The citation has been incorporated into the terrestrial vegetation section of the FEIS.

c. The Plan and analysis follow the 2012 Planning Rule and directives relative to ecological integrity.

1. The Deciding Official recognizes that there are uncertainties associated with future conditions. Discussion is provided in the terrestrial vegetation section of the FEIS regarding NRV, megadisturbances, and potential departures, using some of the literature submitted. The wildlife analysis is based on the terrestrial vegetation analysis. Appendix I and H describe the NRV analysis.
2. The potential effects of climate change, and associated levels of uncertainty, were integral in the development of desired conditions and the effects analysis. Appendix H includes explanation concerning NRV as a basis for desired future conditions; and documents adjustments made to desired conditions using BASI to account for changes in climate.
3. The Plan does not include a "plan B" of desired conditions because there is insufficient information available to do so. Numerous variables such as topography, microsite conditions, and available seed sources cannot be reflected by the models used to predict species presence or distribution shifts. However, monitoring is prescribed (appendix B) which would be integral to inform the decision maker on the status and trend of vegetation on the HLC NF. As climate-related changes occur and more localized information becomes available, adjusted desired conditions could be incorporated via forest plan amendments, if necessary.
4. The figures from Halofsky et al 2018 are included in the carbon and climate section of the FEIS. The figure from Millar and Stephenson (2015) is not added but is paraphrased in the terrestrial vegetation section to disclose that more frequent and more extreme disturbance events are projected for some ecosystems. The FS recognizes that changes in frequency and magnitude of disturbances can create novel systems that increase our uncertainty in any projections of future vegetation types or species distributions.

d. Carbon sequestration is analyzed in detail in a manner consistent with BASI.

1. The Deciding Official recognizes the important role that the HLC NF plays in the carbon cycle. As reported in the carbon and climate section of the FEIS, maintaining healthy vegetation is important to ensure the HLC NF continues to sequester carbon. This section places the role of the HLC NF in the context of the global issue of carbon sequestration, and is derived from a carbon assessment white paper (appendix J) which provides a

detailed quantitative analysis of baseline carbon stocks and flux on the forest (including soils), carbon storage in harvested wood products, and the relative effects of disturbance and environmental factors on carbon storage over time. It also considers potential carbon and climate effects in the future. This white paper is based on peer-reviewed and published datasets and tools and is provided in the project record.

2. The carbon and climate section of the FEIS and appendix J discloses the past, present, and potential capacity of the HLC NF forests to sequester carbon.
3. An analysis that estimates the carbon flux for specific management scenarios for each forest type on the HLC NF would be too fine scale with the available data and modeling tools. The carbon and climate section of the FEIS uses BASI from the baseline carbon assessment and a disturbance assessment to estimate the maximum potential effects of management alternatives on carbon storage. This section also provides a discussion of these effects and puts them into context of forest dynamics across the national forest as well as national and global emissions. An analysis of the alternatives would likely fail to detect statistically significant differences among the alternatives as uncertainty is very high at such small scales and would not provide meaningful information to the decision given current laws and regulations. The FEIS adequately and accurately describes these potential effects and is warranted in not including a quantitative analysis of the effects of stand management scenarios.

e. Potential species distribution changes and appropriate management responses are disclosed as appropriate.

1. The terrestrial vegetation section of the FEIS discusses the trends and factors that may contribute to changes in tree species distribution. The suggested figure from Rocky Mountain Forests at Risk was not included because it was not needed to convey that species are projected to expand and contract. Modelling changes to climatic factors to project future distribution without modelling other contributing factors is less reliable because it overlooks the interactions of these factors that would affect changes to distribution. The projections for distribution changes are highly uncertain due to uncertainties of interactions among species and disturbance.
2. The FS used the BASI for the HLC NF to inform the desired species compositions over the planning horizon; bur oak or other novel species were not included.
3. The Plan does not preclude the use of assisted migration, but detailed projections relevant at the scale of the HLC NF are not available in terms of introducing novel species. Refer to plan component FW-VEGT-GDL-03. The FS would follow regional seedling transfer guidelines which are continually assessed for climate adaptability. Assisted migration may be a strategy adopted by the HLC NF if and when there is sufficient information to guide this activity.
4. Triage is a difficult approach due to the uncertainty of specific locations that are more or less at risk or of achieving the NRV. The terrestrial vegetation section of the FEIS discusses the general conditions that would contribute to vulnerabilities that would reduce unit's ability to achieve the NRV for certain vegetation types. The Plan and analysis identify the species that best contribute to future resilience, such as drought tolerant species.

f. Climate change and positive feedback loops are a global phenomenon. Given that greenhouse gases mix readily in the atmosphere it is difficult and very uncertain to ascertain the indirect and cumulative effects of emissions from multiple projects that derive the EIS alternatives. Relative to national and global emissions, forest management activities contribute negligibly to overall greenhouse gas emissions and climate effects. Forest management activities may affect only 0.11 Tg of carbon stored in the forest ecosystem each year, which is extremely small compared to the approximately 91 Tg of carbon stored in the forest ecosystem. The action alternatives would not significantly, adversely, or permanently affect forest carbon storage, but would rather achieve a more resilient forest condition that would improve the ability of the HLC NF to maintain carbon stocks and enhance carbon uptake. This is described in the carbon and climate section of the final EIS as well as the supporting carbon assessment (appendix J).

g. Projected timber and wood sale quantities are not minimum or maximum levels of allowable timber production; they are estimates of likely harvest levels and are well below the sustained yield limit because they include all applicable resource constraints. Sustained yield limit does represent a maximum amount of volume production that would be allowed. The timber model indirectly incorporated the possible effects of climate change by including likely disturbance levels, as described in appendix H and the timber and terrestrial vegetation sections of the FEIS. There is no further need to adjust timber metrics based on climate change.

h. The carbon and climate section of the FEIS places the contribution of the HLC NF and its role of sequestering carbon into the context of global carbon and climate trends. This section is supported by a quantitative analysis of forest carbon stocks and factors influencing storage. The Plan does not make any commitment or authorize any actions on the ground. There is no requirement to conduct a detailed emissions analysis of the activities that may occur during Plan implementation; such an analysis would be speculative. It would also be highly speculative and uncertain to conduct a cumulative analysis to take into account the potential activities on non-NFS lands and other national forests.

i. Appendix H of the FEIS includes clarification on this modeling assumption. The SIMPPLLE model does not include the capacity for detailed climate modeling. Rather, each decade is categorized into general climate trends (warm/dry, normal, cool/moist) that tie to assumptions in the model that reflect the likely outcomes.

j. Relevant and opposing literature was incorporated into the analysis as appropriate (refer to the carbon and climate section of the FEIS and appendix J). A peer review process is not required. Please refer to the response to literature table below for a summary of the FS review of all submitted literature.

k. It is not FS policy to maximize carbon or elevate the consideration of carbon above the many other services that NFS lands provide. In some instances, it is desirable to reduce carbon stocks to ensure the continued provisioning of other ecosystem services and for protecting lives and property. Hazardous fuel reduction treatments lower carbon stocks indefinitely as long as the treatments are maintained. However, any beneficial effects on carbon by avoiding a high-severity disturbance event, for example, is ancillary or a co-benefit to the primary reason fuel treatments are conducted. In the absence of fuels reduction treatments, the fire-adapted forest where the proposed treatments would take place may be more at risk to large and higher-severity wildfires, resulting in decreased ecosystem services and potentially increased carbon emissions. High-severity fires, especially when they occur repeatedly, can affect human health and safety, infrastructure, and ecosystem services, and can cause delayed regeneration or even a transition of forests to nonforest ecosystems in some areas. By reducing the threat of wildfire, management activities may create conditions more advantageous for supporting forest health in a changing climate and reducing greenhouse gas emissions over the long term. In fact, reducing stand density, one of the goals of the Plan, is consistent with adaptation practices to increase resilience of forests to climate-related environmental changes.

1. Logging is a suitable use on national forests, as per law and the 2012 Planning Rule. As described in the carbon and climate section of the FEIS, there is a relationship between tree removals from a site and greenhouse gas emissions or sequestration and climate change. The Paris Protocol reference to forest reduction is concerned with deforestation at the global scale. Vegetation treatments (or natural disturbances) on NFS lands are not deforestation but rather are an altering of stands to a more open state; or the conversion of forests back to the early successional stage of development and the initiation of new forests through regeneration. The forests on the HLC NF have been cycling through this

natural succession process for millennia. Old growth is recognized for its role in sequestering carbon, as described in the old growth section of the FEIS. The Plan is explicit in promoting this specific forest condition (FW-VEGF-DC-05, FW-VEGF-GDL-04, 05).

2. See the response to #2a.
3. The amount of carbon expected to be influenced by thinning in the alternatives is very small with respect to the amount of carbon that the HLC NF contains and expected emissions would be negligible with respect to both national and global greenhouse gas emissions. The biomass removed from the forest in fuels reduction treatments is not immediately emitted to the atmosphere. Rather that material can be used for wood products which substitute for more fossil fuel intensive materials, thus resulting in lower net emissions. The Intergovernmental Panel on Climate Change recognizes wood and fiber as a renewable resource that can provide lasting climate-related mitigation benefits that can increase over time with active, sustainable management.
4. The carbon and climate section of the FEIS addresses the effects of land management practices on carbon sequestration, using BASI. In the absence of timber harvests and thinning, forests thin naturally from mortality-inducing natural disturbances and other processes resulting in dead trees that would decay over time, emitting carbon to the atmosphere. Wood and fiber removed from the forest would be transferred to the wood products sector for a variety of uses. Carbon can be stored in wood products for a variable length of time. Wood can be used in place of other materials that emit more greenhouse gases. Likewise, biomass can also be burned to produce heat or electrical energy or converted to liquid transportation fuels that would otherwise come from fossil fuels. In fact, removing carbon from forests for human use can result in a lower net contribution of greenhouse gases to the atmosphere than if the forest were not managed. The Intergovernmental Panel on Climate Change recognizes wood and fiber as a renewable resource that can provide lasting climate-related mitigation benefits that can increase over time with active management. Reducing stand density may also reduce the risk of more severe disturbances, such as insect and disease outbreak and severe wildfires, which may result in lower forest carbon stocks and greater greenhouse gas emissions.
5. Thinning forests may increase ambient temperatures within those stands for a short period of time, but would make additional moisture and nutrients available, and create conditions more resilient to fire and insect disturbances. Thinning unnaturally dense stands would also help restore forest structure and function and ultimately support long-term carbon uptake and storage. Management activities overall would not increase temperatures in a broader sense.

l. The effects of management activities on nonforest lands, including greenhouse gas emissions from cattle grazing in the HLC NF, are disclosed in the FEIS and the corresponding carbon assessment (appendix J).

m. The terrestrial vegetation and timber sections of the FEIS acknowledge the risk of forest decline and associated impacts to projected timber and economic outputs.

n. The Plan includes a suite of desired conditions that represent the natural diversity and abundance of vegetation types on the HLC NF. The analysis, as reported in the terrestrial vegetation section of the FEIS, acknowledges those types and species that are vulnerable to warm/dry conditions anticipated with climate change.

1. The desired conditions in the Plan include the maintenance of all the vegetation types historically found on the HLC NF, including those that are less tolerant of warm and dry climate conditions. The desired range of spruce and fir forests are important components

to ecosystem diversity. GA-level quantitative desired conditions show that the need to increase, decrease, or maintain these cover types varies depending on the specific area. The desired conditions for spruce/fir forests are further described in appendix H and the terrestrial vegetation section of the FEIS.

2. Douglas-fir forests are important, and the desired conditions call for this species to remain prevalent on the HLC NF. Reductions in the Douglas-fir cover type and species extent are desired because there is ample evidence suggesting that the current levels of Douglas-fir are above the NRV levels due to factors such as fire exclusion, as described in Appendices H and I and the terrestrial vegetation section of the FEIS. Forest management actions would be designed to achieve (and maintain) the desired range for Douglas-fir, taking into account the effects of natural processes. Once monitoring shows that this species is present at the desired level, management actions would not be taken to reduce it further.

o. The monitoring plan reflects the reasonably foreseeable fiscal and organizational capacity of the HLC NF. The potential for working with volunteers and partners is one of the goals of the Plan (FW-CONNECT-GO-04).

p. Monitoring of drought is not specifically included in the HLC NF monitoring plan (appendix B of the Plan), because this information is available through other data sources and reported by other organizations.

q. The FS has internal policies related the agency's fossil fuel use and energy efficiency which are not part of forest plan revision. Carbon sequestration is addressed in the carbon and climate section of the FEIS. Plan component FW-CARB-DC-01 addresses the provision of this ecosystem service.

r. The HLC NF acknowledges the importance of considering climate change and carbon sequestration and has included robust analyses of these concepts throughout the FEIS. The HLC NF utilizes the work of the Northern Rockies Adaptation Partnership, as summarized in Halofsky et al 2018, to consider the potential effects to watershed functions. The applicable findings in the suggested information source would be consistent and complementary to this BASI.

s. The HLC NF has incorporated a robust range of desired conditions for vegetation which considered resilience and potential climate-related impacts, as described in appendix H and the terrestrial vegetation section of the FEIS. Wildlife habitat plan components also provide additional species-specific habitat components where needed. Appendix C of the Plan, and appendix J of the FEIS, also address potential management actions related to climate change adaptations that would be consistent with the plan components.

CR126 Fire – Climate Change

Concern: Commenters asked for climate change to be included in the analysis relating to wildland fire. One indicated that fuel treatments do not increase terrestrial carbon stocks.

Response: Climate change is factored into the analysis relating to wildland fire. In the FEIS refer to the Fire and Fuels section, Environmental consequences, Effects common to all alternatives, Climate change. Here it describes how it is expected that climate change is likely the single most important factor influencing fire. Additionally, see Future wildfire and fire regimes in the FEIS under the Fire and Fuels section. This section discusses the influence of climatic variability on fire. Throughout the FEIS it is recognized that fuel treatments can influence carbon storage. See the aquatic ecosystems: wildfire and fuels, effects to all alternatives section in the FEIS. Additionally, carbon storage is discussed extensively in the climate and carbon sequestration section. Within this section it is acknowledged that the forest fluctuates between being a source and a sink of carbon. A large part of this is due to wildfire occurrence.

CR266 Carbon Climate – Recreation

Concern: Commenter disagrees with use of climate change as a reason to eliminate any activities on the Forest, especially motorized recreation. Comments include multiple references that contradict the BASI that the FS used in its analysis.

Response: The HLC NF planning team followed the 2012 Planning Rule in its analysis of environmental consequences of the Plan. The directives require us to analyze the effects of our activities to the process of carbon sequestration and under the expected climate changes. The carbon and climate section of the FEIS, and an associated whitepaper in the project record, provides this analysis using the BASI. The impacts of various forest uses are disclosed; however, no uses (including motorized recreation) were excluded from the HLC NF on the basis of climate or carbon impacts. Please also see the responses to literature cited by the public, below.

CR267 Carbon Climate – Wildlife

Concern: The Plan should address potential climate change impacts on wildlife habitat and should conserve connectivity areas to assure that species can move in response to climate change.

Response: The Plan includes components that are designed to mitigate the effects of climate change, to the extent possible through management and planning, by promoting ecosystem resilience (e.g. FW-VEGT-DC-01) and habitat connectivity (e.g. FW-VEGT-DC-04, FW-WL-DC-04). A detailed description of how climate change was considered in development of the Plan can be found in appendix J of the FEIS, along with potential adaptation strategies that would help sustain native wildlife.

See also the responses to CR48, "Carbon Climate - Veg and General" and CR73, "Wildlife - Connectivity".

Response to Literature Cited by Public

The public cited hundreds of books, publications, articles, websites, etc. as best available scientific information for the team to consider. For all this material, a review was done to determine if and how the information should be used in the 2021 Land Management Plan and/or the FEIS. One of the following response codes was used to respond to each citation (Table 2).

Table 2. Response codes and descriptions to references submitted by the public

Response code	Description
AUTH	Used another publication by the same author; on a similar topic that is more recent and/or more comprehensive.
CITE	Reference was cited in the DEIS or was reviewed, determined to be relevant, and will be cited in the FEIS.
CON	Subject/topic considered but is addressed by other literature or sources of information that is appropriate or equally relevant
DATED	There is a more up-to-date publication available on the same topic and/or publication was a preliminary/draft report.
GEN	Publication is on a general topic or process which was considered directly or indirectly through the 2012 Planning Rule but not cited.
INC	Study results are inconclusive
IRR	Study is irrelevant to the issues under consideration at spatial and temporal scales appropriate to the planning area and to a land management plan; study does not apply to the HLC NF, or is on species, ecosystems, or conditions not found in the planning area.
LRP	Reference cited is an existing law, regulation or policy
N/A	Link was broken; or publication could not be located; or commenter did not provide context for how the publication was to be used. No detailed review was done.
NOT ACC	Not accurate - Does not estimate, identify, or describe the true condition of its subject matter using unbiased scientific methods.
NOT RLB	Not reliable - Reliability indications peer reviewed or published; repeatable; logical conclusions
POST	New scientific information published after the FEIS was completed.
REF	Incorporated by reference in other works used in the analysis (e.g. cited in NCDE Grizzly Bear Conservation Strategy, Lynx Conservation and Assessment Strategy, Climate Change Vulnerability and Adaptation in the Northern Rocky Mountains)

For the citations coded as "N/A", no detailed review was done. These include references provided that required a purchase, web links that were no longer operating, and/or publications that were not attached by the commenter and could not be located through an online search.

Table 3 provides a list of each citation that was reviewed, the response code, and a brief rationale supporting the response organized in order of each commenter. Some citations were provided by multiple commenters; in these cases, the citation is only included once in the table, and all of the commenters are listed in alphabetical order in the Commenter column. For brevity, the "N/A" citations are not included in this table, because no detailed review was done. Refer to the project record for a spreadsheet containing more detailed information, including citations coded as "N/A".

Table 3. Detailed review and response to literature submitted by the public, arranged by commenter

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	2013. Open Letter to Members of Congress from 250 Scientists Concerned about Post-fire Logging.	CON	The Plan includes components that acknowledge the importance of burned forests; and the potential effects of postfire logging are addressed with a variety of literature sources.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	2015. Open Letter to U.S. Senators and President Obama from Scientists Concerned about Post-fire Logging and Clearcutting on National Forests.	CON	The Plan includes components that acknowledge the importance of burned forests; and the potential effects of postfire logging are addressed with a variety of literature sources.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Adler 2016. Climate change, wildfire, and conservation.	GEN	Allowing or not allowing livestock grazing on federal lands is outside the scope of the forest plan revision process. The HLC NF is mandated to follow the Law, regulation, policy, including the 2012 Planning Rule that includes analyzing and providing guidance for livestock grazing.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Allendorf and Ryman 2002. The Role of Genetics in Population Viability Analysis.	CITE	Reference is used to explain current USFS Region 1 sensitive species analysis and incorporated into references specific to that methodology.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Anderson et al 2012. Watershed Health in Wilderness, Roadless, and Roaded Areas of the National Forest System.	CON	The FS has used other references that come to the same conclusion.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Angermeier & Karr 1994. Biological Integrity versus Biological Diversity as Policy Directives.	GEN	The paper suggests a policy shift from "biological diversity" to "biological integrity." The Plan addresses the concept of "ecological integrity" as required and defined in the 2012 Planning Rule and associated Directives (2015).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Anonymous 2013. Exploring biocarbon: the road less traveled in climate policy.	IRR	Source is a blog post, which is specific to southeastern forests. The HLC NF analysis uses other literature sources that are more robust and more relevant to the planning area to discuss the role of the carbon cycle and management actions on the Forest.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Arcese & Sinclair 1997. The Role of Protected Areas as Ecological Baselines.	CON	General paper on the benefits of set aside areas to conservation. Similar considerations informed the alternatives to the Plan, based on the guidance in the 2012 Planning Rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Attiwill 1994. The disturbance of forest ecosystems: the ecological basis for conservative management	CON	The FEIS analysis uses other citations that are equally or more relevant to the planning area to discuss the effects of disturbances versus management actions.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Aubry et al 2013. Meta-Analyses of Habitat Selection by Fishers at Resting Sites in the Pacific Coastal Region.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bader 2016. Review of Grizzly Bear Data and Population Estimates for the Northern Continental Divide Ecosystem.	NOT RLB	Unknown report by unknown consultant, lacking peer review.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Baker and Ehle 2001. Uncertainty in surface-fire history: the case of ponderosa pine forests in the western United States.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Baker and Williams 2015. Bet hedging; dry forest resilience to climate change threats in the western USA based on historical forest structure.	CITE	Citation points out the importance of small trees to resilience, using data from CO, AZ, CA, and OR; they were abundant historically. Desired conditions and terrestrial veg section include small trees in the desirable mix. Analysis uses reliable opposing science (e.g., Fule et al 2013).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Baker et al 2006. Fire, fuels and restoration of ponderosa pine–Douglas fir forests in the Rocky Mountains, USA.	CITE	Citation refutes the low severity historic fire paradigm for dry forests. Terrestrial vegetation section acknowledges this viewpoint using this citation, but also includes and relies upon other science (e.g., Fule et al 2013).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bart et al 2016. Effect of Tree-to-Shrub Type Conversion in Lower Montane Forests of the Sierra Nevada (USA) on Streamflow.	CON	Paper is specific to Sierra Nevada. The potential for vegetation type conversions is addressed in the terrestrial vegetation section of the FEIS using citations more relevant to the project area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bate et al 2007. Snag densities in relation to human access and associated management factors in forests of Northeastern Oregon, USA.	CON	Paper provides methods for estimating snag quantities. However, the HLC NF estimates snags directly from plot data, and uses other literature such as Bollenbacher (2008) to describe snag trends using information more local to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Beck and Suring 2011. Wildlife Habitat-Relationships Models: Description and Evaluation of Existing Frameworks.	IRR	General book chapter on modelling approaches; not directly relevant to the forest plan revision analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Belsky & Blumenthal 1997. Effects of Livestock Grazing on Stand Dynamics and Soils in Upland Forests of the Interior West.	CON	Impacts to soil/timber stands from livestock grazing are analyzed in the FEIS, using other references.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Belsky and Gelbard 2000. Livestock Grazing and Weed Invasions in the Arid West.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Belsky et al 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Beschta 2016. Adapting to Climate Change on Western Public Lands: Addressing the Ecological Effects of Domestic, Wild, and Feral Ungulates	NOT RLB	This citation shows writer bias against livestock grazing. The topic of livestock grazing is analyzed using other more relevant citations.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Beschta et al 2004. Postfire Management on Forested Public Lands of the Western United States.	CITE	This paper is cited in the terrestrial vegetation section of the FEIS, discussing the potential effects of post-fire logging.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bond et al 2012. A Conservation Strategy for the Black-backed Woodpecker (Picoides arcticus) in California – Version 1.0.	IRR	Generally, the technical report outlines the basic biology of black-backed woodpeckers, information that is inherent in plan development. Specific references to management may or may not apply as the document was written with the intent of managing the species in California which has very different ecosystems than Montana.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bond et al 2012. A New Forest Fire Paradigm: The Need for High-Severity Fires.	CON	The natural role and value of mixed and stand replacing fires on the landscape are acknowledged by plan components, and in the analysis using other references equally or more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Booth 1991. Urbanization and the natural drainage system- Impacts, Solutions and Prognoses.	CON	General hydrology. The HLC NF agrees that alteration of natural drainage basins is an impact to soil and water resources. The watershed and soil plan components are set up and used to limit and /or mitigate these effects.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bradley et al 2016. Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States?	CITE	Publication is cited in the terrestrial vegetation section of the FEIS, when discussing the effects of recommended wilderness area designations.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Bull and Blumton 1999. Effect of Fuels Reduction on American Martens and Their Prey.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Campbell et al 2011. Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?	CON	The EIS and appendix J address the effects of fuel reduction treatments using other literature equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Carnex and Frissell 2009. Aquatic and Other Environmental Impacts of Roads: The Case for Road Density as Indicator of Human Disturbance and Road-Density Reduction as Restoration Target; A Concise Review.	CON	Carnefix and Frissell 2009 make a scientific case for including ecologically based road density standards in forest plans. The HLC NF considered broad allocations of where motorized uses are suitable, via the Recreation Opportunity Spectrum; and other plan components that would inform future travel planning decisions regarding road densities. More specific roads analysis would be done during travel and/or project planning; the HLC NF is not including a desired road density matrix in the Plan.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Carroll et al 2001. Carnivores as focal species for conservation planning in the Rocky Mountain Region.	INC	The authors did look at the effects of roads on carnivores, but the authors hedge their findings as the findings were not clear, indeed they state: "Although our interpretation is biologically plausible based on species knowledge, a more rigorous evaluation of the effects of road density on these mesocarnivores must await development of systematic survey data sets."

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Center for Biological Diversity 2014. Nourished by Wildfire.	CON	Publication discusses the importance fire has in ecological processes supporting the FEIS that states "Fire is a critical ecological process". The publication highlights concerns with salvage logging after fire which would be evaluated on a case by case basis with site specific NEPA analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Cherry 1997. The Black-Backed and Three Toed Woodpeckrs: Life History, Habitat Use, and Monitoring Plan.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Clough 2000. Nesting habitat selection and productivity of northern goshawks in west-central Montana.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Cohen & Butler 2005. Wildfire Threat Analysis in the Boulder River Canyon; Revisited	CON	The general concepts of this paper are considered in the forest plan revision process. The overall desire as cited in the Plan is to see fire on the landscape as discussed in this publication. Additionally, there is a plan goal to work with landowners relating to wildfire risk.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Cohen 1999. Reducing the Wildland Fire Threat to Homes: Where and How Much?	CON	The general concepts of this paper are considered in the forest plan revision process. The overall desire as cited in the Plan is to see fire on the landscape as discussed in this publication. Additionally, there is a plan goal to work with landowners relating to wildfire risk.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Cohen et al 2016. Forest disturbance across the conterminous United States from 1985–2012: The emerging dominance of forest decline.	CITE	The publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Collins & Stephens 2007. Managing natural wildfires in Sierra Nevada wilderness areas.	CON	Publication is specific to allowing fire to function in the Sierra Nevada wilderness areas. Connections can be made from this publication supporting the FEIS and Plan desire to allow fire to function in its ecological role as much as possible.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Collins and Stephens 2007. Fire scarring patterns in Sierra Nevada wilderness areas burned by multiple wildland fire use fires.	IRR	This study was conducted in the Sierra Nevada, which differs from the HLC NF in terms of topography, species composition, weather patterns, etc. The fire history of the HLC NF, and associated vegetation conditions, are addressed using data and literature sources more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Committee of Scientists 1999. Sustaining the People's Lands.	GEN	Based on the requirements in the 2012 Planning Rule, the Plan and Monitoring plan are based on reasonably foreseeable budgets. The Forest was also careful to choose monitoring metrics and data sources that would be readily available with or without additional funding from the Forest's budget.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Copeland et al 2007. Seasonal Habitat Associations of the Wolverine in Central Idaho.	AUTH	General reference, inclusive of other references including references from the same author (e.g., Copland et al. 2010)
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Crist et al 2005. Assessing the value of roadless areas in a conservation reserve strategy: biodiversity and landscape connectivity in the northern Rockies.	GEN	The establishment of IRAs is beyond the scope of Revision. Plan components are consistent with the protections for IRAs as described in the RACR. The Plan also recognizes the importance of protections for undeveloped landscapes through the designation of recommended wilderness areas, in context of other allocations such as designated wilderness. The analysis uses other references equally or more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Crocker and Bedford 1990. Goshawk Reproduction and Forest Management.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Darimon et al 2018. Political populations of large carnivores.	GEN	The manuscript outlines the social-ecological challenges of managing large carnivores and supports transparency of understanding, a standard held by the USFS by statue and regulation.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	DellaSala & Hanson 2015. The Ecological Importance of Mixed-Severity Fires: Nature’s Phoenix.	CON	Reference provided is a review of the book, not any relevant excerpts. The ecological importance of mixed and high severity fire, as well as the efficacy of fuels treatments, are analyzed in the FEIS using a variety of literature sources relevant to the HLC NF planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	DellaSala et al 1995. Forest health: moving beyond rhetoric to restore healthy landscapes in the inland Northwest	CON	The Plan is consistent with many of the recommendations in this study, including protections for riparian areas and establishment of a network of undeveloped land allocations. The analysis uses other citations to describe the effects of forest management versus natural disturbance, that are equally or more relevant.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	DellaSala et al 2011. Roadless areas and clean water.	GEN	General hydrology. The HLC NF agrees that disturbance to undeveloped lands is an impact to soil and water resources. The watershed and soil plan components are set up and used to limit and /or mitigate these effects.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Depro et al 2008. Public land, timber harvests, and climate mitigation: Quantifying carbon sequestration potential on U.S. public timberlands.	IRR	Citation is not applicable or reliable for several reasons. It assumes that natural mortality would remove timber on a small fraction of actual recent disturbances (Westerling et al 2006). The “business as usual scenario” is based on 1980's harvest and is not consistent with management on the HLC NF. The study underestimates the role of fire, forest insects, and pathogens in the carbon cycle. Attempting to maximize forest carbon storage near the “potential” may be counterproductive because increasing tree density often increases drought stress,

Commenter(s)	Citation	Response code	Rationale
			vulnerability to mortality from bark beetles, and probability of crown fire (Reinhart 2010). In some forest types, increasing tree density may lead to the loss of old trees and loss of C stocks (Fellows and Goulden 2008). The paper does not account for leakage; where C inventory maintenance or gains in one location results in losses elsewhere due to global market forces (Gan and McCar, 2007; Murray 2008; Wear and Murray 2004).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	DeVelice and Martin 2001. Assessing the extent to which roadless areas complement the conservation of biological diversity.	CON	General paper on the benefits of set aside areas to conservation. Similar considerations informed the alternatives to the Plan, based on the guidance in the 2012 Planning Rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Dudley and Vallauri 2004. Deadwood – Living Forests	CON	Paper is specific to European forests. The Plan and analysis recognize the importance of dead wood to the ecosystem but uses other information and citations more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Dunne et al 2001. A scientific basis for the prediction of cumulative watershed effects.	GEN	General paper on cumulative watershed effects. The FS is required by law, regulation, and policy (including the 2012 Planning Rule) to analyze cumulative effects of management actions. Please see the watershed section of the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ecosystems and human well-being.	GEN	Letter asks FS to protect roadless areas per this report. The Plan was developed under the 2012 Planning Rule and also the Roadless areas rules for IRA protection.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Espinosa et al 1997. The Failure of Existing Plans to Protect Salmon Habitat in the Clearwater National Forest in Idaho	CON	General paper on effects of management activities on salmon habitat. Somewhat applicable in the bull trout watersheds west of the continental divide; However, the Plan includes plan components that would help to alleviate these types of issues with limited activities with Riparian Management Zones.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Everett 1994. Volume IV: Restoration of Stressed Sites, and Processes.	GEN	General reference, Regional and national soil quality standards and ecosystem sustainability are factored into the Plan and soils analysis in the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Fire Science Brief 2009. Listening to the Message of the Black-backed Woodpecker, a Hot Fire Specialist.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Fly et al 2011. Scriver Creek Road Inventory (GRAIP) Report	CON	General paper on effects sediment delivery from roads on streams. The Forest agrees that this is an important issue and as such plan components are included in the Plan to address this issue. The implementation of the Plan as well as subsequent project analysis will be used to reduce the occurrence of this issue. Please see the aquatic ecosystems section of the Plan and the FEIS.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Frissell & Bayles 1996. Ecosystem management and the conservation of aquatic biodiversity and ecological integrity.	GEN	The use of NRV as a guiding principle for vegetation desired conditions is consistent with the 2012 Planning Rule and associated directives (2015); and is also addressed with other more recent literature sources relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Frissell et al 2014. Ecosystem Management and the Conservation of Aquatic Biodiversity and Ecological Integrity.	CON	General paper on effects of climate changes to the northwest forest plans aquatic conservation strategy. Somewhat applicable in the bull trout watersheds west of the continental divide. However, the Plan includes plan components that would help to alleviate impacts to aquatic resources by limiting activities within RMZ's.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Gelbard and Harrison 2005. Invasibility of roadless grasslands: an experimental study of yellow starthistle.	IRR	Study (California) conducted on a species not applicable to the HLC NF (starthistle). The potential threats, effects, and drivers of invasive plants is addressed using other citations more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Gerber et al 2013. Tackling climate change through livestock.	CON	The topic of methane and climate change is addressed with other citations equally or more relevant to the HLC NF. The livestock grazing on the HLC NF is miniscule compared to industrial meat producers.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Goggans et al 1989. Habitat Use by Three-toed and Black-backed Woodpeckers, Deschutes National Forest.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Graham 2003. Hayman Fire Case Study.	CITE	In DEIS letter 1159 the referenced part of this publication addresses selecting treatment type and the need to maintain treatments into the future. Selection of treatment type is done under site specific project analysis. Regarding maintaining desired structure there is a plan component for accomplishing this.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Green et al 1992. Old-growth forest types of the northern region.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Gucinski et al 2001. Forest Roads: A Synthesis of Scientific Information.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Guldin et al 2003. The Science Consistency Review A Tool to Evaluate the Use of Scientific Information in Land Management Decisionmaking.	GEN	The HLC NF Plan analysis was done with the review and guidance of subject matter experts in the Regional office, Washington office, and Rocky Mountain Research Station. This process, consistent with the 2012 Directives, is sufficient to ensure consistency with best available scientific information.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Haines 1993. Wolverine habitat guidelines: for the Malheur National Forest.	DATED	Dated information on the basic ecology/management of wolverines. The analysis includes more up to date citations.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Halverson 2016. Why isn't the U.S. counting meat producers' climate emissions?	CON	The issue of methane and climate change is addressed in the FEIS and appendix J using other citations that are equally or more relevant to the planning area. The livestock grazing that occurs on the HLC NF is not comparable to industrial agricultural uses.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hammer 2016. Oral and Written Comments Submitted for July 7, 2016, HBRC Workshop	NOT RLB	This is a personal opinion letter, not scientific information.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hanson 2010. The Myth of Catastrophic Wildfire: A New Ecological Paradigm of Forest Health.	CITE	This citation as added to the analysis regarding the potential for vegetation treatments to increase fire intensity.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hargis et al 1999. The influence of forest fragmentation and landscape pattern on American martens	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Harmon 2001. Carbon Sequestration in forests: Addressing the Scale Question	CON	The issue of forest age and carbon sequestration is addressed in the EIS and appendix J using literature equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Harmon 2009. Oversight hearing on ''the role of federal lands in combating climate change''	CON	The role of carbon sequestration on the HLC NF is addressed with a variety of other literature sources that are equally or more relevant to the HLC NF planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Harmon and Marks 2002. Effects of silvicultural practices on carbon stores in Douglas-fir – western hemlock forests in the Pacific Northwest, U.S.A.: results from a simulation model.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Harmon et al 1990. Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests	CON	The EIS and appendix J address the issue of forest age and carbon sequestration using other literature sources equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Harris 1984. The Fragmented Forest: Island Biogeography theory and the preservation of biotic diversity.	CITE	Reference is cited in the old growth section of the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hayes and Lewis 2006. Washington State Fisher Recovery Plan	IRR	General reference on the ecology/management of Fisher; would be inclusive of project specific analysis but is not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hayward 1994. Flammulated, Boreal, and Great Gray Owls in the US	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.

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Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hayward and Escano 1989. Goshawk nest-site characteristics in western Montana and northern Idaho	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	He et al 2016. Radiocarbon Constraints imply reduced carbon uptake by soils during the 21st century	CON	The EIS and appendix J address the issue of soil carbon using literature sources equally or more relevant to the HLC NF, and acknowledge uncertainty associated with estimates.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Heinemeyer and Jones 1994. Fisher Biology and management: a literature review and adaptive management strategy	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Henjum et al 1994. Interim Protection for Late-Successional Forests, Fisheries, and Watersheds	CITE	The publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hessburg and Agee 2003. An environmental narrative of Inland Northwest United States forests, 1800–2000.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hillis et al 2002. Blackbacked Woodpecker Assessment	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Holbrook et al 2018. Spatio-temporal responses of Canada lynx (Lynx canadensis) to silvicultural treatments in the Northern Rockies, U.S.	CITE	The publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Homan et al 2005. What the soil reveals: Potential total ecosystem C stores of the Pacific Northwest region, USA	CON	The role of soils in the carbon cycle is addressed in the carbon sequestration report using citations equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Huck 2000. Chapter 4: Reliability and Validity	CON	Although not specifically cited, the concerns in this paper are addressed with other information sources. The uncertainties associated with the models used and the data sources are disclosed in appendix H of the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hutto 1995. Composition of Bird Communities Following Stand-Replacement Fires in Northern Rocky Mountain (U.S.A.) Conifer Forests	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hutto 2006. Toward Meaningful Snag-Management Guidelines for Postfire Salvage Logging in North American Conifer Forests.	CITE	Reference is cited in the snag section of the FEIS, when noting literature that cautions the use of post-fire logging and emphasizes the importance of snag retention. However, salvage is permitted under all alternatives and literature sources such as this could be applied more specifically during project analysis and design.

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Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Hutto 2008. The Ecological Importance of Severe Wildfires: Some Like it Hot	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ingalsbee 2004. Collateral Damage: The Environmental Effects of Firefighting The 2002 Biscuit Fire Suppression Actions and Impacts	CON	Considered and analyzed but addressed by other literature or sources of information that is appropriate or equally relevant.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Jordan 2016. Methane from food production could be wildcard in combating climate change, Stanford scientist says	CON	The issue of methane and climate change is addressed using other citations that are equally or more relevant to the project area. The livestock grazing that occurs on the HLC NF is not comparable to industrial agricultural uses.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Karr 1991. A long-neglected aspect of water resource management	CON	This citation is more applicable towards monitoring. The FS is actively engaged in ecological monitoring even outside of aquatic habitat.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Karr et al 2004. Postfire salvage loggings effects on aquatic ecosystems in the American West.	CITE	This publication is cited in the terrestrial vegetation section of the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Kassar & Spitler 2008. Fuel the Burn: The Climate and Public Health Implications of Off-road Vehicle pollution in California	CON	This paper addresses OHV-related pollution in California. The impacts of OHV use is addressed in the FEIS using information equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Kauffman 2004. Death Rides the Forest: Perceptions of Fire Land Use and Ecological Restoration of Western Forests	CON	This citation is similar to other cited publications used that are equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Keith et al 2009. Re-evaluation of forest biomass carbon stocks and lessons from the world's most carbon-dense forests PNAs	CON	The role of forests on the HLC NF in the carbon cycle is addressed in the carbon sequestration report using citations equally or more relevant.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Kosterman 2014. Correlates of Canada Lynx Reproductive Success in Northwestern Montana.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Krebs et al 2007. Multiscale Habitat Use by Wolverines in British Columbia, Canada	CON	General habitat relationships are considered using other cited references (e.g., Copland et al. 2010 and Heinemeyer et al 2017)
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Kreutzweiser & Capall 2001. Fine sediment deposition in streams after selective forest harvesting without riparian buffers	CON	General paper on effects sediment delivery from roads on stream litter decay. The Forest agrees that this is an important issue and as such plan components are included in the Plan to address this issue. The implementation of the Plan as well as subsequent project analysis will be used to reduce the occurrence of this issue. Please see the aquatic ecosystem section of the Plan and the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Kuhns & Daniels. Undated. Firewise Landscaping for Utah	CON	Considered and analyzed but addressed by other literature or sources of information that is appropriate or equally relevant.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Kutsch & Werner 2010. Soil Carbon Dynamics: an Integrated Methodology	CON	The role of soils in the carbon cycle is addressed in the carbon sequestration report using citations equally or more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Lacy 2001. Our sedimentation boxes runneth over: public lands soil law as missing link in holistic natural resource protection.	GEN	There may seem to be a lack of laws directly addressing soil protection on federal lands, but there is a regulatory framework in place to direct soil management. This includes the Multiple-Use, Sustained-Yield act of 1960, the Forest and Rangeland Renewable Resources Planning Act of 1974, the National Forest Management Act of 1976, FSM 2500- Chapter 2550 -Soil Management, and the Region 1 Soil Quality Standards.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Law & Harmon 2011. Forest sector carbon management, measurement and verification, and discussion of policy related to mitigation and adaptation of forests to climate change	CON	Paper discusses carbon management, measurement, and policy related to the forest sector. Relevant, but the carbon report utilizes a body of other literature more or equally relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Law 2014. Role of Forest Ecosystems in Climate Change Mitigation and Adaptation	CON	Citation provides information from Pacific NW ecosystems. The issue of the impacts of logging and fuel reduction on carbon stores is addressed in the carbon sequestration section of the EIS using citations more relevant to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Lecerf & Richardson 2010. Litter decomposition can detect effects of high and moderate levels of forest disturbance on stream condition	CON	General paper on effects sediment delivery from roads and timber harvest. The Forest agrees that this is an important issue and as such plan components are included in the Plan to address this issue. The implementation of the Plan as well as subsequent project analysis will be used to reduce the occurrence of this issue. Please see the aquatic ecosystems section of the Plan and the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	LeQuire 2009. Listening to the Message of the Black-backed Woodpecker, a Hot Fire Specialist	IRR	General manuscript on the ecology/management of the species; this information would be inclusive in project level analysis but is not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Lertzman & Fall 1998. From Forest Stands to Landscpaes: Spatial scales and the roles of disturbances	CON	The analysis is consistent with the overall points in this chapter, such as the appropriate consideration of scale when considering the role of natural disturbances and landscape pattern; and the utilization of NRV. The effects to terrestrial ecosystems are analyzed with references equally or more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Lofroth 1997. Northern Wolverine Project V/olverine Ecology in Logged and Unlogged Plateau and Foothill Landscapes	CON	General information about species ecology; consistent with other citations used in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Lorenz et al 2015. The role of wood hardness in limiting nest site selection in avian cavity excavators	IRR	General manuscript on the ecology/management of the species; this information would be inclusive in project level analysis but is not directly relevant to forest plan revision.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Loucks et al 2003. USDA Forest Service Roadless Areas: Potential Biodiversity Conservation Reserves	CON	General paper on the benefits of set aside areas to conservation. Similar considerations informed the alternatives to the Plan, based on the guidance in the 2012 Planning Rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Marcot & Murphy 1992. Population Viability Analysis and Management	GEN	This citation provides general information about analysis approaches for species viability. The Plan and analysis follow the management approaches required by the 2012 Planning Rule and associated directives, as well as other law, regulation, and policy, with regards to population viability.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Masson & Delmotte 2018. Global Warming of 1.5' An Intergovernmental Panel on Climate Change Special Report on the impacts of global warming of 1.5' preindustrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.	CON	The impacts of climate change are addressed through other citations, such as the findings of NRAP, using climate information that is downscaled and equally or more relevant to the HLC NF forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Maxell et al 1998. Inclusion of the Boreal toad (Bufo boreas boreas) on the Sensitive Species List for all Region 1 Forests.	IRR	General manuscript on the ecology/management of the species; this information would be inclusive in project level analysis but is not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	May et al 2006. Impact of infrastructure on habitat selection of wolverines	CON	General information about species ecology that is consistent with other citations used in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	McClelland 1977. Relationships Between Hole-Nesting Birds, Forest Snags, and Decay in Western Larch-Douglas-Fir Forests - of the Northern Rocky Mountains	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	McClelland 1980. Influences of Harvesting and residue management on cavity-nesting birds	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	McClelland 1985. Letter to Flathead National Forest Supervisor Edgar Brannon re: old growth management in draft forest plan	CON	Letter cites concerns to the 1986 FNF forest plan, including site specific information on wildlife observations. The forest types and wildlife referenced are not necessarily consistent with those found on the HLC NF. The HLC NF used other literature equally or more relevant to the planning area to develop the old growth plan components and conduct the old growth analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	McClelland 1999. Pileated Woodpecker Nest and Roost Trees in Montana: Links with Old-Growth and Forest “Health"	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Mcintosh et al 1994. Management History of Eastside Ecosystems: Changes in Fish Habitat Over 50 Years, 1935 to 1992	CON	General paper on effects of management activities on fish habitat. However, the Plan includes plan components that alleviate aquatic impacts by limiting certain activities within Riparian Management Zones. In addition, the Forest Plan and FEIS analysis rely on a comprehensive monitoring program (PIBO), that collects data across FS and BLM lands in the Interior Columbia Basin and Upper Missouri River Basin. The systematic approach to this monitoring program evaluates land management effects to aquatic resources across the federal lands in the West including, the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	McKenzie, Donald, Ze'ev Gedalof, David L. Peterson, and Philip Mote. 2004. Climatic change, wildfire, and conservation. Conservation Biology 18:4: 890 -902	REF	The influence of climate change on wildfires is acknowledged and addressed in the EIS. This publication is cited in Halofsky et al 2018, which is used in the analysis to describe potential effects of climate change.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Mealey 1983. Wildlife Resource Planning Assistance to the Payette and Boise National Forests	DATED	Memo outlines a population viability approach; however, significant advances in analyses have occurred since this memo.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Miserendino & Masi 2010. The effects of land use on environmental features and functional organization of macroinvertebrate communities in Patagonian low order streams	CON	General paper on effects sediment delivery from roads and timber harvest on macroinvertebrates. The Forest agrees that this is an important issue and as such plan components are included in the Plan to address this issue. The implementation of the Plan as well as subsequent project analysis will be used to reduce the occurrence of this issue. Please see the aquatic ecosystem section of the Plan and the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Mitchell et al 2009. Forest fuel reduction alters fire severity and long-term carbon storage. in three Pacific Northwest ecosystems	CON	This study is based in the Pacific Northwest, which differs in vegetation and disturbance regimes. The issue of fuel reduction treatments and carbon storage is addressed in the EIS and appendix J using references equally or more relevant to the HLC NF, such as Halofsky et al 2018.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Montana Bull Trout Science Group 1998. The Relationship Between Land Management Activities and Habitat Requirements Of Bull Trout	GEN	Many aspects of this report were incorporated directly into the Northern Region Bull Trout Conservation Strategy and later, the Columbia Headwaters Recovery Unit Implementation Plan. The Plan is consistent with these strategies.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Moomaw & Smith 2017. The Great American Stand: US Forests and the Climate Emergency. Why the United States needs an aggressive forest protection agenda focused in its own backyard.	CON	Under the Plan, native vegetation communities would be maintained and not converted to other uses; and plan components are developed to promote resistance and resilience to climate change. The EIS and appendix J address the issue of climate change using literature sources equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Moriarty et al 2016. Forest Thinning Changes Movement Patterns and Habitat Use by Pacific Marten	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Moser and Garton 2009. Short-term effects of timber harvest and weather on northern goshawk reproduction in northern Idaho	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Moyle et al 1996. Management of Riparian Areas in the Sierra Nevada	GEN	This reference was cited as BASI for larger buffers to fish bearing streams. The 2012 Planning Rule requires the development of Riparian Management Zones. The HLC NF Plan implements this direction. The BASI used to develop these plan components is referenced in the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Natural Resources Defense Council 2013. NCDE Grizzly Bear Conservation Strategy Comments	NOT RLB	Document is a letter, not scientific literature
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Nesser 2002. Notes from the National Soil Program Managers meeting in Reno as related to soil quality issues.	CON	Other citations are used relative to soil quality issues. The 15% standard in bulk density does not suggest that a 15% increase in bulk density is necessarily detrimental, just that it is the level of change that is detectable given the range in bulk density of soils due to natural variability. While Powers specifically refers to the 15% increase in bulk density, Nesser suggests that it is more appropriate to look at the overall effect of combined impacts on an area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Nie and Schembra 2014. The Important Role of Standards in National Forest Planning, Law and Management	GEN	The 2012 Planning Rule requires the FS to use BASI, including input from the public and from the FS research branch. The Forest specialists work in conjunction with the Regional and Washington level specialists to increase consistency in the use of BASI. The Plan is consistent with the 2012 Planning Rule for all plan components, including standards.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Noon et al 2003. Conservation Planning for US National Forests: Conducting Comprehensive Biodiversity Assessments	GEN	The Plan is consistent with the 2012 Planning Rule, including the requirements for a coarse and fine-filter approach to provide for species viability.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Noss & Lindenmayer 2006. The Ecological Effects of Salvage Logging after Natural Disturbance	CON	Analysis addresses the effects of post-fire logging using other literature sources that are equally or more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Noss 2001. Biocentric Ecological Sustainability: A Citizen's Guide	CON	The Plan and analysis are consistent with the approaches described in the 2012 Planning Rule and associated directives with respect to biodiversity and ecological integrity; many of these concepts are consistent with this citation but other sources of information are used in the analysis.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Noss et al 2006. Managing fire-prone forests in the western United States.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Nott et al 2005. Managing Landbird populations in forests of the pacific northwest: formulating population management guidelines from landscape scale ecological analyses of maps data from avian communities on seven national forests in the pacific northwest	IRR	General manuscript on the ecology/management of the species; this paper would be inclusive in project level analysis but is not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Odion & DellaSala 2011. Backcountry thinning is not the way to healthy forests	CON	The FEIS acknowledges and accepts the need for fire on the landscape. FIES also identifies the need to treat fuels around HVRAs as discussed in this newspaper editorial.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Odion & Hanson 2006. Fire Severity in Conifer Forests of the Sierra Nevada, California	CON	Fire regime and lack of fire are factors discussed in the FEIS using other literature citations equally or more relevant to the HLC NF. Additionally, changes in climate and human activity also influence frequency and severity and are discussed and cited in the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Olson et al 2014. Modeling the effects of dispersal and patch size on predicted fisher (Pekania [Martes] pennanti) distribution in the U.S. Rocky Mountains.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Page & Dumroese 2000. Soil quality standards and guidelines for forest sustainability in northwestern North America	REF	Paper examining calculated changes in soil carbon, nitrogen, erosion, and cation exchange capacity based on thresholds for several FS regional guidelines. Soils from a variety of climates and geographic areas in R1, R4, and R6. Suggests that site-specific information is important in development of guidelines. This is addressed in the monitoring plan (Plan appendix B). Additionally, pre-disturbance and site-specific conditions are considered in project analysis. This paper is cited by the regional soil quality standards, which is part of the regulatory framework for the soils resource.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Pfankuch 1975. Stream reach inventory and channel stability evaluation. USDA Forest Service Northern Region, Montana.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Pierce et al 2004. Fire-induced erosion and millennial scale climate change in northern ponderosa pine forests	CON	Considered and analyzed but addressed by other literature or sources of information that is appropriate or equally relevant.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Raley et al 2012. Biology and conservation of martens, sables, and fishers: A New Synthesis	IRR	General manuscript on the ecology/management of the species; this would be inclusive in project level analysis but is not directly relevant to forest plan revision.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Raley et al 2012. Habitat Ecology of Fishers in Western North America A New Synthesis.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Reed et al 2003. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates	CON	Manuscript is a general discussion of analytical approaches and presents an approach to population viability, one of many approaches. The HLC NF approaches population viability as required by law, policy, and regulation, including the 2012 planning rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Reed, D.H., J.J. O'Grady, B.W. Brook, J.D. Ballou, R. Frankham. 2003. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. Biological Conservation 113(2003) 23-34.	CON/IRR	Broad scale evaluation of use of Population Viability Analysis as a tool to establish Minimum Viable Population not directly applicable at scale of forest planning or under 2012 Planning Rule coarse filter direction.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Reeves et al 2011. Detrimental Soil Disturbance Associated with Timber Harvest systems on National Forests in the Northern Region.	CON	Generally, agreement that detrimental soil disturbance stays below 15% across units in R1. Some sites only had limited amount of data though. The DEIS does cite the results of forest plan monitoring in appendix C (references Soil Monitoring reports from 2012-2017; USDA, 2012-2017). Reeves et al. is a regional analysis that includes data from 1999 to 2009 and does not include data collected using the current monitoring methods. The results from the Helena NF and Lewis and Clark NF are not meaningful due to the very small sample sizes (n=11 and n=4, respectively). The trends from Reeves et al. can be regarded regionally but should not be considered by individual forests due to lack of statistical power.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Reid & Dunne 1984. Sediment Production from Forest Road Surfaces	CON	Other information is used to address the topic of impacts to RMZs from logging and other activities. The sediment production from road surfaces is not directly related to any form of logging or thinning. This work does not describe impacts that would be consistent with the protections provided by RMZ plan components in the Plan.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Reynolds et al 1992. Management recommendations for the Northern goshawk in the Southwestern United States	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Rhodes & Baker 2008. Fire Probability, Fuel Treatment Effectiveness and Ecological Tradeoffs in Western U.S. Public Forests	CON	Considered and analyzed but addressed by other literature or sources of information that is appropriate or equally relevant.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Rhodes 2007. The watershed impacts of forest treatments to reduce fuels and modify fire behavior	CON	The FEIS addresses the potential impacts of watershed restoration work including vegetation treatments to change fire behavior using literature that is equally or more relevant. This includes addressing the issue of efficacy of hazardous fuel treatments.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Rhodes et al 1994. A coarse screening process for evaluation of the effects of land management activities on salmon spawning and rearing habitat in ESA consultations.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Rieman et al 1997. Does Wildfire Threaten Extinction for Salmonids? Responses of Redband Trout and Bull Trout Following Recent Large Fires on the Boise National Forest.	CITE	This paper is relevant and will be cited in the FEIS, Chapter 3.5.6 environmental consequences, aquatic ecosystems and soils.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Rieman et al 2001. Evaluation of potential effects of federal land management alternatives on trends of salmonids and their habitats in the interior Columbia River basin	IRR	This paper describes the trend in aquatic ecosystem condition across the Interior Columbian Basin-ICBEMP analysis area. They use a Bayesian Belief Network model based on conditional probability. Given the scale of analysis the relevance of this model is outside the spatial and temporal scope of the planning area. The paper concludes that there is improvement (positive trend) in aquatic ecosystems on federal lands but there is uncertainty in a positive trend in salmonid populations given multiple factors that affect recruitment and viability of fish populations beyond habitat constraints.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Riggers et al 2001. Reducing Fire Risks to Save Fish – A Question of Identifying Risk	NOT RLB	There are recent publications that are more pertinent, literature provided was a preliminary report from a subcommittee meeting-opinion piece. This report was not peer reviewed or published and no conclusive results or discussion.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ripple et al 2014. Ruminants, climate change and climate policy	NOT RLB	Opinion piece. Related to the concern about livestock grazing and methane emissions. This issue is addressed with other more reliable information sources.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Rowland et al 2003. Evaluation of Landscape Models for Wolverines in the Interior Northwest, United States of America	CON	General reference on the ecology/management of wolverine, in regard to specific issues relating to winter recreation; such issues are covered with other citations (e.g., Heinemeyer et al. 2017)
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ruggiero 2007. Scientific Independence: A Key to Credibility	GEN	The Plan and analysis are consistent with the 2012 Planning Rule and associated directives with respect to the use of best available scientific information.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ruggiero et al 1994. The Scientific Basis for Conserving Forest Carnivores: American Marten,	AUTH	General technical report outlining the basic science and ecology of carnivore species; this information is covered by other citations including other papers by the same authors.

Commenter(s)	Citation	Response code	Rationale
	Fisher, Lynx, and Wolverine in the Western United States.		
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ruggiero et al 1994. Viability Analysis in Biological Evaluations: Concepts of Population Viability Analysis, Biological Population, and Ecological Scale	CON	Manuscript is a general discussion of analytical approaches and presents an approach to population viability, one of many approaches. The HLC NF approaches population viability as required by law, policy, and regulation, including the 2012 planning rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ruggiero et al 2007. Wolverine Conservation and Management.	AUTH	General manuscript outlining the basic science and ecology of wolverine; this information is covered by other citations including other papers by the same authors.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Saab and Dudley 1998. Responses of Cavity-Nesting Birds to Stand-Replacement Fire and Salvage Logging in Ponderosa Pine/Douglas-Fir Forests of Southwestern Idaho.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Sallabanks et al 2001. Wildlife Habitat relationships in Oregon and Washington	IRR	Report discussion innumerable broad subjects, all of which are focused on Washington and Oregon and not directly applicable to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Samson 2006. Habitat estimates for maintaining viable populations of the northern goshawk, black backed woodpecker, flammulated owl, pileated woodpecker, American Marten, and Fisher.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Sauder 2014. A Dissertation Presented in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy with a Major in Natural Resources in the College of Graduate Studies University of Idaho	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but is not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Sauder and Rachlow 2014. Both forest composition and configuration influence landscape-scale habitat selection by fishers (Pekania pennanti) in mixed coniferous forests of the Northern Rocky Mountains	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Saunois et al 2016. The global methane budget 2000-2012	IRR	Identifies the uncertainties in the methane budget. Not directly applicable to the HLC NF plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Saunois et al 2016. The growing role of methane in anthropogenic climate change	CON	The issue of methane, grazing, and climate change is addressed in the EIS and appendix J using literature sources equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schoennagel et al 2004. The Interaction of Fire, Fuels, and Climate across Rocky Mountain Forests	CON	Considered and analyzed but addressed by other literature or sources of information that is appropriate or equally relevant. Additionally, this publication includes Montana forest and states "dry ponderosa pine forests, it is both ecologically appropriate and operationally possible to restore a low-severity fire regime through thinning and prescribed burning". This finding is supported by Reinhardt Et al 2008 which we cite in the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schultz 2010. Challenges in Connecting Cumulative Effects Analysis to Effective Wildlife Conservation Planning	CON	Manuscript is a general discussion of analytical approaches and presents an approach to population viability, one of many approaches. The HLC NF approaches population viability as required by law, policy, and regulation, including the 2012 planning rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schultz 2012. The U.S. Forest Service's analysis of cumulative effects to wildlife: A study of legal standards, current practice, and ongoing challenges on a National Forest	CON	Manuscript is a general discussion of analytical approaches and presents an approach to population viability, one of many approaches. The HLC NF approaches population viability as required by law, policy, and regulation, including the 2012 planning rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schultz et al 2013. Wildlife Conservation Planning Under the United States Forest Service's 2012 Planning Rule	GEN	Paper outlines 2012 Planning Rule and suggests criteria for selecting focal species. The Plan is consistent with the 2012 Planning Rule with regards to focal species.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schultz, Courtney. 2010. Challenges in Connecting Cumulative Effects Analysis to Effective Wildlife Conservation Planning. BioScience 60(7):545-551.	CON/IRR	Focuses on project-scale analysis, as well as on use of MIS, which are no longer part of forest planning. Concepts are relevant to the project planning and analysis scale, but not clearly relevant to the scale of a programmatic forest plan.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schultz, Courtney. 2012. The US Forest Service's analysis of cumulative effects to wildlife: A study of legal standards, current practice, and ongoing challenges on a National Forest. Envir. Impact Assess. Review 32 (2012): 74-81.	CON/IRR	Very similar to Schultz 2010 publication; Focuses on project-scale analysis, as well as on use of MIS, which are no longer part of forest planning. Concepts are relevant to the project planning and analysis scale, but not clearly relevant to the scale of a programmatic forest plan.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Schwartz et al 2013. Stand- and landscape-scale selection of large trees by fishers in the Rocky Mountains of Montana and Idaho	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Scrafford et al 2018. Roads elicit negative movement and habitat-selection responses by wolverines (Gulo gulo luscus).	CON/IRR	Study in Scrafford et al. was in far northern area where a heavily-roaded landscape with large scale industrial activity overlaps with key wolverine habitat. This is very unlike HLC NFS lands where key wolverine habitat is at high elevation and largely unroaded (refer to FEIS). FEIS analysis used relevant work (e.g. Heinemeyer et al. 2017 and 2019) regarding recreational uses, including motorized travel, on wolverines.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Sherriff et al 2014. Historical, Observed, and Modeled Wildfire Severity in Montane Forests of the Colorado Front Range	CON	Considered and analyzed but addressed by other literature or sources of information that is appropriate or equally relevant. Additionally this publication states "Goals of ecological restoration and wildland fire hazard mitigation are both compatible with management practices, like prescribed fire and thinning to reduce fuels, below approximately 2200 m in our study area, which experienced the greatest increase in fire severity, and likely fuels, since fire exclusion" This finding is supported by Reinhardt et al 2008 which we cite in the FEIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Solomon et al 2007. 2007: Technical Summary. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change	CON	Climate change is addressed through other citations, such as Halofsky et al 2018, using climate information that is downscaled and equally or more relevant to the HLC NF forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Spiering and Knight 2005. Snag density and use by cavity-nesting birds in managed stands of the Black Hills National Forest	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but is not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Squires 2009. Letter to Carly Walker of Missoula County Rural Initiatives	AUTH	This paper provides general information about lynx ecology, which was considered and inclusive of other citations, including some by the same authors.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Squires 2013. Combining resource selection and movement behavior to predict corridors for Canada lynx at their southern range periphery	AUTH	This paper provides general information about lynx ecology, which was considered and inclusive of other citations, including some by the same authors.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Squires et al 2006. Lynx Ecology in the Intermountain West.	AUTH	This paper provides general information about lynx ecology, which was considered and inclusive of other citations, including some by the same authors.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Squires et al 2006. The association between landscape features and transportation corridors on movements and habitat-use patterns of wolverines	AUTH	This paper provides general information about lynx ecology, which was considered and inclusive of other citations, including some by the same authors.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Squires et al 2007. Sources and Patterns of Wolverine Mortality in Western Montana	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Squires et al 2010. Seasonal Resource Selection of Canada Lynx in Managed Forests of the Northern Rocky Mountains.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Stritthold & DellaSala 2001. Importance of Roadless Areas in Biodiversity Conservation in Forested Ecosystems: Case Study of Klamath-Siskiyou Ecoregion of the United States	CON	General paper on the benefits of set aside areas to conservation. Similar considerations informed the alternatives to the Plan, based on the guidance in the 2012 Planning Rule and associated directives.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Sullivan et al 2006. Defining and Implementing Best Available Science for Fisheries and Environmental Science, Policy, and Management	GEN	The 2012 Planning Rule requires the FS to use BASI in development of its Forest Plans; in that effort, the FS solicits input from the public and we also receive input from the FS research branch. The Forest specialists work in conjunction with the regional and Washington level specialists to increase consistency in the use of BASI.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Sylvester 2014. Off-Highway Vehicles in Montana Popular and a Growing Part of the Economy	IRR	It is not clear how this information would help inform an emissions disclosure regarding this use specific to the HLC NF.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Thompson et al 2009. Forest Resilience, Biodiversity, and Climate Change. A Synthesis of the Biodiversity/Resilience/Stability Relationship in Forest Ecosystems	CON	The topic of the role of old forests in sequestering carbon was considered with other citations equally or more relevant to the HLC NF, in the carbon sequestration section of the EIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Traill et al 2010. Pragmatic population viability targets in a rapidly changing world	CON	Manuscript is a general discussion of analytical approaches and presents an approach to population viability, one of many approaches. The HLC NF approaches population viability as required by law, policy, and regulation, including the 2012 planning rule and associated directives.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Traill, L.W., B.W. Brook, R.R. Frankham, and C.J.A. Bradshaw. 2010. Pragmatic population viability targets in a rapidly changing world. Biological Conservation 143(2020):28-34.	CON	Information related to management of individual populations of species when population numbers can be known; broad scale evaluation not directly relevant to 2012 Planning Rule direction to manage based on retaining key ecosystem characteristics (coarse filter). Also considered contradicting science (e.g. Shoemaker et al. 2013), and literature discussing difficulties of PVA to estimate MVP (e.g. discussion in Reed et al. 2003).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Trombulak & Frissell 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities	CON	Manuscript represents a comprehensive review of the possible impacts of roads on fish and wildlife populations. This general information is inclusive of any number of citations that are more current
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Turner et al 1995. A carbon budget for forests of the conterminous united states.	DATED	The role of forests on the HLC NF in the carbon cycle is addressed in the carbon sequestration report using citations equally or more relevant.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Turner et al 1997. The Carbon Crop: Continued	CON	The topic of the effects of harvest on carbon sequestration was considered with other citations equally or more relevant to the HLC NF, in the carbon sequestration section of the EIS.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	United Nations Environmental Programme 2002. Report of the sixth meeting of the conference of the parties to the convention on biological diversity	N/A	The link to the citation does not work; no review was done.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 1987. Old Growth Habitat Characteristics and Management Guidelines	DATED	The HLC NF uses the BASI to define old growth (Green et al 1992, errata corrected 2011), which is more current than the definitions used in this document (1984). The distributions and

Commenter(s)	Citation	Response code	Rationale
			patch sizes used by the Kootenai are not necessarily congruent with the ecosystems and wildlife species present on the HLC NF. Some of the citations used in this document, however, are utilized in the HLC NF analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 1997. Evaluation of EIS Alternatives by the Science Integration Team	GEN	All references submitted to the HLC NF were reviewed and added to the analysis as appropriate. Consideration of appropriate geography was also a part of our review.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2000. Expert Interview Summary for the Black Hills National Forest Land and Resource Management Plan Amendment	IRR	Paper is based on an expert opinion, which can have value; however, the sample size was three, significantly limiting inference, moreover the area of concern was not equivocal to the Planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2000. Forest Service Roadless Area Conservation Draft Environmental Impact Statement Volume 1	GEN	The Plan is consistent with all law, regulation, and policy for IRAs. The FEIS addresses the impacts of the IRAs located on the HLC NF across all resource areas.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2000. Forest Service Roadless Area Conservation Final Environmental Impact Statement Volume 1	GEN	The Plan is consistent with all law, regulation, and policy for IRAs. The FEIS addresses the impacts of the IRAs located on the HLC NF across all resource areas.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2003. Bristow Area Restoration Project Environmental Assessment, Kootenai National Forest	IRR	The EA outlines a general description of the ecology/management of the species. This information is more relevant to a project-level analysis and does directly inform forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2007. Draft Environmental Impact Statement Grizzly Vegetation and Transportation Management Project Three Rivers Ranger District, Kootenai National Forest	GEN	General document, with findings inclusive in other literature considered (e.g., Grizzly Bear Conservation Strategy)
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2007. TREGO EA Response to Comments	N/A	The reference could not be located; no review was done.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2008. Young Dodge chapter 4 - public involvement and response to public comment	CON	Detrimental soil impacts are addressed using other more relevant citations. The 15% detrimental soil disturbance areal limit is defined by the regional soil quality standards. The 15% limit is a benchmark that indicates when changes in soil properties or conditions may result in substantial or permanent impairment of productivity. This is not based on the feasibility of logging methods. Furthermore, bulk density can be used as an indicator of soil compaction; detrimental soil compaction can alter soil function and potentially alter soil productivity.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2008. YOUNG DODGE; Draft Supplemental Environmental Impact Statement	IRR	The document does not contain the quote cited by the commenter. The 15% standard is based on regional soil quality standards.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2009. Draft environmental impact statement: Lakeview-Reeder fuels reduction project	GEN	The Plan uses the definition of ecological integrity from the 2012 planning rule and associated directives (2015).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2011. Environmental Assessment: Griffin Creek Resource Management Project	IRR	The EA outlines a general description of the ecology/management of the species. This information is more relevant to a project-level analysis and does directly inform forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2016. Categorical exclusion worksheet: resource considerations soils Smith Shields Forest Health Project	CON	The Plan is consistent with Region 1 soil quality standards. The FSM 2500 acknowledges that the link between soil quality and productivity is unclear and our understanding will continue to evolve as research continues. Thus, the Washington office is directed to coordinate studies with research and development staff to validate the soil quality indicators to ensure protection of soil productivity.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA 2017. Draft Environmental Impact Statement Pine Mountain Late-Successional Reserve Habitat Protection and Enhancement Project Lake and Mendocino Counties, California	CON	The HLC NF analysis uses a variety of literature sources related to future climate and the use of the natural (historical) range of variability, that are equally or more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA FS 2000. Environmental Effects of Postfire Logging: Literature Review and Annotated Bibliography.	CITE	Cited in terrestrial vegetation section (cited as McIver et al 2000).
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA, USDI 1996. Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins	IRR	This citation is from data collected in the Columbia River basin. Only 1 watershed on the H-LC falls within this area (Blackfoot). The Plan uses data collected by the PIBO program to evaluate the influence of roads on fish habitat conditions.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USDA, USDI 1996. Status of the Interior Columbia Basin	IRR	This citation is from data collected in the Columbia River basin. Only 1 watershed on the H-LC falls within this area (Blackfoot). The Plan uses data collected by the PIBO program to evaluate both status and trend of aquatic conditions.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	USEPA 1999. Considering ecological processes in environmental impact assessments	CON	Concepts are addressed using other literature sources equally or more relevant to the HLC NF planning area.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Vanbianchi 2017. Canada lynx use of burned areas: Conservation implications of changing fire regimes	CON	Findings of Vanbianchi et al. 2017 are out of context as they relate to the planning area and lynx use of burned areas. While it is true the authors found lynx used burned landscapes more often than previously thought, the overall probability of lynx use was low within new (1-6 years post fire), high severity burned areas, and that use within those burned areas occurred within residual, unburned cover patches (ie., fire skips). Research staff out of Region 1 are presently conducting similar research in NW MT. The study is not complete, but preliminary observations of both collared and non-collared individuals (ie., from tracks) indicate that lynx are using unburned patches (fire skips) within wildfire perimeters. And, use was especially notable along fire perimeters (the ecotone between burned and unburned forest) during the first-year post-fire – likely because those areas tended to have higher densities of snowshoe hare. So, it appears that lynx are continuing to use habitat within their previous home ranges.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	VanderWerf 2009. CO2 emissions from forest loss	CON	The impacts of deforestation are addressed in the carbon sequestration section of the EIS, using other equally or more relevant literature citations. No deforestation is planned on the HLC NF; natural vegetation types would be maintained.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Veblen 2003. Key Issues in Fire Regime Research for Fuels Management and Ecological Restoration	CON	The FEIS references numerous publications on fire regimes that are equally or more relevant. Additionally, the FEIS recognizes that fire regime is only one factor to consider in management actions.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Verbyla and Litaitis 1989. Resampling Methods for Evaluating Classification Accuracy of Wildlife Habitat Models	IRR	General manuscript on model theory and approach; not directly relevant to the forest plan revision process.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Vizcarra 2017. Woodpecker Woes: The Right Tree Can Be Hard to Find	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Wales et al 2007. Modeling potential outcomes of fire and fuel management scenarios on the structure of forested habitats in northeast Oregon, USA	CON	The HLC NF conducted an NRV analysis that similarly concluded that large diameter trees are less abundant than they were historically; and also conducted modeling to predict future outcomes. The Plan and analysis recognize the importance of natural disturbances and used other references equally or more relevant. Supporting publication that management actions should include fire and other active management to restore and maintain ecosystems.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Wasserman et al 2012. Multi Scale Habitat Relationships of Martes americana in Northern Idaho, U.S.A.	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Weir and Corbould 2010. Factors Affecting Landscape Occupancy by Fishers in North-Central British Columbia	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Whitlock et al 20018. Long-term relations among fire, fuel, and climate in the north-western US based on lake-sediment studies.	CITE	This publication is cited in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Wilderness Society 2014. Transportation Infrastructure and access on national forests and grasslands. A literature review May 2014	CON	The impacts of the transportation system on the HLC NF is analyzed across resources using information and literature that is equally or more relevant to the planning area.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Williams & Baker 2014. Global Ecology and Biogeography (2014) 23, 831-835 High-severity fire corroborated in historical dry forests of the western United States: response to Fulé et al.	CON	The FEIS or Plan does not identify the need or desire to remove all mixed and/or high severity fire. The FEIS recognizes that all fire types have their place on the landscape. In areas of WUI or other identified values the FEIS and Plan do provide desired conditions that would seek to limit high severity fire in some areas.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Wisdom et al 2000. Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad-Scale Trends and Management Implications	CON	Paper provides general information, regarding how accessible routes are often snagged out for safety or firewood gathering purposes. This is acknowledged in the analysis.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Witmer et al 1998. Forest Carnivore Conservation and Management in the Interior Columbia Basin: Issues and Environmental Correlates	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Woodbridge & Hargis 2006. Northern Goshawk Inventory and Monitoring Technical Guide	IRR	General manuscript on the ecology/management of the species; would be inclusive in project level analysis but not directly relevant to forest plan revision.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Woodbury et al 2007. Carbon sequestration in the U.S. forest sector from 1990 to 2010	CON	Carbon sequestration levels, rates, and trends at the broad scale and at the HLC NF scale are addressed in the carbon sequestration section of the EIS. The HLC NF analysis used more recent citations that provided carbon sequestration data specific to Region 1 and HLC NF using similar methods as this citation.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Wuerthner 2006. WORLD VIEW	GEN	The FS views fire as an essential part of the ecosystem and recognizes management is needed is some areas due to values. The 2012 Planning Rule and the Plan reflect a reasoned approach between these 2 paradigms.

Commenter(s)	Citation	Response code	Rationale
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ziemer & Lisle 1993. Evaluating Sediment Production by Activities Related to Forest Uses -A Pacific Northwest Perspective	CON	The HLC NF uses other literature citations equally or more relevant to the planning area to address potential watershed effects from logging.
Alliance for the Wild Rockies; Jeff Juel; Wildlands Defense	Ziemer et al 1991. LONG-TERM SEDIMENTATION EFFECTS OF DIFFERENT PATTERNS OF TIMBER HARVESTING	GEN	General paper on simulated effects of timber harvest on sediment delivery from watersheds and ineffectiveness of BMPs. The Forest agrees that this is an important issue and as such plan components and monitoring requirements General paper on effects sediment delivery from roads and timber harvest. The Forest agrees that this is an important issue and as such plan components are included in the Plan to address this issue. The implementation of the Plan as well as subsequent project analysis will be used to reduce the occurrence of this issue. Please see the aquatic ecosystems section of the Plan and the FEIS are included in the Plan to address this issue. The implementation of the Plan as well as subsequent project analysis will be used to reduce the occurrence of this issue. Please see the aquatic ecosystems section of the Plan and the FEIS.
Alliance for the Wild Rockies; Wildlands Defense; Jeff Juel; Defenders of Wildlife; and Wild Earth Guardians	Aubry et al 2007. Distribution and Broadscale Habitat Relations of the Wolverine in the Contiguous United States	AUTH	General information about the species included in other references, including references by the same authors (e.g., Copeland et al. 2010)
Alliance for the Wild Rockies; Wildlands Defense; Jeff Juel; Greater Yellowstone Coalition	Schwartz, Charles C., Mark A. Haroldson, and Gary C. White; 2010. Hazards Affecting Grizzly Bear Survival in the Greater Yellowstone Ecosystem	CON	Broad reference to connectivity, roads and other issues affecting grizzly populations. These topics are considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Backcountry Hunters and Anglers	Gehman et al 2010. Snow-Tracking Surveys on the Helena National Forest, December 2009 — March 2010; By Steve Gehman, Betsy Robinson, and Mike Porco	GEN	The local presence of species across the HLF NF was considered; these surveys in particular are not cited or needed to inform the Plan or FEIS analysis.
Backcountry Hunters and Anglers	Gehman et al 2012. Snow-Tracking Surveys on the Helena National Forest, December 2011 — March 2012; By Steve Gehman, Betsy Robinson, and Kalon Baughan	GEN	The local presence of species across the HLF NF was considered; these surveys in particular are not cited or needed to inform the Plan or FEIS analysis.
Backcountry Hunters and Anglers	Gehman, Steve 2014. With support from Kalon Baughan and Betsy Robinson- Wild Things Unlimited; April 2014. Carnivore Surveys in the Ogden Mountain	CON	The local presence of species across the HLF NF was considered; these surveys in particular are not cited or needed to inform the Plan or FEIS analysis.

Commenter(s)	Citation	Response code	Rationale
	to Nevada Creek Region; Selected Data Summaries and Conclusions		
Backcountry Hunters and Anglers	Pilgrim & Schwartz 2011. Project Report: Helena National Forest Carnivore Surveys. Conducted by Wild Things Unlimited-winter 2010-2011. individual and sex identification	GEN	The local presence of species across the HLF NF was considered; these surveys in particular are not cited or needed to inform the Plan or FEIS analysis.
Backcountry Hunters and Anglers	Pilgrim 2010. Project Report: Helena National Forest and Beaverhead-Deerlodge National Forest Carnivore Surveys. Conducted by Wild Things Unlimited-winter 2009-2010. Lynx (Lynx canadensis) and wolverine (Gulo gulo) sample results (updated).	GEN	The local presence of species across the HLF NF was considered; these surveys in particular are not cited or needed to inform the Plan or FEIS analysis.
Backcountry Hunters and Anglers and Defenders of Wildlife	Gehman et al 2014. Snow-Tracking Surveys on the Helena National Forest, December 2012 — March 2013; By Steve Gehman, Betsy Robinson, and Kalon Baughan	GEN	The local presence of species across the HLF NF was considered; these surveys in particular are not cited or needed to inform the Plan or FEIS analysis.
Bitterroot Backcountry Cyclists	Taylor, Audrey R. and Richard L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions.	AUTH	Effects of nonmotorized recreation discussed in FEIS (elk and Canada lynx sections, for example) using other more recent and relevant literature.
Capital Trail Vehicle Association; Carroll College	Wang, Linda 2011. Federal Income Tax on Timber; A Key to Your Most Frequently Asked Questions. United States Department of Agriculture, 2011. Revised by Linda Wang USDA Forest Service	CON	The economic considerations for the timber resource is addressed using other literature sources that are equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Carroll College	Sylvester, James T. Montana recreational Off-Highway Vehicles Fuel-Use and Spending Patterns 2013; Prepared for: Montana State Parks by James T. Sylvester, Bureau of Business and Economic Research, University of Montana	CON	The economic considerations for various modes of recreation are addressed using other literature sources that are equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Carroll College; Citizens for Balanced Use	Wilson, John P. and Joseph P. Seney. 1994. Erosional Impact of Hikers, Horses, Motorcycles, and Off-Road Bicycles on Mountain Trails in Montana. Source: Mountain Research and Development, Vol. 14, No. 1 (Feb., 1994), pp. 77-88	CON	This was a specific small study on the Gallatin that found displacement from horses provided the most available sediment. Cannot be expanded to the level of the plan. Soil properties are more important in determining erosion potential, than the method of conveyance. Site specific effects of specific types of recreation on trail erosion is beyond the scope of forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	2004. Danskin Mountain (Boise NF)	IRR	Citation is website regarding MVUM for the Boise NF. Not relevant to the HLC NF planning area or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	2006 Public Opinion Poll on Western Colorado Forest Management Issues, Key Findings	IRR	Document shows the results of a poll specifically of users of the GMUG in Colorado. The users and landbase are not necessarily consistent with that of the HLC NF. The HLC NF considered public comments throughout the forest planning process associated with desired recreational opportunities.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	36 CFR Parts 212, 251, 261, and 295; Travel Management; Designated Routes and Areas for Motor Vehicle Use; Final Rule	IRR	Law, regulation, and policy for travel management. The Plan is not a travel planning document. It is consistent with applicable law, regulation, and policy.
Capital Trail Vehicle Association; Citizens for Balanced Use	A Guide to the Trail (multiple pages within website)	IRR	Examples of urban trails. Not relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Adams. “Access Denied - Closing Our Forests”.flv ; Carl Anthony Adams	IRR	YouTube video, opinion. Not directly relevant. The Plan is not a travel planning document.
Capital Trail Vehicle Association; Citizens for Balanced Use	Allen 2015. Alliance for Wild Rockies should work on projects, not lawsuits, DAVID ALLEN, Aug 27, 2015	IRR	Opinion piece on site-specific projects. Not relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	ALLIANCE FOR THE WILD ROCKIES and NATIVE ECOSYSTEMS COUNCIL, Plaintiffs, vs. ABIGAIL KIMBELL, Regional Forester; UNITED STATES FOREST SERVICE, and UNITED STATES FISH AND WILDLIFE SERVICE, Defendants.	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Anderson 2018. Guest view: Green groups rely on dark money too; TERRY L. ANDERSON Jul 6, 2018	NOT RLB	Opinion article, not directly relevant to the HLC NF forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Arizona Peace Trail, website	IRR	The motorized trails included as examples from Arizona are not directly relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Arizona State Parks 2003. Economic Importance of Off-Highway Vehicle Recreation to Arizona.	CON	Recreation economics are viewed differently by the National Forest System than by the Industry. Accounting for Forest related visitor use spending, the National Forest only considers non-durable good expenditures within fifty miles of the Forest boundary. This article is contextually considered in that recreation economics were reviewed in the contribution model and are not expected to change as a result of the Plan decision. The spectrum of motorized uses available remains, and visitor patterns remain linked to greater economic and cultural trends, as oppose to management area designation.
Capital Trail Vehicle Association; Citizens for Balanced Use	AWR Files Lawsuit: East Reservoir Project, 5/12/2015	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Backus 2004. ATVs banned from some trails in Pioneers; By Perry Backus of The Montana Standard - 05/13/2004	IRR	This article about ATV trail closures on the B-D is not directly relevant to the HLC NF or the forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Baird 2006. Environmentalists: Court rules issue is settled, suit is moot	IRR	Newspaper article about road conflict in Utah; not directly applicable to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Baumann 2014. FWP chief says grizzly delisting nearing, By LISA BAUMANN Associated Press, May 16, 2014	DATED	The Plan is consistent with the latest law, regulation, policy, and scientific information regarding grizzly bears. The analysis uses a body of literature more recent and relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	BBC News 2003. Fire-ravaged Portugal faces erosion	CON	The issue of post-fire erosion is addressed with information more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Berger Group Inc 2009. Economic Contribution of Off-Highway Vehicle Recreation in Colorado	IRR	The economic contribution of OHV use in the HLC NF planning area has been considered using information relevant to the planning area. This information is specific to Colorado.
Capital Trail Vehicle Association; Citizens for Balanced Use	Blog: July 4, 2017: Coldest July Temperature Ever Recorded In The Northern Hemisphere	NOT RLB	Blog, containing posts refuting climate change. Does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	Bodkin 2017. Climate change not as threatening to planet as previously thought, new research suggests	IRR	Newspaper article. Discusses research that climate is warming more slowly than predicted earlier. Does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	Booker 2009. Polar bear expert barred by global warmists	IRR	Polar bear populations are not directly relevant to issues on the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Bosworth 2006. Travel Management, Schedule for Implementation; letter from Chief Bosworth, June 8, 2006	IRR	The Plan is not a travel planning document.
Capital Trail Vehicle Association; Citizens for Balanced Use	Bunte and Abt 2001. Sampling Surface and Subsurface Particle-size Distributions in Wadable Gravel-and Cobble-bed Streams for Analysis in Sediment Transport, Hydraulics, and Streambed Monitoring.	GEN	Reference deals with physical properties of sediment mobilization. Nothing about trail erosion as noted in the Description. National Core BMPs will be followed.
Capital Trail Vehicle Association; Citizens for Balanced Use	Bureau of Economic Analysis 2018. Outdoor Recreation Satellite Account, Prototype Estimates, 2012-2016.	CON	Recreation economics are viewed differently by the National Forest System, then by the Industry. Accounting for Forest related visitor use spending, the National Forest only considers non-durable good expenditures within fifty miles of the Forest boundary. This article is contextually considered in that recreation economics were reviewed in the contribution model and are not expected to change as a result of the Plan decision. The spectrum of motorized uses available remains, and visitor patterns remain linked to greater economic and cultural trends, as oppose to management area designation.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Burr et al 2007. Physiological Demands of Off-Road Vehicle Riding	CITE	This publication has been cited in FEIS in relation to health benefits of recreation.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2002. Following the paper trail; By Eve Byron, IR Staff Writer - 03/11/02	IRR	Article about environmental groups and funding. Not directly relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2002. From backpacks to briefcases, for many protecting the environment has become a big bucks business in Montana; By Eve Byron, IR Staff Writer - 03/10/02	IRR	Article about litigation. Not directly applicable to the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2002. Groups draw money from across the U.S.; By Eve Byron, IR Staff Writer - 03/10/02	IRR	Article about environmental groups and funding. Not directly relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2003. Deal cuts plan's size in half, By Eve Byron, IR Staff Writer - 01/23/03	IRR	Newspaper article about a past site-specific logging project. Not relevant to the forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2005. Timber sale reduced by 85%, By EVE BYRON - IR Staff Writer - 12/07/05	IRR	Newspaper article about a past site-specific logging project. Not relevant to the forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2009. Changing attitudes stymie elk managers, by EVE BYRON; Independent Record - 04/26/2009	IRR	News article; not a scientific paper. Not directly applicable to the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2010. Area forests hazardous to impassable; By EVE BYRON Independent Record; May 28, 2010	NOT RLB	Not peer reviewed. The relative impacts of wildfire and motorized uses on the resources of the HLC NF are analyzed with other literature citations.
Capital Trail Vehicle Association; Citizens for Balanced Use	Byron 2015. Road accessing NF land gated, locked (December 15, 2012 article)	IRR	The Plan is not a travel management document. This article about a specific gated area is not relevant to the HLC NF forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Cappiello 2008. Grizzlies thriving in Montana, By DINA CAPPIELLO - Associated Press - 09/17/08	DATED	The Plan is consistent with the latest law, regulation, policy, and scientific information regarding grizzly bears. The analysis uses a body of literature more recent and relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Cates 2014. Public gives input on forest plan; Kristen Cates, kcates@greatfallstribune.com Published 8:07 p.m. MT June 30, 2014	NOT RLB	Opinion article
Capital Trail Vehicle Association; Citizens for Balanced Use	Cates-Carney 2015. Environmental Groups Suing Over Bull Trout Recovery Plan, By Corin Cates-Carney • Oct 7, 2015	IRR	Article about environmental groups suing another agency (FWS) about a bull trout recovery plan. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	CBS News 2007. Number of Hunters In U.S. Declining September 3, 2007	IRR	News article, not a scientific paper; information is national in scale and not directly applicable to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Census.gov: Age and Sex Composition in the United States: 2012	IRR	The census data provided is not directly applicable to the HLC NF forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Cessford 1995	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Chaney 2014. Judge Clarifies USFS must Analyze New Acres before Logging in Swan, Dec 9, 2014 by Rob Chaney	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Chaney 2017. Glacier Park easing boating restrictions due to mussels, ROB CHANEY rchaney@missoulian.com, 3/17/2017	IRR	Newspaper article about boating restrictions in Glacier NP. Not directly applicable to the HLC NF forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Chavez et al 1993	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Chief Mountain and Silver State Trail Systems	IRR	Exact link not accessible; related to OHV trail system in another area. Not directly relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Climate Science and Policy Watch website	NOT RLB	The HLC NF uses a body of science related to climate change and potential impacts. Opposing literature is not provided at this site; it is an opinion piece.
Capital Trail Vehicle Association; Citizens for Balanced Use	CO2.earth website	NOT RLB	Cannot locate the information referenced in the letter; website appears to indicate increasing CO2 levels. HLC NF uses other literature to discuss climate change and carbon.
Capital Trail Vehicle Association; Citizens for Balanced Use	Cole 1991. Changes on Trails in the Selway-Bitterroot Wilderness, Montana, 1978-89; David N. Cole	CON	The potential impacts of various trail uses is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Collins 2000. Locked out of the public lands, Rich folks are blocking the public domain, say hunters and ORV riders. Katharine Collins | April 24, 2000	CON	Motorized access and effects are addressed in the FEIS with information that is equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Confirmation bias; From Wikipedia, the free encyclopedia	IRR	The Plan is not a travel plan document. Information is not directly applicable to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Continental Divide National Scenic Trail Decision Notice and Finding of No Significant Impact, 1989	CON	The Plan is consistent with law, regulation, and policy related to the CDNST, including the issue of motorized uses. The specific link does not work and the document is not cited.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Cordell et al 2005. Off-Highway Vehicle Recreation in the United States, Regions and States: A National Report from the National Survey on Recreation and the Environment (NSRE)	CON	Subject of recreation visitation, motorized and nonmotorized, and economic benefits associated with it are summarized and analyzed using current peer reviewed expenditure data, as well as methodology.
Capital Trail Vehicle Association; Citizens for Balanced Use	Cox 2010. How Much of the World is Covered by Cities? | Newgeography.com	CON	The issue of climate change has been addressed with a body of other literature more relevant to the HLC NF and the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Crimmons 2006. Management Guidelines for Off-Highway Vehicle Recreation	IRR	The Plan is a programmatic document and does not address site-specific trail planning, design, or maintenance.
Capital Trail Vehicle Association; Citizens for Balanced Use	Davis, Stacy C., Patricia S. Hu, Lorena F. Truett. 1999. Fuel Used for Off-Road Recreation: A Reassessment of the Fuel Use Model.	CON	The economic contributions of OHV use are acknowledged in the FEIS and Assessment. This publication provides information about OHV fuel use at a statewide level and is over 20 years old; it does not provide additional information critical to the recreation or economics analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	DOJMT Motor Vehicle Registrations 2012	IRR	The HLC NF Plan and FEIS acknowledge the popularity and contributes of OHV use as appropriate. This document is at a statewide level and is not specifically relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Dr. Roy Spencer website	IRR	Specific article not found. The HLC NF uses other literature to discuss climate change issues.
Capital Trail Vehicle Association; Citizens for Balanced Use	Dubb 2005. Pacific Crest Quest (a 3000-mile motorized route that follows closely to the PCT)	IRR	The motorized trails included as examples from the Pacific Crest Trail area are not directly relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	East Fork Rock OHV Trail System	IRR	Citation is a website about an OHV trail system in Oregon. Not relevant to the HLC NF planning area or forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	English et al. Tennessee OHV Economic Impact, A $3.4 Billion Industry,	IRR	The economic contribution of OHV use in the HLC NF planning area has been considered using information relevant to the planning area. This information is specific to Tennessee.
Capital Trail Vehicle Association; Citizens for Balanced Use	EPA/USFS Website: Sustainable ATV Trails	IRR	The Plan is a programmatic document and does not address site-specific trail design.
Capital Trail Vehicle Association; Citizens for Balanced Use	Erb 2018. Volunteers repair fire-damaged Continental Divide National Scenic Trail; JORDAN ERB jerb@helenair.com Jul 12, 2018	IRR	Not relevant to the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	FHA 2017. Connecting Communities: Integrating Transportation and Recreation Networks, how do OHVs connect communities?	CON	Subject of recreation visitation, motorized and nonmotorized, and economic benefits associated with it are summarized and

Commenter(s)	Citation	Response code	Rationale
			analyzed using current peer reviewed expenditure data, as well as methodology.
Capital Trail Vehicle Association; Citizens for Balanced Use	Fish and wildlife management on federal lands: debunking state supremacy, BRIEFING PAPER; 6/1/2017	NOT RLB	USFS follows existing legal requirements.
Capital Trail Vehicle Association; Citizens for Balanced Use	Forsyth 2016. Myths about global warming are not facts	IRR	Opinion newspaper article. Does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	Freddy et al 1986. Responses of Mule Deer to Disturbance by Persons Afoot and Snowmobiles	AUTH	Effects of nonmotorized recreation discussed in FEIS (elk and Canada lynx sections, for example) using other more recent and relevant literature.
Capital Trail Vehicle Association; Citizens for Balanced Use	Fritz et al 1993	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	FS Environmental Appeal Decisions website	IRR	Website related to FS appeals - not directly relevant to the HLC NF forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Furillo 2017. Sacramento County reeling from jury's $107 million verdict against it in mining case; By Andy Furillo, 3/22/2017 6:47:00 PM	IRR	Article about environmental groups and funding. Not directly relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Gander & Ingold 1997	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Gaspipe 2006. ATV rider blog, TransAM Trail	IRR	The motorized trails included as examples are not directly relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Geoft & Alder 2001	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Gevock 2005. Elk kill up 25% By Nick Gevock of The Montana Standard - 11/30/2005	IRR	News article, not a scientific paper. Information is not directly applicable to the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Global Warming Petition Project	NOT RLB	Petition/opinion - credentials of signatories are provided but does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	Green Decoys homepage	IRR	Article about environmental groups. Not directly relevant to the HLC NF forest plan revision process or analysis.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Green Decoys Montana homepage	IRR	Article about environmental groups. Not directly relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Hamilton 1997. A Partial Literature Review Of The Effects Of Various Human Activities On Wildlife; Compiled By Nora Hamilton, Bureau Of Land Management, National Technical Assistant For Trails, September, 1997.	INC	The information presented is largely dated and the outcomes are less than clear to differentiate the effects of motorized versus nonmotorized recreation on wildlife.
Capital Trail Vehicle Association; Citizens for Balanced Use	Hellmund 1998	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	How radical environmentalists are using “sportsmen’s” groups as camouflage	IRR	Article about environmental groups. Not directly relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Idaho Trails mapping tool	GEN	Document is an example map of a trails mapping tool. The HLC NF used a collaborative mapping tool to engage the public on existing and desired uses. This example map is not relevant to the HLC NF and is therefore not specifically cited.
Capital Trail Vehicle Association; Citizens for Balanced Use	Inhofe 2006. Hot & Cold Media Spin Cycle: A Challenge to Journalists Who Cover Global Warming Senator James Inhofe, Chairman, Senate Environment And Public Works Committee; Senate Floor Speech Delivered: Monday September 25, 2006	NOT RLB	The issue of climate change and associated impacts are addressed with a body of literature more relevant to the HLC NF and reliable. This is a speech and not a literature citation.
Capital Trail Vehicle Association; Citizens for Balanced Use	Johnson, EA 2016. 'Global cooling' far more devastating than global warming. Guest View: EA Johnson	NOT RLB	The issue of climate change, including opposing science, has been addressed with a body of other literature more relevant to the HLC NF and the forest plan revision process. This citation is an opinion article, not a peer-reviewed source.
Capital Trail Vehicle Association; Citizens for Balanced Use	Judge: Hebgen Logging Project needs USFWS Assessment for Bears, Lynx, 12/9/2014	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Kawashima 1. Neuroscience and Smart Aging, PowerPoint by Ryuita Kawashima; 2. Motorcycles Make You Smarter: Japanese Study Discovers A Link Between Riding and Thinking	CITE	This publication has been cited in FEIS in relation to health benefits of recreation.
Capital Trail Vehicle Association; Citizens for Balanced Use	Koch 2013. Wildfire smoke becoming a serious health hazard	CON	The issue of wildfire smoke and health is discussed in the FEIS using citations equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Kollmeyer 2005. Timber suit disappointing, By Jane Kollmeyer - 07/17/05 Jul 17, 2005	IRR	Opinion piece about past site-specific salvage sales. Not relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Kuglin 2014. Law of the land: How litigation has shaped the Forest Service; Tom Kuglin Nov 9, 2014	IRR	Article about litigation. Not directly applicable to the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Lassen Backcountry Discovery Trail, website	IRR	The motorized trails included as examples from the Lassen are not directly relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Lawsuit Launched for Endangered Species Act Protection of Monarch Butterflies	IRR	Article about ESA litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	List of nonmotorized groups	IRR	Lists of nonmotorized groups are not directly relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Marion & Wimpey 2007. Environmental Impacts of Mountain Biking: Science Review and Best Practices By Jeff Marion and Jeremy Wimpey	CON	The impacts of various recreation uses, including motorized and nonmotorized uses, is addressed in the FEIS using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	McKee 2003. Residents turn to wood as natural gas prices soar, Helena IR 2003	CON	The availability of firewood is addressed as appropriate in the Other Forest Products section of the FEIS.
Capital Trail Vehicle Association; Citizens for Balanced Use	Meeting notes from TSH Restoration Collaborative Committee and Wildlife considerations/notes for TSH project	IRR	Meeting notes about a site-specific project. Not relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Michigan Cross Country Cycle Trail (MCCCT) maps, from Web page of Michigan Cross Country Trail Maps	IRR	Citation is a series of maps from Michigan. Not relevant to the HLC NF planning area or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Michigan cross country trails overview web page	IRR	Citation is a series of maps from Michigan. Not relevant to the HLC NF planning area or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Michigan Dept. of Natural Resources: Designated ORV, ATV, Motorcycle and MCCCT Trails, map	IRR	Citation is a series of maps from Michigan. Not relevant to the HLC NF planning area or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Modoc Backcountry Discovery Trail, website	IRR	The motorized trails included as examples from the Modoc are not directly relevant to the HLC NF or the forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Montana Environmental Quality Council 2015. Summary of Road Information for Montana's National Forest System. HJ13 Study - Environmental Quality Council	IRR	Information not relevant to the Plan or plan components.
Capital Trail Vehicle Association; Citizens for Balanced Use	Montana State Parks: RECREATION GRANTS, Recreational Trails Program	IRR	Document is specific to funding and trail programs for the State of Montana and is not applicable to NFS lands or policy.
Capital Trail Vehicle Association; Citizens for Balanced Use	Montana Wilderness Association vs. US Forest Service 2008	GEN	The Plan is consistent with law, regulation, and policy regarding WSAs.
Capital Trail Vehicle Association; Citizens for Balanced Use	Montana Wilderness Association vs. US Forest Service 2011	GEN	The Plan is consistent with law, regulation, and policy regarding WSAs.
Capital Trail Vehicle Association; Citizens for Balanced Use	Montana Wilderness Association vs. US Forest Service Wilderness Study area decision 2002	GEN	The Plan is consistent with law, regulation, and policy regarding WSAs.
Capital Trail Vehicle Association; Citizens for Balanced Use	Montana Wilderness Study Act of 1977	CITE	The WSA act is included as regulatory framework in the FEIS. The Plan is consistent with this framework.
Capital Trail Vehicle Association; Citizens for Balanced Use	Moore 1994. Conflicts on Multiple-Use Trails: Synthesis of the Literature and State of the Practice	GEN	Although not specifically cited, the Plan is generally consistent with the principles presented in this document, to the degree appropriate in a programmatic land management plan.
Capital Trail Vehicle Association; Citizens for Balanced Use	Motor Vehicle Use Map (MVUM) Development in Support of the Travel Management Rule (36CFR212)	IRR	The Plan is not a travel planning document.
Capital Trail Vehicle Association; Citizens for Balanced Use	MT. Montana State Parks: RECREATION GRANTS Off-Highway Vehicle Program	CON	Not specifically relevant to Forest Plan revision. The economic benefits of motorized uses are acknowledged as appropriate in the FEIS and assessment.
Capital Trail Vehicle Association; Citizens for Balanced Use	MTDOT. Montana Department of Transportation www.mdt.mt.gov Instructions for Agricultural Standard Deduction Refund Application for Montana’s Diesel or Gasoline Tax	CON	Not specifically relevant to Forest Plan revision. The economic benefits of motorized uses are acknowledged as appropriate in the FEIS and assessment.
Capital Trail Vehicle Association; Citizens for Balanced Use	MFWP. 2014-2018 Statewide Comprehensive Outdoor Recreation Plan (SCORP)	CITE	This citation has been included in the cumulative effects analysis (other agency land management plans).
Capital Trail Vehicle Association; Citizens for Balanced Use	Multiple websites concerning off-road vehicle tourism.	IRR	The importance of OHV tourism and associated trails on the HLC NF is addressed as appropriate in the FEIS and Assessment using information more relevant to the HLC NF planning area.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Multiple websites concerning recreational vehicles and noise.	IRR	Sound is a site-specific issue and beyond the scope of the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Multiple websites concerning sage grouse.	IRR	There is no occupied sage grouse habitat on NFS lands in the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	National Off-Highway Vehicle Conservation Council home page	IRR	The Plan is a programmatic document and does not address site-specific trail planning, design, or maintenance.
Capital Trail Vehicle Association; Citizens for Balanced Use	National Off-Highway Vehicle Conservation Council website, reference to Great Trails book	IRR	The Plan is a programmatic document and does not address site-specific trail planning, design, or maintenance.
Capital Trail Vehicle Association; Citizens for Balanced Use	National Shooting Sports Foundation 2010. Issues Related to Hunting Access in the United States; January 2010 (comment cites November 2010 but couldn't find that one)	CON	The Plan is consistent with law, regulation, and policy with respect to IRAs. The FEIS uses citations equally or more relevant to address the effects of suitable uses in IRAs.
Capital Trail Vehicle Association; Citizens for Balanced Use	NATIONAL TRAILS SYSTEM ACT (AND RELATED LAWS); [As Amended Through Public Law 106–170, Dec. 31, 1999]	CITE	Law, regulation and policy. This law is considered in the FEIS analysis and the Plan is consistent with it.
Capital Trail Vehicle Association; Citizens for Balanced Use	NATIVE ECOSYSTEMS COUNCIL ALLIANCE FOR THE WILD ROCKIES WILDWEST INSTITUTE v. Sitz Angus Ranch; Gary L. Clark; Moose Creek Grazing Association; Max L. Robinson, Sr.; Max J. Robinson, Jr.; Montana Stockgrowers Association; Montana Wool Growers Association, Intervenors-Appellees.	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	NATIVE ECOSYSTEMS COUNCIL, Plaintiff–Appellant, v. Leslie WELDON, in her official capacity as Regional Forester of Region One of the U.S. Forest DWM Service; United States Forest Service, an agency of the U.S. Department of Agriculture, Defendants–Appellees.	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	NATIVE ECOSYSTEMS COUNCIL, Plaintiff--Appellant, v. UNITED STATES FOREST SERVICE, an agency of the U.S. Department of Agriculture; DWIGHT CHAMBERS, acting supervisor, Helena National Forest; KATHLEEN MCALLISTER, Acting Regional Forester for Region One U.S. Forest Service; DALE BOSWORTH, Chief of United States Forest Service, Defendants--Appellees.	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	NCAR 2007. US Fires Release Large Amounts Of Carbon Dioxide	CON	Emissions from fire is analyzed in the FEIS including more recent publication from Wiedinmyer.
Capital Trail Vehicle Association; Citizens for Balanced Use	Nie et al 2017. Fish and wildlife management on federal lands: debunking state supremacy	NOT RLB	USFS follows existing legal requirements.
Capital Trail Vehicle Association; Citizens for Balanced Use	Nie et al 2017. Fish and wildlife management on federal lands: debunking state supremacy. Power point presentation, 2017	NOT RLB	PowerPoint presentation. USFS follows existing legal requirements.
Capital Trail Vehicle Association; Citizens for Balanced Use	NOHVCC 2018. Presentation: A Trail System for Economic Development, 2017 NOHVCC Conference; Manchester, NH.	CON	Recreation economics are viewed differently by the National Forest System, then by the Industry. Accounting for Forest related visitor use spending, the National Forest only considers non-durable good expenditures within fifty miles of the Forest boundary. This article is contextually considered in that recreation economics were reviewed in the contribution model and are not expected to change as a result of the Forest Plan decision. The spectrum of motorized uses available remains, and visitor patterns remain linked to greater economic and cultural trends, as opposed to management area designation.
Capital Trail Vehicle Association; Citizens for Balanced Use	NVUM ROUND 1 output, forest-level visitation and confidence intervals	GEN	The HLC NF followed the wilderness inventory and evaluation procedure in the FSH 1909.12, Chapter 70.
Capital Trail Vehicle Association; Citizens for Balanced Use	Off-Highway Vehicle Environmental Impact Statement and Proposed Plan Amendment for Montana, North Dakota and South Dakota (3-State OHV) decision	IRR	The Plan is not a travel management document. Land management plan regulations and policy are different between the BLM and FS. Adjacent BLM land management plans were considered in the cumulative effects analysis, which are more recent.
Capital Trail Vehicle Association; Citizens for Balanced Use	Online blog. Crossing Montana to Canada on Dirt Bikes, online blog/forum.	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Online blog. Crossing Montana to Canada on Dirt Bikes.	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Outdoor Industry Association 2012. The Outdoor Recreation Economy.	CON	Industry wide economic contributions are a much broader economic context than specific expenditures for the purpose of visitation to National Forests.
Capital Trail Vehicle Association; Citizens for Balanced Use	Paiute ATV trail: Web page provides an overview of the trail	IRR	Citation is a website about the Paiute ATV trail. Not relevant to the HLC NF planning area or forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Person, Daniel 2011. Environmental groups no strangers to courthouse, From the Green Town, USA series, By DANIEL PERSON and CARLY FLANDRO, Chronicle Staff Writers, Mar 28, 2011	IRR	Article about site-specific project litigation. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Pinchot Institute for Conservation. Protecting front range forest, Watersheds from high-severity wildfires an assessment by the Pinchot institute for conservation funded by the Front range fuels treatment partnership	CON	The EIS analyzes the causal effects of recent insect activity, and potential future activity, using a variety of literature sources equally or more relevant to the planning area; and addresses the effects of land allocations such as wilderness areas.
Capital Trail Vehicle Association; Citizens for Balanced Use	R.S. 2477: The Legal Battle Continues	CON	General article about trail conflict issues. The HLC NF considered information more relevant to the planning area regarding trail uses.
Capital Trail Vehicle Association; Citizens for Balanced Use	Research: Grizzlies not so dependent on pine nuts, Associated Press, Nov 8, 2013	NOT RLB	The Plan is consistent with the latest law, regulation, policy, and scientific information regarding grizzly bears. The analysis uses a body of literature more recent and relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Ridge to Rivers website	IRR	Citation is specific to urban and motorized trails in Boise, ID. It is not relevant to the HLC NF or forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Samuelson 2015. Can we set the world's temperature?	IRR	Newspaper article. Focused on renewable energy versus fossil fuels. Not relevant to the issues or the decision being made with forest plan revision on the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Schneider and Schoeneck 2005. All-terrain Vehicles in Minnesota: Economic impact and consumer profile	IRR	The economic contribution of OHV use in the HLC NF planning area has been considered using information relevant to the planning area. This information is specific to Minnesota.
Capital Trail Vehicle Association; Citizens for Balanced Use	Schultz, Richard D., and James A. Bailey 1978. Responses of National Park Elk to Human Activity. The Journal of Wildlife Management, Vol. 42, No. 1 (Jan. 1978), pp. 91-100	IRR	Reference is only relevant to habituated populations (e.g., in a national park).
Capital Trail Vehicle Association; Citizens for Balanced Use	Silberman 2003. The Economic Importance Of Off-Highway Vehicle Recreation, Economic data on off-highway vehicle recreation for the State of Arizona and for each Arizona County Study, Jonathan Silberman, PhD. Prepared by School of Management	IRR	The economic contribution of OHV use in the HLC NF planning area has been considered using information relevant to the planning area. This information is specific to Arizona.
Capital Trail Vehicle Association; Citizens for Balanced Use	Silberman and Anderick 2006. Economic Value of Off Highway Vehicle Recreation 2006.	CON	Subject of recreation visitation, motorized and nonmotorized, and economic benefits associated with it are summarized and analyzed using current peer reviewed expenditure data, as well as methodology.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Simon, Andrew 2006. Evaluation of the Importance of Channel Processes in CEAP-Watershed Suspended Sediment Yields. IN: Proceedings of the Eighth Federal Interagency Sedimentation Conference, April 2-6, 2006. Reno, NV, USA.	IRR	Paper is related to channel bank and edge effects in low gradient agriculture systems (Iowa, Nebraska, etc.)
Capital Trail Vehicle Association; Citizens for Balanced Use	Simon, Ronna J. 2006: Using Multiple Indicators to Detect Geomorphic Channel Changes in Response to Wildfire; Lee H. MacDonald and Peter R. Robichaud 2008: Post-fire Erosion and the Effectiveness of Emergency Rehabilitation Treatments over Time	CON	The topic of soil erosion is covered with other literature sources more relevant to the HLC NF forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	Social impact analysis (SIA): principles and procedures training course (1900-03), course description	GEN	The Plan is consistent with the 2012 Planning Rule.
Capital Trail Vehicle Association; Citizens for Balanced Use	Southeast Federation Mineralogical Societies Inc. webpage on Public Lands Access	IRR	Link does not access the indicated article. Motorized access and effects are addressed in the FEIS with information that is relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	State of CA, OHV Sound Regulations 2003	IRR	The issue of sound is addressed as appropriate in the FEIS using information more relevant to the HLC NF planning area. The Plan is consistent with all applicable law, regulation, and policy.
Capital Trail Vehicle Association; Citizens for Balanced Use	Sunding, David; Aaron Swoboda and David Zilberman. 2003. The Economic Cost of Critical Habitat Designation: Framework and Application to the Case of California Vernal Pools. February 20, 2003.	CON	Quantitative valuation of ecosystem services such as habitat are not provided due to incompleteness of potential cost/benefit analysis. Key ecosystem services are reviewed qualitatively by alternative.
Capital Trail Vehicle Association; Citizens for Balanced Use	Swarthout, Elliott C.H. and Robert J. Steidl. 2003. Experimental Effects of Hiking on Breeding Mexican Spotted Owls	IRR	Spotted owls do not occur in the planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Swearingen & Johnson 1994. Keeping Visitors on the Right Track - Sign and Barrier Research at Mount Rainer", Park Science 14(4) published in 1994	IRR	The issue of sign usage and visitor damage at Mount Rainer is not directly relevant to the Plan or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Sylvester 2009. Montana Off-Highway Vehicles 2008. Prepared for Montana Department of Fish, Wildlife, and Parks.	CON	Subject of recreation visitation, motorized and nonmotorized, and economic benefits associated with it are summarized and analyzed using current peer reviewed expenditure data, as well as methodology.
Capital Trail Vehicle Association; Citizens for Balanced Use	Sylvester 2014. Montana Recreational Off-Highway Vehicles Fuel Use and Spending Patterns 2013.	CON	Subject of recreation visitation, motorized and nonmotorized, and economic benefits associated with it are summarized and analyzed using current peer reviewed expenditure data, as well as methodology.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	The link does not work.	IRR	Link is general to the Sawtooth NF, suggest that it should be to their travel management process. The Plan is not a travel management document.
Capital Trail Vehicle Association; Citizens for Balanced Use	The Montana Legislature, EQC meeting information	DATED	The Plan is consistent with the latest law, regulation, policy, and scientific information regarding grizzly bears. The analysis uses a body of literature more recent and relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Tol et al 2006. Opinion: Save the Panel on Climate Change!	NOT RLB	The issue of climate change and associated impacts are addressed with a body of literature more relevant to the HLC NF and reliable. This is an opinion piece.
Capital Trail Vehicle Association; Citizens for Balanced Use	U.S. Forest Service; Departmental Regulation 5600-2	GEN	The Plan is consistent with all applicable law, regulation, and policy.
Capital Trail Vehicle Association; Citizens for Balanced Use	Uken 2014. Montana suicides continue to creep up; rate remains twice the national average	CON	The issue of the health benefits of outdoor recreation is addressed with other information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	United States Supreme Court: DAUBERT v. MERRELL DOW PHARMACEUTICALS, INC., (1993); No. 92-102 Argued: March 30, 1993. Decided: June 28, 1993	DATED	Substantially more research on the effects of motorized vehicles has been conducted with corresponding effects on legal obligations to minimize effects.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 1993. Sound Levels of Five Motorcycles Travelling Over Forest Trails, Rock Creek ORV Area. Harrison, Makel and Besse. USFS 1993	CON	The issue of sound and recreation experiences is addressed in the FEIS and Assessment using information that is equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2000. National Survey on Recreation and The Environment (NSRE 2000)	CON	The publication is national in scope, 20 years old, and not specific to the HLC NF. Known information on recreation use types and trends was incorporated as appropriate in the FEIS and/or Assessment. The recreation use numbers presented in this document would not help further inform the recreation analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2004. Recreation Statistics Update, Update Report No. 3: Trends and Demographics of Off-road Vehicle Users	CON	The FEIS acknowledges the increase in OHV use in a general fashion, and in context to the HLF NF. The demands for all types of recreation, including OHV use, were considered in the development of the Plan and in the FEIS analysis. The specific statistics listed in this document are national in scope and are not necessary for inclusion in the FEIS.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2005. Finalized Forest Service Rule Improves the Forest Planning Process and Increases Public Involvement--WASHINGTON, DECEMBER 12, 2006 AT 12:00 PM EST	DATED	The Plan is consistent with the latest law, regulation, and policy.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2006. Reference is to letter from RF in Feb. 2006 certifying that part of the CDNST would remain motorized, or alternative routes would be established	CON	The Plan is consistent with law, regulation, and policy related to the CDNST, including where existing motorized routes are the potential for re-routing the trail. There is no need to cite this specific document.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2007. The WEPP Road Batch Model: A Tool for Reducing Erosion from Trails	IRR	Information is not relevant to the forest plan revision process or analysis; site specific trail construction and maintenance are not addressed with this programmatic planning effort.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2011. Review of the Forest Service Response: The Bark Beetle Outbreak in Northern Colorado and Southern Wyoming	CON	The EIS analyzes the causal effects of recent insect activity, and potential future activity, using a variety of literature sources equally or more relevant to the planning area; and addresses the effects of land allocations such as wilderness areas.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2012. Colorado State FS; 2012 Report on the health of Colorado's Forests, Forest stewardship through active management	CON	The EIS analyzes the causal effects of recent insect activity, and potential future activity, using a variety of literature sources equally or more relevant to the planning area; and addresses the effects of land allocations such as wilderness areas.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA 2015. Meeting notes from TSH Restoration Collaborative Committee and Wildlife considerations/notes for Tenmile South Helena project	IRR	Meeting notes about a site-specific project. Not relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA Forest Service 2003. Social Assessment of the Beaverhead-Deerlodge National Forest	CON	Both statistics are available in NVUM reports for the Forest.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA FS 2008. National Visitor Use Monitoring Results, USDA Forest Service, National Summary Report, Data collected through FY2007.	CITE	Citation is used in the FEIS.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA FS website: Michigan Cross Country Motorcycle Trail	IRR	The motorized trails included as examples from Michigan are not directly relevant to the HLC NF or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, Boise NF Motor vehicle use maps Web page of MVUMs	IRR	Citation is a website regarding MVUM for the Boise NF. Not relevant to the HLC NF planning area or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, Gifford Pinchot NF web page	IRR	Citation is a website about OVH trails on the Gifford Pinchot NF. Not relevant to the HLC NF planning area or forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, Mendocino NF OHV trails web page	IRR	Citation is a website about OHV trails on the Mendocino NF. Not relevant to the HLC NF planning area or forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, Sawtooth MVUMs	IRR	Citation is a website regarding MVUM for the Sawtooth NF. Not relevant to the HLC NF planning area or the forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, USDI 2001. Off-Highway Vehicle Environmental Impact Statement And Proposed Plan Amendment For Montana, North Dakota And Portions Of South Dakota, USFS/BLM 2001	IRR	The HLC NF Plan is not a travel management document. Land management plan regulations and policy are different between the BLM and FS. Adjacent BLM land management plans were considered in the cumulative effects analysis, which are more recent than this FEIS which is nearly 20 years old.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, Wallowa Whitman OHV trails Web page provides a short description of trails and links to more specific trails	IRR	Citation is a website about trails on the Wallowa Whitman. Not relevant to the HLC NF planning area or forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDA, Welcome to the Canfield Mountain Trail System.	IRR	Citation is a website about trails in Idaho. Not relevant to the HLC NF planning area or forest plan revision process.
Capital Trail Vehicle Association; Citizens for Balanced Use	USDI, BLM’s Comprehensive Travel and Transportation Management (CTTM) program	IRR	Website regarding a travel management program for the BLM. The Plan for the HLC NF is not a travel management document. The trends and status of motorized uses are acknowledged in the Assessment and FEIS using sources more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	USFS Roadless Area Conservation Website	CITE	The law, regulation, and policy for IRAs is utilized in the FEIS as regulatory framework. The Plan is consistent with this framework.
Capital Trail Vehicle Association; Citizens for Balanced Use	USFS Trails Unlimited website	IRR	Website is for a FS program that supports trail projects. It is not relevant to the forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	USFWP. U.S. Forest Service and Montana Department of Fish Wildlife and Parks Collaborative Overview and Recommendations for Elk Habitat Management on the Custer, Gallatin, Helena, and Lewis and Clark National Forests	CITE	This publication was cited in the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	USGAO 2009. Enhanced planning could assist agencies in managing increased use of off-highway vehicles	CON	The Plan provides programmatic strategic planning for motorized uses. The citation provided is national in scope and provides recommendations that are broadly consistent with the forest planning effort. Utilizing specific information from the publication would not help further inform the Plan or FEIS.
Capital Trail Vehicle Association; Citizens for Balanced Use	USGAO 2013. FOREST SERVICE TRAILS: Long- and Short-Term Improvements Could Reduce Maintenance Backlog and Enhance System Sustainability	CON	The HLC NF forest plan revision team considered the existing trail network and the need for the Plan to support all types of recreation uses and maintenance needs over time, including but not limited to leveraging partnerships. Specific information and

Commenter(s)	Citation	Response code	Rationale
			figures from this document are at a broader scale and would not further inform the Plan or FEIS analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Various websites that display OHV tourism	IRR	The importance of OHV tourism on the HLC NF is addressed as appropriate in the FEIS and Assessment using information equally or more relevant to the HLC NF planning area.
Capital Trail Vehicle Association; Citizens for Balanced Use	Vella et al 2013. Participation in Outdoor Recreation Program Predicts Improved Psychosocial Well-Being Among Veterans With Post-Traumatic Stress Disorder: A Pilot Study	CITE	This publication has been cited in FEIS in relation to health benefits of recreation.
Capital Trail Vehicle Association; Citizens for Balanced Use	Walsh 2014. Photographer retraces Bob Marshall's epic hike in 'spirit'	IRR	The HLC NF followed the wilderness inventory and evaluation procedure in the FSH 1909.12, Chapter 70.
Capital Trail Vehicle Association; Citizens for Balanced Use	Ward & Cupal 1976. Telemetered Heart Rate of Three Elk as Affected by Activity and Human Disturbance	NOT RLB	Preliminary study with very limited sample size; also, very dated.
Capital Trail Vehicle Association; Citizens for Balanced Use	Website: PlayCleanGo: stop invasive species in your tracks	GEN	General best management practices already in place. No further review needed.
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The positive benefits of OHV recreation are addressed as appropriate in the FEIS using information equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Capital Trail Vehicle Association; Citizens for Balanced Use	Websites, OHV use/benefits	CON	The Plan is consistent with law, regulation, and policy related to the CDNST, including the issue of motorized uses. The specific link does not work and the document is not cited.
Capital Trail Vehicle Association; Citizens for Balanced Use	White et al 2005. WILDLIFE RESPONSES TO MOTORIZED WINTER RECREATION IN YELLOWSTONE 2005 ANNUAL REPORT, by P.J. White and Troy Davis Yellowstone Center for Resources & Dr. John Borkowski, Montana State University	IRR	Report focuses on a habituated population; not relevant outside habituated areas as indicated by other literature
Capital Trail Vehicle Association; Citizens for Balanced Use	White, Eric M. and Daniel J. Stynes 2010. Spending Profiles of National Forest Visitors, NVUM Round 2 Update. March 2010.	CON	Recreation economics are viewed differently by the National Forest System, then by the Industry. Accounting for Forest related visitor use spending, the National Forest only considers non-durable good expenditures within fifty miles of the Forest boundary. This article is contextually considered in that recreation economics were reviewed in the contribution model and are not expected to change as a result of the Forest Plan decision. The spectrum of motorized uses available remains, and visitor patterns remain linked to greater economic and cultural trends, as oppose to management area designation.
Capital Trail Vehicle Association; Citizens for Balanced Use	Whitney 2014. Judge Halts Gallatin National Forest Timber Sale, By Eric Whitney • Dec 5, 2014	IRR	Newspaper article about site-specific projects. Not relevant to the HLC NF forest plan revision process or analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Whitney 2016. Environmental Group Sues Over Cabinet-Yaak Grizzlies, By Eric Whitney • Feb 11, 2016	IRR	Article about environmental groups suing over grizzly bears. The Plan is consistent with all law, regulation and policy. This article does not inform the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use	Wiedinmyer & Neff 2007. Carbon Balance and Management Research: Estimates of CO2 from fires in the United States: implications for carbon management	CON	The impact of fires and fossil fuel emissions to carbon sequestration and climate change is addressed with other literature more or equally relevant to the HLC NF.
Capital Trail Vehicle Association; Citizens for Balanced Use	WILD WILDERNESS; WINTER WILDLANDS ALLIANCE; BEND BACKCOUNTRY ALLIANCE, Plaintiffs-Appellants, v. JOHN ALLEN, Forest Supervisor of the Deschutes National Forest; UNITED STATES FOREST SERVICE, a federal agency, Defendants-Appellees, and OREGON STATE SNOWMOBILE ASSOCIATION; AMERICAN COUNCIL OF SNOWMOBILE ASSOCIATIONS; KEN ROADMAN; ELK LAKE RESORT, Intervenor-Defendants-Appellees. Appeal from the United States District Court for the District of Oregon; Thomas M. Coffin, Magistrate Judge, Presiding Argued and	IRR	The Plan is not a travel plan. The Plan is consistent with all applicable law, regulation, and policy. This legal decision from Oregon is not directly relevant to the HLC NF forest plan revision process or analysis.

Commenter(s)	Citation	Response code	Rationale
	Submitted October 5, 2016 Portland, Oregon+B256:C269		
Capital Trail Vehicle Association; Citizens for Balanced Use	Wind in her hair: 86-year-old Darby woman has been riding motorcycles for 70 years	CITE	This publication has been cited in FEIS in relation to health benefits of recreation.
Capital Trail Vehicle Association; Citizens for Balanced Use	YouTube video, 2012. Dr David Evans on Global Warming	IRR	Does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	YouTube video, 2015. Nobel Laureate Smashes the Global Warming Hoax	IRR	Does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use	YouTube video: The Global Warming is a Business. Documentary from 2007	IRR	Does not provide literature or context specific to issues relevant to forest plan revision.
Capital Trail Vehicle Association; Citizens for Balanced Use; and Wild Earth Guardians	Interagency Lynx Biology Team 2013. Canada Lynx Conservation Assessment and Strategy; 3rd Edition, August 2013	CITE	The Plan retained the direction from the NRMLD, as required by current law, regulation, and policy. This work is cited as appropriate in the analysis.
Capital Trail Vehicle Association; Citizens for Balanced Use; Helena Hunters & Anglers; and Rocky Mountain Elk Foundation	Ranglack, Garron, Rotella, Proffitt, Gude, and Canfield. 2016. Security areas for maintaining elk on publicly accessible lands during archery and rifle hunting seasons in southwestern Montana.	CITE	This publication was cited in the analysis.
Carroll College	Cronon 1995. The Trouble with Wilderness; or, Getting Back to the Wrong Nature; by William Cronon (William Cronon, ed., Uncommon Ground: Rethinking the Human Place in Nature, New York: W. W. Norton & Co., 1995, 69-90)	IRR	The designation of wilderness is beyond the scope of forest plan revision. Other information relative to recommended wilderness was used.
Carroll College	Felton, Vernon 2015. A Look at Why Bikes Are Banned in Wilderness	CON	The issue of mechanized means of transportation in wilderness is addressed using other information that is equally or more relevant to forest plan revision.
Carroll College	French 2016. Montana No. 2 in nation for wildlife vs. car collisions; By BRETT FRENCH french@billingsgazette.com	IRR	Wildlife collisions are not directly applicable to the forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Carroll College	Gardner 1998. CITIES TURNING TO BICYCLES TO CUT COSTS, POLLUTION, AND CRIME; by Gary Gardner, 1998	IRR	Publication is focused on health and environmental benefits of bicycle use within city environments.
Carroll College	Goltz 1998. Why Protect Wilderness? James P Goltz New Brunswick Protected Natural Areas Coalition February 1998	IRR	The designation of wilderness is beyond the scope of forest plan revision. Other information relative to recommended wilderness was used.
Carroll College	Larson, Courtney L, Sarah E. Reed, Adina M. Merenlender, Kevin R. Crooks; 2016. Effects of Recreation on Animals Revealed as Widespread through a Global Systematic Review.	AUTH	Effects of nonmotorized recreation discussed in FEIS (elk and Canada lynx sections, for example) using other more recent and relevant literature.
Carroll College	Morgan, Todd A CF. 2017. Montana's Forest Industry Conditions & Outlook 2017	AUTH	The issue of impacts relative to the forest industry is addressed using information that is equally or more relevant, including other publications by this author.
Carroll College	Seney 1991. Erosional impact of hikers, horses, off-road bicycles, and motorcycles on mountain trails, by Joseph Paul Seney. 1991 MSU thesis	IRR	Site specific effects of specific types of recreation on trail erosion is beyond the scope of the forest plan revision process.
Carroll College	Teasdale, Aaron. 2017. Do Bikes Belong in Wilderness Areas? No. But hikers and bikers must find a way to come together. By Aaron Teasdale | Dec 20 2017	CON	The issue of mechanized means of transportation in wilderness is addressed using other information that is equally or more relevant to forest plan revision.
Carroll College	Turtenwald 2018. How Does Hunting Affect the Environment? By Kimberly Turtenwald; Updated April 25, 2018	IRR	The regulation of hunting is not within the purview of the USFS; plan components provide the framework needed to support the hunting regulations set forth by the MFWP.
Carroll College	Wagner Undated. Economy; Montana's Economic Performance: Department of Labor and Industry, Research and Analysis Bureau	CON	Economic considerations are addressed using other literature sources that are equally or more relevant to the HLC NF.
Center for Large Landscape Conservation	GILBERT-NORTON, Lynne, RYAN WILSON, JOHN R. STEVENS, AND KAREN H. BEARD. 2010. Meta-Analytic Review of Corridor Effectiveness	GEN	Paper is a meta-analysis that highlights the general benefit of corridors to wildlife populations, a theme that is extensively covered within the Plan
Center for Large Landscape Conservation	MAWDSLEY, Jonathan R., ROBIN O'MALLEY, AND DENNIS S. OJIMA. 2009. Review of Climate-Change Adaptation Strategies for Wildlife Management and Biodiversity Conservation	GEN	Paper is a general review of strategies for addressing managing under changing climatic conditions, strategies, including connectivity, which are covered broadly within the Plan and DEIS
Center for Large Landscape Conservation	SCHWARTZ, Michael K., JEFFREY P. COPELAND, NEIL J. ANDERSON, JOHN R. SQUIRES, ROBERT M. INMAN, KEVIN S. MCKELVEY, KRISTY L. PILGRIM, LISETTE P. WAITS, AND SAMUEL A. CUSHMAN. 2009. Wolverine gene flow across a narrow climatic niche.	CON	The issue of connectivity for wildlife is addressed with a body of literature that is equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Center for Large Landscape Conservation; and Olsen, Lance	Chen, I-Ching, Jane K. Hill, Ralf Ohlemüller, David B. Roy, Chris D. Thomas, 2011. Rapid Range Shifts of Species Associated with High Levels of Climate Warming	CITE	This work is at a broad (global) scale; it is cited in the invasive plants section.
Center for Large Landscape Conservation; and Olsen, Lance	Heller, Nicole E. and Erika S. Zavaleta. 2009. Biodiversity management in the face of climate change: A review of 22 years of recommendations.	GEN	Paper is a general review of strategies for addressing managing under changing climatic conditions, strategies, including connectivity, which are covered broadly within the Plan and DEIS, as per the 2012 Planning Rule. The HLC NF uses Halofsky et al 2018 and other information to inform forest plan revision.
Citizens for Balanced Use	Heung, J., Benitez, L., et al. 2018. Colorado Outdoor Rx: Elevating Coloradans' Health Through the Outdoors. "OutdoorRx: Elevating Coloradans' Health Through the Outdoors - A Cross-Sector Framework" Denver CO: Colorado Outdoor Recreation Industry Office	CON	The health benefits of recreation are discussed in DEIS, so citation does not add new information
Citizens for Balanced Use	Sugden, Brian D. and Scott W. Woods 2007. SEDIMENT PRODUCTION FROM FOREST ROADS IN WESTERN MONTANA	CITE	This publication is cited in the analysis.
Continental Divide Trail Coalition	USDA 2009. Continental Divide National Scenic Trail Comprehensive Plan	CITE	This citation was used in the FEIS and in the development of the Plan.
Continental Divide Trail Coalition	USDA 2016. Letter from Regional Foresters to Forest Supervisors on Developing Forest Plan Direction for the Continental Divide National Scenic Trail	CITE	Added to regulatory information in the FEIS in Designated Areas.
Continental Divide Trail Coalition	USDI 1976. Continental Divide Trail Study Report, USDI, Bureau of Outdoor Recreation, 1976	IRR	This background info on the CDNST is not needed to inform the Plan or FEIS analysis.
Continental Divide Trail Coalition	USDI 2004. Continental Divide National Scenic Trail Leadership Council Vision and Guiding Principles, Continental Divide National Scenic Trail	GEN	The Plan and FEIS uses other regulatory guidance for the CDNST.
Continental Divide Trail Coalition	USFS Continental Divide Trail Coalition 2017. CDNST: Optimal Location Review, www.contintaldividetrail.org; 2017	IRR	Development of a CDNST Unit Plan is beyond the scope of the forest plan revision process and has been identified as a possible future action in appendix C of the Plan.
Defenders of Wildlife	Anderson, Charles R.; JR., Mark A. Ternent, David S. Moody; 2002. Grizzly bear-cattle interactions on two grazing allotments in northwest Wyoming;	CON	General list of guidelines on reducing livestock depredation, a topic considered in reference to specific species (e.g., grizzly) and covered by appropriate citations (e.g., Grizzly Conservation Strategy)

Commenter(s)	Citation	Response code	Rationale
Defenders of Wildlife	Austin 1998. Wolverine winter travel routes and response to transportation corridors in Kicking Horse Pass between Yoho and Banff National Parks	CON/DATED	the topic was considered and covered by more recent citations
Defenders of Wildlife	Boulanger, John; and Gordon B. Stenhouse. 2014. The Impact of Roads on the Demography of Grizzly Bears in Alberta.	CON	General citation on the effects of roads on grizzly survival, a topic that is considered and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Bowman et al 2010. Roads, logging, and the large-mammal community of an eastern Canadian boreal forest	CITE	Study occurred in northern Canada in eastern boreal forest in highly industrialized landscape. Relevant information cited in FEIS.
Defenders of Wildlife	Breck, Stewart and Tom Meier; 2004. Managing Wolf Depredation in the United States: Past, Present, and Future.	CON	General list of guidelines on reducing livestock depredation, a topic considered in reference to specific species (e.g., grizzly) and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Brodie & Post 2010. Nonlinear responses of wolverine populations to declining winter snowpack.	CON	the topic was considered and covered by alternative citations
Defenders of Wildlife	Cegelski et al 2006. Genetic diversity and population structure of wolverine (Gulo gulo) populations at the southern edge of their current distribution in North America with implications for genetic viability	IRR	Study provides information regarding observed genetic diversity within HLC NF wolverine population and others and indicates need to maintain diversity but does not provide management-oriented information that informs development of plan components nor analysis of impacts to wolverine of the plan or alternatives except in a broad and somewhat speculative sense.
Defenders of Wildlife	Cook and Olaughlin 2008. Off-highway vehicle and snowmobile management in Idaho	GEN	Paper provides general documentation of trends in recreation
Defenders of Wildlife	Copeland 1996. Biology of the wolverine in central Idaho	DATED/ AUTH	The citation is dated, and other more recent publication cover the same topics, including publications by the same authors
Defenders of Wildlife	Copeland 2009. Investigating the relationship between winter recreation and wolverine spatial use in Central Idaho	CON/AUTH	inclusive of other references including references from the same author
Defenders of Wildlife	Copeland et al 2010. The bioclimatic envelope of the wolverine (Gulo gulo): do climatic constraints limit its geographic distribution?	CITE	This publication is cited in the Biological Assessment for the Plan.
Defenders of Wildlife	Costello, Cecily M., Richard D. Mace, and Lori Roberts 2016. Grizzly Bear Demographics in the Northern Continental Divide Ecosystem 2004-2014 Research Results & Techniques for Management of Mortality	CITE	This publication is cited in the analysis.
Defenders of Wildlife	Cree et al 2002. Snowmobile Activity and Glucocorticoid Stress Responses in Wolves and Elk	CON/GEN	Paper discusses individual level effects of motorized winter recreation. The topic of snowmobile effects is considered and covered by alternative literature.

Commenter(s)	Citation	Response code	Rationale
Defenders of Wildlife	Croteau, Jill 2016. Alberta bear experts warn of conflicts with cyclists as woman recovers from attack; By Jill Croteau Reporter Global News; 2016	CON	This is a newspaper article used as a singular example of bear/recreation interactions. This issue is addressed by the Grizzly Bear Conservation Strategy and other literature.
Defenders of Wildlife	Dawson et al 2010. Wolverine, Gulo gulo, home range size and denning habitat in lowland boreal forest in Ontario	CON	the paper focuses on the effects of roads on wolverine behavior/distribution, the topic is considered more broadly through incorporation of connectivity and fragmentation, areas that are considered and covered by alternative citations
Defenders of Wildlife	Fisher et al 2013. Wolverines (Gulo gulo luscus) on the Rocky Mountain slopes: natural heterogeneity and landscape alteration as predictors of distribution	CON	The effects of management on wolverine populations and individuals is considered and covered by alternative citations
Defenders of Wildlife	Gates, CC, K Aune. 2008. Bison bison. The IUCN Red List of Threatened Species 2008: Downloaded on 12 January 2016.	CON	The status of bison is considered using other information.
Defenders of Wildlife	Gates, Cormack C., Curtis H. Freese, Peter J.P. Gogan, and Mandy Kotzman 2010. American Bison: Status Survey and Conservation Guidelines 2010	IRR	General statement about the history of bison; does not inform the Plan or analysis.
Defenders of Wildlife	Gehring, Thomas M., Kurt C. VerCauteren and Jean-Marc Landry; 2010. Livestock Protection Dogs in the 21st Century: Is an Ancient Tool Relevant to Modern Conservation Challenges?	CON	General list of guidelines on reducing livestock depredation, a topic considered in reference to specific species (e.g., grizzly) and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Heinemeyer et al 2010. Investigating the interactions between wolverines and winter recreation use: 2010 annual report	CON/AUTH	this topic was considered and covered by alternative citations including citations by the same authors
Defenders of Wildlife	Herrero, Stephen and Susan Fleck 1989. Injury to People Inflicted by black, grizzly, or polar bears: recent trends and new insights.	GEN/IRR	Paper analyzes specific causes of bear attacks to humans and identifies certain risk factors that may increase likelihood of danger to individual humans, largely in National Parks. Paper does not analyze nor make recommendations about management of recreation at a landscape scale, nor does it analyze potential impacts to wildlife of nonmotorized recreation.
Defenders of Wildlife	Idaho Department of Fish and Game 2014. Management plan for the conservation of wolverines in Idaho	GEN/IRR	General document on the distribution of wolverine in ID and management within the state
Defenders of Wildlife	Inman 2013. Wolverine Ecology and Conservation in the Western United States	CITE	This citation is utilized in the Biological Assessment for the Plan.
Defenders of Wildlife	Inman et al 2007. Wolverine reproductive chronology. In: Wildlife Conservation Society, Greater Yellowstone Wolverine Program, Cumulative Report, May 2007	AUTH	The topic of wolverine ecology is covered in a body of other literature sources, including other publications by this author.

Commenter(s)	Citation	Response code	Rationale
Defenders of Wildlife	Inman et al 2007. Wolverine reproductive rates and maternal habitat in Greater Yellowstone. In: Wildlife Conservation Society, Greater Yellowstone Wolverine Program Wolverine reproductive rates and maternal habitat in Greater Yellowstone	AUTH	The topic of wolverine ecology is covered in a body of other literature sources, including other publications by this author.
Defenders of Wildlife	Inman et al 2013. Developing priorities for metapopulation conservation at the landscape scale: Wolverines in the western United States	AUTH	The topic of wolverine ecology is covered in a body of other literature sources, including other publications by this author.
Defenders of Wildlife	Johnson et al 2012. Projected range shifting by montane mammals under climate change: implications for Cascadia's National Parks	GEN/CON	General paper on the effects of climate change on high elevation species, an area considered in relation to wolverine and other species and covered by alternative citations
Defenders of Wildlife	KASWORM, Wayne F; TIMOTHY L. MANLEY. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana.	CON	Reference used to support general statement on bear/roads interactions; this topic is generally considered and included in other citations.
Defenders of Wildlife	Knight and Judd 1983. GRIZZLY BEARS THAT KILL LIVESTOCK; By: RICHARD R. KNIGHT and STEVEN L. JUDD; 1983	CON	Reference used to support general statement on bear/grazing interactions; this topic is considered and included in the analysis using other citations that are equally or more relevant.
Defenders of Wildlife	Kyle and Strobeck 2001. Genetic structure of North American wolverine (Gulo gulo) populations	GEN/CON	paper identifies challenges of managing populations of wolverines due to small effective population size, an area considered more broadly through issues of connectivity and covered by alternative citations
Defenders of Wildlife	Lamb, Clayton T., Garth Mowat, Aaron Reid, Laura Smit, Michael Proctor, Bruce N. McLellan, Scott E. Nielsen, Stan Boutin; 2017. Effects of habitat quality and access management on the density of a recovering grizzly bear population.	CITE	This publication is cited in the analysis.
Defenders of Wildlife	Mace, Richard D.; John S. Waller; Timothy L. Manley; L. Jack Lyon; and Hans Zuuring. 1996. Relationships Among Grizzly Bears, Roads and Habitat in the Swan Mountains Montana; The Journal of Applied Ecology, Vol. 33, No. 6 (Dec., 1996)	CON	Reference used to support general statement on bear/roads interactions; this topic is generally considered and included in other citations.
Defenders of Wildlife	MacKenzie 1989. Alpine countries seek controls on skiers, builders and roads.	GEN	general paper on the effects of development on the environment
Defenders of Wildlife	Magoun and Copeland 1998. Characteristics of wolverine reproductive den sites	CON/AUTH	the topic is considered and covered by alternative citations, including some by the same authors
Defenders of Wildlife	May 2007. Spatial ecology of wolverines in Scandinavia. Ph.D. Dissertation	CON	the topic of wolverine reproductive ecology was considered and covered by alternative citations
Defenders of Wildlife	MFWP 2014. Furbearer Program. Statewide harvest and management report 2012-2013	CON/AUTH	the topic of trapping was considered and covered by alternative citations, including citations by the same authors

Commenter(s)	Citation	Response code	Rationale
Defenders of Wildlife	MFWP 2015. DRAFT Environmental Impact Statement Bison Conservation and Management in Montana June 2015; MT FWP	CON	The status of bison is considered using other information.
Defenders of Wildlife	MFWP 2015. Montana's state wildlife action plan; Montana fish, wildlife & parks 2015	CITE	This is considered in the cumulative effects analysis.
Defenders of Wildlife	MFWP 2016. Northern continental divide ecosystem, grizzly bear population monitoring annual report – 2016; Prepared By: Cecily M. Costello, Lori L. Roberts, MFWP	CON	General information on grizzly populations and demographics, a topic that is considered and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Murray, C. 2010. Days of the Blackfeet: A Historical Overview of the Blackfeet Tribe for K-12 Teachers. Montana Office of Public Instruction. Helena, MT. 57 pp.	IRR	This history of the Blackfeet is not directly applicable to forest plan revision topics.
Defenders of Wildlife	Musiani, Marco; Tyler Muhly, C. Cormack Gates, Carolyn Callaghan, Martin E. Smith, and Elisabetta Tosoni; 2005. Seasonality and reoccurrence of depredation and wolf control in western North America	CON	General list of guidelines on reducing livestock depredation, a topic considered in reference to specific species (e.g., grizzly) and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Musioani, Marco; Charles Mamo, Luigi Boitani, Carolyn Callaghan, C. Cormack Gates, Livia Mattel, Elisabetta Visalberghi, Stewart Breck and Giulia Volpi; 2003. Wolf Depredation Trends and the Use of Fladry Barriers to Protect Livestock in Western North America	CON	General list of guidelines on reducing livestock depredation, a topic considered in reference to specific species (e.g., grizzly) and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Nature Serve, 2016. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia.http://explorer.natureserve.org/servlet/NatureServe?searchName=Bison+bison (Accessed: Aug. 20, 2017).	IRR	General information about bison; does not directly inform the Plan or analysis.
Defenders of Wildlife	Northern Rockies Adaptation Partnership. 2014. DRAFT Vulnerability Assessment Summaries 2014	GEN/CON	General paper on the effects of climate change on high elevation species, an area considered in relation to wolverine and other species and covered by alternative citations
Defenders of Wildlife	Packila et al 2007. Wolverine road crossings in western Greater Yellowstone. Pages 103–120 in Greater Yellowstone wolverine program	CON	the paper focuses on the effects of roads on wolverine behavior/distribution, the topic is considered more broadly through incorporation of connectivity and fragmentation, areas that are considered and covered by alternative citations
Defenders of Wildlife	Peacock 2011. Projected 21st century climate change for wolverine habitats within the contiguous United States.	GEN/CON	General paper on the effects of climate change on high elevation species, an area considered in relation to wolverine and other species and covered by alternative citations

Commenter(s)	Citation	Response code	Rationale
Defenders of Wildlife	Proctor, Michael F., David Paetkau, Bruce N. Mclellan, Gordon B. Stenhouse, Katherine C. Kendall, Richard D. Mace, Wayne F. Kasworm, Christopher Servheen, Cori L. Lausen, Michael L. Gibeau, Wayne L. Wakkinen, Mark A. Haroldson, Garth Mowat, Clayton D. Apps, Lana M. Ciarniello, Robert M. R. Barclay, Mark S. Boyce, Charles C. Schwartz, Curtis Strobeck. 2012. Population Fragmentation and Inter-Ecosystem Movements of Grizzly Bears in Western Canada and the Northern United States.	CON	Reference used to support general statement on bear/roads interactions; this topic is generally considered and included in other citations.
Defenders of Wildlife	Rolando et al 2007. The impact of impact of high-altitude ski- runs on alpine grassland bird communities	GEN	General paper on the effects of development on the environment
Defenders of Wildlife	Ruediger 2005. Management considerations for designing carnivore highway crossings	GEN/CON	The paper focuses on the effects of roads on wolverine behavior/distribution, the topic is considered more broadly through incorporation of connectivity and fragmentation, areas that are considered and covered by alternative citations.
Defenders of Wildlife	Ruid, David B., William J. Paul, Brian J. Roell, Adrian P. Wydeven, Robert C. Wiliging, Randy L. Jurewicz, and Donald H. Lonsway. 2009. Wolf—Human Conflicts and Management in Minnesota, Wisconsin, and Michigan. In: A.P. Wydeven et al. (eds.), Recovery of Gray Wolves in the Great Lakes Region of the United States	CON	The issue of human-wildlife conflict is addressed with other literature sources equally or more relevant to the HLC NF.
Defenders of Wildlife	Sagor, Jens Thomas; Jon E. Swenson & Eivin Roskaft; 1997. COMPATIBILITY OF BROWN BEAR Ursus arctos AND FREE-RANGING SHEEP IN NORWAY.	CON	Reference used to support general statement on bear/grazing interactions; this topic is generally considered and included in other citations
Defenders of Wildlife	Schwartz et al 2009. Wolverine gene flow across a narrow climatic niche	GEN/CON/ AUTH	Paper identifies challenges of managing populations of wolverines due to small effective population size, an area considered more broadly through issues of connectivity and covered by alternative citations include papers by the same authors
Defenders of Wildlife	Schwartz, Charles C.; Patricia H. Gude, Lisa Landenburger, Mark A. Haroldson & Shannon Podruzny, 2012. Impacts of rural development on Yellowstone wildlife: linking grizzly bear Ursus arctos demographics with projected residential growth.	CON	This is a broad reference to connectivity; this topic is considered using other literature that is equally or more relevant to the HLC NF.
Defenders of Wildlife	Servheen et al 2017. Board of Review: The death of Mr. Brad Treat due to a grizzly bear attack on June 29, 2016 on the Flathead National Forest. March 3, 2017.	CON/INC/ IRR	Referenced document is an incident report of one case of a fatality; is not a scientific publication and its purpose is to make conclusions about a single incident. It provides general recommendations for individuals who choose to recreate in bear

Commenter(s)	Citation	Response code	Rationale
			habitat but does not make statements or recommendations about overall management of recreation in bear habitat.
Defenders of Wildlife	Shedlock 2016	CON	General list of guidelines on reducing grizzly/human conflict, a topic considered in reference to specific species (e.g., grizzly) and covered by appropriate citations (e.g., Grizzly Conservation Strategy)
Defenders of Wildlife	Tabish, Dillon. 2016. FWP Confirms Bear that Killed West Glacier Cyclist was a Male Grizzly DNA results show the bear involved in the fatal mauling on June 29 was a male grizzly	CON	This is a newspaper article used as a singular example of bear/recreation interactions. This issue is addressed by the Grizzly Bear Conservation Strategy and other literature.
Defenders of Wildlife	USDA 2018. Draft Record of Decision for the Malheur, Umatilla, and Wallowa-Whitman National Forests Revised Land Management Plans; July 2018	GEN	Cited as a need to consider specific habitat attributes in developing strategies for management, a topic that is inclusive of the larger landscape approach to management inherent in a forest plan
Defenders of Wildlife	USFWS 2013. Endangered and threatened wildlife and plants: on a petition to list the North American wolverine as endangered or threatened	GEN/LRP	General reference to wolverine petition for listing
Defenders of Wildlife	Weaver 2013. Safe Havens, Safe Passages for Vulnerable Fish and Wildlife: Critical Landscapes in the Southern Canadian Rockies, British Columbia and Montana	GEN/CON	Paper identifies challenges of managing populations of wolverines due to small effective population size, an area considered more broadly through issues of connectivity and covered by alternative citations
Defenders of Wildlife	Weaver 2014. Conservation Legacy on a Flagship Forest: Wildlife and Wildlands on the Flathead National Forest, Montana	CON	Issues of connectivity were considered and covered by alterative citations
Defenders of Wildlife	Wipf et al 2002. Effects of ski piste preparation on alpine vegetation	GEN	General paper on the effects of development on the environment
Defenders of Wildlife	Zedeno, M. N., J. A. M Ballenger, and J. R. Murray. 2014. Landscape Engineering and Organizational Complexity among Late Prehistoric Bison Hunters of the Northwestern Plains. Current Anthropology 55(1): 23-58	CON	General reference on human history in the region; this topic is considered in general using other information sources.
Defenders of Wildlife; Greater Yellowstone Coalition	Proctor, Michael F., Bruce N. McLellan, Gordon B. Stenhouse, Garth Mowat, Clayton T. Lamb, Mark S. Boyce. 2018. Resource roads and grizzly bears in British Columbia and Alberta, Canada	CITE	Cited in updated grizzly bear analysis in FEIS and in BA; background information about grizzly bear habitat security and analysis context regarding road density and habitat security

Commenter(s)	Citation	Response code	Rationale
Defenders of Wildlife; Pew Charitable Trusts	Heinemeyer, Kimberly S., John R. Squires, Mark Hebblewhite, Julia S. Smith, Joseph D. Holbrook, and Jeffrey P. Copeland 2017. Wolverine – winter recreation research project: investigating the interactions between wolverines and winter recreation final report; December 15, 2017.	CITE	The publication is cited in the analysis.
Defenders of Wildlife; Wild Earth Guardians	Banci et al 1994. American Marten, Fisher, Lynx and Wolverine in the Western United States	CITE	This publication is cited in the analysis.
Defenders of Wildlife; Wild Earth Guardians	Krebs et al 2004. Synthesis of survival rates and causes of mortality in North American wolverines	CON	The topic of mortality sources for wolverine is covered by other citations equally or more relevant to the HLC NF.
Defenders of Wildlife; Wild Earth Guardians; and the Wilderness Society	McKelvey 2011. Climate Change predicted to shift wolverine distributions, connectivity, and dispersal corridors	CON	This is a general citation for connectivity; this topic is broadly considered, including the effects of climate change on wolverine, using other literature sources that are equally or more relevant to the HLF NF (e.g., U.S. Department of the Interior, Fish and Wildlife Service, 2013).
Donohoe, Joe	Haber, Jonathan and Peter Nelson; 2015. Planning for Connectivity: A guide to connecting and conserving wildlife within and beyond America's national forests.	CON	Broad reference to connectivity; this topic is generally considered using other literature sources equally or more relevant to the HLC NF.
Donohoe, Joe; and the Greater Yellowstone Coalition	Peck, Christopher P., Frank T. Van Manen, Cecily M. Costello, Mark A. Haroldson, Lisa A. Landenburger, Lori L. Roberts, Daniel D. Bjornlie, and Richard D. Mace; 2017. Potential paths for male-mediated gene flow to and from an isolated grizzly bear population.	CITE	The publication is cited in the analysis.
Dundas, Jim	Cordell, Ken H., Carter J. Betz, Gary T. Green, and Becky Stephens. 2008. Internet Research Information Series (IRIS) Report: Off-Highway Vehicle Recreation in the United States and its Regions and States: An Update National Report from the National Survey on Recreation and the Environment (NSRE); February 2008.	IRR	Travel planning is outside the scope of the forest plan revision process
Dundas, Jim	Montana Environmental Council Report. Roads, land, & big game harvest; the environmental quality council house joint resolution NO. 13, 2015-2016	IRR	Travel planning is outside the scope of the forest plan revision process
Dundas, Jim	Wilderness at a Glance, weblink	CON	The issue of public use of wilderness is addressed using other information sources.
Elk Creek Minerals	duBray and Snee. Composition, Age, and Petrogenesis of Late Cretaceous Intrusive Rocks in the Central Big Belt Mountains, Broadwater and Meagher Counties, Montana	CON	The issue of management of minerals within RWAs is addressed using other information; management of RWAs would be in accordance with law, regulation, and policy.

Commenter(s)	Citation	Response code	Rationale
Elk Creek Minerals; Montana Mining Association	Tysdal, R.G., Steve Ludington, and A.E. McCafferty, 1996. Mineral and energy resource assessment of the Helena National Forest, West-Central Montana	CITE	This publication is cited in the analysis.
Environmental Protection Agency	Mikkelson, Kristin; Dr. Eric Dickenson, Prof. Reed Maxwell, Prof. John McCray & Prof. Jonathan Sharp 2013. Bark beetle infestations affect water quality in the Rocky Mountains of North America; Feb 12, 2013; Global Water Forum.	INC	This talk at a conference does not provide science to support the potential impacts on the HLC NF. It is unknown whether or not these trends are only going to occur in the mountainous watersheds of Colorado, or if other bark beetle infested watersheds throughout the world could experience similar changes in water quality.
Form Letter: mountain biking; multiple signatories	Harmon 2015. Multiple articles (several more similar in letter) regarding MT biking in Helena, including Shuttle Fest	NOT RLB	These citations are newspaper articles, not scientific literature. This information is taken as public comment regarding the popularity of mountain biking on the HLC NF.
Glacier Two Medicine Alliance	Tara, Luna 2015. Vascular Plants and Plant Communities of the Blackfeet Reservation and Badger-Two Medicine Area of the Lewis and Clark National Forest. East Glacier Park, Montana.	CITE	No changes to SCC recommended as a result of floristic survey data. Cultural species discussed in appendix A of the at-risk plant's specialists report. Additional species incorporated into appendix A following document review.
Glacier Two Medicine Alliance	Tews, A., M. Enk, S. Leathe, W. Hill, S. Dalbey, and G. Liknes. (2000). Westslope Cutthroat Trout (Oncorhynchus clarki lewisi) In Northcentral Montana: Status and Restoration Strategies. (Special Report by Montana Fish, Wildlife and Parks in collaboration with Lewis and Clark National Forest) (70 pp.)	CITE	This publication has been cited in the analysis.
Great Falls Bicycle Club; John Juras	Biking guide to the Big Snowies	CON	The presence of mountain biking in the Snowies was acknowledged in the analysis based on public comment.
Greater Yellowstone Coalition	Blanchard, B. M. and R. R. Knight. 1991. Movements of Yellowstone grizzly bears, 1975–87.	CON	Information on grizzly bear dispersal is incorporated into the direction for the Grizzly Bear Conservation Strategy; and addressed with other literature that is equally or more relevant.
Greater Yellowstone Coalition	Conservation Strategy for the Grizzly Bear in the Northern Continental Divide Ecosystem; July 2018; MOU: Montana Fish, Wildlife &Parks (MFWP); the Montana Department of Natural Resources and Conservation (DNRC); the Blackfeet Nation; the Confederated Salish and Kootenai Tribes (CS&KT); the National Park Service (NPS); the U.S. Forest Service (USFS); the U.S. Fish and Wildlife Service (USFWS); the U.S. Geological Survey (USGS); the Bureau of Land Management (BLM); and USDA Wildlife Services.	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)

Commenter(s)	Citation	Response code	Rationale
Greater Yellowstone Coalition	Crow Indian Tribe Et al vs. USA and State of Wyoming. 2018	CON	Information on grizzly bears is incorporated into the direction for the Grizzly Bear Conservation Strategy; and addressed with other literature that is equally or more relevant to the topic.
Greater Yellowstone Coalition	Cushman, Samual A., Kevin S. Mckelvey, and Michael K. Schwartz; 2009. Use of Empirically Derived Source-Destination Models to Map Regional Conservation Corridors.	CON	Broad reference to connectivity; this topic is considered using information that is equally or more relevant to the HCL NF (e.g., the conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Haroldson, Mark A., Charles C. Schwartz, Katherine C. Kendall, Kerry A. Gunther, David S. Moody, Kevin Frey, David Paetkau; 2010. Genetic analysis of individual origins supports isolation of grizzly bears in the Greater Yellowstone Ecosystem.	CON	Broad reference to connectivity; this topic is considered using information that is equally or more relevant to the HCL NF (e.g., the conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Interagency Grizzly Bear Committee 2018. Five-year (2018-2022) plan goals, objectives and 2018 planned actions	CON	Broad reference to connectivity; this topic is considered using information that is equally or more relevant to the HCL NF (e.g., the conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Mclellan, Bruce N., and Frederick W. Hove; 2001. Natal dispersal of grizzly bears.	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	MFWP 2006. Grizzly bear management plan for western Montana, draft programmatic environmental impact statement 2006-2016 Prepared by: Arnold Dood, Shirley J. Atkinson and Vanna J Boccadori; Montana Department of Fish, Wildlife and Parks	CON	Broad reference to connectivity; this topic is considered using information that is equally or more relevant to the HCL NF (e.g., the conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	MFWP 2013. Grizzly Bear Management Plan for Southwestern Montana 2013; final programmatic environmental impact statement.	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Picton, Harold D. 1986. A Possible Link between Yellowstone and Glacier Grizzly Bear Populations.	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Primm, Steve, and Seth M. Wilson; 2004. Re-connecting Grizzly Bear Populations: Prospects for Participatory Projects.	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Proctor, Michael F., Bruce N. Mclellan, Curtis Strobeck, and Robert M.R. Barclay; 2004. Gender-specific dispersal distances of grizzly bears estimated by genetic analysis.	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Greater Yellowstone Coalition	Servheen, C., T. Manley, D.M. Starling, A. Jacobs, and J. Waller. 2017. The death of Mr. Brad Treat due to a grizzly bear attack June 29, 2016 on the Flathead National Forest. Interagency Board of Review Report.	IRR	Beyond the scope of the forest plan revision process; this site-specific design information may be useful at the project level.

Commenter(s)	Citation	Response code	Rationale
Greater Yellowstone Coalition	USDI 2006. United States Department of the Interior Bureau of Land Management; record of decision and approved Dillon resource management plan; February 2006	CON	Other land management plans, including the BLM, are considered in the cumulative effects analysis. The Dillon plan is not adjacent to the HLC NF; however, the Butte, Lewistown, and Missoula plans were considered.
Greater Yellowstone Coalition	Walker, Richard and Lance Craighead; 1997. Analyzing Wildlife Movement Corridors in Montana Using GIS	CON	Broad reference to connectivity, generally considered using other literature sources (e.g., draft conservation strategy, Peck et al. 2017)
Gunther, Jake; and Zammit, Tony	Sage and Nickerson 2018. Trail usage and value - a Helena, MT Case Study	CON	These reports were reviewed, but analysis involves multiple ownerships. The objective of the National Forest plan is to identify unique contribution from Forest visitation. Visits and values described in these analyses are statistically incorporated in the visitor use data analyzed by the NFS.
Helena Hunters & Anglers	Avey 2016. Letter from Bill Avey to the Public, withdrawing the Big Game security FP amendment in the Divide Travel Plan area.	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Basile and Lonner 1979. Vehicle Restrictions Influence Elk and Hunter Distribution in Montana	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Burbridge & Neff 1976. Elk-Logging-Roads Symposium Proceedings	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Cook et al 2004. Nutritional Condition of Northern Yellowstone Elk	CON	Topic was covered by related literature e.g., J. G. Cook, 2002; J. G. Cook et al., 1996; K. M. Proffitt, Hebblewhite, Peters, Hupp, & Shamhart, 2016; Ranglack et al., 2014; K. M. Stewart, Bowyer, Dick, Johnson, & Kie, 2005
Helena Hunters & Anglers	Cook et al 2005. Thermal Cover Needs of Large Ungulates: A Review of Hypothesis Tests.	CITE	This publication is cited in the analysis.
Helena Hunters & Anglers	Devoe 2018. Evaluating and Informing Elk Habitat Management Relationships of NDVI with Elk Nutritional Resources, Elk Nutritional Condition, and Landscape Disturbance	CITE	Incorporated into FEIS
Helena Hunters & Anglers	John G., Larry L. Irwin, Larry D. Bryant, Robert A Riggs, Jack Ward Thomas; 2004. Thermal Cover Needs of Large Ungulates: A Review of Hypothesis Tests.	CITE	This publication was cited in the analysis; the year was wrong in the comment letter.

Commenter(s)	Citation	Response code	Rationale
Helena Hunters & Anglers	Kolman, Joe 2016. Roads, Land, and Big Game Harvest, HJ13 Study – (MT) Environmental Quality Council Prepared by Joe Kolman, Environmental Analyst	CON	The issue of hunting opportunities was addressed with other information equally or more relevant to the HLC NF.
Helena Hunters & Anglers	Leege 1984. Evaluating and Managing Summer Elk Habitat	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Lonner and Cada 1982. Some effects of forest management on elk hunting opportunity, by Terry N. Lonner, Montana Department of Fish, Wildlife and Parks, Bozeman, MT and John D. Cada, Montana Department of Fish, Wildlife and Parks, Bozeman, MT, 1982	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Lyon and Canfield 1991. Habitat selections by rocky mountain elk under hunting season stress.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Lyon et al 1985. Coordinating Elk and Timber Management	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Lyon, Jack 1979. Influences of logging and weather on elk distribution in western Montana	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Lyon, Jack L. 1987. HIDE2: Evaluation of Elk Hiding Cover Using a Personal Computer.	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Lyon, Jack L. and Alan G. Christensen, USDA, Forest Service, 1992. A Partial Glossary of Elk Management Terms.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Lyons and Hillis 2013. Letter from Lyons and Hillis to Greg Munther regarding elk-road standards.	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Marcm and Lyon 1987. ELK HIDING COVER AS INFLUENCED BY TIMBER STAND THINNING, by C. Les Marcm, School of Forestry, University of Montana and L. Jack Lyon, Intermountain Research Station	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979

Commenter(s)	Citation	Response code	Rationale
Helena Hunters & Anglers	McCorquodale, Scott M. 2013. A Brief Review of the Scientific Literature on Elk, Roads, & Traffic.	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Montgomery, Robert A., Gary J. Roloff & Joshua J.Millspaugh, 2012. Importance of visibility when evaluating animal response to roads	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Montgomery, Robert A., Gary J. Roloff, and Joshua J. Millspaugh, 2013. Variation in Elk Response to Roads by Season, Sex, and Road Type.	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	MFWP 2013. U.S. Forest Service and Montana Department of Fish Wildlife and Parks: Collaborative Overview and Recommendations for Elk Habitat Management on the Custer, Gallatin, Helena, and Lewis and Clark National Forests, 2013	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	MFWP 2015. Elk Refuge Areas and their Impacts.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Naylor, Leslie M., Michael J. Wisdom, and Robert G. Anthony 2009. Behavioral Responses of North American Elk to Recreational Activity.	GEN	Considered but information is not specifically relevant at the scale of the programmatic level decision and analysis. This reference was read and considered along with the body of literature on elk when developing plan components and carrying out analysis.
Helena Hunters & Anglers	Ogara and Dundas 2002. Chapter 2 Distribution: Past and Present	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979) Montana Fish, Wildlife and Parks 2015.
Helena Hunters & Anglers	Perry and Overly 1976. Impact of Roads on Big Game Distribution in Portions of the Blue Mountains of Washington.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Picton 1991. A Brief History of Elk: The Hunt, Research and Management.	AUTH	Other more recent or relevant literature included in the FEIS to describe the present condition of elk across the planning area, including Hillis et al 1991.
Helena Hunters & Anglers	Proffitt, Kelly M., Mark Hebblewhite, Wibke Peters, Nicole Hupp, and Julee Shamhart, 2016. Linking landscape-scale differences in forage to ungulate nutritional ecology.	CITE	This publication was cited in the analysis.

Commenter(s)	Citation	Response code	Rationale
Helena Hunters & Anglers	Ranglack, Dustin, Bob Garrott, Jay Rotella, Kelly Proffitt and Justin Gude, and Jodie Canfield 2014. Evaluating elk summer resource selection and applications to summer range habitat management.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Rowland, M.M., M. J. Wisdom, B. K. Johnson, and M. A. Penninger. 2005. Effects of Roads on Elk: Implications for Management in Forested Ecosystems. Pages 42-52 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA.	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Rumble, Mark A; and R. Scott Gamo; 2011. Habitat use by elk (cervus elaphus) within structural stages of a managed forest of the northcentral United States.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Tenmile-South Helena, Elk Need Security PowerPoint	CON	Topic was covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Helena Hunters & Anglers	Thomas et al 1979. Wildlife Habitats in Managed Forests the Blue Mountains of Oregon and Washington.	CITE	The publication was cited in the analysis.
Helena Hunters & Anglers	Trout Unlimited. The Importance of The Roadless Backcountry For Big-Game Hunting Opportunity And Success On Montana Public Lands: What The Science Tells Us; TU, TRCP, MWF, undated	GEN	Summary document of multiple scientific papers, many of which are either included in the Plan/EIS or the topics presented covered
Helena Hunters & Anglers	USDA FS 2013. Custer, Gallatin, Helena, and Lewis and Clark National Forests Framework for Project-Level Effects Analysis on Elk.	CITE	This publication was cited in the analysis.
Helena Hunters & Anglers	Wisdom, Michael J., Haiganoush K. Preisler, Leslie M. Naylor, Robert G. Anthony, Bruce K. Johnson, and Mary M. Rowland 2018. Elk responses to trail-based recreation on public forests.	GEN	Considered but information is not specifically relevant at the scale of the programmatic level decision and analysis. This reference was read and considered along with the body of literature on elk when developing plan components and carrying out analysis.
Helena Hunters & Anglers; and Montana Fish, Wildlife, & Parks	Christensen, Lyon, and Unsworth 1993. Elk Management in the Northern Region: Considerations in Forest Plan Updates or Revisions	CITE	This publication was cited in the analysis.

Commenter(s)	Citation	Response code	Rationale
Helena Hunters & Anglers; Gayle Joslin	Jellison, B.A. 1998. Rocky Mountain Elk vulnerability within the Bighorn National Forest. Rocky Mountain Elk Foundation (WY 96107), Bow Hunters of Wyoming and Wyoming Game and Fish Department. In a Rocky Mountain elk habitat conservation plan for the WGFD Sheridan region (And Portions of the Cody Region) Wyoming Game and Fish Department Sheridan Region Updated May 2004. 62pp	CON	Elk security and hiding cover are considered at length and covered by other citations that are equally or more relevant to the HLC NF.
Helena Hunters & Anglers; Gayle Joslin	Kite, R., G. Nelson, T. Stenhouse, and C. Derimont. 2016. A movement-driven approach to quantifying grizzly bear (Ursus arctos) near-road movement patterns in west-central Alberta, Canada. Biological Conservation, Vol. 195, March 2016. pp 24-32	CON	Bear security cover is considered at length and covered by other citations that are equally or more relevant to the HLC NF.
Helena Hunters & Anglers; Gayle Joslin; and Montana Fish, Wildlife, & Parks	Hillis, J.M., M.J. Thompson, J.E. Canfield, L.J. Ly n, C.L. Marcum, P.M. Dolan, D.W. Cleery. 1991. Defining elk security: The Hillis Paradigm. in Elk Vulnerability - A Symposium. Montana State Univ., Bozeman, April 10-12, 1991.	CITE	This publication is cited in the analysis.
Helena Hunters & Anglers; Montana Fish, Wildlife & Parks	Proffitt, Kelly M., Justin A. Gude, Kenneth L. Hamlin, and Matthew Adam Messer, 2013. Effects of Hunter Access and Habitat Security on Elk Habitat Selection in Landscapes with a Public and Private Land Matrix.	CITE	This publication was cited in the analysis.
Johnson, E.A.	USGS 1996. Mineral and energy resource assessment of the Helena National Forest, West-Central Montana	CITE	This publication is cited in the analysis.
Kegley, Brittany	Perkins, Casey. 2018. "Our Chance to Keep It Wild in the Helena-Lewis and Clark National Fore." Wilderness Areas Montana Wilderness Association, 10 July 2018, https://wildmontana.org/wild-word/our-chance-to-keep-it-wild-in-the-helena-lewis-and-clark-national-forest.	CON	The importance of wilderness was considered using the full range of public comments received as well as other information equally or more relevant to the forest plan revision process; this specific paper is not cited in the analysis.
Kegley, Brittany	Sierra Club 2014. Off-Road Use of Motorized Vehicles Use in officially designated wilderness: The Sierra Club reaffirms its support for the Wilderness Act's prohibition of "mechanized modes of transport," including nonmotorized vehicles, from entry into designated wilderness.	CON	The issue of motorized use impacts to wilderness is addressed using other information that is equally or more relevant to forest plan revision.
Knowles, Randall	Brown 2018. Driven by climate change, fire reshapes US West; Matthew Brown Associated Press; September 4, 2018	CON	The topics of climate change, wildfire, and road/trail impacts are covered by information sources equally or more relevant to the HLC NF and the forest plan revision process.
Knowles, Randall	Dettmer, Sarah 2018. If nothing else, Montana cares about its outdoor recreation; Sarah Dettmer, Great Falls Tribune, Aug. 20, 2018	CON	The value of outdoor tourism was addressed using information equally or more relevant to the HLC NF and the forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Knowles, Randall	Elliott 2018. National Parks Pass: The best money you'll ever spend; Christopher Elliott; GF Tribune, 9/19/2018	CON	General information. the Plan and analysis include information on the importance of recreation as well as access using other information sources that are equally or more relevant.
Knowles, Randall	Inbody 2018. UM: Wildfires cost Montana $240 million in tourism dollars; Kristen Inbody, GF Tribune, April 2, 2018	CON	The value of outdoor tourism was addressed using information equally or more relevant to the HLC NF and the forest plan revision process.
Knowles, Randall	USDI, USFWS, and USDofCommerce, U.S. Census Bureau. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation	CON	General information. The Plan and analysis include information on the importance of recreation as well as access using other information sources that are equally or more relevant.
Maryland Ornithological Society	Links to Bird sighting websites, including survey from Vigilante campground	CON	Bird viewing is covered as a general use of the Forest; this specific survey is not cited.
Meagher County Commissioners	Graham, Russell T., Alan E. Harvey, Martin F. Jurgensen, Theresa B. Jain, Jonalea R. Tonn, Deborah S. Page-Dumroese; 1994. Managing Coarse Woody Debris in Forests of the Rocky Mountains.	CITE	This publication has been cited in the analysis.
Meagher County Commissioners	James K. Brown, James K; Elizabeth D. Reinhardt and Kylie A. Kramer; 2003. Coarse Woody Debris: Managing Benefits and Fire Hazard in the Recovering Forest.	CITE	This publication has been cited in the analysis.
Meagher County Commissioners	Meagher County Wildfire Protection Plan	CITE	All CWPPs are included in the cumulative effects analysis; and by reference as part of existing law and policy (HFRA).
Montana Department of Natural Resource Conservation	Hayes, Steven W. CF, Todd A. Morgan CF, and Chelsea P. McIver. 2014. Montana's Forest Products Industry and Timber Harvest, 2014. Univ. of MT; Bureau of Business and Economic Research	CON	Reference is a poster from the Bureau of Economic Research. The analysis does not necessarily dispute the findings; but places the contribution of the HLC NF timber program in context using other information that is equally or more relevant.
Montana Fish, Wildlife, & Parks	MFWP 2007. Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout and Yellowstone Cutthroat Trout in Montana.	CITE	This publication is cited in the analysis.
Montana Fish, Wildlife, & Parks	MFWP and USDA 2013. U.S. Forest Service and Montana Department of Fish Wildlife and Parks Collaborative Overview and Recommendations for Elk Habitat Management on the Custer, Gallatin, Helena, and Lewis and Clark National Forests	CITE	This publication is cited in the analysis.
Montana Fish, Wildlife, & Parks	Spoon & Canfield 1999. Draft Environmental Assessment Elkhorn Mountains Westslope Cutthroat Trout Restoration Program	REF	The Draft EA mentioned for westslope cutthroat trout recovery efforts in the Elkhorns by the state of MT is programmatic in nature. It defines the scope and intensity of WCT recovery actions in the Elkhorns. These efforts are encouraged or "in-spirit" of the larger MOU for the conservation agreement for WCT and Yellowstone cutthroat trout. The FEIS references the

Commenter(s)	Citation	Response code	Rationale
			MOU (2007) on pages 75-76 and the importance and plan components in support of WCT recovery efforts.
Montana Fish, Wildlife, & Parks	USDA 2016. Blackfoot Travel Plan Final Environmental Impact Statement Volume 2 – Appendices	CON	Topic was consider covered by related literature, e.g., Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Thomas, 1979
Montana Fish, Wildlife, & Parks	USDA FS 2016. Record of Decision: Big Game Security Forest Plan Amendment for the Divide Travel Plan Area.	CON	This is not actually literature nor a true reference, but a request to retain components of a decision that was rescinded in part due to litigation. Although this decision is not directly referenced in the FEIS (in part because it was rescinded), the process it refers to came out of the MFWP/FS 2013 Elk Recommendations documents, which is cited extensively. Discussion in the FEIS and in response to comments (specifically CR44) addresses the issues of existing 'secure areas' as well as the issue of fixed numeric standards for secure habitat.
Montana Mining Association	Berg, Richard B. 2015. Compilation of Reported Sapphire Occurrences in Montana.	IRR	HLC NF has diverse geology and mining history. This reference is too detailed for the programmatic level of analysis conducted for forest plan revision.
Montana Mining Association	Cox 2015. 2015 Mining and Mineral Symposium; May 8–10, 2015; Montana Bureau of Mines and Geology; Butte, Montana	GEN	Management of RWAs would be consistent with law, regulation, and policy, and would not preclude valid existing rights.
Montana Mining Association	Lyden, C.J., 1948, The gold placers of Montana: Montana Bureau of Mines and Geology Memoir 26, 151 p.	IRR	This information is not needed to inform the analysis for forest plan revision. The minerals resource is described using other information sources equally or more relevant to the HLC NF.
Montana Mining Association	Ruppel 1963. Geology of the Basin Quadrangle; Jefferson, Lewis and Clark, and Powell Counties, Montana; By EDWARD T. RUPPEL; 1963	GEN	Management of RWAs would be consistent with law, regulation, and policy, and would not preclude valid existing rights.
Montana Mining Association	Vann Struth Consulting Group Inc. 2013. Employment Projections for the Squamish-Lillooet Regional District; FINAL REPORT June 2013.	IRR	HLC NF has diverse geology and mining history, which is described using other information sources equally or more relevant.
Montana Wilderness Association	APHA 2013. Improving Health and Wellness through Access to Nature	CITE	This publication is cited in the analysis.
Montana Wilderness Association	Haber, Jonathan 2015. Creating the Next Generation of National Forest Plans (Missoula, MT: Bolle Center for People and Forests, 2015)	GEN	The Plan is consistent with the 2012 Planning Rule and associated directives, including the context and format of desired condition plan components.
Montana Wilderness Association	Krueger Undated. The forest as nature's health service (from PNW Juneau Forestry Sciences Lab)	CON	The topic of health and wellness is discussed using other information sources that are equally or more relevant to the HLC NF.

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Montana Wilderness Association	Montana Snowmobile Ass'n v. Wildes, 103 F. Supp. 2d 1239 (D. Mont. 2000)	CON	The Plan provides clear direction and the FEIS utilizes information sources equally or more relevant to address the impacts of suitable uses in each ROS setting.
Montana Wilderness Association	RUSSELL COUNTRY SPORTSMEN v. UNITED STATES FOREST SERVICE	GEN	The Plan is consistent with all applicable law, regulation, and policy for WSAs.
Montana Wilderness Association; Sally Cathey	McCool. Does Wilderness Designation Lead to Increased Recreational Use?	IRR	Designated wilderness is beyond the authority of the FS and the Plan. Only Congress may designate wilderness. Additionally, the results of the study determined that designation of wilderness did not substantially increase recreation use.
Montana Wilderness Association; Sally Cathey	MWA and MWS 2015. Field Measures of Wilderness Character 2015 Helena--Lewis & Clark National Forest Montana Wilderness Association	CON	The results from this study were considered in the wilderness evaluation for the Plan. May be a source to reference during site specific project work.
Mountain States Legal Foundation	USDI 2016. Interior Department Disburses $6.23 Billion in FY 2016 Energy Revenues; Federal Revenues Support State, Tribal, National Needs; November 25, 2016 from USDI, Office of Natural Resources Revenue	IRR	The economic considerations of energy development is addressed as appropriate using other literature sources equally or more relevant to the HLC NF.
National Wildlife Federation	Baker, B. W., and E. P. Hill. 2003. Beaver (Castor canadensis). Pages 288-310 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild Mammals of North America: Biology, Management, and Conservation. Second Edition.	CON	General reference to history of beavers in North America. Beavers are addressed using literature equally or more relevant to the HLC NF.
National Wildlife Federation	Baldwin, Jeff 2015. Potential mitigation of and adaptation to climate-driven changes in California's highlands through increased beaver populations.	CON	The ecological importance of beaver activity is acknowledged in several plan components. The watershed and wildlife analysis encompasses general effects related to beaver, by their inclusion in the guild of wildlife dependent on riparian and wetland habitats.
National Wildlife Federation	Boyles, Stephanie L. 2006. Report on the Efficacy and Comparative Costs of Using Flow Devices to Resolve Conflicts with North American Beavers along Roadways in the Coastal Plain of Virginia; Stephanie L. Boyles Wildlife Biologist; 2006	IRR	This paper addresses site-specific considerations but does not inform the programmatic analysis for forest plan revision.
National Wildlife Federation	Buckley, Mark 2011. The Economic Value of Beaver Ecosystem Services Escalante River Basin, Utah.	CON	The benefits of beavers to ecosystems is acknowledged in the Plan and in the analysis using information that is equally or more relevant.
National Wildlife Federation	Castro et al 2018. The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains; April 10, 2018; US Fish and Wildlife Service Janine Castro, National Oceanic and Atmospheric Administration Michael Pollock and Chris	CON	The benefits of beavers to ecosystems is acknowledged in the Plan and in the analysis using information that is equally or more relevant.

Commenter(s)	Citation	Response code	Rationale
	Jordan, University of Saskatchewan Gregory Lewallen, US Forest Service Kent Woodruff		
National Wildlife Federation	Chadwick, Amy, Stephen Carpenedo, and Skip Lisle. Undated. Living with Beavers; Management Solutions for Nuisance Beaver Activity, MFWP. Amy Chadwick, Stephen Carpenedo, MT DEQ Wetland Program, Skip Lisle of Beaver Deceivers International	IRR	General information on beaver management techniques; this information is more appropriate for specific issues and not relevant to forest planning.
National Wildlife Federation	Fouty 2008. Climate Change and Beaver Activity; How Restoring Nature's Engineers Can Alleviate Problems; Suzanne Fouty 2008	NOT RLB	Manuscript is an anecdotal description of a single stream and the effects of beaver removal. The topic of beavers is covered using citations that are more relevant to forest plan revision.
National Wildlife Federation	Goldfarb 2018. 'Beaver Believers' say dam-building creatures can make the American West lush again; Interview with Goldfarb, 2018	NOT RLB	Interview, not the published work. The topic of beavers is covered using citations that are more relevant to forest plan revision.
National Wildlife Federation	Goldfarb, Ben 2018. BEAVERS, REBOOTED; Artificial beaver dams are a hot restoration strategy, but the projects aren't always welcome; By Ben Goldfarb, in the Scott Valley, California; 2018	CON	The benefits of beavers to ecosystems is acknowledged in the Plan and in the analysis using information that is equally or more relevant.
National Wildlife Federation	Maughan 2013. Beaver restoration would reduce wildfires; More effective and less expensive than logging, beaver also provide fish, wildlife and flood control benefits	NOT RLB	Opinion piece. The topic of beavers is covered using citations that are more relevant to forest plan revision.
National Wildlife Federation	Morelli, Toni Lyn; Christopher Daly, Solomon Z. Dobrowski, Deanna M. Dulen, Joseph L. Ebersole, Stephen T. Jackson, Jessica D. Lundquist, Constance I. Millar, Sean P. Maher, William B. Monahan, Koren R. Nydick, Kelly T. Redmond, Sarah C. Sawyer, Sarah Stock, Steven R. Beissinger; 2016. Managing Climate Change Refugia for Climate Adaptation.	CON	The ecological importance of beaver activity as key to the healthy function and resilience of watersheds and riparian systems is acknowledged in several plan components FW-WTR-DC-09, FW-WTR-GO-04, FW-WTR-GDL-01, and FW-WTR-GDL-03. Similar research and other information supported development of these components. The watershed and wildlife analyses encompass general effects related to beaver within the analysis of the guild of wildlife species dependent on riparian and wetland habitats.
National Wildlife Federation	Schultz, Courtney A., Thomas D. Sisk, Barry R. Noon, Martin A. Nie 2012. Wildlife Conservation Planning Under the United States Forest Service's 2012 Planning Rule.	GEN	Paper outlines 2012 Planning Rule and suggests criteria for selecting focal species. The HLC NF is consistent with the 2012 Planning Rule with regards to focal species.
National Wildlife Federation	Scrafford, Matthew A.; Daniel B. Tyers, Duncan T. Patten, Bok F. Sowell. 2018. Beaver Habitat Selection for 24 Years since Reintroduction North of Yellowstone National Park	CON	The ecological importance of beaver activity as key to the healthy function and resilience of watersheds and riparian systems is acknowledged in several plan components FW-WTR-DC-09, FW-WTR-GO-04, FW-WTR-GDL-01, and FW-WTR-GDL-03. Similar research and other information supported development of these components. The watershed and wildlife analyses encompass general effects related to beaver within the

Commenter(s)	Citation	Response code	Rationale
			analysis of the guild of wildlife species dependent on riparian and wetland habitats.
National Wildlife Federation	Stabler 1985. Increasing Summer Flow in Small Streams through Management of riparian Areas and Adjacent Vegetation: A Synthesis; by D. Frederic Stabler, 1985	DATED	References to beavers in this manuscript are generally historical and speak to the general benefits of beavers as ecosystem engineers. The topic of beavers is covered with other more recent information sources relevant to the HLC NF.
National Wildlife Federation	State of New Mexico. 2016. Wetland Protection and Beaver Habitat Restoration as Climate Adaptation Tools in New Mexico; State of NM, 2016	IRR	Technical guide referencing a specific program in New Mexico; not directly relevant to the HLC NF forest plan revision.
National Wildlife Federation	USDA 2008. Forest Service Strategic Framework for Responding to Climate Change; 2008	GEN	The HLC NF is consistent with FS policy related to climate change responses and focal species under the 2012 Planning Rule.
National Wildlife Federation	USFWS 2014. Report of the Climate Change Adaptation and Beaver Management Team to the Joint Implementation Working Group; Implementing the National Fish, Wildlife, and Plant Climate Change Adaptation Strategy; Climate Change Adaptation and Beaver Management Team (Team)	CON	The ecological importance of beaver activity as key to the healthy function and resilience of watersheds and riparian systems is acknowledged in several plan components FW-WTR-DC-09, FW-WTR-GO-04, FW-WTR-GDL-01, and FW-WTR-GDL-03. Similar research and other information supported development of these components. The watershed and wildlife analyses encompass general effects related to beaver within the analysis of the guild of wildlife species dependent on riparian and wetland habitats.
National Wildlife Federation	Wade, A.A., C. Brick, S. Spaulding, T. Sylte, and J. Louie. April 2016. Watershed Climate Change Vulnerability Assessment Lolo National Forest; U.S. Department of Agriculture, Forest Service, Northern Region and Lolo National Forest.	CON	The ecological importance of beaver activity as key to the healthy function and resilience of watersheds and riparian systems is acknowledged in several plan components FW-WTR-DC-09, FW-WTR-GO-04, FW-WTR-GDL-01, and FW-WTR-GDL-03. Similar research and other information supported development of these components. The watershed and wildlife analyses encompass general effects related to beaver within the analysis of the guild of wildlife species dependent on riparian and wetland habitats.
National Wildlife Federation	Whitlock, Cathy; Wyatt F. Cross, Bruce Maxwell, Nick Silverman, and Alisa A. Wade; 2017. 2017 Montana climate assessment	CON	The topic of climate and associated effects is covered using a large body of literature that is equally or more relevant to the HLC NF, including the work of the Northern Rockies Adaptation Partnership.
National Wildlife Federation	Wurtzebach, Zachary and Courtney Schultz; 2016. Measuring Ecological Integrity: History, Practical Applications, and Research Opportunities.	CON	Paper discusses the concept of 'ecological integrity' broadly. The topic of beavers is covered with information sources equally or more relevant to the HLC NF.
Nelson, Danica	Gander, Hans & Paul Ingold. 1997REACTIONS OF MALE ALPINE CHAMOIS Rupicapra r. rupicapra TO HIKERS, JOGGERS AND MOUNTAINBIKERS	IRR	Literature references for species not found in planning area.

Commenter(s)	Citation	Response code	Rationale
Nelson, Danica	Papouchis, Christopher M., Francis J. Singer and William B. Sloan 2001. Responses of Desert Bighorn Sheep to Increased Human Recreation. The Journal of Wildlife Management, Vol. 65, No. 3 (Jul. 2001)	GEN	Paper provides a literature search on effects of mountain biking to soil, vegetation, wildlife, and water. No specific references to effects on wilderness character. Not specifically used in programmatic level analysis, but part of body of science considered in overall planning. Useful for travel planning and other site-specific planning.
Nelson, Danica	Taylor, Audry R. and Richard L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions	GEN	Paper provides a literature search on effects of mountain biking to soil, vegetation, wildlife, and water. No specific references to effects on wilderness character. Not specifically used in programmatic level analysis, but part of body of science considered in overall planning. Useful for travel planning and other site-specific planning.
Nixon, Brian	Quinn, Michael and Greg Chernoff. 2010. Mountain Biking: A Review of the Ecological Effects, February 2010.	GEN	Rec Review: Paper provides a literature search on effects of mountain biking to soil, vegetation, wildlife, and water. No specific references to effects on wilderness character. Not specifically used in programmatic level analysis, but part of body of science considered in overall planning. Useful for travel planning and other site-specific planning.
Northern Rocky Mountain Grotto; Zach Angstead	Keeler, Ray 2015. Forest Cave and Karst Management Plans— The need to include “How to” Wording.	IRR	The management of these features is regulated by the Federal Cave Resource Protection Act of 1988. The Plan is consistent with the 2012 Planning Rule and all other law, regulation, and policy.
O'Connell, Shane	Cawley and Freemuth 1997. A critique of the multiple use framework in public lands decision making: RM Cawley, J Freemuth, In: Western Public Lands and Environmental Politics; 1997	GEN	The 2012 planning rule requires the FS to consider a variety of uses across the planning area.
Olsen, Lance	Abatzoglou et al 2014. Seasonal Climate Variability and Change in the Pacific NW of the US	CITE	This publication is cited in the analysis.
Olsen, Lance	Abella & Fornwalt 2015. Ten years of vegetation assembly after a North American mega fire	CITE	This publication is cited in the analysis.
Olsen, Lance	Acuna et al 2014. Why Should We Care About Temporary Waterways?	IRR	Not peer reviewed. HLC NF consideration of waterways includes other regulatory framework.
Olsen, Lance	Adams et al 2009. Temperature sensitivity of drought-induced tree mortality portends increased regional die-off under global change-type drought	IRR	Species does not occur on HLC NF. Topic of drought and potential die-off are covered by other information sources more relevant to the HLC NF.
Olsen, Lance	Allen et al 2010. A global overview of drought & heat-induced tree mortality reveals emerging climate change risks for forests	CITE	This publication is cited in the analysis.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Allen et al 2015. On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene	CITE	This publication is cited in the analysis.
Olsen, Lance	Anderegg et al 2012. Consequences of widespread tree mortality triggered by drought and temperature stress	CITE	This publication is cited in the analysis.
Olsen, Lance	Anderegg et al 2013. Drought's legacy: multiyear hydraulic deterioration underlies widespread aspen forest die-off and portends increased future risk	CITE	This publication is cited in the analysis.
Olsen, Lance	Anderegg et al 2015. Tree mortality predicted from drought-induced vascular damage	IRR	Models cannot be implemented for forest plan revision. Aspen is addressed with other citations equally or more relevant.
Olsen, Lance	Anderson and Bows 2011. Beyond 'dangerous' climate change: emission scenarios for a new world	CON	Downscaled climate change models and emissions scenarios that are more relevant to the HLC NF are used in Halfosky et al 2018.
Olsen, Lance	Andrus et al 2018. Moisture availability limits subalpine tree establishment	CITE	This publication is cited in the analysis.
Olsen, Lance	Appendix I: Bur oak (unknown source)	IRR	The species referenced is not native to planning area and the FS is not aware of a study that predicts its future range. FS uses other information sources more relevant to the HLC NF to inform species compositions expected over the planning horizon.
Olsen, Lance	Aragorn 2017. Hunters lived on Tibetan plateau thousands of years earlier than thought	IRR	This paper discussing the Tibetan Plateau is not relevant to forest planning or the planning area.
Olsen, Lance	Araujo and Rahbek 2006. How does climate change affect biodiversity? Science 2006	CON	The general topic of potential future species distributions is covered with other references equally or more relevant to the HLC NF.
Olsen, Lance	Arendal 2019. Climate feedbacks- the connectivity of the positive ice/snow albedo feedback, terrestrial snow and vegetation feedbacks and the negative cloud/ radiation feedback	NOT RLB	This is a graphics website; not a paper or publication. Climate change feedbacks addressed with other citations.
Olsen, Lance	Armsworth et al 2015. Are conservation organizations configured for effective adaptation to global change?	IRR	The organizational structure of the FS as a conservation entity is not within the scope of a forest plan revision.
Olsen, Lance	Arnone et al 2008. Prolonged suppression of ecosystem CO2 uptake after an anomalously warm year	CON	The process of carbon sequestration is addressed in the EIS and appendix J using literature sources equally or more relevant to the HLC NF.
Olsen, Lance	Arrhenius 1896. On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground	DATED	Interesting perspective as one of the first works related to carbon (1896) but far more recent publications are used to analyze carbon and climate in the analysis.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Ault et al 2016. Relative impacts of mitigation, temperature, and precipitation on 21st-century megadrought risk in the American Southwest	IRR	Specific to the Southwest. Topic of drought risk and vulnerability is covered by Halofsky et al 2018 and other citations.
Olsen, Lance	Badolo et al 2015. Climatic Variability and Food Security in Developing Countries	IRR	The FS does not directly impact food security.
Olsen, Lance	Barnosky et al 2012. Approaching a state shift in Earth's biosphere	IRR	Planetary scale risks and societal change/policy needs. Halfosky et al 2018 provides analysis downscaled and more relevant to HLC NF.
Olsen, Lance	Bartumeus & Levin 2008. Fractal reorientation clocks: Linking animal behavior to statistical patterns of search	IRR	Not applied to forest management. Animal movement, connectivity addressed with other citations that are more relevant.
Olsen, Lance	Bataineh & Daniels 2014. An objective classification of large wood in streams	IRR	Classification system is not possible to use to inform the analysis.
Olsen, Lance	Bazzaz & Fajer 1992. Plant Life in a CO2-Rich World	DATED	Magazine article. Halofsky et al 2018 covers this topic using more recent science.
Olsen, Lance	Bearup et al 2014. Hydrological effects of forest transpiration loss in bark beetle-impacted watersheds	CON	Topic of tree mortality effects to watersheds is addressed with other citations that are equally or more relevant to the HLC NF.
Olsen, Lance	Biederman et al 2015. Recent tree die-off has little effect on streamflow in contrast to expected increases from historical studies.	CITE	Publication is cited in the analysis.
Olsen, Lance	Biggs et al 2009. Turning back from the brink: Detecting an impending regime shift in time to avert it	CON	Indicators studied can't be relied on to detect/avoid regime shifts. Other citations used to describe vulnerability of fisheries.
Olsen, Lance	Black et al 2018. Rising synchrony controls western North American Ecosystems	CON	This citation is more relevant to the Pacific Northwest. Not directly applicable to Revision. Concepts of climate change and synchrony of factors sufficiently covered by the use of other citations.
Olsen, Lance	Black et al 2018. Study sees climate impact on land and at sea	CON	Web article about weather extremes and risks to farms. General topic of climate and weather extremes addressed with other citations more directly relevant to the HLC NF.
Olsen, Lance	Bloomberg et al 2017. Recommendations of the Task Force on Climate-related Financial Disclosures.	REF	The Plan decision is not linked to a change in atmospheric temperature; therefore, this type of research is outside the scale of the NEPA decision. Climate concerns relating to National Forests are addressed through our mitigation and climate strategy programs (NRAP) and discussed in the climate section of the FEIS.
Olsen, Lance	Bloomberg et al 2017. Technical Supplement: The Use of a Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities	CON	The HLC NF incorporates future climate scenarios from other citations and vegetation modeling to disclose climate-related risks.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Bond Lamberty et al 2018. Globally rising soil heterotrophic respiration over recent decades	IRR	This paper describes global trends; the FS does not analyze or monitor at this scale.
Olsen, Lance	Breshears et al 2005. Regional vegetation die-off in response to global-change-type drought	CON	Vulnerabilities for species in planning area are addressed in Halofsky et al 2018 which provides analysis downscaled/relevant to HLC NF.
Olsen, Lance	Breshears et al 2016. Rangeland Responses to Predicted Increases in Drought Extremity	CITE	This work is cited in the analysis. Other citations, such as Halofsky et al 2018, also address expected rangeland responses to drought.
Olsen, Lance	Brienen et al 2015. Long-term decline of the Amazon carbon sink	IRR	Not relevant to the planning area – global scale.
Olsen, Lance	Brooks et al 2009. Eco hydrologic separation of water between trees and streams in a Mediterranean climate	IRR	Conceptual framework. Unclear how this would inform forest plan revision. Similar subject to Evaristo et al, 2015.
Olsen, Lance	Buma et al 2016. Emerging climate-driven disturbance processes: widespread mortality associated with snow-to-rain transitions across 10° of latitude and half the range of a climate-threatened conifer	CON	Species vulnerability is covered for species that occur on the HLC NF in Halofsky et al 2018 and other citations.
Olsen, Lance	Bunnell and Kremsater 2012. Migrating Like a Herd of Cats: Climate Change and Emerging Forests in British Columbia	CON	Potential species shifts are covered by other sources such as Halofsky et al 2018.
Olsen, Lance	Burbrink et al 2016. Asynchronous demographic responses to Pleistocene climate change in Eastern Nearctic vertebrates	IRR	Broad scale (North America) modeling on animal populations. Not directly applicable to forest plan revision on the HLC NF.
Olsen, Lance	Burke et al 2006. Modeling the Recent Evolution of Global Drought and Projections for the Twenty-First Century with the Hadley Centre Climate Model	CON	NRAP provides a synthesis of climate models downscaled to the HLC NF planning area.
Olsen, Lance	Cahill et all 2012. How does climate change cause extinction?	CON	Risks and vulnerabilities to species found on the HLC NF are summarized from other sources such as Halofsky et al 2018.
Olsen, Lance	Carnicer et al 2010. Widespread crown condition decline, food web disruption, and amplified tree mortality with increased climate change-type drought	IRR	Study from Europe. Potential dieback is covered by more local sources in Halofsky et al 2018 and other citations.
Olsen, Lance	Carpenter et al 2011. Early Warnings of Regime Shifts: A Whole-Ecosystem Experiment	INC	Paper notes the need more research to identify indicators of vulnerability.
Olsen, Lance	Charney et al 2016. Observed forest sensitivity to climate implies large changes in 21st century North American forest growth.	CITE	Publication is cited in the analysis.
Olsen, Lance	Choi et al 2017. Newly discovered deep-branching marine plastid lineages are numerically rare but globally distributed	IRR	Does not discuss ecosystems present on the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Clarke et al 2015. Influence of different tree-harvesting intensities on forest soil carbon stocks in boreal and northern temperate forest ecosystems	CON	The issue of soil carbon is addressed in the EIS and appendix J using other citations equally or more relevant to the HLC NF. Additional detail on harvesting intensities is not necessary to illustrate the impacts of alternatives to soil carbon stocks.
Olsen, Lance	Climate Adaptation website: Scenarios Planning for Climate Adaptation	CON	The HLC NF uses Halofsky et al 2018 to inform potential future climate scenarios and incorporates monitoring and adaptive management into the Plan. See also appendix J of the FEIS, which addresses specific strategies.
Olsen, Lance	Colacito et al 2018. Temperature and growth: a panel analysis of the United States.	REF	The Plan decision is not linked to a change in atmospheric temperature; therefore, this type of research is outside the scale of the NEPA decision. Climate concerns relating to National Forests are addressed through our mitigation and climate strategy programs (NRAP) and discussed in the climate section of the FEIS.
Olsen, Lance	Coumou et al 2018. The influence of Arctic amplification on mid Latitude summer circulation	CON	Citation provides further evidence of feedback processes that lead to more persistent hot-dry extremes. However, the HLC NF uses Halfosky et al 2018, which considers future climate extremes. This citation is not needed to further enforce the concept of considering future climates.
Olsen, Lance	Creed et al 2016. Hunting on a hot day: effects of temp on interactions between African wild dogs & their prey	IRR	Paper does not discuss issues or species that apply to the HLC NF.
Olsen, Lance	Crowther et al 2016. Quantifying global soil carbon losses in response to warming	CON	The FS located a publication by Crowther, not Crowley as cited in the comment. The publication is related to soils at the global scale. Halfosky et al 2018 provides analysis that is downscaled/relevant to the HLC NF.
Olsen, Lance	Dai et al 2012. Generic Indicators for Loss of Resilience Before a Tipping Point Leading to Population Collapse	IRR	Paper discusses experiment with yeast to demonstrate critical slowing down warning for loss of resilience. Not applicable to forest plan revision on HLC NF.
Olsen, Lance	Dakos & Bascompte 2014. Critical slowing down as early warning for the onset of collapse in mutualistic communities	IRR	Study in South America, indicators of tipping points. Unclear how to relate “critical slowing down” to ecosystems on HLC NF. Publication not relevant to planning area.
Olsen, Lance	Danby and Hik 2007. Variability, contingency and rapid change in recent subarctic alpine tree line dynamics	CON	Citations such as Halofsky et al 2018 identify vulnerabilities to treeline communities and are more relevant to the HLC NF.
Olsen, Lance	Darling and Cote 2018. Insights Magazine-Seeking Resilience in Marine Ecosystems	CON	This work is specific to marine ecosystems and corals. The general topic of resistance to climate change is broadly relevant, but topic is covered with numerous other literature sources more directly related to terrestrial ecosystems.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Dean et al 2016. Conventional intensive logging promotes loss of organic carbon from the mineral soil	CON	The issue of soil carbon is addressed in the FEIS and appendix J using other citations equally or more relevant to the HLC NF. Additional detail on harvesting intensities is not necessary to illustrate the impacts of alternatives to soil carbon stocks.
Olsen, Lance	Dell et al 2013. Temperature dependence of trophic interactions are driven by asymmetry of species responses and foraging strategy	CON	Theoretical model of possible effects of climate change on on a theoretical community and the corresponding dynamics. The resulting consideration of community resilience are inclusive of other citations and generally considered using more empirical examples.
Olsen, Lance	Diffenbaugh and Field 2013. Changes in Ecologically Critical Terrestrial Climate Conditions	CON	Halofsky et al 2018 provides an analysis that is more downscaled/relevant to the HLC NF.
Olsen, Lance	DiMarco & Santini 2015. Human pressures predict species' geographic range size better than biological traits	IRR	Laboratory test of theoretical model, addressing issues at a broader scale than the HLC NF.
Olsen, Lance	Dodson and Root 2013. Conifer regeneration following stand-replacing wildfire varies along an elevation gradient in a ponderosa pine forest, OR, USA	CITE	This publication is cited in the analysis.
Olsen, Lance	Doncaster et al 2016. Early warning of critical transitions in biodiversity from compositional disorder	IRR	Experiment to identify warning of transitions in biodiversity; general and not directly applicable to forest plan revision on the HLC NF.
Olsen, Lance	Drake & Griffen 2010. Early warning signals of extinction in deteriorating environments	IRR	Broader scale issue than the HLC NF.
Olsen, Lance	Dufresne, Saint, Lu 2016. Positive feedback in climate: Stabilization or Runaway, Illustrated by a Simple Experiment.	IRR	Not directly applicable; paper is about the broad theory of climate change and not relevant to the HLC NF forest plan revision process.
Olsen, Lance	Duncan 1999. Dead and dying trees: Essential for life in the forest	CON	Other peer reviewed literature used to describe the function of dead wood, such as Graham et al 1994 and Brown et al 2003.
Olsen, Lance	Duncan 2002. Dead wood all around us: Think regionally to manage locally	CON	Other peer reviewed literature used to describe the function of dead wood, such as Graham et al 1994 and Brown et al 2003.
Olsen, Lance	Duncan 2004. Dead wood, living legacies: habitat for a host of fungi	CON	Other peer reviewed literature used to describe the function of dead wood, such as Graham et al 1994 and Brown et al 2003.
Olsen, Lance	Eby e al 2019. Lifetime of Anthropogenic Climate Change: Millennial Time Scales of Potential CO2 and Surface Temperature Perturbations	CON	Consistent with climate projections used and referenced from Halfosky et al 2018.
Olsen, Lance	Ellison et al 2012. On the forest cover–water yield debate: from demand- to supply-side thinking	IRR	Although there is a direct link to forests and inland precipitation, this study is at too large a scale to demonstrate any effects on the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Emilson et al 2018. Climate driven shifts in sediment chemistry enhance methane production in northern lakes	IRR	Forest plan revision would not affect lake sediments. This work at the global scale is not directly relevant to the HLC NF.
Olsen, Lance	Essl et al 2015. Historical legacies accumulate to shape future biodiversity in an era of rapid global change	IRR	Global in scale; concept not directly applicable to forest planning issues.
Olsen, Lance	Evaristo et al 2015. Global separation of plant transpiration from groundwater and streamflow	IRR	Runoff models should incorporate separation. HLC NF uses BASI for runoff models - Brooks etal, 2009
Olsen, Lance	Ficklin et al 2018. Natural and managed watersheds show similar responses to recent climate change	CON	This citation is broad-scale information on natural and human modified streamflow; large-scale climate trends affect water availability. Broadly relevant but considered with other information sources.
Olsen, Lance	Fields et al 2007. North America. Climate Change 2007: Impacts, Adaptation and Vulnerability	REF	This citation is referenced in Halfosky et al 2018, which provides a basis for HLC NF analysis.
Olsen, Lance	Fiore et al 2012. Global air quality and climate	IRR	Publication not relevant to the planning area.
Olsen, Lance	Flombaum and Sala 2008. Higher effect of plant species diversity on productivity in natural than artificial ecosystems	IRR	Paper specific to Patagonia. The broader concept of biodiversity in natural systems is widely accepted; this citation does not add information needed for forest plan revision.
Olsen, Lance	Ford et al 2011. Can forest management be used to sustain water-based ecosystem services in the face of climate change?	CON	Paper is specific to the Appalachians; concepts in general apply but the HLC NF uses other references more pertinent to the Rockies.
Olsen, Lance	Foster & Orwig 2006. Preemptive and Salvage Harvesting of New England Forests: When Doing Nothing Is a Viable Alternative	CON	Ecosystems studied are different than HLC NF. Disturbances and salvage covered in the analysis using other citations that are more relevant.
Olsen, Lance	Foster et al 2016. Energy budget increases reduce mean streamflow more than snow–rain transitions: using integrated modeling to isolate climate change impacts on Rocky Mountain hydrology	CON	Halofsky et al 2018 covered most of what this paper relates to. This paper was trying to tease out the snowpack vs rain in warming climate to help quantify the magnitude of river discharge response. Very localized study.
Olsen, Lance	Franklin and Lindenmayer 2009. Importance of matrix habitats in maintaining biological diversity	IRR	Manuscript discusses recent tests of Island Biogeography Theory; while theoretically important for setting the bounds of management theory, it lacks specificity to the Forest Plan beyond the suggestion that 'islands' and the 'matrix' are managed to optimize habitat conditions, a theme that is consistent with forest planning.
Olsen, Lance	Friedlingstein 2010. Update on CO2 Emissions – to the editor	CON	Global summary of emissions. Other citations such as Halfosky et al 2018 are used to discuss this topic.
Olsen, Lance	Fryxell et al 2008. Multiple movement modes by large herbivores at multiple spatiotemporal scales	CON	General information about elk ecology; this topic is covered by other citations more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Funk, Jason and Stephen Saunders et al 2014. Rocky Mountain Forests at Risk: Confronting Climate driven Impacts from Insects, Wildfires, Heat and Drought	CON	The topic of forest mortality in relation to disturbances and drought is important and is discussed using a body of other literature that are equally or more relevant to the HLC NF.
Olsen, Lance	Furness et al 2013. Assessing the Vulnerability of Watersheds to Climate Change	CON	Watershed analysis utilizes Halofsky et al 2018 and other citations to disclose vulnerability of watersheds to climate change.
Olsen, Lance	Ganguly et al 2009. Higher trends but larger uncertainty and geographic variability in 21st century temperature and heat waves	CON	Halofsky et al 2018 covers this topic, which selected the best climate scenario predictions for R1.
Olsen, Lance	Gannett 1888. Do Forests Influence Rainfall?	IRR	Paper discusses Midwest states. General function of rainfall; not relevant to forest plan revision.
Olsen, Lance	Garibaldi et al 2013. Wild Pollinators Enhance Fruit Set of Crops Regardless of Honeybee Abundance.	CITE	This reference is cited in the pollinator specialist report. The effects of native wild pollinators on farming and crop pollination is discussed in the Pollinator Specialist Report.
Olsen, Lance	Gauthier et al 2015. Boreal forest health and global change	IRR	Biome scale, very broad. Topic of forest management is covered with other citations more relevant to the HLC NF.
Olsen, Lance	Golladay et al 2016. Achievable future conditions as a framework for guiding forest conservation and management	CITE	Paper is cited in the analysis. Paper supports approach of modeling and monitoring for the HLC NF.
Olsen, Lance	Government of BC. Assisted Migration Adaptation Trial	CON	Study doesn’t involve Region 1 but does include species present on the HLC NF. Assisted migration is not precluded in the Plan. HLC NF would follow Region 1 guidelines for seedling transfer. This topic is covered using other citations in the analysis.
Olsen, Lance	Granados et al 2012. Climate change and the world economy: short-run determinants of atmospheric CO2	REF	The Plan decision is not linked to a change in atmospheric temperature; therefore, this type of research is outside the scale of the NEPA decision. Climate concerns relating to National Forests are addressed through our mitigation and climate strategy programs (NRAP) and discussed in the climate section of the FEIS.
Olsen, Lance	Grant 1992. Money of the Mind: Borrowing and Lending in America from the Civil War to Michael Milken.	REF	The Plan decision is not linked to a change in atmospheric temperature; therefore, this type of research is outside the scale of the NEPA decision. Climate concerns relating to National Forests are addressed through our mitigation and climate strategy programs (NRAP) and discussed in the climate section of the FEIS.
Olsen, Lance	Grekousis & Mountrakis 2015. Sustainable Development under Population Pressure: Lessons from Developed Land Consumption in the Conterminous U.S.	IRR	Addresses topic of increasing population in open spaces and natural areas. The FS does not convert NFS lands to urban uses.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Hall & Fagre 2003. Modeled Climate induced Glacier Change Clacier NP	IRR	Melting of Glaciers in Glacier NP is an important effect of climate change but not directly applicable to the HLC NF forest plan revision. Impacts of climate change are addressed with other citations.
Olsen, Lance	Halofsky et al 2017. Assessing Vulnerabilities and Adapting to Climate Change in the Northwestern United States.	AUTH	Citation is used in the analysis, in its final published form (Halofsky et al 2018).
Olsen, Lance	Halofsky et al 2018. Northern Rockies Adaptation partnership (Ch. 5 Effects of Climate Change on Forest Vegetation in the Northern Rockies)	CITE	This citation is used in the analysis.
Olsen, Lance	Hansen et al 2005. Effects of Exurban Development on Biodiversity: Patterns, Mechanisms, and Research Needs	IRR	Paper discusses large scale issues with rural development. The FS does not convert NFS lands to urban uses. Population growth is broadly covered in the cumulative effects analysis.
Olsen, Lance	Hartfield et al 2018. A look at 2017; takeaway points from the State of the Climate supplement	CON	Summarizes climate/weather events of 2017 aross the globe. Broadly relevant, but existing and expected climate is covered with other citations such as Halofsky et al 2018 that are downscaled to the HLC NF.
Olsen, Lance	Harvey et al 2016. High and dry: post-fire tree seedling establishment in subalpine forests decreases with post-fire drought and large stand-replacing burn patches	CITE	Publication is cited in the analysis.
Olsen, Lance	Healey et al 2008. The Relative Impact of Harvest and Fire upon Landscape-Level Dynamics of Older Forests: Lessons from the NW Forest Plan	CON	Forests and harvest practices differ from HLC NF. Disturbances and older forests represented by other citations & modeling. Population growth is broadly covered in the cumulative effects analysis.
Olsen, Lance	Hoegh and Guldberg 2018. Chapter 3: Impacts of 1.5 deg C global warming on natural and human systems	CON	The attached citation states “do not cite, quote, or distribute” – draft chapter of the IPCC. Global in scale. Although potentially more recent, publication does not add new info specifically relevant to the HLC NF that is not covered by the literature citations already used, such as Halofsky et al 2018.
Olsen, Lance	Hoerling & Kumar 2003. The Perfect Ocean for Drought	IRR	Global scale. Halofsky et al 2018 summarizes similar information for Region 1 and is more relevant to the HLC NF.
Olsen, Lance	Holden et al 2018. Decreasing fire season precipitation increased recent western US forest wildfire activity	CITE	This publication is cited in the analysis.
Olsen, Lance	Holthaus 2018. Terrified by ‘hothouse Earth’? Don’t despair – do something.	NOT RLB	Opinion piece which supports the importance of climate change mitigation.
Olsen, Lance	Holtsmark 2012. The outcome is in the assumptions: analyzing the effects on atmospheric CO2 levels of increased use of bioenergy from forest biomass	CON	The topic of wood harvest and the carbon cycle are covered by sources such as Halfosky et al 2018 and Region 1 carbon assessments.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Howard 2012. Extreme Weather to Become More Commonplace	CON	Website article summarizing potential for extreme weather due to climate change. Topic covered by other citations, such as Halfosky et al 2018, where relevant to the HLC NF.
Olsen, Lance	Huntingford et al 2013. The Timing of climate change	IRR	Summary article about a study; the summary itself is not relevant. The study itself, (Mora) is assessed separately.
Olsen, Lance	Isaak et al 2011. Climate change effects on stream and river temperatures across the northwest U.S. from 1980–2009 and implications for salmonid fishes.	CON	Other information, such as Halofsky et al 2018, is equally or more relevant, and is used in the EIS to describe stressors and vulnerabilities to fish.
Olsen, Lance	Jackson 2016. Reinventing conservation – again	NOT RLB	Editorial piece.
Olsen, Lance	Jarvis et al 2016. Early warning signals detect critical impacts of experimental warming	IRR	Early warning signals; cannot be directly applied to ecosystems on HLC NF.
Olsen, Lance	Jasechko et al 2013. Terrestrial water fluxes dominated by transpiration	CON	Citation is very broad scale; climate models summarized in Halofsky et al 2018 are more applicable to the HLC NF.
Olsen, Lance	Jenkins et al 2015. US protected lands mismatch biodiversity priorities	IRR	National in scale; the Plan is consistent with law and policy regarding providing for biodiversity.
Olsen, Lance	Johnson 2016. Looking to the Future and Learning from the Past in our Nat'l Forests	CON	This is a blog. The topic of assisted migration is covered with other literature sources.
Olsen, Lance	Johnson and Wilby 2015. Seeing the landscape for the trees: Metrics to guide riparian shade management in river catchments	IRR	This study was conducted in the United Kingdom. Riparian area vegetation and water temperature is addressed with other more relevant information sources.
Olsen, Lance	Keane et al 2018. Chapter 5 Effects of Climate Change on Forest Vegetation in the Northern Rockies	CITE	This publication is cited in its final version, within Halfosky et al 2018.
Olsen, Lance	Keppel et al 2012. Refugia: identifying and understanding safe havens for biodiversity under climate change	IRR	Paper discusses a global framework to identify refugia; not directly applicable to HLC NF forest plan revision.
Olsen, Lance	Kerr et al 2007. Humans and Nature Duel Over the Next Decade's Climate	IRR	Paper is not peer reviewed. Other influences such as Pacific Decadal Oscillation are more important to climate on the HLC NF.
Olsen, Lance	Kirilenko and Sedjo 2007. Climate change impacts on forestry.	GEN	Subject of economic risk from climate change, ecosystem integrity is a resource specific concern and addressed in the general discussion of climate change and potential resource conditions.
Olsen, Lance	Kirkland 2012. Logging Debris Matters: Better Soil, Fewer Invasive Plants	CON	Study sites differ from HLC NF. Topic of coarse woody debris is addressed with other citations more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Klos et al 2009. Drought impact on forest growth and mortality in the southeast USA: an analysis using Forest Health and Monitoring data	IRR	The species in this study are not present on HLC NF. The topic of drought tolerance is covered by other citations for local species.
Olsen, Lance	Kormos et al 2016. Trends and sensitivities of low streamflow extremes to discharge timing and magnitude in Pacific NW mountain streams	REF	Not cited in EIS but is included as a reference in Halofsky et al 2018, which is used to discuss streamflow and climate change.
Olsen, Lance	Kueppers et al 2016. Warming and provenance limit tree recruitment across and beyond the elevation range of subalpine fores.t	CITE	Halfosky et al 2018 provides analysis downscaled/relevant to HLC NF; however, this paper is also cited.
Olsen, Lance	Kulakowski et al 2013. Long-term aspen cover change in the western US.	CITE	The publication was cited in the analysis.
Olsen, Lance	Lambin & Meyfroidt 2011. Global land use change, economic globalization, and the looming land scarcity	CON	Land use change on non-NFS lands is addressed as appropriate using other information sources; NFS land are allocated to maintaining native vegetation.
Olsen, Lance	Leemans & Eickert. Another reason for concern: regional and global impacts on ecosystems for different levels of climate change	CON	Study is very broad scale. Climate change impacts on the ecosystems of the HLC NF are addressed using other literature such as Halofsky et al 2018.
Olsen, Lance	Lehnert et al 2013. Conservation value of forests attacked by bark beetles: Highest number of indicator species is found in early successional stages	IRR	The species discussed in this study are not present on the HLC NF. Forest species and insects that occur on the HLC NF are addressed with other citations.
Olsen, Lance	Leighty et al 2006. Effects of Management on Carbon Sequestration in Forest Biomass in Southeast Alaska	IRR	This study is based on different ecosystem and disturbance regimes than what are found on the HLC NF. Impacts on carbon are covered by other citations.
Olsen, Lance	Leppi et al 2012. Impacts of climate change on August stream discharge in the Central-Rocky Mountains	CON	The watershed section addresses impacts of climate change on stream discharge using Halfosky et al 2018 and other citations.
Olsen, Lance	Lewis et al 2016. Defining a new normal for extremes in a warming world	CON	Halfosky et al 2018 provides information that is downscaled and more relevant to the HLC NF.
Olsen, Lance	Liang et al 2016. Positive biodiversity- productivity relationship predominant in global forests	CON	The 2012 Planning Rule and HLC NF analysis consider the concepts of biodiversity and potential threats with other literature sources equally or more relevant.
Olsen, Lance	Lindenmayer et al 2011. How to make a common species rare: A case against conservation complacency	IRR	Status/risks to wildlife are addressed with other citations that are more relevant to the HLC NF.
Olsen, Lance	Litzow & Hunsicker 2016. Early warning signals, nonlinearity, and signs of hysteresis in real ecosystems	IRR	Paper discusses early warnings of ecological change broadly; not directly applicable to HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Liu et al 2014. Wildland fire emissions, carbon, and climate: wildfire-climate interactions	CITE	This publication is cited in the analysis.
Olsen, Lance	Lloret et al 2012. Extreme climatic events and vegetation: the role of stabilizing processes.	CITE	This publication is cited in the analysis.
Olsen, Lance	Lorente et al 2012. Wildfire and forest harvest disturbances in the boreal forest leave different long-lasting spatial signatures	CON	Topics of fire and harvest are addressed with citations more applicable to the vegetation types and disturbance regimes found on the HLC NF.
Olsen, Lance	Luce & Holden 2009. Declining annual streamflow distributions in the Pacific Northwest U.S., 1948–2006	CON	The watershed section addresses impacts of climate change on stream discharge using Halfosky et al 2018.
Olsen, Lance	LuoChen 2015. Climate change-associated tree mortality increases without decreasing water availability.	CITE	Publication is cited in the analysis.
Olsen, Lance	Luyssaert et al 2008. Old-growth forests as global carbon sinks	CON	Study is global in scale. The importance of old growth in the carbon cycle is addressed using literature more or equally relevant to the HLC NF.
Olsen, Lance	Maclagan et al 2018. Don't judge habitat on its novelty: Assessing the value of novel habitats for an endangered mammal in a peri-urban landscape	IRR	Not directly applicable to the HLC NF; the FS uses other science regarding habitat of species in the context of climate change.
Olsen, Lance	Madsen & Wilcox 2012. When It Rains, It Pours Global Warming and the Increase in Extreme Precipitation 1948 to 2011	IRR	Paper is national in scale. Precipitation trends relevant to the HLC NF are provided by Halfosky et al 2018.
Olsen, Lance	Magnusson et al 2016. Tamm Review: Sequestration of carbon from coarse woody debris in forest soils	CON	Soil carbon is addressed in the FEIS and appendix J using other literature citations equally or more relevant to the HLC NF. Downed wood is measured and included in the FIA data used by the referenced carbon reports. Additional detail is not needed to demonstrate the differences to carbon across alternatives.
Olsen, Lance	Malmsheiner et al 2008. Forest Management solutions for Mitigating Climate Change in the United States	CON	This topic is addressed using citations more relevant to the HLC NF.
Olsen, Lance	Mantgem et al 2018. Pre-fire drought and competition mediate post-fire conifer mortality in western U.S. National Parks	CITE	This publication is cited in the analysis.
Olsen, Lance	Marris 2007. What to Let Go	IRR	Paper discusses concept of triage broadly and does not inform how this approach might be conducted on species that occur on the HLC NF. Species vulnerabilities covered by other citations such as Halofsky et al 2018.
Olsen, Lance	Marris 2009. Planting the forest of the future	IRR	This citation is a news article, not a peer reviewed source. Potential species shifts & assisted migration are covered by other citations.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Martin et al 2009. Eluding catastrophic shifts	IRR	The model framework presented in this study is not possible to apply for the HLC NF analysis; use other citations such as Halfosky et al 2018 are used to disclose potential shifts.
Olsen, Lance	Martinuzzi et al 2015. Scenarios of future land use change around United States' protected areas	CON	The FS does not convert NFS lands to urban uses. The all lands approach is emphasized in the Directives; cumulative effects address management on adjacent lands. The scenarios presented in this study are broad.
Olsen, Lance	Mazza 2015. Heed the Head: Buffer Benefits Along Headwater Streams	IRR	Study is focused on ecosystems in the Pacific Northwest. Riparian buffers are discussed with citations more relevant to the HLC NF.
Olsen, Lance	McAlester 1970. Animal Extinctions, Oxygen Consumption, and Atmospheric History	CON	Threats to wildlife on the HLC NF are addressed with other citations; and species viability is provided as required by law, regulation, and policy.
Olsen, Lance	McDowell & Allen 2015. Darcy's law predicts widespread forest mortality under climate warming	CON	Study is global in scale; potential vulnerabilities and mortality of vegetation due to climate warming addressed with other citations more or equally relevant to the HLC NF.
Olsen, Lance	McMenamin et al 2008. Climatic change and wetland desiccation cause amphibian decline in Yellowstone NP	REF	This citation is used by Halofsky et al 2018, which discloses species vulnerabilities. The HLC NF incorporates this information.
Olsen, Lance	Meehl & Tebaldi 2004. More Intense, More Frequent, and Longer Lasting Heat Waves in the 21st Century	CON	The topic of temperature changes is addressed using Halfosky et al 2018, which provides downscaled climate predictions for the HLC NF.
Olsen, Lance	Meehl et al 2016. US daily temperature records past, present, and future	CON	The topic of temperature changes is addressed using Halfosky et al 2018, which provides downscaled climate predictions for the HLC NF.
Olsen, Lance	Meyn et al 2009. Relationship between fire, climate oscillations, and drought in British Columbia, Canada, 1920–2000	CON	Relationships between climate, drought, and fires that apply to the HLC NF are provided by Halfosky et al 2018 and other citations.
Olsen, Lance	Millar & Stephenson 2015. Temperate forest health in an era of emerging megadisturbance	CITE	This publication is cited in the analysis.
Olsen, Lance	Millar et al 2007. Climate Change and Forests of the Future: Managing in the Face of Uncertainty	CITE	This publication is cited in the analysis.
Olsen, Lance	Mooney and Dennis 2018. Climate scientists are struggling to find the right words for very bad news.	CON	Broad concept of climate change is covered by other citations.
Olsen, Lance	Mora et al 2013. The projected timing of climate departure from recent variability	CON	Paper supports notion of departure from historical range of variation, and how to model when the climate will depart. The EIS addresses the potential for these departures using other literature equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Mora et al. Suitable Days for Plant Growth Disappear under Projected Climate Change: Potential Human and Biotic Vulnerability	CON	Halfosky et al 2018 provides information that is downscaled and more relevant to the HLC NF.
Olsen, Lance	Muelbauer et al 2014. How wide is a stream? Spatial extent of the potential ‘‘stream signature’’ in terrestrial food webs using meta-analysis	GEN	This reference is a discussion on the importance of biological processes within riparian zones. The "biological signature" often extends beyond the average channel width. The paper found that many important biological exchanges are detected within 50-350 feet of the stream channel thus, buffer distances need to consider biological components as well as hydro-geomorphic metrics. The RMZ widths and accompanying plan components support the importance of adequate riparian zones and stream buffer widths. The 2012 Planning Rule requires the establishment of adequate RMZ widths to protect aquatic resources.
Olsen, Lance	NASA 2018. NASA Satellites Reveal major Shifts in Global Freshwater	CON	Paper addresses freshwater changes on a very broad scale. HLC NF uses other citations to discuss impacts of climate change and water.
Olsen, Lance	Nicholls 2009. Climate science: how the climate is changing and why (and how we know it).	IRR	This citation is a general climate overview. Other citations are used to place climate change issues in context of HLC NF plan revision.
Olsen, Lance	Nicolacida and Costa 2018. New Fed Paper: The consequences of higher temperatures on the US economy may be more widespread than previously thought	REF	The Plan decision is not linked to a change in atmospheric temperature; therefore, this type of research is outside the scale of the NEPA decision. Climate concerns relating to National Forests are addressed through our mitigation and climate strategy programs (NRAP) and discussed in the climate section of the FEIS.
Olsen, Lance	Nolan et al 2018. Past and future global transformation of terrestrial ecosystems under climate change	IRR	Paper describes broad ecosystem shifts; not applied to the HLC NF. Halfosky et al 2018 provides analysis downscaled/relevant to HLC NF.
Olsen, Lance	Norris et al 2016. Evidence for climate change in the satellite cloud record	CON	The concept of climate change is described in the EIS using other citations that are more relevant.
Olsen, Lance	North Central Climate Science Center (Colorado State University) website - LERI	IRR	Unclear how this tool would inform the forest plan revision analysis.
Olsen, Lance	Nowak et al 2007. Oxygen Production by Urban Trees in the United States	IRR	This study is specific to urban forests and not relevant to the HLC NF.
Olsen, Lance	Obermeier et al 2016. Reduced CO2 fertilization effect in temperate C3 grasslands under more extreme weather conditions	CON	The role of grasslands in the carbon cycle is addressed in the EIS and appendix J using literature sources equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Ofstad et al 2016. Home ranges, habitat and body mass: simple correlates of home range size in ungulates	CON	This citation describes a theoretical test of the effect of interspecific body size and habitat relationships on home range size; this topic is broadly covered by the diverse approach outlined in the Plan.
Olsen, Lance	O'Gorman & Schneider 2009. The physical basis for increases in precipitation extremes in simulations of 21st-century climate change	IRR	This study was conducted in the tropics. The expected precipitation and climate for the HLC NF planning area is provided in Halofsky et al 2018.
Olsen, Lance	Oliver 2012. Adaptation: Planning for Climate Change and Its Effects on Federal Lands	CON	This study focuses on the Pacific Northwest; other sources are used to address the topic of adaptation and response to climate change.
Olsen, Lance	Olsen, Lance 2018. In A Heating-Up West, Must Business-As-Usual Conservation Be Interrupted? The Movement of protecting ecosystems needs to change its thinking if it wants to save them.	NOT RLB	Opinion piece; used as context for public comment rather than literature. Some of the literature cited within the article is used/reviewed.
Olsen, Lance	Ornes 2018. How does climate change influence extreme weather? Impact attribution research seeks answers.	IRR	Associating climate change to extreme weather events such as hurricanes. Not directly applicable to the forest plan revision on the HLC NF. Climate change impacts addressed using other literature sources.
Olsen, Lance	O'Sullivan et al 2016. Thermal limits of leaf metabolism across biomes	CON	This study is very broad; the topic is covered by Halfosky et al 2018 with more relevance to local species and ecosystems.
Olsen, Lance	Overpeck 2013. The challenge of hot drought	NOT RLB	This citation is an editorial work that is not specific to planning area; the topic of expected drought is covered by other citations.
Olsen, Lance	Oxygen, Carbon Dioxide, and Energy	NOT RLB	Not a peer reviewed study – teacher's lesson aid.
Olsen, Lance	Pace et al 2017. Reversal of a cyanobacterial bloom in response to early warnings	CON	This citation is a general study; the resilience of water bodies is addressed with other citations more relevant to the HLC NF.
Olsen, Lance	Pacific Forest Trust 2016. A risk assessment of California's key source watershed infrastructure	IRR	Conditions different than the HLC NF. Broad concept is addressed in the EIS using more local information and framework (such as Watershed Condition Framework).
Olsen, Lance	Paltan et al 2018. Global implications of 1.5C and 2C warmer worlds on extreme river flows.	CON	Broad scale implications of temp increase on river flows. Downscaled information regarding climate change effects relevant to the HLC NF is provided in other sources, such as Halofsky et al 2018.
Olsen, Lance	Parmesan & Yohe 2003. A globally coherent fingerprint of climate change impacts across natural systems	CON	This citation is very broad; the topic of climate change is addressed with other studies more applicable to the HLC NF, e.g. Halofsky et al 2018.
Olsen, Lance	Parmesan 2006. Ecological and Evolutionary Responses to Recent Climate Change	CON	This citation is a general study; the threats from climate change and responses by species is addressed by citing Halofsky et al 2018 and other sources.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Pauli et al 2013. Frontiers in Ecology and the Environment: The subnivium: a deteriorating seasonal refugium	IRR	The effects of climate change are broadly addressed using other citations that are equally or more relevant to the HLC NF and the forest planning process. Management suggestions at the end of the paper are appropriate at the site-specific, project planning and analysis scale but not at the framework programmatic scale of the forest plan.
Olsen, Lance	Pect et al 2017. Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being	CON	This citation may be broadly relevant as it relates to the impacts of climate change. However, citations more relevant and local to the HLC NF are used to describe these concepts.
Olsen, Lance	Pederson et al 2009. A century of climate and ecosystem change in Western Montana: what do temperature trends portend?	CITE	Publication is cited in the analysis.
Olsen, Lance	Pederson et al 2011. The Unusual Nature of Recent Snowpack Declines in the North American Cordillera	CON	Some of the data used in this citation is applicable to HLC NF; however, Halofsky et al 2018 also summarizes snowpack changes and provides analysis downscaled/relevant to the HLC NF.
Olsen, Lance	Peng et al 2011. A drought-induced pervasive increase in tree mortality across Canada's boreal forests	CON	The topic of drought influences on tree mortality is covered by other citations equally or more relevant to the HLC NF.
Olsen, Lance	Peterson & Chen 2008. Household Location Choices: Implications for Biodiversity Conservation	CON	Paper refers to a general trend of increasing population near natural areas. This trend is discussed with information more relevant to the HLC NF.
Olsen, Lance	Petrie et al 2017. Climate change may restrict dryland forest regeneration in the 21st century	CITE	Publication is cited in the analysis.
Olsen, Lance	Phillips et al 2009. Drought Sensitivity of the Amazon Rainforest	IRR	Study conducted in the Amazon; the topic of drought impacts is covered by Halfosky et al 2018 and other citations more relevant to the HLC NF.
Olsen, Lance	Pierce et al 2008. Attribution of Declining Western U.S. Snowpack to Human Effects	CON	The topic of declining snowpack is addressed by citing Halofsky et al 2018 and others.
Olsen, Lance	Portner & Farrell 2008. Physiology and Climate Change	IRR	Study is based on ocean fish. Impacts to the HLC NF environment is provided by other more relevant sources.
Olsen, Lance	Powell et al 2014. Climate extremes in the Southeast United States: variability, spatial classification, and related planning	IRR	Modeling and trends in the Southeast; not directly applicable. The HLC NF uses more local sources such as Halfosky et al 2018.
Olsen, Lance	Prein 2018. Convection-Permitting Climate Modeling- A new Era for Water Research	IRR	Powerpoint discussing water climate modeling. Not relevant to forest plan revision on the HLC NF.
Olsen, Lance	Prein et al 2016. Future Intensification of hourly precipitation extremes.	GEN	For climate change scenarios and responses, the Plan used direction from NRAP.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Pretzsch et al 2018. Wood density reduced while wood volume growth accelerated in Central European forests since 1870.	IRR	Study in Europe. Not clear how it would apply to carbon estimates on the HLC NF. The HLC NF analysis uses other BASI for the local area.
Olsen, Lance	Proffitt et al 2013. Effects of Hunter Access and Habitat Security on Elk Habitat Selection in Landscapes with a Public and Private Land Matrix	CITE	Publication is cited in the analysis.
Olsen, Lance	Prugh et al 2008. Effect of habitat area and isolation on fragmented animal populations	GEN	Manuscript discusses recent tests of Island Biogeography Theory; while theoretically important for setting the bounds of management theory, it lacks specificity to the Plan beyond the suggestion that fragmentation is an issue, a theme that is consistent with forest planning.
Olsen, Lance	Pyne & Poff 2017. Vulnerability of stream community composition and function to projected thermal warming and hydrologic change across ecoregions in the western U.S.	CON	Issues related to climate change and streams are addressed using other literature equally or more relevant to the HLC NF, namely Halofsky et al 2018.
Olsen, Lance	Rasmussen 2018. NASA Finds Amazon Drought Leaves Long Legacy of Damage	CON	Potential effects of drought to the ecosystems on HLC NF described with other citations that are equally or more relevant.
Olsen, Lance	Raupach et al 2014. The declining uptake rate of atmospheric CO2 by land and ocean sinks	IRR	This citation is a broad discussion of carbon cycles and is not relevant at the planning area scale.
Olsen, Lance	Reese 2018. As countries crank up the AC, emissions of potent greenhouse gases are likely to skyrocket	IRR	Article about emissions caused by air conditioning. Not relevant to forest plan revision on the HLC NF.
Olsen, Lance	Rehfeldt et al 2001. Physiologic Plasticity, Evolution, and Impacts of a changing climate on pinus contorta	CON	Study specific to the impacts of climate change on lodgepole pine. Other Rehfeldt articles are referenced in Halofsky et al 2018.
Olsen, Lance	Reyer et al 2013. A plants perspective of extremes: terrestrial plant responses to changing climatic variability	IRR	General perspective of climate effects on plants, not directly relevant. The effects of climate change and vulnerabilities of plant species found on the HLC NF is addressed with citations such Halofsky et al 2018.
Olsen, Lance	Rich 2018. Losing Earth: The Decade We Almost Stopped Climate Change	IRR	Opinion piece; narrative on past climate change-related policies and inaction.
Olsen, Lance	Rich et al 2008. Phenology of Mixed Woody-Herbaceous Ecosystems Following Extreme Events: Net and Differential Responses	IRR	This study focuses on plant communities not present on the HLC NF; responses of local ecosystems to climate changes are covered by other citations more relevant to the planning area.
Olsen, Lance	Roach 2004. Source of Half Earth's Oxygen Gets Little Credit	IRR	Phytoplankton does not directly inform the HLC NF plan revision.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Roitberg & Mangel 2016. Cold snaps, heatwaves, and arthropod growth	IRR	The theoretical model used in this citation is used to understand the potential relative implications of cold versus heat stress, an issue beyond consideration of forest planning.
Olsen, Lance	Rother & Veblen 2016. Limited conifer regeneration following wildfires in dry ponderosa pine forests of the CO Front Range	CITE	Publication is cited in the analysis.
Olsen, Lance	Roxy et al 2016. A reduction in marine primary productivity driven by rapid warming over the tropical Indian Ocean	IRR	Plankton in the Indian Ocean are not directly applicable to HLC NF forest plan revision.
Olsen, Lance	Safeeq & Hunsaker 2016. Characterizing Runoff and Water Yield for Headwater Catchments in the Southern Sierra Nevada	IRR	This publication is not directly relevant to the planning area. The impacts of climate change on streamflow are addressed with other literature sources more relevant to the HLC NF.
Olsen, Lance	Schaefer et al 2014. The impact of permafrost carbon feedback on global climate	IRR	No permafrost in the region or HLC NF; publication is not relevant.
Olsen, Lance	Scheffer et al 2015. Creating a safe operating space for iconic ecosystems	CON	This citation is global in scale. The concept of management to increase resilience covered by other citations more relevant to the planning area.
Olsen, Lance	Scheffers et al 2016. The broad footprint of climate change from genes to biomes to people	IRR	This broad citation is not relevant to the HLC NF planning area or forest planning.
Olsen, Lance	Schwalm et al 2012. Reduction in carbon uptake during turn of the century drought in western North America	CON	The EIS and appendix J disclose the importance of maintaining forests as forests. Land conversions are not anticipated on the HLC NF. The topic is addressed with other citations equally or more relevant to the HLC NF.
Olsen, Lance	Seekell 2016. Passing the point of no return: Early warning signals indicate impending ecosystem regime changes	IRR	This study is specific to lake ecology and not directly relevant to the planning area or forest planning issues.
Olsen, Lance	Sekerci & Petroviskii 2015. Mathematical Modelling of Plankton–Oxygen Dynamics Under the Climate Change	IRR	This paper addresses global concepts; it is not directly relevant to the HLC NF planning area or revision process.
Olsen, Lance	Service 2004. As the West Goes Dry	CON	The topic of changing snowpack and water availability is covered using Halofsky et al 2018 and other citations that are equally or more relevant to the HLC NF.
Olsen, Lance	Sewell & Sloan 2004. Disappearing Arctic sea ice reduces available water in the American west	CON	This study is broad in scope; the topic of future drought is disclosed using citations more specific to the HLC NF.
Olsen, Lance	Sickinger 2018. Forest policy looms over Oregon's climate change debate	IRR	Opinion piece. In addition, forest conditions and forestry practices differ in type and scope on HLC NF. Logging intensity and methods is not comparable to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Sivakumar 2006. Climate prediction and agriculture: current status and future challenges.	IRR	Climate projections related to impacts to agriculture; this use does not occur on NFS lands on the HLC NF.
Olsen, Lance	Skliris et al 2016. Global water cycle amplifying at less than Clausius-Clapeyron rate	IRR	Very large-scale paper (Global); water sustainability addressed with other citations such as Halofsky et al 2018.
Olsen, Lance	Slater & Villarini 2016. Recent trends in U.S. flood risk	IRR	This citation addresses specific changes in flood risk that are more applicable to other states. Not relevant to the HLC NF forest plan.
Olsen, Lance	Smith et al 2015. Near-term acceleration in the rate of temperature change	CON	The topic of temperature change is addressed with other literature more or equally relevant to the HLC NF; namely, Halofsky et al 2018.
Olsen, Lance	Snyder et al 2015. Accounting for groundwater in stream fish thermal habitat responses to climate change	IRR	This study was conducted in the eastern U.S. Threats to aquatics on the HLC NF are disclosed w/ other citations more relevant to the planning area.
Olsen, Lance	Sole 2007. Scaling laws in the drier	IRR	The ecosystems in this study are vastly different from those on the HLC NF.
Olsen, Lance	Solomon et al 2009. Irreversible climate change due to carbon dioxide emissions	IRR	This citation is very broad in scale. The topic of climate change is covered by other literatures sources that are equally or more relevant.
Olsen, Lance	Stancil 2015. The Power of One Tree - The Very Air We Breathe	IRR	This source is a blog, not a scientific journal. It does not contain information necessary to inform the analysis.
Olsen, Lance	Steffen et al 2018. Trajectories of the Earth System in the Anthropocene	CON	Broad and global in scale. The EIS and appendix J disclose the concept of climate change and impacts on the ecosystems of the HLC NF, using literature sources that are equally or more relevant.
Olsen, Lance	Stephenson et al 2014. Rate of tree carbon accumulation increases continuously with tree size.	CITE	Publication is cited in the analysis.
Olsen, Lance	Stevens & Rumann 2017. Evidence for declining forest resilience to wildfires under climate change	CITE	This publication is cited in the analysis.
Olsen, Lance	SunVose 2016. Forest Management Challenges for Sustaining Water Resources in the Anthropocene	IRR	Very large-scale paper (Global); water sustainability addressed with other citations such as Halofsky et al 2018.
Olsen, Lance	Tan et al 2015. Ecosystem carbon stocks and sequestration potential of federal lands across the conterminous U.S.	DATED	More recent, local estimates of carbon stocks for Region 1 and the HLC NF are available.
Olsen, Lance	Tan Zhuang 2015. Arctic Lakes are continuous Methane sources to the atmosphere under warming conditions	CON	The topic of methane and climate change is addressed as appropriate using other citations more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Tanner et al 2014. Livelihood resilience in the face of climate change.	GEN	Subject of economic risk from climate change, ecosystem integrity is a resource specific concern and addressed in the general discussion of climate change and potential resource conditions.
Olsen, Lance	Tatchell 2008. The oxygen crisis	NOT RLB	This is an editorial piece; it does not provide info to inform the analysis.
Olsen, Lance	Teitelbaum et al 2015. How far to go? Determinants of migration distance in land mammals	CON	This study provides a test of theoretical factors affecting the evolution and phenotypic expression of migration behavior. Information on migration and landscape connectivity relevant to HLC NF addressed with other citations.
Olsen, Lance	The Economist 2018. In the line of fire: The world is losing the war against climate change	NOT RLB	Magazine article regarding politics and concerns with climate change.
Olsen, Lance	Thomas 2017. Mapping the Future: U.S. Exposure to Multiple Landscape Stressors	CON	Threat maps and stressors in the Pacific Northwest. The broad concepts apply to the HLC NF, but are described using more local, peer-reviewed sources.
Olsen, Lance	Thomas and Gillingham 2015. The performance of protected areas for biodiversity under climate change	CON	The concepts of biodiversity conservation and the role of protected areas are guided by the 2012 Planning Rule for the HLC NF and addressed in the analysis using literature sources more relevant to the HLC NF.
Olsen, Lance	Thompson 2005. Fanning the flames: climate change stacks odds against fire suppression	IRR	Citation is not peer reviewed and not directly relevant to the HLC NF. Fire suppression and climate addressed with other citations, such as Halofsky et al 2018.
Olsen, Lance	Thompson 2006. Does wood slow down “sludge dragons?” The interaction between riparian zones and debris flows in mountain landscapes	CON	Citation is not peer reviewed. RMZs and debris flows is addressed with Halfosky et al 2018.
Olsen, Lance	Thrush et al 2009. Forecasting the limits of resilience: integrating empirical research with theory	CON	This paper discusses measuring resilience and identifying thresholds. Similar topics are addressed using other citations, primarily Halfosky et al 2018.
Olsen, Lance	Toner 2002. Plankton Declining in Oceans, Study Finds	IRR	Citation discusses plankton in the ocean; it is not relevant to planning area. The forest carbon cycle is addressed with other citations.
Olsen, Lance	Top climate Events of 2017 Climate Signals	IRR	These climate signals are not directly relevant to the forest plan revision. Climate change is incorporated using resources such as Halofsky et al 2018.
Olsen, Lance	Trumbore et al 2015. Forest health and global change	CON	Citation is global in scale. The concept of forest health is covered with other citations equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Tschakert 2015. 1.5°C or 2°C: a conduit's view from the science-policy interface at COP20 in Lima, Peru	IRR	This citation discusses global policy and is not directly relevant to the planning area or forest management issues.
Olsen, Lance	Union of Concerned Scientists 2014. Map: Projected changes in suitable ranges for key rocky mountain tree species	CON	See response to comments; figure will not be included. Species distributions are discussed w/ other citations.
Olsen, Lance	Urza & Sibold 2016. Climate and seed availability initiate alternate post-fire trajectories in a lower subalpine forest	CITE	This publication is cited in the analysis.
Olsen, Lance	USDA 2010. National Roadmap for Responding to Climate Change	GEN	This national roadmap is incorporated by following the framework in the 2012 Planning Rule, associated directives and the work of the Northern Rockies Adaptation Partnership.
Olsen, Lance	USDA 2012. Future Scenarios, A Technical Document Supporting the Forest Service 2010 RPA Assessment	REF	Document was used in Halfosky et al 2018, which the analysis cites extensively.
Olsen, Lance	USDA Undated. Quercus macrocarpa	IRR	Bur oak is not present or predicted to become present on HLC NF.
Olsen, Lance	USEPA 2016. Climate Change Indicators: Sea Surface Temperature	NOT RLB	This citation is a series of charts from a website. Climate projections relevant to HLC NF are provided by Halofsky et al 2018.
Olsen, Lance	VanMantgem et al 2013. Climatic stress increases forest fire severity across the western United States.	CITE	Publication is cited in the analysis.
Olsen, Lance	VanMantgem et al 2018. Pre-Fire drought and competition mediate post-fire conifer mortality in western US National Parks	CITE	This publication is cited in the analysis.
Olsen, Lance	vanNes & Scheffer 2007. Slow Recovery from Perturbations as a Generic Indicator of a Nearby Catastrophic Shift	CON	This citation is very broad. The topic of resilience of ecosystems is addressed with other literature equally or more relevant to the HLC NF.
Olsen, Lance	Vanoni et al 2016. Drought and frost contribute to abrupt growth decreases before tree mortality in 9 temperate tree species.	IRR	This citation is from a study in Switzerland. The impacts of climate on local tree species is covered by other citations more relevant to the HLC NF.
Olsen, Lance	Vose et al 2012. Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector	CITE	This publication is cited in the analysis.
Olsen, Lance	Walther et al 2002. Ecological responses to recent climate change	CON	The topic of ecological responses to climate change is covered by Halofsky et al 2018 and other information sources more specific to the HLC NF planning area.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance	Weart 2003. The Discovery of Rapid Climate Change	IRR	This citation is an editorial piece exploring the history of climate change science; it is not directly applicable to forest planning issues.
Olsen, Lance	Welch et al 2016. Predicting conifer establishment post wildfire in mixed conifer forests of the N. American Mediterranean-climate zone	CON	Conditions differ from HLC NF; regeneration failures after fire addressed with other citations.
Olsen, Lance	Westerling et al 2011. Continued warming could transform Greater Yellowstone fire regimes by mid-21st century.	CITE	Publication is cited in the analysis.
Olsen, Lance	Williams & Dumroese 2016. Planning the Future's Forests with Assigned Migration	CITE	This publication is cited in the analysis.
Olsen, Lance	Williams, A.P.; Allen, C.D.; Macalady, A.D. [et al.]. 2013. Temperature as a Potent Driver of Regional Forest Drought Stress and Tree Mortality. Temperature as a potent driver of regional forest drought stress and tree mortality. Paper and PowerPoint.	REF	This study is referenced by Halfosky et al 2018; this work is used extensively in the analysis to discuss the effects of drought.
Olsen, Lance	Wobus et al 2018. Re-Framing Future Risks of Extreme Heat in the United States	IRR	Uses CMIP5 data to examine future extreme heat; not related specifically to forests or forest plan issues. Halofsky et al 2018 provides analysis downscaled and relevant to HLC NF.
Olsen, Lance	Wong & Daniels 2016. Novel forest decline triggered by multiple interactions among climate, an introduced pathogen and bark beetles.	CITE	Publication is cited in the analysis.
Olsen, Lance	Xu et al 2018. Forest drought resistance distinguished by canopy height- (Goldilocks)	CON	Southwestern species and site conditions. Resilience to drought is addressed with other citations that are more relevant to the HLC NF.
Olsen, Lance	Yang et al 2018. Post-drought decline of the Amazon carbon sink	CON	Global scale; example of impacts of drought. Other information more pertinent to the HLC NF is used.
Olsen, Lance	Zhang et al 2015. Gains and losses of plant species and phylogenetic diversity for a northern high-latitude region	CON	This citation focuses on Alberta. Similar vulnerabilities are addressed for local species using citations such as Halofsky et al 2018.
Olsen, Lance	Zhu et al 2018. Limits to growth of forest biomass carbon sink under climate change	CON	The role and future capacity of forests to sequester carbon is addressed in the EIS and appendix J, using literature sources that are equally or more relevant to the HLC NF.
Olsen, Lance	Zorn et al 2012. A regional-scale habitat suitability model to assess the effects of Flow reduction on fish assemblages in MI streams	CON	This citation focuses on Michigan. Fish habitat and future trends and vulnerabilities are addressed with Halofsky et al 2018 and other citations more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Olsen, Lance; and Western Watersheds Project	Vose et al 2016. Effects of Drought on Forests and Rangelands in the U.S.: A Comprehensive Science Synthesis USDAFS, GTRWO93b.	CITE	This publication is cited in the analysis.
Patterson, Scott	Outdoor Foundation 2017. 2017 Outdoor Recreation Participation	CON	Backcountry skiing has been recognized as a use on the HLC NF and addressed as appropriate using other information sources equally or more relevant to the HLC NF.
Pew Charitable Trusts	Baker & Bithmann 2005. Snowmobiling in the Adirondack Park: Environmental and Social Impacts; By: Elizabeth Baker and Eric Bithmann; 4/27/05	NOT RLB	Not peer reviewed paper. The topic of snowmobiling is covered using other information sources more relevant to the HLC NF.
Pew Charitable Trusts	Dale. R. Seip, Chris J. Johnson and Glen S. Watts; 2007. Displacement of Mountain Caribou from Winter Habitat by Snowmobiles.	CON	Topic is considered and inclusive of other citations (e.g., Heinemeyer et al. 2017)
Pew Charitable Trusts	Idaho Conservation League 2011. How Off-Road Vehicles and Snowmobiles Are Threatening the Forest Service's Recommended Wilderness Areas.	CON	General reference describing how motorized uses affect RWAs. These impacts are addressed using other information sources that are equally or more relevant.
Pew Charitable Trusts	Ingersoll 1998. Effects of Snowmobile Use on Snowpack Chemistry in Yellowstone National Park, 1998; By George P. Ingersoll	CON	Nowhere on the HLC NF do we have use levels close to Yellowstone NP, and emissions from snowmobiles have come a very much improved from 20 years ago.
Pew Charitable Trusts	McClure, M.L., C. Henneman, and B.G. Dickson. 2017. A landscape-level assessment of ecological values for the Helena-Lewis and Clark National Forest; Submitted to: The Pew Charitable Trusts	CON	Provides useful information but does not fully follow the wilderness inventory and evaluation process direction in FSH 1909.12 Chapter 70.
Pew Charitable Trusts	USDI 2000. Air Quality Concerns Related to Snowmobile Usage in National Parks; USDI, 2000	IRR	Nowhere on the HLC NF do we have use levels close to Yellowstone NP, and emissions from snowmobiles have come a very much improved from 20 years ago.
Pew Charitable Trusts	USFWS 2018. North American Wolverine Species Profile, USFWS ECOS online system. Accessed 2018	CON	The topic of wolverine is covered using other literature sources equally or more relevant.
Rocky Mountain Elk Foundation	Cook, Rachel C., John G. Cook, David J. Vales, Bruce K. Johnson, Scott m. Mccorquodale, Lisa a. Shipley, Robert a. Riggs, Larry l. Irwin, Shannon l. Murphie, Bryan l. Murphie, Kathryn a. Schoenecker, Frank Geyer, p. Briggs hall, rocky d. Spencer, Dave a. Immell, Dewaine h. Jackson, Brett l. Tiller, Patrick j. Miller, Lowell Schmitz, 2013. Regional and Seasonal Patterns of Nutritional Condition and Reproduction in Elk.	CON	Topic is considered, as this manuscript supports previous findings including those currently cited (e.g., J. G. Cook, 2002; J. G. Cook et al., 1996; K. M. Proffitt, Hebblewhite, Peters, Hupp, & Shamhart, 2016; Ranglack et al., 2014; K. M. Stewart, Bowyer, Dick, Johnson, & Kie, 2005).

Commenter(s)	Citation	Response code	Rationale
Rocky Mountain Elk Foundation	Keane et al 2009. Forest Ecology and Management 258 (2009) 1033-1034	CON	The Plan utilizes the concept of natural range of variation (NRV) as defined by the 2012 Planning Rule directives, and discusses this concept using other literature sources equally or more relevant.
Rocky Mountain Elk Foundation	Middleton, Arthur D, Matthew J. Kauffman, Douglas E. Mcwhirter, John G. Cook, Rachel C. Cook, Abigail A. Nelson, Michael D. Jimenez, and Robert W. Klaver; 2013. Rejoinder: challenge and opportunity in the study of ungulate migration amid environmental change;	CON/GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands, e.g., FW-WL-DC-03 and very specifically FW-WL-GDL-14 regarding consistency in management across administrative boundaries, where possible. Also implicit in plan components for connectivity (refer to DCs in RM, UB, DI, and LB GAs in particular), and Goals to work with FWP regarding habitat issues across administrative boundaries.
Rocky Mountain Elk Foundation	Quigley, T. M., and M. J. Wisdom. 2005. The Starkey Project: Long-Term Research for Long-Term Management Solutions. Pages 9-16 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA	CON	This is a general reference on elk habitat, covering topics outline and cited including more recent citations (e.g., Proffitt et al. 2016; Ranglack et al., 2014, Proffit et al. 2013, Polfus 2011, Ranglack et al., 2014)
Rocky Mountain Elk Foundation	Sawyer, Hall; Matthew J. Kauffman, Arthur D. Middleton, Thomas A. Morrison, Ryan M. Nielson and Teal B. Wyckoff; 2013. A framework for understanding semi-permeable barrier effects on migratory ungulates.	CON/GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands; e.g., FW-WL-DC-03 and very specifically FW-WL-GDL-14 regarding consistency in management across administrative boundaries, where possible. Also implicit in plan components for connectivity (refer to DCs in RM, UB, DI, and LB GAs in particular), and Goals to work with FWP regarding habitat issues across administrative boundaries.
Rocky Mountain Elk Foundation	Swanson, Mark E., Jerry F Franklin, Robert L Beschta, Charles M Crisafulli, Dominick A DellaSala, Richard L Hutto, David B Lindenmayer, and Frederick J Swanson; 2011. The forgotten stage of forest succession: early-successional ecosystems on forest sites.	CON	Although not explicitly tied together, the importance of early successional forage is outlined and supported by other literature, and the role between fire/thinning and early successional habitat is discussed in the Terrestrial Vegetation section of the FEIS.
Rocky Mountain Elk Foundation	Westbrooks, Randy G. 2004. New Approaches for Early Detection and Rapid Response to Invasive Plants in the United States.	CON	Plan components in the Plan utilize these concepts for weed management, as supported by other literature sources equally or more relevant.
Rocky Mountain Elk Foundation; and Bitterroot Backcountry	Wisdom, Michael J; Alan A. Ager, Haiganoush K. Preisler, Norman J. Cimon, and Bruce K. Johnson 2005. Effects of Off-Road Recreation on Mule Deer and Elk.	CITE	Publication is cited in the analysis, as part of the "Starkey Project".

Commenter(s)	Citation	Response code	Rationale
Cyclists, and Helena Hunters & Anglers			
Rocky Mountain Elk Foundation; and Helena Hunters & Anglers	Wisdom, Michael J; Haiganoush K. Preisler, Leslie M. Naylor, Robert G. Anthony, Bruce K. Johnson, Mary M. Rowland; 2018. Elk responses to trail-based recreation on public forests.	CITE	The topic of roads, trails, and motorized uses on elk is addressed using other literature that is equally or more relevant to the HLC NF.
Sentz, Gene	Chaney 2017. Wildfire evolution forces Forest Service into new thinking. ROB CHANEY rchaney@missoulian.com Feb 4, 2017	NOT RLB	This is a newspaper article (not peer reviewed) quoting a few presenters at a conference. Topics are covered in the Plan and analysis using more reliable information sources.
Solonex	Office of Natural Resources Revenue 2016. News Release: Interior Department Disburses $6.23 Billion in FY2016 Energy Revenues. Federal Revenues Support State, Tribal, National Needs	IRR	The HLC NF does not have significant revenue sources being generated in sale or leasing of land for development energy resources.
The Wilderness Society	Aplet et al 2000. Indicators of Wildness: Using Attributes of the Land to Assess the Context of Wilderness	CON	The Plan is consistent with the 2012 Planning Rule, including the wilderness evaluation process. The factors used in the wilderness evaluation are generally consistent with this work, in different terms, and is based on more recent best available scientific information and policy. Several alternatives, including the preferred alternative, include recommended wilderness areas.
The Wilderness Society	Aycrigg et al 2013. Representation of Ecological Systems within the Protected Areas Network of the Continental United States	CON	The Plan is consistent with the 2012 Planning Rule, including the wilderness evaluation process. Several alternatives, including the preferred alternative, include recommended wilderness areas in which the representation of ecological systems was considered, although this paper was not specifically cited.
The Wilderness Society	Aycrigg et al 2016. The Next 50 Years: Opportunities for Diversifying the Ecological Representation of the National Wilderness Preservation System within the Contiguous United States	CON	The Plan is consistent with the 2012 Planning Rule, including the wilderness inventory and evaluation processes. As such, opportunities to recommend wilderness were assessed for all lands. The potential representation of ecological systems in recommended wilderness was inherently included in this process, although this work was not specifically cited. The preferred alternative includes recommended wilderness on more than 153,000 acres of the HLC NF.
The Wilderness Society	Belote 2018. Quantifying the Range of Variability in Wilderness Areas: A Reference When Evaluating Wilderness Candidates; Science & Research August 2018 | Volume 24, Number 2 by R. Travis Belote	GEN	All lands on the HLC NF were examined with the wilderness inventory and evaluation process as outlined in the 2012 Planning Rule and associated directives. Their "quality" was not compared to existing wilderness as a factor to determine their inclusion as recommended wilderness in any alternative. Therefore, the process used is consistent with the findings of this paper, although the specific methodology was not used.

Commenter(s)	Citation	Response code	Rationale
The Wilderness Society	Belote et al 2015. Allocating Untreated "Controls" in the National Wilderness Preservation System as a Climate Adaptation Strategy: A Case Study from the Flathead National Forest, Montana	GEN	Addresses the issue of underrepresented ecological types in the current wilderness system, noting their importance for biodiversity in the face of climate change. The HLC NF followed the procedures outlined in the 2012 Planning Rule and associated directives regarding the identification of recommended wilderness areas.
The Wilderness Society	Belote et al 2016. Identifying Corridors among Large Protected Areas in the United States	CON	General citation for connectivity done at the spatial extent of the United States; the topic of connectivity is covered using other literature sources equally or more relevant to the HLC NF.
The Wilderness Society	Belote, Travis R; Ryan M. Cooper and Rachel A. Daniels, 2017. Contemporary Composition of Land Use, Ecosystems, and Conservation Status along the Lewis and Clark National Historic Trail.	CITE	Included as reference as additional information to show the relative undeveloped nature of the trail on the HLC NF, particularly in the Lewis and Clark pass area, and its significance to populations of grizzly bear.
The Wilderness Society	Carroll et al 2012. Use of Linkage Mapping and Centrality Analysis Across Habitat Gradients to Conserve Connectivity of Gray Wolf Populations in Western North America	CON	General citation for connectivity; topic broadly covered using other literature sources equally or more relevant to the HLC NF.
The Wilderness Society	Cushman & Languth 2012. Multi-taxa population connectivity in the Northern Rocky Mountains	CON	General citation for connectivity; topic broadly covered using other literature sources equally or more relevant to the HLC NF.
The Wilderness Society	Dietz et al 2015. The world's largest wilderness protection network after 50 years: An assessment of ecological system representation in the U.S. National Wilderness Preservation System	GEN	Citation supports a general statement on the importance of habitat diversity to conservation, a concept which is included in the 2012 Planning Rule.
The Wilderness Society	Faurby & Svenning 2015. Historic and prehistoric human-driven extinctions have reshaped global mammal diversity patterns	IRR	General topic; the scale of study is worldwide and not directly relevant to the forest plan revision process on the HLC NF
The Wilderness Society	Fisichelli, Nicholas A., Gregor W. Schuurman, Cat Hawkins Hoffman. 2015. Is 'Resilience' Maladaptive? Towards an Accurate Lexicon for Climate Change Adaptation.	CON	The Plan and EIS utilize the definition of resilience as shown in the 2015 directives, as well as other literature sources equally or more relevant (e.g., Millar et al 2007).
The Wilderness Society	Hansen et al 2011. Delineating the Ecosystems Containing Protected Areas for Monitoring and Management	CON	Paper discusses protected areas in national parks. The underlying theme (the importance of a network of protected areas) is addressed with other information equally or more relevant to the HLC NF, which helped inform the selection of recommended wilderness in various alternatives.
The Wilderness Society	Hansen et al 2014. Exposure of U.S. National Parks to land use and climate change 1900–2100.	CON	Paper is specific to national parks. The potential effects of climate change to the lands on the HLC NF, including protected areas, are addressed with a body of other literature equally or more relevant to the planning area.

Commenter(s)	Citation	Response code	Rationale
The Wilderness Society	Noson & Filardi 2012. Field Measures of Wilderness Character, Middle fork Judith River, WSA, 2012. Noson and Filardi, Wilderness Institute, College of Forestry and conservation, Univ. of MT.	CON	The topic of wilderness character, including local conditions, was considered using other information sources. Motorized and mechanized means of transportation would be unsuitable in RWAs under the preferred alternative.
The Wilderness Society	Ripple et al 2014. Status and Ecological Effects of the World's Largest Carnivores	CON	Citation supports a general statement on the role of carnivores in ecosystems; this topic is covered by other information equally relevant to the HLC NF.
The Wilderness Society	Rudnick et al 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities	CON	General citation for connectivity; this topic is broadly covered using other literature sources that are equally or more relevant to the HLC NF.
The Wilderness Society	Theobald 2013. A general model to quantify ecological integrity for landscape assessments and US application	CON	The HLC NF defines and models ecological integrity in a manner consistent with the 2012 Planning Rule and associated directives (2015); and utilizes landscape modeling tools to conduct the analysis using methods that are equally or more relevant than the methodologies described in this paper.
The Wilderness Society	Theobald et al 2016. Description of the approach, data, and analytical methods used to estimate natural land loss in the western U.S.	IRR	The HLC NF incorporated many considerations in determining appropriate land allocations and uses, for those uses within the discretion of forest planning. NFS lands would not be subject to many of the "land losses" described in this paper (e.g., urbanization, conversion to agriculture"), although some uses described in the paper (e.g., grazing, timber harvest) would occur. The array of multiple uses allowed on NFS lands was described across a range of alternatives and the effects disclosed using literature sources relevant to the planning area.
The Wilderness Society	Watson et al 2016. Catastrophic Declines in Wilderness Areas Undermine Global Environment Targets	GEN	Global in scale; the losses in wilderness were found in the Amazon and Africa. The HLC NF acknowledges the importance of wilderness and adheres to the wilderness inventory and evaluation process required by the 2012 Planning Rule. None of the alternatives would result in a loss of existing wilderness areas.
The Wildlife Society	Belote 2017. Mapping wildland values to support conservation on the Helena-Lewis and Clark National Forest. Belote 2017	CITE	This paper was specifically was used in development of the alternatives and identifying possible RWAs and ROS categories. It may not be specifically cited in the Plan or FEIS but is in the wildlife/connectivity comments and in project record information.
The Wildlife Society	Belote, Travis R., Matthew S. Dietz, Clinton N. Jenkins, Peter S. McKinley,G. Hugh Irwin, Timothy J. Fullman, Jason C. Leppi, and Gregory H. Aplet; 2017. Wild, connected, and diverse: building a more resilient system of protected areas.	GEN	Similar information relevant to the HLC NF was used in the development of alternatives, specifically with respect to recommended wilderness areas in the context of existing wilderness and IRAS. Belote 2017, which is specific to the HLC NF, was used in developing alternatives and considering areas to include as RWAs, and with primitive ROS designations. This paper is broad scale and specifically says it is "not intended to

Commenter(s)	Citation	Response code	Rationale
			prescribe specific actions", but concepts were used and as such the Plan and is consistent with the concept of providing connectivity of wild landscapes.
The Wildlife Society	Martin et al 2016. The need to respect nature and its limits challenges society and conservation science	GEN	The subject is generally considered throughout the 2012 planning process
Theodore Roosevelt Conservation Partnership	Freddy, D. J., W. M. Bronaugh, and M. C. Fowler. 1986. Responses of mule deer to disturbance by persons afoot and snowmobiles.	GEN/IRR	This and similar literature considered as a whole in developing plan components to minimize disturbance to ungulates and other wildlife in key seasonal habitats. Scale and nature of information is best applied specifically during analysis of more site-specific actions, including when reviewing travel management decisions and other uses of specific areas.
Theodore Roosevelt Conservation Partnership	Merrill, E. H., T. P. Hemker, K., K. P. Woodruff, L. Kuck. 1994. Impacts of mining facilities on fall migration of mule deer.	GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands, limit impacts to connectivity in some areas, and limit disturbance to wildlife on key seasonal ranges.
Theodore Roosevelt Conservation Partnership	Sawyer, H. M.J. Kaughman, and R.M. Nielson. 2009. Influence of Well Pad Activity on Winter Habitat Selection Patterns of Mule Deer.	GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands, limit impacts to connectivity in some areas, and limit disturbance to wildlife on key seasonal ranges.
Theodore Roosevelt Conservation Partnership	Sawyer, H. R. M. Nielson, F. Lindzey, and L. L. McDonald. 2006. Winter habitat selection of mule deer before and during development of a natural gas field.	GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands, limit impacts to connectivity in some areas, and limit disturbance to wildlife on key seasonal ranges.
Theodore Roosevelt Conservation Partnership	Sawyer, H., F. Lindzey, D. McWhirter, and K. Andrews. 2002. Potential Effects of Oil and Gas Development on Mule Deer and Pronghorn Populations in Western Wyoming.	GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands, limit impacts to connectivity in some areas, and limit disturbance to wildlife on key seasonal ranges.
Theodore Roosevelt Conservation Partnership	Wyoming Game and Fish Department 2009. Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats.	GEN	Issues in this and other literature considered in developing plan components designed to allow wildlife movement within and among NFS lands, limit impacts to connectivity in some areas, and limit disturbance to wildlife on key seasonal ranges.
Thornton, Cheri	It's hella fast in Helena, Mountain biking MacDonald and Bear Trap Gulch	NOT RLB	This citation is not a scientific paper; the issue of mechanized means of transportation is addressed with other information.
Trout Unlimited	Earthworks Undated. Protect Montana’s Smith River from Mine Pollution and Dewatering	IRR	A mineral withdraw is beyond the scope of this analysis and will not be included in this forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Trout Unlimited	Geer and Greer 2001. Rock Art of the Smith River; M. Greer, J. Greer, 2001	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	Gestring, Bonnie 2012. The track record of water quality impacts resulting from pipeline spills, tailings failures and water collection and treatment failures. JULY 2012 (REVISED 11/2012). By Bonnie Gestring	IRR	A mineral withdraw is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	GREER, Mavis Ann Loscheider 1995. Archaeological analysis of rock art sites in the smith river drainage of central Montana; Dissertation-University of Missouri-Columbia	IRR	General information, The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	Grisak 2012. An Evaluation of Trout Movements in the Upper Smith River Basin; Final Report; By Grant Grisak Montana Fish, Wildlife & Parks. 2012	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	Grisak et al 2012. Rainbow Trout and Brown Trout Movements Between the Missouri River, Sun River and Smith River, Montana; By: Grant Grisak, Adam Strainer and Brad Tribby-Montana Fish, Wildlife & Parks; 2012	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.
Trout Unlimited	Grisak, 2013. Spawning Times and Locations of Rainbow Trout and Brown Trout in Tributaries to the Smith River, Montana; Prepared by Grant Grisak Montana Fish, Wildlife & Parks; 2013	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.
Trout Unlimited	Kluz 2014. SMITH RIVER STATE PARK AND RIVER CORRIDOR; Visitor Use & Statistics Monitoring Report 2014	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-

Commenter(s)	Citation	Response code	Rationale
			consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	Kluz 2016. MT State Parks: Smith river state park and river corridor, Visitor Use & Statistics Monitoring Report, 2016	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	Kuipers, J.R., Maest, A.S., MacHardy, K.A., and Lawson, G. 2006. Comparison of Predicted and Actual Water Quality at Hardrock Mines; The reliability of predictions in Environmental Impact Statements	IRR	Tintina proposal is not a FS project, but a State of MT MEPA process. This is outside the scope of forest plan revision.
Trout Unlimited	Lance et al 2016. Smith River Fish Behavior Study; By: Michael Lance and Al Zale - Montana Cooperative Fishery Research Unit, Montana State University, Bozeman, MT; Grant Grisak, Jason Mullen, and Dylan Owensby - Montana Fish, Wildlife and Parks, Region 4, Great Falls, MT; Summer 2016 Progress Report	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.
Trout Unlimited	Maxell, Bryce Alan 2009. State-wide assessment of status, predicted distribution, and landscape-level habitat suitability of amphibians and reptiles in Montana. The University of Montana.	CON/GEN	The values of the Smith River are acknowledged via the creation of the Smith River Corridor emphasis area in the Plan. Its ecological values are broadly encompassed using other information sources related to riparian ecosystems and wildlife in the FEIS. Information regarding habitats required by amphibians and reptiles was considered in the WSR evaluation process and in development of plan components for various wildlife habitats.
Trout Unlimited	MDTEQ 2016. Montana Final 2016 Water Quality Integrated Report, MT DEQ, 2016	CITE	The publication is cited in the analysis.
Trout Unlimited	Montana online Field Guide. Westslope Cutthroat Trout	CON	The analysis addresses weststlope cutthroat trout using other literature sources equally or more relevant. This species has been added to the SCC list.
Trout Unlimited	MFWP 2005. Environmental assessment: westslope cutthroat trout restoration: transfer of live fish from north fork deep creek to middle fork camas creek	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.

Commenter(s)	Citation	Response code	Rationale
Trout Unlimited	MFWP 2016. Sheep Creek WCT Distribution and Sampling Map, MFWP 2016	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.
Trout Unlimited	MFWP Undated. Deer Hunting Data spreadsheet	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	MFWP Undated. Elk Hunting Data Spreadsheet	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	Ritter 2015. CONNECTIVITY IN A MONTANE RIVER BASIN: SALMONID USE OF A MAJOR TRIBUTARY IN THE SMITH RIVER SYSTEM; by Thomas David Ritter, Master's thesis, MSU, 2015	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.
Trout Unlimited	Shepard 1997. Fish Resources within the Tenderfoot Experimental Forest Montana: 1991-95, Final Report, 1997; Shepard and White	IRR	Literature was provided specifically in support of the Smith River Headwaters Withdrawal Request. Mining withdrawals are a comprehensive process, which, require a great deal of administrative review and public engagement that are beyond the scope of this analysis.
Trout Unlimited	Swanson 2012. Future Job Growth in Montana Aligning Education and Workforce Development with Expected Future Job Growth; July 2012; A Report by Larry Swanson	IRR	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river. A mineral withdrawal is a comprehensive and time-consuming process and it requires a great deal of administrative review, which could take several years of analysis and public engagement before reaching a final decision. A mineral withdrawal is beyond the scope of this analysis and will not be included in this forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Trout Unlimited	USDI 2016. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT MINING CLAIMS Customer Information WITH Serial No. and Claim Name, Tintina. 2016	IRR	A mineral withdraw is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	USDI 2017. BLM ANNOUNCES SOUTHWEST OREGON WITHDRAWAL. More than 100,000 acres of federal lands will be protected to safeguard critical watersheds. Joint News Release, Forest Service Pacific Northwest Region & Bureau of Land Management Oregon/Washington. 2017	IRR	A mineral withdraw is beyond the scope of this analysis and will not be included in this forest plan revision process.
Trout Unlimited	VanGenderen 2009. SMITH RIVER STATE PARK AND RIVER CORRIDOR RECREATION MANAGEMENT PLAN Updated July 20, 2009, MT FWP	CON	General information. The Smith River corridor is recognized in the Plan as an emphasis area and is also an eligible wild and scenic river based on other information sources.
Walch, Len	Haak, Amy L. Jack E. Williams, Helen M. Neville, Daniel C. Dauwalter, and Warren T. Colyer. 2010. Conserving Peripheral Trout Populations: The Values and Risks of Life on the Edge.	CON	The status of westslope cutthroat trout is addressed with other literature sources. Westslope cutthroat trout has been identified as an SCC by the Regional Forester.
Warren, Greg	Clark and Stankey 1979. The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research; General Technical Report, PNW-98 December 1979; Roger N. Clark and George H. Stankey	GEN	Travel planning is outside the scope of the forest plan revision process. The concept of ROS was applied and analyzed as described in the 2012 Planning Rule and associated directives.
Warren, Greg	Stankey, George H., Gregory A. Warren, and Warren R. Bacon 1986. Recreation Opportunity Spectrum as a Management Tool, 1986.	GEN	Travel planning is outside the scope of the forest plan revision process. The concept of ROS was applied and analyzed as described in the 2012 Planning Rule and associated directives.
Warren, Greg	Warren 2018. Continental Divide National Scenic Trail Planning Handbook, By Greg Warren, 2018	GEN	This topic or process was considered (directly or indirectly through the 2012 Planning Rule) but not specifically cited.
Western Watersheds Project	Ames 1977. Wildlife conflicts in Riparian Management: Grazing, Charles R. Ames, 1977	DATED	Other more recent citations were used relative to the topic of wildlife and grazing conflicts in riparian areas.
Western Watersheds Project	ANDERSON, Jay E. AND KARL E. HOLTE; 1981. Vegetation Development over 25 Years without Grazing on Sagebrush-dominated Rangeland in Southeastern Idaho	IRR	Publication is focused in Idaho. Sagebrush systems are addressed using information sources more relevant to the HLC NF.
Western Watersheds Project	ANDERSON, Jay E. AND RICHARD S. INOUYE. 2001. LANDSCAPE-SCALE CHANGES IN PLANT SPECIES ABUNDANCE AND BIODIVERSITY OF A SAGEBRUSH STEPPE OVER 45 YEARS	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Barnett, J. F. and J. A. Crawford. 1994. Pre-laying nutrition of sagegrouse hens in Oregon. J. Range Manage. 47: 114-118.	IRR	There is no occupied sage grouse habitat on NFS lands on HLC NF. Similar information on grazing management practices is covered in other sources more relevant to the HLC NF.
Western Watersheds Project	Beck, J. L. and D. L. Mitchell. 2000. Influences of livestock grazing on sage grouse habitat. Wildl. Soc. Bull. 28(4): 993-1002.	IRR	There is no occupied sage grouse habitat on NFS lands on HLC NF; similar information on grazing management practices cited in other sources more relevant to the HLC NF.
Western Watersheds Project	Beschta, Robert L., Debra L. Donahue, Dominick A. DellaSala, Jonathan J. Rhodes, James R. Karr, Mary H. O'Brien, Thomas L. Fleischner, and Cindy Deacon Williams. 2013. Adapting to Climate Change on Western Public Lands: Addressing the Ecological Effects of Domestic, Wild, and Feral Ungulates.	CON	The topic of grazing and climate change was covered using other literature citations equally or more relevant to the HLC NF.
Western Watersheds Project	Best, Louis B. 1972. First-year effects of sagebrush control on two sparrows. Journal of Wildlife Management. 36:534- 544;	DATED	Sagebrush habitat is addressed with more recent information sources.
Western Watersheds Project	Blackburn, W.H. 1984. Impact of grazing intensity and specialized grazing systems on watershed characteristics and responses. In: Developing strategies for range management. Westview press: Boulder, CO	DATED	More recent studies on grazing and grazing systems to infiltration and soil impacts or benefits are used.
Western Watersheds Project	Blaisdell, James P.; Murray, Robert B.; McArthur, E. Durant. 1982. Managing Intermountain rangelands--sagebrush-grass ranges. Gen. Tech. Rep. INT-134. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station	IRR	There is no occupied sage-grouse habitat on NFS lands on the HLC NF.
Western Watersheds Project	Bock, C.E., V.A. Saab, T.D. Rich, and D.S. Dobkin. 1993. Effects of livestock grazing on Neotropical migratory landbirds in western North America. Pages 296-309 in D.M. Finch, and P.W. Stangel, editors. Status and management of Neotropical migratory birds. General Technical Report RM-229. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.	CON	The concept of grazing impacts on wildlife is addressed using other literature sources that are equally or more relevant to the HLC NF.
Western Watersheds Project	Burkhardt, Wayne J.; Tisdale, E. W. 1976. Causes of juniper invasion in southwestern Idaho. Ecology. 57: 472-484	CON	General concepts; older citation specific to southwestern Idaho. The topic of nonforested systems, fire, grazing, exotic annuals, etc. are covered by other more recent references relevant to the HLC NF.
Western Watersheds Project	Call, M. W. and C. Maser. 1985. Wildlife habitats in managed rangelands – the Great Basin of southeastern Oregon: sage grouse. Gen. Tech. Rep.	IRR	Citation specific to Oregon and sage-grouse. There is no occupied sage grouse habitat on the HLC NF. The topics of

Commenter(s)	Citation	Response code	Rationale
	PNW-187. U.S. Forest Service, Pacific Northwest Forest and Range Exp. Stn. Portland, OR.		nonforested systems and the impacts of grazing are addressed with other citations more relevant to the HLC NF.
Western Watersheds Project	CAMERON L. ALDRIDGE and R. MARK BRIGHAM, 2003. Distribution, Abundance, and Status of the Greater Sage-Grouse, Centrocercus urophasianus, in Canada.	IRR	Sage-grouse do not occupy NFS lands in planning area; study based in Canada on small isolated population
Western Watersheds Project	Charles R. and Bruce B. Carpenter, 2005. Stocking Rate and Grazing Management	CON	The issue of drought and grazing is addressed using other information sources that are equally or more relevant to the HLC NF. The techniques recommended in this paper could be applied through adaptive management or administrative actions.
Western Watersheds Project	Christensen, N.L. et. al. 1996. The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. Ecological Applications 6:665-691	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Coates, P. S. 2007. Greater Sage-grouse (Centrocercus urophasianus) nest predation and incubation behavior. Ph.D. Diss. Idaho State Univ. Pocatello, ID.	IRR	There is no occupied sage-grouse habitat on NFS lands on HLC NF. Similar information on grazing management practices cited in other sources more relevant to the HLC NF.
Western Watersheds Project	Coggins, K. A. 1998. Relationship between habitat changes and productivity of sage grouse at Hart Mountain National Antelope Refuge. Oregon. M.S. thesis. Oregon State University. Corvallis	IRR	There is no occupied sage-grouse habitat on NFS lands on HLC NF. Similar information on grazing management practices cited in other sources more relevant to the HLC NF.
Western Watersheds Project	Connelly, J. W. and C. E. Braun. 1997. Long-term changes in sage-grouse Centrocercus urophasianus populations in western North America. Wildl. Biol. 3: 229-234	IRR	There is no occupied sage-grouse habitat on NFS lands on HLC NF. Similar information on grazing management practices cited in other sources more relevant to the HLC NF.
Western Watersheds Project	Connelly, J. W., S. T. Knick, M. A. Schroeder, S. J. Stiver. 2004. Conservation assessment of Greater Sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies. Cheyenne, WY.	IRR	There is no occupied sage-grouse habitat on NFS lands on HLC NF. Similar information on grazing management practices cited in other sources more relevant to the HLC NF.
Western Watersheds Project	Davis, J.W. 1982. Livestock vs. riparian habitat management--there are solutions. Pages 175-184 in L. Nelson, J.M. Peek, and P.D. Dalke, editors. Proceedings of the wildlife-livestock relationships symposium. Forest, Wildlife, and Range Experiment Station, University of Idaho, Moscow, Idaho.	CON	General range management concepts; this topic is covered using other citations equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Dyksterhuis, E. J. 1949. Condition and management of range land based on quantitative ecology. Journal of Range Management 2:104-115.	CON	This citation may be a source to consider for site specific projects. The broad topic of rangeland conditions is addressed using other citations more relevant to the forest plan revision process for the HLC NF.
Western Watersheds Project	Earnst, Susan L., Jennifer A. Ballard, and David S. Dobkin. 2004. Riparian songbird abundance a decade after cattle removal on Hart Mountain and Sheldon National Wildlife Refuges. USDA Forest Service PSW-GTR-191.	IRR	Study is located in an area that differs from the HLC NF; and cattle management practices that may not be consistent with those of the FS.
Western Watersheds Project	Eckert, Richard E. Jr., and John S. Spencer.1986. Vegetation response on allotments grazed under rest-rotation management. Journal of Range Management. 39:166-174	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Elmore, W., and B. Kauffman. 1994. A Riparian and Watershed Systems: Degradation and Restoration In M. Vavra, W.A. Laycock, and R.D. Pieper (eds), Ecological Implications of Livestock Herbivory 1994 West. Soc. Range Management: Denver, CO.	CITE	Grazing can occur while streams are improving if all ecological components are linked. This publication is cited in the analysis.
Western Watersheds Project	Feist, Francis G. 1968. Breeding-bird populations on sagebrush-grassland habitat in central Montana. Audubon Field Notes. 22:691-695	DATED	Sagebrush habitat is addressed with more recent information sources.
Western Watersheds Project	Flather, C.H., et.al. 1994. Species endangerment patterns in the United States. USDA Forest Serv. Gen. Tech. Rep. RM-241.	CON	The topic of impacts of grazing on wildlife is addressed using other information sources equally or more relevant to the HLC NF.
Western Watersheds Project	Galt, Dee, Francisco Molinar, Joe Navarro, Jamus Joseph and Jerry Holechek. 2000. Grazing capacity and stocking rate. Rangelands 22(6):7-11.	CON	The topic of grazing capacity/stocking is addressed using other information sources equally or more relevant to the HLC NF.
Western Watersheds Project	Hodgkinson, Harmon S. 1989. Big sagebrush subspecies and management implications.	CON	The general topic of sagebrush habitat is covered using other information sources equally or more relevant to the HLC NF.
Western Watersheds Project	Holechek, Jerry L., and Thor Stephenson. 1983. Comparison of big sagebrush vegetation in northcentral New Mexico under moderately grazed and grazing excluded conditions.	IRR	Study is specific to New Mexico. Sagebrush is addressed using other citations more relevant to the HLC NF.
Western Watersheds Project	Holechek, Jerry L., Hilton Gomez, Francisco Molinar and Dee Galt. 1999. Grazing studies: what we've learned.	IRR	This reference would be more appropriate for a site-specific analysis; not directly relevant to forest plan revision.
Western Watersheds Project	Holloran, M. J. and S. H. Anderson. 2005. Spatial distribution of Greater Sage-grouse nests in relatively contiguous sagebrush habitats.	IRR	There is no occupied sage-grouse habitat on NFS lands on the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Hutchings, S.S. and G. Stewart. 1953. Increasing forage yields and sheep production on Intermountain winter ranges. U.S. Department of Agriculture Circular 925	CON	Somewhat dated information; this topic is covered by other citations equally or more relevant to the HLC NF.
Western Watersheds Project	Jones, K.B. 1981. Effects of grazing on lizard abundance and diversity in western Arizona. Southwestern Naturalist 26: 107-115.	IRR	Study is specific to lizards and habitat conditions in Arizona.
Western Watersheds Project	Knick, S. T., A. L. Holmes, R. F. Miller. 2005. The role of fire in structuring sagebrush habitats and bird communities. FIRE AND AVIAN ECOLOGY IN NORTH AMERICA. Studies in Avian Biology, no. 30.	CITE	Cited in the Livestock Grazing analysis in the Fire and fuels section.
Western Watersheds Project	Knick, S. T., D. S. Dobkin, J. T. Rotenberry, M. A. Schroeder, W. M. Vander Haegen, C. van Riper. 2003.Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 105(4): 611-634.	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Knick, S.T. 1999. Requiem for a Sagebrush Ecosystem? Northwest Science 73:53-57	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Knick, Steven T. and John T. Rotenberry. 1995. Landscape characteristics of fragmented shrub steppe habitats and breeding passerine birds.	IRR	The general concepts in this paper may apply; but the HLC NF planning area supports different sagebrush habitats than this study. Fuels and vegetation treatments on the HLC NF are geared towards conifer encroachment issues which threaten conversion of shrublands to woodlands.
Western Watersheds Project	Kovalchik, B.L., and W. Elmore. 1992. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon. Pages 111-119 in W.P Clary, E.D. McArthur, D. Bedunah, and C.L. Wambolt, compilers. Proceedings--Symposium on ecology and management of riparian shrub communities. General Technical Report INT-289. Forest Service, Intermountain Research Station, Ogden, Utah.	CITE	Information regarding grazing systems and utilization; relationship to streambank stability and effective riparian veg., riparian areas production estimates. Publication is cited in the analysis.
Western Watersheds Project	Krueper, David, Jonathan Bart and Terrell D. Rich. 2003. Response of vegetation and breeding birds to the removal of cattle on the San Pedro River, Arizona (U.S.A.). Conservation Biology 17(2):607-615	IRR	Study specific to Arizona; found increase in bird numbers with increase in cover. The impacts of grazing on wildlife is covered using other information more relevant to the HLC NF.
Western Watersheds Project	Medin, Dean E., Bruce L. Welch and Warren P. Clary. 2000. Bird habitat relationships along a Great Basin elevational gradient. USDA Forest Service Rocky Mountain Research Station Research Paper RMRS-RP-23.	IRR	Study specific to Pocatello area; the topic of riparian species is broadly covered using information sources equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Miller, R. F., S. T. Knick, D. A. Pyke, C. W. Meinke, S. E. Hanser, M. J. Wisdom, A. L. Hild. 2011. Characteristics of sagebrush habitats and limitations to long-term conservation. Pages 145-184 in S. T. Knick and J. W. Connelly (eds). Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and its Habitants. Studies in Avian Biol. Series, vol. 38.	CON	The issue of invasive grasses and livestock is addressed using other citations equally or more relevant to the HLC NF.
Western Watersheds Project	Mosconi, S.L., and R.L. Hutto. 1982. The effect of grazing on the land birds of a western Montana riparian habitat. In L. Nelson, J.M. Peek, and P.D. Dalke, editors. Proceedings of the wildlife-livestock relationships symposium. Forest, Wildlife, and Range Experiment Station, University of Idaho, Moscow, Idaho.	CON	General concepts of higher cover equals higher diversity. Other references used to cover this topic that are equally or more relevant to the HLC NF.
Western Watersheds Project	Mueggler, W. F. 1985. Vegetation associations. In: DeByle, Norbert V.; Winokur, Robert P., eds. Aspen: ecology and management in the western United States. Gen. Tech. Rep. RM-119.	CON	Mueggler 1985 is used as a basis for the nonforested vegetation classification used (see appendix D of the Plan). The topics of grazing, sagebrush, and aspen are covered with other literature sources.
Western Watersheds Project	Nick, S. T., S. E. Hanser, R. F. Miller, D. A. Pyke, M. J. Wisdom, S. P. Finn, E. T. Rinkes, C. J. Henny. 2011. Ecological influence and pathways of land use in sagebrush. KPages 203-251 in S. T. Knick and J. W. Connelly (eds). GREATER SAGE-GROUSE: ECOLOGY AND CONSERVATION OF A LANDSCAPE SPECIES AND ITS HABITATS. Studies in Avian Biol. Series, vol. 38.	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Noss, Reed, et.al. 1995. Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation. Biological Report 28. National Biological Service,	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Parrish, Jimmie R., Frank Howe and Russell Norvell. 2002. Utah Partners in Flight Avian Conservation Strategy Version 2.0. Utah Division of Wildlife Publication No. 02-27.	CON	Study is specific to Utah; wildlife habitat conditions and impacts are addressed with other literature sources more relevant to the HLC NF.
Western Watersheds Project	Pearson, L.C. 1965. Primary production in grazed and ungrazed desert communities of eastern Idaho. Ecology. 46:278-285	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Pederson, E. K., J. W. Connelly, J. R. Hendrickson, W. E. Grant. 2003. Effect of sheep grazing and fire on sage grouse populations in southeastern Idaho.	IRR	There is no occupied sage grouse habitat on NFS lands on the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Peek, James M.; Riggs, Robert A.; Lauer, Jerry L. 1979. Evaluation of fall burning on bighorn sheep winter range. Journal of Range Management. 32(6): 430-432	IRR	Citation is dated and more applicable to site-specific projects; not directly relevant to the forest plan revision process.
Western Watersheds Project	Petersen, Kenneth L. and Louis B. Best. 1985. Nest-site selection by sage sparrows. Condor. 57:217-221.	IRR	The general concepts in this paper may apply; but the HLC NF planning area supports different sagebrush habitats than this study. Fuels and vegetation treatments on the HLC NF are geared towards conifer encroachment issues which threaten conversion of shrublands to woodlands.
Western Watersheds Project	Petersen, Kenneth L. and Louis B. Best. 1986. Diets of nesting sage sparrows and Brewer's sparrow in an Idaho sagebrush community. Journal of Field Ornithology. 57:283-294	IRR	The general concepts in this paper may apply; but the HLC NF planning area supports different sagebrush habitats than this study. Fuels and vegetation treatments on the HLC NF are geared towards conifer encroachment issues which threaten conversion of shrublands to woodlands.
Western Watersheds Project	Petersen, Kenneth L. and Louis B. Best. 1991. Nest site selection by sage thrashers in southeastern Idaho. Great Basin Naturalist. 51:261-266	IRR	The general concepts in this paper may apply; but the HLC NF planning area supports different sagebrush habitats than this study. Fuels and vegetation treatments on the HLC NF are geared towards conifer encroachment issues which threaten conversion of shrublands to woodlands.
Western Watersheds Project	Peterson, Joel G. 1995. Ecological implications of sagebrush manipulation – A literature review. Montana Fish wildlife and Parks, Wildlife Management Division, Helena, MT	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Platts, William S. 1981. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America – Effects of Livestock Grazing. General Technical Report PNW 124, USDA Pacific Northwest Forest and Range Experiment Station, Boise, ID	CON	The topic of livestock grazing impacts is addressed with other literature that is equally or more relevant to the HLC NF.
Western Watersheds Project	Quinn, M.A., and D.D. Walgenbach. 1990. Influence of grazing history on the community structure of grasshoppers of a mixed-grass prairie. Environmental Entomology 19: 1756-1766	CON	The topic of grazing and native plants is addressed using other citations that are equally or more relevant to the HLC NF.
Western Watersheds Project	Rampton, J. 1993. National Wildlife Federation v. BLM, No. UT-06-91-01 US Dep't of Interior, Office of Hearings & Appeals, Hearings Div. p. 23, the "Comb Wash Allotment" decision	IRR	The Plan and analysis are consistent with law, regulation, and policy related to livestock grazing and multiple uses.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Reisner, Michael D.; Grace, James B.; Pyke, David A.; Doescher, Paul S. 2013. Conditions favoring Bromus tectorum dominance of endangered sagebrush steppe ecosystems. Journal of Applied Ecology.	CITE	This publication is cited in the invasives and grazing sections.
Western Watersheds Project	Reynolds, Timothy D. and Charles H. Trost. 1980. The response of native vertebrate populations to crested wheatgrass planting and grazing by sheep. Journal of Range Management. 33:122-125	IRR	The general concepts in this paper may apply; but the HLC NF planning area supports different sagebrush habitats than this study. Fuels and vegetation treatments on the HLC NF are geared towards conifer encroachment issues which threaten conversion of shrublands to woodlands.
Western Watersheds Project	Reynolds, Timothy D. and Charles H. Trost. 1981. Grazing, crested wheatgrass, and bird populations in southeastern Idaho. Northwest Science. 55:225-234	IRR	The general concepts in this paper may apply; but the HLC NF planning area supports different sagebrush habitats than this study. Fuels and vegetation treatments on the HLC NF are geared towards conifer encroachment issues which threaten conversion of shrublands to woodlands.
Western Watersheds Project	Rich, Terrell D. 2002. Using breeding land birds in the assessment of western riparian systems. Wildlife Society Bulletin 30(4):1128-1139	IRR	Not directly applicable to the forest plan revision process.
Western Watersheds Project	Schwan, H.E., Donald J. Hodges and Clayton N. Weaver. 1949. Influence of grazing and mulch on forage growth. Journal of Range Management 2(3):142-148	DATED	The general concept of grazing and forage is addressed with more recent and relevant information sources.
Western Watersheds Project	Szaro, R.C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants 9 (3-4): 69-138	IRR	Paper focuses on southwestern plant communities. General grazing concepts and riparian management captured with other information sources more relevant to the HLC NF.
Western Watersheds Project	Szaro, R.C., S.C. Belfit, J.K. Aitkin, and J.N. Rinne. 1985. Impact of grazing on a riparian garter snake. Pages 359-363 in R.R. Johnson, C.D. Ziebell, D.R. Patton, P.F. Ffolliott, and F.H. Hamre, technical coordinators. Riparian ecosystems and their management: reconciling conflicting uses. General Technical Report RM-120.	CON	General topic of grazing impacts on wildlife is covered using other citations that are equally or more relevant to the HLC NF.
Western Watersheds Project	Taylor, Daniel M. 1986. Effects of cattle grazing on passerine birds nesting in riparian habitat. Journal of Range Management 39(3):254-258	CON	The impacts of grazing on wildlife habitat is addressed using other literature sources more relevant to the HLC NF.
Western Watersheds Project	Trimble, S.W., and A.C. Mendel. 1995. The Cow as a Geomorphic Agent, A Critical Review. Geomorphology 13: 1995.	CON	These general concepts are covered by other references used that are equally or more relevant to the HLC NF.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	USDI 2012. The Department of the Interior's Economic Contributions: Fiscal Year 2011, July 9, 2012, 152	CON	The topic of the relative economic benefits of recreation and livestock grazing is addressed as appropriate using information sources more relevant to the HLC NF.
Western Watersheds Project	USGAO 1998. Public Rangelands: some riparian areas restored, but widespread improvement will be slow. U.S. General Accounting Office. 1988.	CON	The topic of livestock grazing impacts is addressed with other literature that is equally or more relevant to the HLC NF.
Western Watersheds Project	Vallentine, J. F. 1990. GRAZING MANAGEMENT. Academic Press. San Diego, CA.	CON	The economic considerations of livestock grazing are addressed with other information sources relevant to the HLC NF.
Western Watersheds Project	Wagner, F.H. 1978. Livestock grazing and the livestock industry. Pages 121-145 in H.P. Brokaw, editor Wildlife and America. Council on Environmental Quality, Washington, D.C.	DATED	Publication is dated; more recent information is used to consider the impacts of grazing on wildlife.
Western Watersheds Project	WALCHECK, Kenneth C. 1970. Nesting bird ecology of four plant communities in the Missouri river breaks, Montana	IRR	Considerations for sagebrush habitat is based on other literature relevant to the HLC NF.
Western Watersheds Project	Wambolt Carl L. and Harrie W. Sherwood. 1999. Sagebrush response to ungulate browsing in Yellowstone. S Journal of Range Management. 52:363-369.	IRR	Publication describes heavy browse pressure from big game especially elk on northern winter range; this is a different scenario than the sagebrush habitat in the planning area.
Western Watersheds Project	Wambolt, C. L.; Creamer, W. H.; Rossi, R. J. 1994.Predicting big sagebrush winter forage by subspecies and browse form class. Journal of Range Management. 47(3): 231-234	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.
Western Watersheds Project	Wambolt, Carl L. 1995. Elk and mule deer use of sagebrush for winter forage. Montana Ag Research. 12(2): 35-40	IRR	Study focuses on wildlife dependency of sagebrush on winter range; there are different issues of scope within the planning area.
Western Watersheds Project	Wambolt, Carl L. 1996. Mule deer and elk foraging preference for 4 sagebrush taxa. Journal of Range Management. 49(6): 499-503	IRR	Study focuses on wildlife dependency of sagebrush on winter range; there are different issues of scope within the planning area.
Western Watersheds Project	Wambolt, Carl L. and Myles J. Watts. 1996. High stocking rate potential for controlling Wyoming big sagebrush. In: Barrow, Jerry R. et. al. comps. Proceedings: shrubland ecosystems dynamics in a changing environment. 1995 May 23-25; Las Cruces, NM. Gen. Tech. Rep. INT-GTR-338. Ogden, UT: USDA Forest Service, Intermountain Research Station	CON	The topic of sagebrush communities and grazing is broadly considered using other information sources.

Commenter(s)	Citation	Response code	Rationale
Western Watersheds Project	Welch, Bruce L. and Craig Criddle. 2003. Countering Misinformation Concerning Big Sagebrush. USDA Forest Service Rocky Mountain Research Station RBRS-RP-40.	NOT RLB	Paper has some good general information to consider for sagebrush range sites and is a FS document, but also has some writer bias. Regional Forester's letter accompanies document as a disclaimer. Non-scientific, more of an opinion article.
Western Watersheds Project	Welch, Bruce L.; Briggs, Steven F.; Johansen, James H. 1996. Big sagebrush seed storage. Res. Note INT-RN-430. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station	CON	The topic of sagebrush habitat is covered using other literature sources equally or more relevant to the HLC NF.
Western Watersheds Project	Welch, Bruce L.; Wagstaff, Fred J.; Roberson, Jay A. 1991. Preference of wintering sage-grouse for big sagebrush. Journal of Range Management. 44(5): 462-465.	IRR	There is no occupied sage grouse habitat on NFS lands on the HLC NF.
Western Watersheds Project	West, Neil E. 1988. Intermountain deserts, shrub steppes, and woodlands. In: Barbour, Michael G.; Billings, William Dwight, eds. North American terrestrial vegetation. Cambridge; New York: Cambridge University Press: 209-230.	IRR	Sagebrush systems and grazing impacts are addressed using information sources more relevant to the HLC NF.
Western Watersheds Project	Winter, B. M. and Louis B. Best. 1985. Effect of prescribed burning on placement of sage sparrow nests. Condor. 87:294-295.	CON	The concepts of cover needs are captured in other information sources equally or more relevant to the HLC NF.
Western Watersheds Project	Wisdom, M. J., M. M. Rowland, R. J. Tausch. 2005. Effective management strategies for sage-grouse and sagebrush: a question of triage? Trans. N. Wildl. Nat. Res. Conf. 70: 206-227	IRR	Publication is focused in the Great Basin; there is no occupied sage grouse habitat on NFS lands on the HLC NF.
Western Watersheds Project	Woodyard, John, Melissa Renfro, Bruce L. Welch and Kristina Heister. 2003. A 20-year recount of bird populations along a Great Basin elevational gradient. USDA Forest Service Rocky Mountain Research Station Research Paper RMRSRP-43.	IRR	Study is specific to Nevada.
Wild Earth Guardians	456 F3d 955 Great Basin Mine Watch v. Hankins USA	IRR	The cumulative effects analysis for the HLC NF forest plan revision is consistent with existing law, regulation, and policy.
Wild Earth Guardians	Birdsall et al 2012. Roads Impact the Distribution of Noxious Weeds More Than Restoration Treatments in a Lodgepole Pine Forest in Montana, U.S.A.	CON	The impacts of roads are covered as appropriate using information sources equally or more relevant to the forest plan revision process.
Wild Earth Guardians	Chase 2016. What Happens to Lynx When Beetles Eat the Forests?	CON	The influences of mountain pine beetle and other disturbances on lynx habitat conditions is considered using other information equally or more relevant to the HLC NF, at the programmatic level. For example, vegetation modeling incorporated current and potential future infestations.

Commenter(s)	Citation	Response code	Rationale
Wild Earth Guardians	CONNER v. BURFORD 1988	IRR	The effects analysis for the HLC NF forest plan revision is consistent with existing law, regulation, and policy.
Wild Earth Guardians	Copeland et al 1996. Seasonal Habitat Associations of the Wolverine in Central Idaho	CON	Heinemeyer et al. 2017 is cited which covers this topic.
Wild Earth Guardians	Cottonwood Environmental Law Center v. United States Forest Service 2015	GEN	Plan components are consistent and in support of bull trout recovery efforts. The FEIS (pg. 60 and 109) and Plan mention forest requirements under the Northern Region Bull Trout Conservation Strategy specifically, obligations of the HLC NF under the bull trout Columbia Headwaters Recovery Unit Implementation Plan.
Wild Earth Guardians	Executive Order 11644 - Appendix A – Executive Orders	IRR	The Plan and associated analysis for the HLC NF forest plan revision is consistent with existing law, regulation, and policy.
Wild Earth Guardians	Executive Order 13653 --Preparing the United States for the Impacts of Climate Change	IRR	Executive order "Promoting Energy Independence and Economic Growth" (March 2017) rescinded Executive Order 13653 (Preparing the U.S. for the Impacts of Climate Change).
Wild Earth Guardians	French & Harper 2016. Clarification on Conservation Watersheds in Land Management Plans	GEN	The Plan and associated analysis for the HLC NF forest plan revision is consistent with existing law, regulation, and policy, including direction on conservation watersheds in the 2012 Planning Rule.
Wild Earth Guardians	FRIENDS OF WILD SWAN, INC. v. U.S. FOREST SERVICE	GEN	Plan components are consistent and in support of bull trout recovery efforts. The FEIS (pg. 60 and 109) and Plan mention forest requirements under the Northern Region Bull Trout Conservation Strategy specifically, obligations of the HLC NF under the bull trout Columbia Headwaters Recovery Unit Implementation Plan.
Wild Earth Guardians	Heinemeyer et al 2001. Aerial Surveys for Wolverine Presence and Potential Winter Recreation Impacts to Predicted Wolverine Denning Habitats in the Southwestern Yellowstone Ecosystem.	AUTH	A more recent work on this topic, by this author, is cited (Heinemeyer et al. 2017).
Wild Earth Guardians	Heinemeyer et al 2014. Recovery of Wolverines in the Western United States: Recent Extirpation and Recolonization or Range Retraction or Expansion.	AUTH	A more recent work on this topic, by this author, is cited (Heinemeyer et al. 2017).
Wild Earth Guardians	Heinemeyer, Kim and Jeff Copeland 1999. Wolverine Denning Habitat and Surveys on the Targhee National Forest 1998-1999 Annual Report Kim Heinemeyer and Jeff Copeland	INC	This is a preliminary study; page 20 of 22 paragraph 1: "It is preliminary to draw conclusions on potential impacts to wolverine based on a single survey effort."
Wild Earth Guardians	Horan 2016. DEFENDERS OF WILDLIFE V. JEWELL (D. MONT. 2016)	CON	The topic of wolverine habitat was considered using other literature more relevant to the HLC NF forest plan revision process.

Commenter(s)	Citation	Response code	Rationale
Wild Earth Guardians	Hornocker and Hash 1981. Ecology of the wolverine in northwestern Montana.	CITE	This publication is cited in the analysis.
Wild Earth Guardians	Landa et al 1998. Active wolverine Gulo gulo dens as a minimum population estimator in Scandinavia	CON	Heinemeyer et al. 2017 is cited which covers this topic.
Wild Earth Guardians	McKelvey 2016. Sampling large Geographic areas for rare species using environmental DNA: a study of bull trout Salvinenus confluenctus occupancy in Western Montana	CITE	Environmental DNA is an accepted tool for inventory and monitoring or rare species such as bull trout distribution. This was incorporated in the FEIS on page 58 of the FEIS.
Wild Earth Guardians	Olliff 1999. Effects of winter recreation on wildlife of the Greater Yellowstone area: a literature review and assessment	IRR	Broad review of potential winter recreation effects on wildlife population; the effects are more appropriate when considering local actions (i.e., specific trail or access locations) rather than forest plan revision.
Wild Earth Guardians	Paulsen v. Daniels 2005.	IRR	The Plan and associated analysis for the HLC NF forest plan revision is consistent with existing law, regulation, and policy.
Wild Earth Guardians	Ruggierio et al 2000. Wolverine Conservation and Management	CON	Citation is a reference to general description of natural history; this topic is covered by other information sources equally or more relevant to the HLC NF.
Wild Earth Guardians	The Wilderness Society 2014. Transportation Infrastructure and Access on National Forest and Grasslands: A Literature Review	Gen	The forest is managed for multiple resource benefits and to manage all resources, roads are required for access. Plan components within the Forest Plan address the need to limit the road system to roads required for that access and roads no longer needed for that purpose will be decommissioned on a project by project basis to benefit fish and wildlife habitat as well as other resources.
Wild Earth Guardians	USDA 2012. Travel Management, Implementation of 36 CFR, Part 202, Subpart A (36 CFR 212.5(b))	Gen, LRP	The Travel Analysis Report (TAR) for the Helena NF was completed September 8, 2015 and for the Lewis and Clark NF was completed September 21, 2015.
Wild Earth Guardians	USDA 2014. US Department of Agriculture Climate Change Adaptation Plan	GEN	Executive order "Promoting Energy Independence and Economic Growth" (March 2017) rescinded Executive Order 13653 (Preparing the U.S. for the Impacts of Climate Change), which impacts the USDA 2014 Adaptation Plan that required the development of adaptation plans. The HLC NF does not have an adaptation plan for a resilient road system but does incorporate plan components for water and infrastructure that provides for infrastructure sustainability.

Commenter(s)	Citation	Response code	Rationale
Wild Earth Guardians	USFWS 1998. BIOLOGICAL OPINION for the Effects to Bull Trout from .Continued Implementation of Land and Resource Management Plans and Resource Management Plans as Amended by the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana, and Portions of Nevada (INFISH), and the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH).	GEN	Plan components are consistent and in support of bull trout recovery efforts. The FEIS (pg. 60 and 109) and Plan mention forest requirements under the Northern Region Bull Trout Conservation Strategy specifically, obligations of the HLC NF under the bull trout Columbia Headwaters Recovery Unit Implementation Plan.
Wild Earth Guardians	USFWS 2016. Species Status Assessment for the Canada Lynx	GEN	Report gives a 'Draft' assessment of lynx in contiguous U.S., with the smallest consideration at the distinct population segment which is a scale much greater than HLC NF, moreover, the issues presented in the document are considered within existing laws, regulations, and policies governing lynx management. The BA for Canada Lynx cites the species status assessment from 2017.
Wild Earth Guardians	USFWS. Biological Opinion on the proposed Divide Travel Plan (Travel Plan), pursuant to Section 7 of the Endangered Species Act of 1973. Effects	IRR	The Divide Travel Plan Biological Opinion pertains to a specific project area outside the spatial and temporal scale appropriate for the planning area/land management plan. Plan components are consistent and make mention of forest obligations for bull trout recovery under the Northern Region bull trout conservation strategy and the Columbia Headwaters Recovery Unit Implementation Plan.
Wild Earth Guardians	Wild Earth Guardians 2015. Letter to the Acting Flathead NF Forest Supervisor, re: NOI amending Forest Plan incorporating the NCDE Grizzly Bear Plan	IRR	Information is specific to the Flathead NF; not directly applicable to the HLC NF forest plan revision process.
Wild Earth Guardians	Wild Earth Guardians 2016. DEIS Comments re: Forest Plan Revision of the Flathead NF and the NCDE Grizzly Bear Conservation Strategy	GEN	Plan components are consistent and in support of bull trout recovery efforts. The FEIS (pg. 60 and 109) and Plan mention forest requirements under the Northern Region Bull Trout Conservation Strategy specifically, obligations of the HLC NF under the bull trout Columbia Headwaters Recovery Unit Implementation Plan.
Wild Earth Guardians	WildEarth Guardians v. Montana Snowmobile Association	IRR	Not scientific information that would inform forest plan revision.

Commenter(s)	Citation	Response code	Rationale
Wild Earth Guardians	Wilderness Society 2016. Achieving Compliance with the executive order "Minimization Criteria" for Off Road Vehicle Use on Federal Public Lands: Background Cases, and Recommendations	IRR	Complying with executive orders would be required as part of existing law, regulation, and policy. The more specific recommendations in the paper are related to travel planning and implementation, which is outside the scope of the HLC NF forest plan revision process.
Wild Earth Guardians	Winter Wildlands Alliance v. US Forest Service	Gen	Over-snow vehicle use and the areas that pertain to them were considered the analysis for Recreation Access in the FEIS. Site-specific recommendations for travel plan closures is beyond the scope of the analysis for the Plan.
Wildlife Conservation Society	Redford, Kent H. and Eva Fearn 2007. Protected Areas and Human LIVELIHOODS.	IRR	Broad in scope; not directly relevant to the forest plan revision process on the HLC NF.
Winter Wildlands Alliance	Gehman 2016. Winter Wildlife Surveys in the Little Prickly Pear Creek area of the Helena National Forest, Year Two. Report prepared by Steve Gehman, Wild Things Unlimited. May 2016.	CON	These surveys were not specifically cited, but specialist knowledge of this information and the associated public comments were taken into consideration when including the Nevada Mountain RWA in several alternatives, including the preferred alternative.
Winter Wildlands Alliance	Outdoor Foundation 2016. Outdoor Recreation Participation Topline Report.	CON	Report is nationwide in scale. Levels of use and expected trends for recreation activities, including backcountry skiing, was considered using information more relevant to the HLC NF planning area. The Plan provides the appropriate programmatic framework for supporting this use sustainably on the landscape.
Winter Wildlands Alliance	Switalski 2016. Journal of Conservation Planning Vol. 12 (2016) 1-7; Snowmobile Best Management Practices for Forest Service Travel Planning: A Comprehensive Literature Review and Recommendations for Management- Introduction to Snowmobile Management and Policy	CON	The potential impacts from, and management strategies for, snowmobile use were considered in the analysis for ROS settings in the Plan, which specify broadly whether winter over-snow motorized uses are suitable or not in a given area. At the Forest Planning level, this analysis is general in nature and the Forest Plan does not include site-specific travel management, which is addressed by travel plans.
Winter Wildlands Alliance	USDA 2009. Winter Recreation Sustainability Analysis, Deschutes National Forest, 2009	IRR	The Plan follows the national definitions and guidance for assigning ROS classes, as required by the 2012 Planning Rule and associated directives.
Zammit, Tony	MFWP Montana Statewide Elk Management Plan	CITE	The publication was cited in the analysis.

Appendix H. Terrestrial Vegetation, Wildlife, and Timber Methodologies and Results

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Introduction

This appendix includes the background information, methodologies, and model results for all components of the terrestrial vegetation, old growth, snags and downed wood, and timber analyses, as well as specific wildlife habitat conditions that were included in the vegetation model.

Alternatives B and C are identical in terms of vegetation and timber plan components, and other elements that substantially influence vegetation. Therefore, they are analyzed together as “alternatives B/C”.

See appendix J for additional information regarding how climate change was incorporated in the analysis; and appendix I for a detailed summary of the natural range of variation (NRV) analysis.

As a result of the objection resolution process, several additional changes (primarily to alternative F) were made to the FEIS. These changes were focused primarily on modifications to several recommended wilderness areas, as described in Part 1 of the FEIS. These changes resulted in subsequent updates to ROS and SIO classifications as well as lands suitable for timber production and lands unsuitable for timber production where harvest can occur for other purposes. These updates are reflected in the 2021 Land Management Plan. The changes overall affected less than several hundred acres.

The timber analysis and summaries displayed in this appendix have not been updated to reflect these changes. This is because the updated layers were interwoven throughout the timber modeling process, which is too complex to be redone in a reasonable or timely fashion. Other more straightforward analyses that summarized combinations of these layers with relevant timber factors were also not redone, to ensure that the analysis compares the equivalent numbers throughout. The alteration of several hundred acres is too small to affect measurable change in the modeling process, or to alter the relative comparisons and conclusions reached throughout the analysis.

Methodology overview

Terrestrial vegetation

The terrestrial vegetation section documents the coarse filter analysis of the terrestrial ecosystems. The analysis area includes all lands administered by the HLC NF. Information is summarized at several scales:

1. Forestwide, to provide information on the broad scale context;
2. Broad potential vegetation type (PVT), because indicators vary by site capability;
3. Geographic area (GA) because the unique disturbance history and human uses of each area has and will continue to influence vegetation;
4. Managed landscapes versus unmanaged landscapes (defined as designated wilderness, recommended wilderness - RWA, wilderness study areas, and inventoried roadless areas - IRAs); and
5. Wildland urban interface (WUI) areas versus non-WUI areas. For the HLC NF analysis, the WUI is mapped based on County Wildland Protection Plans (CWPPs) where available, and standard Hazardous Fuels Reduction Act (HFRA) definitions where CWPP maps are unavailable. The WUI will change over time as human developments and land use change.

The analysis area for cumulative effects also includes lands of other ownership within and adjacent to the HLC NF. The terrestrial vegetation analysis is based on large part upon desired future conditions. These conditions are enumerated in detail in the “*Desired conditions and vegetation metrics*” section below. A NRV analysis was conducted to assess ecological integrity and to provide the basis for desired vegetation conditions (appendix I). The SIMPPLLE model was used to estimate the NRV; the calibrations applied to this model are described in the "*Vegetation models*" section below.

Old growth, snags, and downed wood

Three scales of analysis are used; all NFS lands are considered within these boundaries:

1. Forestwide - to provide information on the broad scale abundance of old growth.
2. Broad PVT - because old growth types and conditions vary by site capability.
3. GA - because the unique disturbance and human use history of each area influences the abundance and type of old growth.

The desired condition for old growth in the 2021 Land Management Plan (hereinafter referred to as the Plan) in all of the action alternatives applies forestwide and by each broad PVT. Smaller scales, such as individual watersheds or drainages, or even the smallest GAs, would not necessarily be appropriate to encompass the disturbances that affect old growth or the array of natural vegetation conditions (such as nonforested plant communities) where old growth desired conditions would not be applicable.

Forest Inventory and Analysis (FIA) field procedures collect the data required to provide a statistically sound estimate of the amount of old growth present across the landscape at mid to broad scales. Confidence intervals around estimates vary based on the size of the sample and the variability of vegetation. Two datasets are used. "Hybrid 2011", is used for forestwide and broad PVT estimates because it represents all NFS lands across the planning area. "F12_F15_Partial_IntGrid_4X_Hybrid_2016COMBINED", is used for estimates on all GAs except the Rocky Mountain Range, because these areas have had an intensified plot grid installed.

Old growth cannot be estimated into the past or the future with available models, because the spatial data avilable (R1-VMap) cannot reliably derive attributes such as stand age. However, the large-tree structure attribute estimated from FIA at the mid to broad scale shows a correlation to old growth and is used as an analysis indicator. An unknown subset of these areas may be old growth and therefore the expected trend may be similar.

The analysis area for snags is forestwide by snag analysis group. Snag analysis groups are consistent with broad PVTs, except that areas dominated by lodgepole pine are addressed separately. This is important for the snag analysis because lodgepole pine is relatively short lived, generally smaller in diameter than other species, and subject to stand replacing disturbances which result in unique snag conditions and dynamics.

Downed woody debris is analyzed using broad PVTs to be consistent with the best available information to inform the desired condition.

Timber and other forest products

Timber suitability was mapped using the best available geospatial information. Lands that may be suitable for timber production were determined based on the factors required by NFMA and the 2012 Planning Rule and are the same for all alternatives. Of those lands that may be suitable, the lands that are suitable for timber production vary by alternative based on management objectives.

Timber harvest outputs (projected wood sale quantity, projected timber sale quantity, harvest by decade, and sustained yield limit) were modeled using PRISM, a software modeling system designed to assist decision makers in exploring and evaluating multiple resource management choices and objectives. Models constructed with PRISM apply management actions to landscapes through a time horizon and display outcomes. Management actions are selected to achieve desired goals while complying with identified objectives and constraints. PRISM outputs are used to display tradeoffs between alternatives and to predict sustainable timber harvest levels over time. The existing condition of vegetation is based on data sources which accurately reflect conditions on the landscape, including the impacts of recent fires, bark beetles, and management, as described in the *Data sources* section. The timber model incorporates detailed yield tables built using local data and prescriptions, as described in the *PRISM model design* section. Future projections include potential disturbances, climate conditions, and applicable constraints from plan components including fire suppression.

The analysis area for timber suitability, timber supply, timber harvest, and other forest products includes all NFS lands on the HLC NF. The analysis area for timber demand consists of sixteen counties that contain infrastructure and/or communities that utilize timber from the HLC NF (Table 1).

Table 1. Counties affected by HLC NF timber outputs

County group	Counties
North	Glacier, Pondera, Teton
Central	Cascade, Choteau
East	Fergus, Judith Basin, Meagher, Wheatland
West	Broadwater, Jefferson, Lewis and Clark, Powell
Secondary	Deer Lodge, Gallatin, Park

Data sources

A variety of well-researched and documented datasets and tools are used which collectively make up the best available science for quantifying vegetation. This determination is made based upon the following:

- Systematic field inventories using National and Regional field sampling protocols provide statistically based, consistent methodologies for quantifying vegetation characteristics and a high level of known accuracy. FIA plot data meets these criteria and are used to quantify the existing condition of vegetation. FIA intensified grid plots provide a larger and more recently sampled dataset for most of the HLC NF; these plots were re-measured following the recent mountain pine beetle outbreak and therefore reliably depict current vegetation conditions.
- Vegetation mapping derived from National and Regional remote sensing protocols provide consistent methodologies for classifying and mapping vegetation characteristics and are assessed for accuracy so that their level of uncertainty is quantifiable. This information is inherently less accurate and detailed than systematic plot sampling but provides valuable complementary information and allows for an analysis of the spatial distribution of vegetation. The R1 VMap used (version 2014) is based on imagery from 2011, and therefore incorporates most of the impacts of the recent mountain pine beetle outbreak. The product is also updated to incorporate more recent wildfires and management activities to ensure it accurately depicts current vegetation conditions.
- Other databases and map sources are used where appropriate, with a clear understanding of their purpose, accuracy, and limitations. As needed, professional judgment and interpretation are provided to frame the information found in all data sources.

The analysis also draws upon the best available literature citations relevant to the ecosystems on the HLC NF. Sources that were the most recent; peer-reviewed; and local in scope or directly applicable to the local ecosystem were selected. Uncertainty is acknowledged and interpreted. Local studies and anecdotal information that are not peer-reviewed is included where appropriate. New studies and literature are continually becoming available and may be incorporated throughout the forest plan revision process.

Forest inventory and analysis (FIA)

FIA data comes from measurements taken at a set of points established on a systematic grid across the U.S. (Renate Bush, Berglund, Leach, Lundberg, & Zeiler, 2006). Data collection standards are strictly controlled, and the sample design and collection methods are scientifically designed, repeatable, and publicly disclosed. These plots are spatially balanced and statistically reliable for providing unbiased estimates at broad scales. A multitude of vegetation attributes are recorded, including but not limited to species, height, diameters, habitat type, age, physical defects, insect and disease, ground cover, fuel loading, understory species and ground cover. Plots are re-measured on a 10-year cycle, meaning that 10% are re-read each year, allowing evaluation of trends in forest conditions over time.

FIA plots are used for many aspects of the analysis, including: estimating the existing condition; validating the reliability of spatial datasets and/or build logic to update those datasets; seeding spatial datasets with the information required by vegetation models; and providing the tree lists needed for yield table development. Plots that have changed due to harvest or fire are excluded from analysis.

FIA base grid

The FIA program maintains a national grid of plots that are referred to as the “base grid”. The sample was designed to measure forested plots; non-forest plots are established but no data are recorded. Each plot represents about 5,000 acres. There are 150 base FIA plots on the Helena NF; 3 on the Beaverhead-Deerlodge NF portion of the Elkhorns; and 306 on the Lewis and Clark NF; for a total of 459 plots.

Starting with annual plots collected in 2006, the Northern Region has contracted with the FIA program to collect the “All Condition Inventory” (Renate Bush & Reyes, 2014). This inventory measures plots and portions thereof that do not meet the definition of “forested”. However, at this time, only a subset of the base grid plots has information collected on nonforested plots.

The base grid is used to summarize conditions for the entire planning area, and to represent GAs that do not have a grid intensification completed. The most recent plot measurement dates range from 1996 to 2011, with about half being measured prior to the mountain pine beetle outbreak that began in 2006.

FIA intensified grid

To enhance analyses at multiple scales, the FIA base grid has been intensified by four times (4x) across the HLC NF. This dataset is designed to capitalize on the statistical design of the base grid and allows for more accurate estimates at smaller scales. The grid intensification uses data collection protocols established for the Northern Region that are compatible with national protocols (Renate Bush & Reyes, 2014). This dataset is referred to as “intensified grid”, or “4x grid”. Plots are established across all NFS, regardless of whether they are forested.

The initial installation of intensified plots began in 2006 and is complete for all GAs except the Rocky Mountain Range (Table 2). There are no intensified plots on the portion of the Elkhorns GA that lies on the Beaverhead-Deerlodge NF. On GAs where the intensification is complete, 4x grid plots are added to base grid plots to create an analysis dataset.

Table 2. FIA and FIA 4x Intensified grid sample status by GA, as of 2016

Geographic Area	Base FIA Plots	4x Grid Installation Date	4x Plots Installed	4x Plots Yet to Install	Plots in 4x Dataset	Plots with live/dead re-measurement	Plots with full re-measurement
Big Belts	49	2006-08	191	0	240	82 (2008-10)	78 (2016)
Castles	10	2010	44	0	54	35 (2012)	0
Crazies	10	2010	32	0	42	0	0
Divide	35	2007-08	145	0	180	96 (2012)	142 (2012-15)
Elkhorns[1]	181	2006-07	72	0	87	24 (2009-10)	72 (2012)
Highwoods	7	2010	28	0	35	0	0
Little Belts	137	2009-10	588	0	725	365 (2012)	0
Rocky Mountain[2]	1222	2012-today	297	217	368	0	0
Snowies	20	2010-14	81	0	101	0	0
Upper Blackfoot	51	2007-08	228	0	279	101 (2009-10)	156 (2014-15)
Total	**459**		**1,706**	**217**	**2,111**	**703**	**448**

1 Only 15 of the 18 base FIA plots in the Elkhorns are included in the 4x dataset because the remaining 3 lie on the Beaverhead-Deerlodge NF, outside the 4x sample area. All 18 plots are included in the Hybrid 2011 dataset.
2 Only 71 of the 122 base FIA plots in the Rocky Mountain Range are included in the 4x dataset, because those plots are within the area where the 4x inventory is completed. The remaining 51 base FIA plots would be included when the 4x inventory is complete. All 122 plots are included in the Hybrid 2011 dataset.

The intensified plots are on a 10-year re-measurement cycle. However, starting in 2006 the HLC NF experienced wide-spread mortality caused by mountain pine beetle which created a short term need for rapid re-measurements. Plots on western GAs that had at least 20 square feet basal area per acre of pine trees were re-visited to determine changes in status (live/dead). In addition, full re-measurements have been conducted according to the regular schedule. The analysis datasets used to make estimates contain a "hybrid" of the most recent measurement of all plots.

The benefits of the intensified grid dataset include improved accuracy due to a large sample size; recent measurements reflect current conditions caused by the mountain pine beetle outbreak and some fires; and nonforested plot data. The weakness is that it is not complete on the Rocky Mountain Range GA. Plots are only installed on NFS lands; therefore, the geographic extent of plots is less than the total administrative boundary area which includes inholdings of other ownerships.

R1 summary database and estimator tool

The R1 Summary Database is developed by the Northern Region Inventory and Analysis staff to summarize plot data (Renate Bush & Reyes, 2014). This database includes statistical reporting functions and derived attributes or classifications consistent with the Region 1 Classification System (Barber, Bush, & Berglund, 2011). FIA and intensified grid plots are summarized using this tool. Based on the measured data, a suite of standardized classification algorithms populate attributes of interest (Barber et al., 2011; Renate Bush & Reyes, 2014). The database structure includes:

- Oracle tables reside at a data center that warehouse inventory data in the FSVeg database. The Oracle tables contain attributes collected at the site; derived attributes such as the R1 Existing Vegetation Classifications, R1 Wildlife habitat models, old growth; and spatial datasets.

- Access databases house a subset of the data in the Oracle Tables for a specified set of inventory data called *analysis datasets*. This database contains queries and reports built off of the Oracle Tables. The analysis datasets used include:
    - F12_F15Partial_IntGrid_4x_Hybrid_2016COMBINED, which includes the latest measurements of the intensified grid and base plots in those areas.
    - R1 Hybrid 2011, which includes the most recent available measurements of base plots, and the sample covers the entire HLC NF planning area.
- The R1 Estimator Form is a stand-alone program that derives estimates and confidence intervals for data in the access database that is selected (Renate Bush & Reyes, 2014). Reports were generated which include the mean, standard error, and 90% confidence intervals. For all attributes other than potential vegetation, estimates were made excluding plots that had changed since fire or harvest. Potential vegetation is estimated including all plots because fire or harvest would not change this attribute. All reports are available in the planning record.

Region 1 vegetation map (VMap)

The Region 1 Vegetation Map (VMap) is a spatially explicit map product that contains information about the extent, composition and structure of vegetation. Satellite and airborne acquired imagery are used and refined through field sampling and verification. This geospatial dataset includes all watershed areas that intersect with NFS lands on the HLC NF; private lands in these watersheds are included, so the map provides "wall to wall" coverage. The information is grouped into vegetation that is alike and organized into polygons. Each polygon has a life form, canopy cover, dominance type, and size class assigned consistent with the Region 1 Existing Vegetation Classification System (Barber et al., 2011). Additional information is attached using a digital elevation model (elevation, slope, and aspect); as well as continuous variables for tree size and canopy cover; probabilities of species occurrence; and additional attributes estimated by associating map classes to inventory plots.

The VMap was designed to allow consistent, continuous applications between regional inventory and map products across all land ownerships that is of sufficient accuracy and precision. VMap attributes have been assessed for accuracy through a process outlined for Region 1 (S. R. Brown, Jr, 2014; Vanderzanden, Brown, Ahl, & Barber, 2010). This accuracy assessment includes the results in Table 3 (S. R. Brown, Jr, 2014), which are within national mapping standards.

Table 3. Accuracy of VMap 2014 attributes for the HLC NF

Attribute	Accuracy
Lifeform	91%
Dominance Type (Dom40)	70%
Tree Canopy Cover	79%
Tree Size Class	69%

Relationships between VMap and FIA existing conditions

Both FIA plots and VMap are used to depict existing vegetation. While the grid plots provide the most statistically reliable estimates, the VMap provides the spatial depiction needed for modeling. The vegetation model input file for SIMPPLLE, which is also used for PRISM, is based on VMap with additional attributes inferred from FIA plots. As part of this process, the input file was adjusted to be as similar to FIA estimates of species, size class, and density class as possible. However, inconsistencies remain due to the inherent differences in the products, such as data collection methods and timing. However, the estimates from plots and the map should be similar, to ensure that the comparison between the existing condition and the NRV are valid as a cornerstone for the development of desired conditions. The following information discloses the level of similarity between the two data sources.

- Forestwide, VMap and the FIA plots correlate well for cover type. While the map shows slightly less ponderosa pine and more mixed mesic conifer, the trends compared to the desired condition are consistent. In the warm dry PVT and cool moist PVT the map and plots closely agree. In the cold PVT, VMap closely agrees with FIA for most cover types, except that the map shows lower amounts of lodgepole pine and higher amounts of spruce/fir.
- Forestwide, the mapped values are nearly within the plot confidence interval for all size classes except medium. Both sources indicate a need to decrease this class relative to the desired condition. In the warm dry PVT the biggest discrepancy between plots and the map is in the medium class, with VMap indicating that more is present. All other classes are similar. VMap closely agrees with FIA plots in all cases for the cool moist PVT. In the cold PVT, VMap shows slightly higher amounts of small and medium size classes, and slightly less grass/shrub. However, the data sources agree that a decrease in small and medium with an increase in large is warranted relative to desired conditions.
- Forestwide, VMap is nearly within the FIA estimate confidence interval for all canopy cover (density) classes except 60%+. The map and plots indicate a desired decrease in the 60%+, although the magnitude of the desired change varies. In the warm dry PVT, VMap is generally within the confidence interval for plot estimates except the 60%+ is slightly high. The sources agree that a decrease in this class is warranted to achieve the desired condition. Similar to the forestwide scale, in the cool moist PVT, VMap indicates that more 60%+ is present than the FIA plots. Both sources indicate a reduction is warranted to achieve the desired condition. In the cold PVT, VMap shows less of the nonforested/<10% tree canopy than FIA, and more of the 60%+. The sources agree on a desired trend of decreasing the 60%+, while the 40-59% class is at the low end of the desired range.

To provide disclosure of the variability caused by utilizing these data sources, all charts in the *SIMPPLLE Model Results* section include the FIA existing condition and the modeling input file starting condition (based on VMap). The FIA existing condition is used for most desired condition components of the Plan because it is determined to be the most accurate. The exception is density class; for this attribute, the classification of remotely sensed imagery is more accurate than the algorithm used to estimate canopy cover from FIA plots. Therefore, for density class, the model input file starting condition is used as the existing condition in the Plan. The EIS discusses in detail instances where the disparity between existing condition estimates are problematic for the interpretation of model results.

HLC NF geographic information system (GIS)

The HLC NF has a library of geographic information system (GIS) data. The library includes several mapped data layers, with associated metadata, including fire history, insect and disease surveys, grizzly bear habitat, lynx habitat layers, roads, topographical features, and administrative-related boundary layers. Many summaries and assessments of vegetation condition were developed using GIS, which is both an analysis tool and a display technology. This tool was also used to map timber suitability; to build analysis units needed for PRISM; and compile the spatial data used for the SIMPPLLE model.

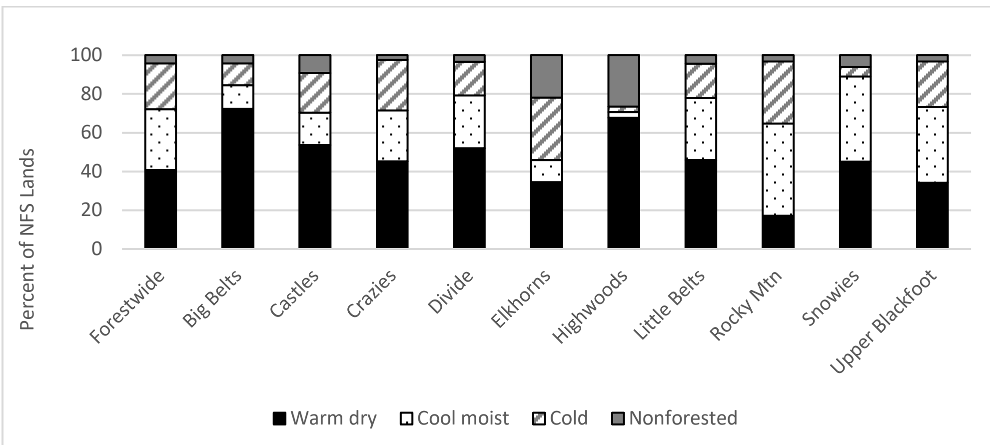
Potential vegetation types

Terrestrial vegetation characteristics are stratified by broad PVT, which identify sites of similar environmental conditions. Broad PVTs are groupings of habitat types and mid-level PVTs. The hierarchical classification for broad PVT is as follows:

- Habitat type is a fine-scale site classification based on physical and environmental similarities, which result in similar potential plant communities and ecological processes. The designation of habitat types is based on the potential climax plant community (Pfister, Kovalchik, Amo, & Presby, 1977). Climax conditions represent the culmination of the plant community that would occur through natural succession in the absence of stand replacing disturbances. Though the general characteristics of the climax plant community may be the same on sites of the same habitat type, at any one point in time existing plant communities could be very different due to factors unique to each site, such as disturbance history, pattern and frequency.

- Mid-level PVTs group habitat types into areas of similar climate, slope, soils, and other biophysical characteristics. A map layer was developed in 2004 (Jones, 2004) to depict PVT, which is the only available layer that provides a consistently derived and contiguous map of PVT across the Region.
- Broad PVTs are more coarse groupings for purposes of broad level analysis and monitoring. Region 1 produced a description of these groups and how PVTs and habitat types are nested (Milburn, Bollenbacher, Manning, & Bush, 2015). These groups serve as the basis for description and analysis of ecological conditions at the forestwide scale. Areas within each of the groups would have similarities in patterns of potential natural plant communities, potential productivity, natural biodiversity, and ecological processes.

Figure 1 displays the proportion of each broad PVT; see appendix D of the Plan for more detailed descriptions, and appendix A of the FEIS for a map.



R1 Summary Database (Hybrid 2011 and F12_F15Partial_IntGrid_4X_Hyrbrid_2016). Only the HLC NF portion of the Elkhorns is displayed. Plots affected by fire and harvest are included.

Figure 1. Percent of each broad PVT on NFS lands

The warm dry PVT occupies the warmest and driest sites on the HLC NF that support forests. These sites support ponderosa pine and dry Douglas-fir habitat types. This group occurs at lower elevations, on warm southerly aspects, and/or on droughty soils. Forests are often dominated by Douglas-fir, ponderosa pine, or limber pine. Open forest savannas may occur on this group, where grasses or shrubs are dominant and trees are widely scattered due to repeated frequent fires.

The cool moist PVT comprises the most productive forest sites on the HLC NF. Moist Douglas-fir habitat types are in this group, along with lower subalpine fir and spruce habitat types. This setting occurs on mid to high elevation sites across all aspects. Lodgepole pine and Douglas-fir are the most common dominant species, with Engelmann spruce and subalpine fir common as well.

The cold broad PVT occupies the highest elevation areas that support forests. Some sites are cold, moist subalpine fir habitat types that support moderately dense forest cover. Remaining areas are cold, drier subalpine fir and whitebark pine types where growing conditions are harsher and tree density more open. Subalpine fir, Engelmann spruce, and whitebark pine are the most common species.

Nonforest PVTs consist of the persistent nonforested vegetation climax types. They occur on sites where establishment and growth of conifers is impeded, for example in areas of shallow or very droughty soils; very wet soils and high-water tables; or very frequent disturbance. Persistent nonforested areas include alpine meadows, dry grasslands and shrublands, mesic grasslands and shrublands, and riparian areas. There are also areas on the forest that are non-vegetated, where very sparse or no vegetation grows, such as scree or barren areas. These are excluded from the analysis.

R1 broad PVTs are included in the R1 Summary Database, based on field classified habitat type. For modeling, it was also necessary to map them. The PVT map was developed by the Northern Region in the early 2000s (Jones, 2004). Sources of data included field plots and remote sensing. Lands with no field data were populated by extrapolation of plot data and the use of models that integrated site factors influencing vegetation, such as precipitation, slope and elevation. This layer, referred to as *R1 Potential Vegetation Types* or *R1-PVT*, is the best available PVT layer, although its level of accuracy is unknown. It is the only map of potential vegetation that covers the planning area.

To have both potential vegetation and existing vegetation attributes applied to polygons for analysis, the R1-PVT map was joined to VMap. VMap polygons are the best delineations for vegetation; therefore, a single R1-PVT label was applied to each VMap polygon based on the majority type. Because R1-PVT is raster-based and the VMap is polygon-based, illogical combinations of potential and existing vegetation were inevitable. It was necessary to refine the attributes in a logical fashion to improve accuracy. An analysis was done to compare the R1-PVT to VMap as well FIA plots. Because it has a known level of accuracy and is based on the most current data available, VMap was assumed to be correct. Using this data, logic was written to correct illogical combinations between potential and existing vegetation.

Most desired conditions are displayed by PVT. Several PVTs are not included. “Urban” is excluded because it would not have existed in the NRV. Although known to occur, “alpine” is not represented in SIMPPLLE or existing data. “Sparse” areas sometimes have cover types assigned in the R1 Summary Database but are assumed to be non-vegetated in the NRV and are therefore also excluded. About 5% of the Forest is Non-Vegetated (water or sparse) so percentages of PVTs do not equal 100%.

Nonforested vegetation, xeric ecotones, and forest savannas

Nonforested ecosystems are important components of the HLC NF. These areas are classified slightly differently depending on the attribute of interest. To avoid these inconsistencies, the abundance of nonforested vegetation conditions is tracked through cover type (dominant species) in the Plan.

Areas are considered nonforested for cover type when they have less than 20 square feet of basal area per acre or 100 trees per acre. Conversely, areas are considered nonforested for density when there is less than 10% canopy cover of trees. This includes grass and shrublands with 0-5% canopy cover, open forest savannas with 5-10% canopy cover. There are more areas considered nonforested for density class than there are for cover type. That is, there are some forest cover types that do not have a density class – most likely, the differences between these classifications represent savannas. Based on FIA, the abundance of nonforested cover types is 14% forestwide, while the abundance of the nonforest/none density class is 22%, indicating that at least roughly 8% of the forest is in a very open forested condition. Additional savannas may also occur in areas with a nonforested cover type, to an unknown degree.

There are three categories classified as “nonforested” in FIA data and/or VMap.

1. *Nonforested communities (grass, shrub, forb) growing on nonforested PVTs*. Tree encroachment is usually limited on these types due to site conditions (moisture regime and soil type). To the extent that PVT mapping accurately captures these areas, the NRV modeling represents them by including pathways that maintain a nonforested community type through time.

2. *Xeric Ecotone (nonforested communities on forested PVTs whose dominance is maintained by disturbance)*. These are common systems on the HLC NF and consist of the driest forest habitat types where the past frequent disturbance regime served to limit the establishment of conifers, resulting in either maintaining the nonforested communities indefinitely or shifting between forested and nonforested communities. In latter scenario, the forest would tend to encroach during cool/moist periods, and then retract again in warm/dry periods when fire disturbance was more common. In addition, *forest savannas* could occur where scattered fire-resistant large trees are present, but the site remains dominated by grasses and shrubs. These types are the most difficult to classify and map because there may be a presence of trees currently. These types are also not well represented by the NRV modeling, because on forested PVTs the model efficiently establishes forest cover after disturbances and generally keeps them classified in a forested pathway, rather than allowing them to be maintained in a nonforested state. To account for this weakness, adjustments are made as necessary using other BASI.
3. *Recently disturbed forests on forested PVTs that have not yet regenerated may be classified as nonforested*. VMap generally captures these well and considers them "transitional", and based on the PVT, the NRV modeling should regenerate them as forested areas. However, in the FIA plot data used for the existing condition, it is difficult to identify these areas versus the other nonforested types. Geographic context is used to help interpret this data. It is not possible in the model to capture potential scenarios wherein some of these sites may not naturally regenerate due to drought or a changing climate.

Vegetation models

The vegetation management strategy for the HLC NF is to manage the landscape to maintain or trend towards vegetation desired condition. Modeling was done to define the NRV; inform the development of desired conditions and identification of lands suitable for timber production; provide estimates for vegetation treatments, acres, and timber outputs over time; and evaluate the degree to which each alternative moves towards desired conditions. Three vegetation models were used:

- Forest Vegetation Simulator
- PRISM (replaces the Spectrum model used in the DEIS)
- SIMulating Patterns and Processes at Landscape scaLEs (SIMPPLLE)

The models are used interactively to analyze vegetation as follows:

1. Yield tables for all potential vegetation management options and disturbance events are developed by running Forest Vegetation Simulator. Yield tables show timber volume and changes to vegetation through time associated with different management alternatives.
2. Expected future wildland fire and insect disturbances are modeled in SIMPPLLE.
3. The acres of expected disturbances and severities from SIMPPLLE are input into PRISM, which assigns the changes to vegetation in those areas based on yield tables.
4. The PRISM model is run to develop a schedule of future vegetation treatments and timber outputs that are designed to move the landscape toward desired conditions and other objective functions. The model uses the yield tables to assign post-treatment or disturbance conditions.
5. The projected treatment types, acres, and resulting vegetation changes from PRISM are input back into SIMPPLLE.
6. SIMPPLLE is run into the future to provide an analysis of expected vegetation conditions, based on a finer-scale integration of ecological processes and disturbances, and management activities.

Model simulations 5 decades into the future were conducted to analyze alternatives. Fifty years is a reasonable time period over which to model and capture vegetation trends, considering that some changes occur quickly while others are gradual. Fifty years is a relatively short time period to portray shifts that occur for long-lived conifers. However, there is an increasing level of uncertainty with ecological and social change the farther into the future you go, especially related to climate change.

Out of necessity, all models simplify complex and dynamic relationships between ecosystem processes and vegetation over time and space. The models use assumptions based on corroboration of data and review of scientific literature, as well as professional judgement. Although the best available information is used, uncertainty in the results remains because of the inability to accurately predict the timing, magnitude, and location of future disturbances. In addition, modeling potential treatments, accurately representing limitations, and integrating multiple ecological processes is very complex. The results from these models provide information useful for understanding vegetation change over time and the relative differences between alternatives. Models provide information of comparative value and are not intended to be predictive. Model outputs augment other information used for the analysis, including research and professional knowledge.

PRISM model design

PRISM (**P**lan-level fo**R**est act**I**vity **S**cheduling **M**odel) is a management scheduling tool used by the HLC NF to estimate treatment acres and harvest volume from the forest under different alternative considerations. The PRISM model formulation is designed to answer several management questions:

1. What vegetative treatments should they be scheduled to move us towards the desired conditions for vegetation, with and without budget limitations?
2. What is the PWSQ and PTSQ, with and without a budget limitation?
3. What amount of timber can be removed annually in perpetuity on a sustained-yield basis?

PRISM is designed to assist decision makers in evaluating resource management choices and objectives. Management actions are selected by the model to achieve desired goals (objectives) while complying with management objectives and limitations (constraints). PRISM makes it possible to display management actions to landscapes at multiple spatial and temporal scales. PRISM was used to model the alternatives with objectives based on achievement of desired conditions for forest composition and size classes. For example, a downward trend in the small size class and upward trend in the large size class are desired conditions, which the model may achieve with regeneration treatments, commercial thinning, and retaining stands to advance into larger tree size classes.

The key variables and assumptions used for PRISM modeling are summarized in this section. Please see the project record document "*Helena and Lewis & Clark National Forests Plan Revision: Construction of Vegetative Yield Profiles & PRISM Model Design*" for more detailed information. The assumptions used are designed to best approximate probable future management scenarios that are consistent with forest plan direction; these assumptions are not binding management constraints for implementation of the Plan. Some key considerations include:

- Treatment prescriptions represent commonly used activities and schedules based on vegetation types, but actual site-specific prescriptions would be specifically tailored to each site.
- Actual budgets may vary and so too would the amount of vegetation management that occurs.
- Project costs as well as timber values could change in the future.
- There is a high level of uncertainty in the timing and location of future disturbance events.
- Project design and analysis may apply resource constraints differently based on a site-specific analysis that follows the most current law, regulation, and policy at the time of implementation.
- Implementation of the Plan would consider many additional desired conditions, which may result in a treatment regime that differs relative to the type and timing of vegetation treatments.

The projected timber volumes, harvest acres, and prescribed burning acres depict possible management scenarios to provide for a comparison of alternatives. The model results also form the basis of the potential management actions described in appendix C of the Plan and inform the objectives for vegetation treatments (FW-TIM-OBJ and FW-VEGT-OBJ). Actual implementation of the Plan may vary based on the factors described above as well as other considerations such as litigation.

PRISM model changes between the Draft and Final

Between the DEIS and FEIS, PRISM replaced the Spectrum model. These models provide similar functionality. In addition, the modeling map was updated to: 1) correctly classify the cold and cool moist PVTs; 2) update vegetation type and structure to reflect disturbances and treatments up to 2018; and 3) adjust size, density, and vertical structure to be more similar to FIA data. Additional refinements include:

- The desired condition goals were updated to reflect the new desired conditions in the Plan.
- Future disturbances were updated based on new SIMPPLLE modeling of future fire.
- Disturbance acres were proportioned across the landscape based on the historical proportion on lands that are suitable versus unsuitable for timber production.
- Corrections were made to the “natural attrition” assumptions in lodgepole pine.
- The assumption of the required ratio of clearcut to shelterwood prescriptions was relaxed to allow the model more flexibility in choosing harvest type.
- The sustained yield limit for each proclaimed Forest was added as a top constraint to projected timber sale quantity.
- A non-declining even flow criteria was applied to the HLC NF as a whole to model the alternatives.
- RMZs were constrained to a low harvest level. Alternative A was calibrated to consider RMZs similarly to the action alternatives, to provide a consistent comparison and reflect the likely future management scenario if that alternative were implemented.
- Pre-commercial thinning activities were eliminated in lynx habitat; the potential for exemptions within the wildland urban interface (WUI) are not reflected in the model design.
- Updates to cost accounting were done to account for the budgets and treatments that occur on the Beaverhead-Deerlodge NF portion of the planning area.
- The updated lynx potential habitat layer for the HLC NF was incorporated.

Planning horizon

The planning horizon is a specified time frame broken down into periods of an equal number of years. The HLC NF PRISM model used 15 ten-year periods as the planning horizon. A long planning horizon helps ensure the sustainability of management options applied to long-lived vegetation. The results are shown for the first 50 years because results become more and more uncertain farther out into the future.

Yield tables and prescriptions

Growth and yield tables were developed using the Forest Vegetation Simulator. Since its development in 1973, it has become a system of highly integrated analytical tools based upon a body of scientific knowledge developed from decades of research. Available data from FIA and FIA intensified grid plots was stratified according to vegetation type and structure, and FVS was run to estimate key variables throughout the life of the plot under several management scenarios. PRISM uses yield table information to select management options to move towards the desired condition, and to show the outcomes of the harvest schedule over time. Yield tables included outputs such as stand age, basal area, diameter, trees per acre, culmination of mean annual increment, merchantable cubic feet board feet, diameter of removals and residual volume, fire risk, bark beetle risk and defoliator risk, and vegetation type and structure class.

Management actions consist of activities associated with a generalized silvicultural prescription. The prescriptions, timing choices, and constraints are for modeling purposes and do not constitute standards or guidelines for implementation. Silvicultural prescriptions were defined by vegetation type, structure, and other resource condition. Each prescription assigned a suite of activities designed to achieve desired conditions. Yield tables reflect the outcome of each activity in the prescription. The prescriptions and activities included in the yield tables are shown in Table 4 and Table 5. Detailed prescriptions can be found in the project record (“*HLC_Rxs_yieldtables20151116.xlsx*”).

Table 4. Silvicultural systems and activities used in yield tables

Prescription		Activities	
NG	natural growth - no disturbance	pct	Pre-commercial thin
SR	stand replacing wildfire	ct	commercial thin (or improve cut)
MS	mixed severity wildfire	ub	understory burn
BS	severe bark beetle	bb	broadcast burn
NA	natural attrition	sc	seed cut
CS	clearcut/seedtree	or	overstory removal
SW	shelterwood	gp	group selection opening
US	unevenaged Cut	ss	single tree selection
PB	Prescribed burn	wf	wildfire
		bs	severe bark beetle

Table 5. Applicable prescriptions by vegetation type in PRISM

Vegetation Type[1]	CS	SW	US	PB	SR	MS	BS	NA
C	X		X	X	X	X	X	
D		X	X	X	X	X	X	
E	X			X	X	X	X	X
F		X		X	X	X	X	
G	X			X	X	X	X	X
H	X			X	X	X		
I	X			X	X	X	X	

[1]see Table 12 for definition of vegetation types

Land stratification and analysis units

The planning area is subdivided into areas that facilitate analyzing land allocation and expected management. In PRISM, each stratum is a layer and a unique combination of layers results in an “analysis area.” There are six layers used in the model; the first four describe static landscape stratifications. The final two describe the vegetation type and structural characteristics of the site at the current time. The combination of classes in each layer creates a repeatable land unit with unique characteristics. Each analysis area may be scheduled to a different suite of management actions that yield a variety of outputs. A minimum map unit size of 20 acres is used. Only forested vegetation types were included; therefore, the results do not represent actions (e.g. prescribed fire) that occur on nonforested vegetation types.

Geographic area and wildland urban interface (WUI)

This PRISM layer is the combination of two static layers. Two geographic areas were identified, because the Blackfoot GA is primarily west of the Continental Divide and subject to maritime influences which result in differing productivity. The other area is comprised the rest of the forest's "Island Ranges" on the east side of the Continental Divide. The wildland urban interface (WUI) is also depicted so that different costs of treatments can be applied, and for reporting purposes. Table 6 describes the combinations of geographic area and WUI used in PRISM. Each combination is labeled with a single-character unique identifier used to label the attribute. For the HLC NF analysis, the WUI is mapped based on County Wildland Protection Plans (CWPPs) where available, and standard Hazardous Fuels Reduction Act (HFRA) definitions where CWPP maps are unavailable. The WUI will change over time as human developments and land use change.

Table 6. Geographic area strata for PRISM

Group	Description	Identifier
Island Ranges WUI	All GA's except the Blackfoot, in the WUI	A
Island Ranges Non-WUI	All GA's except the Blackfoot, not in the WUI	C
Blackfoot WUI	Blackfoot GA, in the WUI	B
Blackfoot Non-WUI	Blackfoot GA, not in the WUI	D

Management Area Groups (MAGs)

Prescription options and resource constraints are affected by land allocations and management emphasis. While the Plan does not include "management areas" as such, there are land classifications that direct management (Table 7). These considerations are combined to create functional management area groups for modeling. These groups were developed to achieve the goal of different model runs and to reflect alternatives (Table 8). Management area groups are hierarchical, meaning that the most restrictive land allocations are identified first if more than one allocation applies to an area.

Table 7. Spatial attributes used in PRISM management area groups

Attribute	Acronym	Summary of plan components	Varies by alternative
Wilderness	W	No harvest. Some Rx fire allowed. (FW-WILD-DC-02; FW-WILD-SUIT-03)	No
Wilderness study areas	WSA	No harvest. Some Rx fire allowed. (FW-WSA-DC-01; FW-WSA-SUIT-01; FW-WSA-SUIT-03)	No
Research natural areas	RNA	Rare harvest allowed but assume none in model; limited Rx fire allowed (FW-RNA-DC-01; FW-RNA-GDL-01; FW-RNA-SUIT-01)	Yes
Recommended wilderness	RW	No harvest. Rx fire allowed. (FW-RECWILD-DC-02, FW-RECWILD-SUIT-02, FW-RECWILD-SUIT-04)	Yes
Inventoried roadless areas	IRA	Little harvest allowed. Rx fire allowed. (FW-IRA-DC-02, FW-IRA-SUIT-01, FW-IRA-SUIT-03)	No
Lands suitable for timber production	TS	More harvest occurs on suitable lands than on unsuitable. (FW-TIM-DC-01, FW-TIM-DC-05, FW-TIM-SUIT-01, FW-TIM-SUIT-02)	Yes

Recreation opportunity spectrum	ROS	More harvest occurs in roaded natural (RN) and rural (R) than in semi-primitive motorized (SPM), semi-primitive nonmotorized (SPNM), or primitive (P) (FW-ROS-DC and FW-ROS-GDL)	Yes

Sustained yield limit management area groups

The sustained yield limit is calculated for each Proclaimed NF individually from lands that may be suitable for timber production. Because the sustained yield limit is not subject to resource objectives or constraints, the management area groups for this model run only include two timber suitability allocations: not suitable for timber production and may be suitable for timber production, split by proclaimed forest. Acres on the Beaverhead-Deerlodge NF are not considered in the calculations.

Table 8. Management area groups for sustained yield limit calculation in PRISM

Group	Description	Identifier
May be suitable, LCNF	Lands identified as may be suitable on the LCNF	S
Not suitable, LCNF	Lands not suitable on the LCNF.	N
May be suitable, HNF	Lands identified as may be suitable on the HNF	H
Not suitable, HNF	Lands not suitable on the HNF.	F
May be suitable, B-D	Lands identified as may be suitable on the B-D	B
Not suitable, B-D	Lands not suitable on the B-D.	D

Action alternative management area groups

The following management area groups (Table 9) apply to the action alternatives, to reflect components in the Plan. RMZs are in management area group 3, unless they were already included in more restrictive groups (1 or 2).

Table 9. Management area groups for action alternatives in PRISM

Suitability	Areas Included	Description	MAG
Unsuitable for timber production	W, RW, WSA, RNA, ROS = P	No harvest for model purposes. Limited Rx fire.	1
	IRA, or ROS = SPNM	Harvest very limited. Rx fire allowed.	2
	ROS = SPM; or RMZ	Low harvest. Rx fire allowed.	3
	All else	Moderate harvest and Rx fire.	4
Suitable for timber production	ROS = SPM	Suitable areas constrained by ROS.	5
	All else	Suitable area.	6

No-action alternative MAGs

Table 10 shows the management area groups for the no-action alternative. Because recreation opportunity spectrum classes were not included in the 1986 Forest Plans, these groups differ slightly from the action alternatives. The no-action groups include RMZs in a fashion similar to the action alternatives, to provide a consistent comparison, and to reflect the likely management scenario if alternative A was implemented.

Table 10. No action (alternative A) management area groups in PRISM

Timber suitability	Areas included *(hierarchical)*	Description	MAG
Unsuitable	W, RW (1986), WSA, RNA	No harvest. Some Rx fire.	1

	IRA	Harvest very limited. Rx fire allowed.	2
	RMZ	Low harvest. Rx fire allowed.	3
	All else	Harvest and Rx fire can occur.	4
Suitable	Suitable lands	Suitable areas	6
Unsuitable	SPNM and MAG3, MAG4, or MAG6 (or SPNM and RMZ)	Functions the same as MAG2	7
	RMZ and MAG4 or MAG6	Functions the same as MAG3	8

Wildlife habitat

Key wildlife habitats were used to identify where harvest constraints may apply; and/or to facilitate the analysis. Lynx constraints were developed and apply across potential lynx habitat, regardless of whether it is occupied or unoccupied (Table 11). After initial test runs, no constraints were applied for grizzly bear, but it was useful to report model outputs for those habitat areas in the analysis.

Table 11. Wildlife habitat analysis groups for PRISM

Wildlife group	Description	Identifier
Potential lynx, NOT grizzly core	Potential lynx habitat DOES NOT overlap with grizzly bear core.	L
Potential lynx AND grizzly core	Potential lynx habitat that DOES overlap with grizzly bear core.	B
Not potential lynx, AND grizzly core	Grizzly core habitat that does not overlap potential lynx habitat	G
Other	Not as above (not grizzly and not potential lynx)	O

There was a technical change that occurred to the potential lynx habitat layer after the completion of the modeling, which resulted in 15,931 acres of potential habitat being added in the Big Belts, most of which occurred in MAGs 1 and 2. These acres were not included in the PRISM wildlife layers.

Stand Type

Vegetation Type

Combinations of cover type and PVT define vegetation type (Table 12). Some types are representative of the entire HLC NF, while some differ between geographic areas.

Table 12. Vegetation type strata used in PRISM

Area	PVT	Cover Type	Description	Identifier
Forestwide	Warm dry	Ponderosa pine	Dry PVTs dominated by ponderosa pine, limber pine, and/or juniper.	C
Split Blackfoot & island ranges	Warm dry	Douglas-fir	Dry PVTs dominated by Douglas-fir or western larch.	D
Forestwide	Warm dry	Lodgepole, Aspen/Hardwood	Dry PVTs dominated by lodgepole pine or hardwoods.	E
Split Blackfoot & island ranges	Cool moist	Ponderosa pine, Douglas-fir	Moist PVTS dominated by ponderosa pine, limber pine, juniper, Douglas-fir, and/or western larch.	F
Split Blackfoot & island ranges	Cool moist	Lodgepole, Aspen/Hardwood	Moist PVTs dominated by lodgepole pine or hardwoods.	G
Forestwide	All but cold	Spruce/Fir, whitebark pine	Dry or Moist PVTs dominated by Engelmann spruce, subalpine fir, and/or whitebark pine.	H

Forestwide	Cold	Any	Cold PVTs dominated by any species.	I

Structure class (size and density)

Structure classes are combinations of size and density class (Table 13). Size classes are based on basal area weighted diameter. The seedling class is grouped with the 0-4.9” class. The largest size class is 15” or greater diameter. Density classes are identified based on percent canopy cover of live trees.

Table 13. Structure class strata used in PRISM

Size Class	Canopy cover (density)	Description	Identifier
0-4.9”	10-39.9%	Seedling/sapling size class, low or low-moderate density	F
0-4.9”	>40%	Seedling/sapling size class, moderate-high or high density	G
5-9.9”	10-24.9%	Small size class, low density	H
5-9.9”	25-39.9%	Small size class, low-moderate density	I
5-9.9”	40-59.9%	Small size class, moderate-high density	J
5-9.9”	60%+	Small size class, high density	K
10-14.9”	10-24.9%	Medium size class, low density	L
10-14.9”	25-39.9%	Medium size class, low-moderate density	M
10-14.9”	40-59.9%	Medium size class, moderate-high density	N
10-14.9”	60%+	Medium size class, high density	O
15”+	10-24.9%	Large size class, low density	P
15”+	25-39.9%	Large size class, low-moderate density	Q
15”+	40-59.9%	Large size class, moderate-high density	R
15”+	60%+	Large size class, high density	S

PRISM goals, management options, and constraints

For each alternative, a treatment schedule is formulated to achieve the goal; namely, to move toward the desired vegetation condition. The number of acres by strata allocated to each activity renders a solution to the planning problem. Decision variables are combinations of strata, prescription, and timing option.

Desired vegetation condition goals

Forestwide desired condition ranges were defined for vegetation type and structure class. The ranges of the forest plan desired conditions were formulated to represent only forested acres included in PRISM vegetation types. For the FEIS, the desired condition goals in PRISM were updated based on desired condition updates. The desired conditions represent plan components FW-VEGT-DC-02, FW-VEGF-DC-02, and FW-VEGF-DC-03.

Objective functions

The objective function for the alternatives is to minimize the total deviation (above or below) the desired vegetation condition goals through time. Deviation from a goal is recognized as a single deviation point (1) per acre above or below the stated goal range in a given time period. For alternative E, a “rollover” run was done, where first harvest volume was maximized, and then achievement of desired conditions was applied while also imposing a constraint of achieving 95% of the maximum timber volume. This was done to capture the theme of the alternative, which is to emphasize timber outputs while meeting resource constraints. Alternatives A, B/C and D are run solely with an objective function to maximize achievement of the desired conditions. To blend these objectives, alternative F was set to achieve no less than 28 mmbf/year in the first decade under a constrained budget, or 35 mmbf with an unconstrained budget, which represents a volume level in between those achieved for alternatives B/C/D and E in the DEIS.

Prescription options

Based on constraints and the specified management goals or objectives, the PRISM model determines the management prescription to apply to an analysis area as well as the timing of the implementation. Not all prescriptions are permissible in each management area group (Table 14). Salvage after disturbance is not estimated, per the 2012 Planning Rule directives, because salvage sales are unpredictable. Natural disturbance activities are scheduled based on predicted levels from the SIMPPLLE model, as described below in the *disturbance processes* section.

Table 14. Allowable prescriptions/activities by PRISM management area group

PRISM prescription/activity	Management area group
Natural growth and natural attrition	Everywhere
Stand-replacing and mixed severity wildfire	Everywhere
Severe bark beetle	Everywhere
Clearcut/seed tree, shelterwood, uneven aged cut	MAG 2 through 6
Prescribed burn	Everywhere
Associated activities (thinning, burning, etc)	MAG 2 through 6

There has been a correction to “natural attrition” prescription assumption in lodgepole pine. In the DEIS, it was assumed that lodgepole dies at age 150. For the FEIS, it is assumed that 10% begin to die at age 40, 20% of what is left at age 150, and 50% of what is left at age 160. This rectified an age imbalance on the Lewis & Clark NF that resulted in available volume artificially dropping in later time periods. Another model improvement done for the FEIS was that the prescriptions for lodgepole pine in the cool moist PVT were applied to lodgepole pine in the cold PVT.

Minimum rotation ages and timing options

Prescriptions include different opportunities and timings for activities to move toward desired conditions. Timing choices specify the range of ages in which a stand may be treated. As required by FW-TIM-STD-06, minimum rotation age is set to be 95% culmination of mean annual increment estimated from previous analyses and professional judgement (Table 15). For regeneration stands (stands originating from anticipated future management), the model is given 5 decades of flexibility around the rotation age. The rotation for the existing stands has flexibility for the entire modeling period. The medium and large tree size classes are made available for harvesting the first period. In addition, it is assumed that at least 2 decades pass between a thin and a final cut.

Table 15. PRISM minimum rotation age

Vegetation type	Expected culmination	Minimum rotation age, existing stands[1]	Minimum rotation age, regenerated stands
C (warmdry PP)	120	90	140
D (warmdry DF/mix)	120	60	120
E (warmdry LP/AS)	120	60	120
F (coolmoist PP/DF/mix)	120	60	120
G (coolmoist LP/AS)	110	50	100

H (coolmoist/warmdry AF/WB)	100	50	120
I (cold)	150	100	150

1 Minimum rotation ages of existing stands are modified from CMAI to reflect estimates in initial age.

Costs, values, and budget constraints

Although the model is not used for economic optimization, costs and budget constraints are needed for effects analysis. Between the DEIS and FEIS, updates to the spatial layers and cost accounting were done to account for the budgets and treatments that occur on the Beaverhead-Deerlodge NF portion of the planning area. Treatments in this area are subject to the Plan and contribute to desired vegetation conditions, but do not contribute to the volume metrics for the HLC NF. It was assumed that the proportion of cost allocated to this area was the same as the proportion of those acres to HLC NF acres.

Budget constraint

The model included a budget constraint to reflect reasonably foreseeable budget levels. Each alternative was run with and without this constraint. The budget constraint is a 3-year average of actual budgets for fiscal years 2013, 2014, and 2015, at $5,322,000 per year. This budget supports NEPA teams, program management, sale admin and sale preparation, and the pre-construction and construction engineering costs as well as prescribed burning associated with timber harvest and ecosystem burning in forested areas, within and outside the WUI. The budget constraint includes “timber” funding, as well as fuels funding (adjusted to reflect forested areas). The budget is held constant. The three averages used are as follows:

- Non-WUI fuels $1,189,100 + WUI fuels $2,518,600 + timber $1,614,300

The following breakdown of budget was applied to the first 5 decades of the model period, to reflect where funds are required to be spent.

- Ensure that costs incurred in the WUI add up to at least $2,518,600.
- Ensure that costs incurred in non-WUI add up to at least $1,189,100.
- The remainder of funding can be applied anywhere in MAGS 1 through 6.

Management costs

Management costs associated with vegetation treatments are shown in Table 16. All costs are part of the constrained budget. The assumptions used to build these costs are described below the table.

Table 16. Management costs in PRISM

Activity	Prescription	MAG	Veg type	Period	Costs[1]	Production coefficient	Timing
Sale analysis, preparation, & administration	All harvest	All but MAG 1	All	All	$518 /mcf	1/mcf harvested	With harvest
Reforestation	Evenaged	All but MAG 1	All	All	$274/ac	0.5/ac	With harvest
	Unevenaged				$560/ac		
Pre-commercial thinning	All harvest & burning	All but MAG 1	C, D, E, F	All	$358/ac	0.6/ac	20 yrs after harvest or burn
			G, H, I			0.2/ac	
Road Re-construction	All harvest	All but MAG1 & 2	All	All	$7,060/ mi	0.01 miles/ac	With harvest

Activity	Prescription	MAG	Veg type	Period	Costs[1]	Production coefficient	Timing
Prescribed Burning	All burning	WUI	All	All	$463/ac	1/ac	With burn
		Non-WUI			$162/ac		
Weed treatments	All harvest & burning	All but MAG 1	All	All	$141/ac	0.75/ac	With harvest or burn
Dead/downed material surcharge	All harvest & burning	All but MAG1	All	First 3	+$200/ ac	0.75/ac	With harvest or burn
Whitebark pine surcharge	All harvest & burning	All but MAG1	COLD	All	+$500/ ac	0.5/ac	With harvest or burn

[1] Costs do not include cost pools. For activities that only occur sometimes in a given regime, the activities and costs are adjusted to reflect the probabilities of the treatment occurring specified in the prescriptions.

- The cost for timber sale analysis, preparation, and administration are based on budget allocations which encompass the variability in project location, cost, complexity, and logging system. Unit cost data comes from a three-year budget allocation average. The HLC NF is typically funded at the unconstrained budget request level for timber and fuels dollars.
- Reforestation costs are based on local costs in recent Knutsen-Vandenberg funding plans and include site preparation.
    - For clearcut/seedtree/shelterwood, 75% is assumed to be natural regeneration at $40/acre plus site preparation $180/acre which occurs 50% of the time (adjusted cost $130/ac). 25% is planting ($612/ac) plus site preparation burn $180/acre which occurs 50% of the time (adjusted cost $702/ac). The adjusted mix cost accounting for natural regeneration (75%) and planting (25%) is $274/acre.
    - For uneven-aged harvest, 75% is planting and 25% is natural with the same costs/proportions described above. The adjusted mix cost accounting is $560/ac.
    - The production coefficient accounts for the proportion of “KV” funding (outside the constrained budget and covers most reforestation for non-salvage). Reforestation occurs with regeneration harvest. However, areas outside suitable timber are not “KV required”, and may be reforested with constrained budget. The coefficient assumes that KV covers 90% of post-harvest reforestation in the suitable base (MAG 5 & 6) but 0% in the unsuitable lands where harvest can occur (MAGs 2 through 4).
- Pre-commercial thinning costs are based on local costs. KV can cover this but is non-essential and therefore not assumed. The production coefficient is based on history by vegetation type of how often these treatments actually occur on the ground, as documented in prescriptions.
- Road reconstruction/admin reflect local costs for road work associated with timber or fuels projects that are counted against the constrained budget. Purchaser-related road work, including new construction and de-commissioning of roads associated with projects, is assumed to be $0 against the constrained budget. Costs borne by the purchaser are inherently included in log values. New road construction is done minimally on the HLC NF.
- Prescribed burning reflects all costs for preparation and burning (excluding site-prep), including intermediate entries as part of a harvest prescription and ecosystem burns. While burning (of non-

activity fuels) can be eligible for KV, it is non-essential and therefore not assumed. The 3-year average of treatment unit costs applied for WUI ($463/ac) and non-WUI ($162/ac).

- Weeds treatment costs reflect work done pre and/or post-harvest. While this can be eligible for KV funding, it is non-essential and therefore is not assumed. The cost assumes an average of treatment types based on the contract documentation ($49/ac for roadside; $74 for off-road; $225 for backpack), plus $25/acre for the cost of herbicide for a total $141/ac. Production coefficient reflects that weed treatments accompany harvest or burning 75% of the time.
- The dead/downed material surcharge reflects the increased treatment costs that are expected over the next 3 decades due to the buildup of down/dead fuels as a result of the recent mountain pine beetle outbreak. This material results in lower productivity. It is assumed that this material will be present for about 3 decades in about 75% of the places that the Forest prioritizes to treat.
- The whitebark pine surcharge is designed to encompass all elements unique to whitebark systems that are more expensive than the costs reflected elsewhere (protection of leave trees, inaccessibility, more expensive reforestation and timber stand improvement, labor for site preparation, etc). The production coefficient assumes that whitebark is present in the cold treated sites 50% of the time.

Forest product values and volume assumptions

Forest product values were developed for each vegetation type (Table 17). Because the model was not used to conduct economic analysis, these values were not utilized except to calculate additional nonsaw volume as appropriate. The following assumptions were used:

- The prices reflect a Regional analysis of 10-year average stumpage prices by species, subtracting logging and hauling costs, and adjusting for inflation to 2015 dollars.
- Values were based on proportions of tractor (60%), cable (30%), cut-to-length (5%), and helicopter (5%) logging systems reflecting the typical mix on the HLC NF.
- The sawtimber prices are developed based on the proportions of each wood type that is typical for each vegetation type. Lodgepole pine pricing ($108.68/MBF) is used for “whitewoods” (lodgepole pine, Engelmann spruce, and subalpine fir). Douglas-fir is valued at $114.66/MBF. Typically ponderosa pine “is sold as “nonsaw” for $0.50/MBF.
- Nonsaw material (4” to 7” diameter) is not represented in sawlog volumes in yield tables. This material adds approximately 15% more volume to all types with a value of $1/CCF. Volume estimates are adjusted accordingly to calculate the projected wood sale quantity.
- In addition, outside of the model an additional 1.35 mmcf of firewood is added to the projected wood sale quantity to reflect the Forest’s typical firewood sale program.

Table 17. Forest product values by vegetation type for PRISM

Vegetation Type	Species assumptions	Sawtimber ($/MBF)	Nonsaw (CCF)	Nonsaw ($/CCF)
C	80% Bull pine; 20% Douglas-fir	$71.68	(+) 15%	$1
D	80% Douglas-fir; 20% Bull pine	$103.92		
F	80% Douglas-fir; 20% Whitewood	$113.47		
E, G	80% Whitewood; 20% Douglas-fir	$109.87		
H, I	100% Whitewoods	108.68		

Other management requirements

Harvest policy

Non-declining even flow, or non-declining yield, means that the volume from a certain area is steady or increasing into the future. The sustained yield calculation did not include a non-declining even flow constraint for the first 50 years, in order to get the Forest into an age-balanced state, but this constraint was applied in later decades to ensure sustainable harvest over time. This differs from how modeling was done for the 1986 Forest Plans under the 1982 Planning Rule, which required that each decade conform to a non-declining even flow (219.16(a)1). No such requirement is included in the 2012 Planning Rule. Although not required, the PRISM formulation for the projected timber sale quantity (PTSQ) does include an objective to achieve non-declining even flow, applied across the Forest as a whole, for all alternatives. In addition, the sustained yield limit is used as a maximum constraint on PTSQ for all alternatives.

Dispersion of openings

To distribute treatments across the landscape, this constraint limits the amount of area that can be in an opening at one time. The amount of area in openings is limited to < 30% by management area group, excluding group 1. Openings were modeled by entry as shown in Table 18; and they recover over time as shown in Table 19.

Table 18. Openings modeled in PRISM by treatment type

Treatment	Size of opening
Prescribed fire or low/mixed severity burn entry	0.45 ac opening for each ac burned
Stand replacing wildfire	0.85 ac opening for each ac burned
Mixed severity wildfire	0.65 opening for each ac burned
Severe bark beetle	0.30 opening for each ac infested
Group/single tree select	0.30 ac opening for each ac harvested
Clearcut/seedtree or shelterwood harvest	0.95 ac opening for each ac harvested
Existing seedling/sapling stands	0.75 opening for each ac

Table 19. Recovery of openings over time in PRISM

Decade after harvest	Percent effective opening
1	100 %
2	75 %
3	50 %
4	25 %
5	0% (fully recovered)

Wildlife

It was determined that a constraint for grizzly bear is not needed due to the small amount of grizzly bear habitat that is eligible to be selected for management. Most of these areas are in management area groups where little to no treatment can occur. Specific constraints in potential lynx habitat are applied to comply with the Northern Rockies Lynx Management Direction (NRLMD, appendix F of the Plan), as shown in Table 20.

Table 20. Lynx constraints within potential lynx habitat in PRISM

Rx	MAG	Veg type	Period	Constraint	Rationale to meet NRLMD
Even-aged harvest or burning	All but MAG1	Any	Each decade	No more than 15% of each MAG harvested or with a final broadcast burn in an Rx burn regime.	Covers S1 by incorporating recovery period (30% total over 2 decades). De-facto covers S2, because no more than 15% can be impacted by regen harvest and is more conservative by constraining fire.
Any	Any	G, H	Any	No pre-commercial thinning allowed.	Covers S5. Costs for thinning not incurred.
All harvest or burning	Any	Any	Any	No lynx multistory habitat can be treated.	Covers S6.

Harvest and prescription constraints

To meet the intent of management intensity by management area group and account for operational constraints, prescriptions and activities are allocated as shown in Table 21. In addition, the total acres of thinning is limited to 2,000 per year or less and uneven-aged harvest is limited to 500 acres per year or less, to reflect operational capacity. Finally, the model was calibrated so that both clearcut/seedtree and shelterwood prescriptions are represented in the regeneration harvest mix (within 25% of half of the acres each).

Table 21. Harvest and silviculture method constraints in PRISM by management area group

Management area group	Harvest and silviculture method constraints
MAG1	Only the Rx burning (PB) regime can be selected.
MAG2	At least 10,000 average acres per decade must be allocated to PB (not necessarily in each decade). 0-5% of the total planned harvest acres can occur here.
MAG3	1-10% of the total planned harvest acres can occur here. PB can occur as desired.
MAG4	No more than 25% of harvest acres should occur here.
MAG5 & 6	At least 65% of planned harvest acres should occur here.

Prescribed burning

Underburns, broadcast burns, and site prep burns across all management area groups and prescriptions are set to occur on between 2,000 to 10,000 acres per year. The maximum level is set because of considerations such as operational capacity, air quality standards, and weather window limitations. The minimum level is set to reflect that the Forest applies prescribed fire frequently.

Disturbance processes – wildfire and bark beetles

The expected amount of future natural disturbances (stand replacing fire, mixed severity fire, and severe bark beetle) was determined using the SIMPPLLE model. Disturbance levels were input into PRISM, requiring a certain number of acres to undergo disturbance every decade. For the FEIS, future disturbances were updated based on new SIMPPLLE modeling of future fire (see appendix H). The following assumptions were used in SIMPPLLE:

- The assumed future climate be consistent with the hot/dry NRV.

- Fire suppression was modeled by correlating the most 2000-2017 fire occurrence/size data (which resulted from current day suppression tactics) and modifying the weather ending event model logic to represent those results.

The projected disturbance acres from SIMPPLLE are applied to the acres being modeled in PRISM, based on vegetation type and structure class, using the following assumptions:

- For fire by vegetation type, the average from the first 5 decades is used for all 25 decades.
- Acres are not averaged for the size classes because the distribution of size classes might not accommodate the average values in a given timestep. Therefore, for fire acres by size class, there are minimum and maximum constraints on the sum of decades 1-5 at 90% of the total for each size class. For decades 6-25, the minimum is 90% of the average of decades 1-5.
- Disturbances are more likely to occur in management area groups 1 and 2, because a) these represent the bulk of the area on the HLC NF (roughly 70%); and b) management outside these areas lowers the potential impacts of disturbance.
- Disturbance acres were proportioned in PRISM management area groups that are suitable versus unsuitable for timber production, based on historical proportions (9% of wildfire from 1985-2016 and 34% of bark beetle infestations 2000-2015 occurred on lands suitable for timber production).
- Because the HLC NF recently underwent a mountain pine beetle outbreak, a constraint is set starting in decade 4 and then every 6 decades thereafter to capture the episodic nature of this insect.
- Minimum time periods must pass before a site is eligible to receive another disturbance of the same kind: 20 years for stand replacing and mixed severity fire; and 60 years for severe bark beetle.

SIMPPLLE model design

SIMulating **P**atterns and **P**rocesses at **L**andscape sca**LE**s (SIMPPLLE)(Chew, Moeller, & Stalling, 2012) is a model that simulates changes in vegetation on landscapes in response to natural disturbances and management activities, as they interact with climate. This model was used to: 1) calculate the NRV; and 2) project disturbances and vegetation conditions into the future, as affected by anticipated treatments, disturbances and climate. These results can be used to evaluate relative differences between alternatives.

The VMap was the base map used to develop the input map for SIMPPLLE, and it was calibrated with FIA plot data. Broad PVTs, GAs, ownership, and other features such as WUI areas were also integrated.

SIMPPLLE takes a landscape condition at the beginning of a simulation and uses logic to grow the landscape through time, while simulating processes (growth, fire, insects, management, etc.) that might occur and the effects of those processes. One timestep is 10 years, and simulations are made for multiple timesteps. The logic assumptions in the model come from a variety of sources, including expert opinion, empirical data, data from other models, and from initial model logic files that reflect a long history of trial-and-error and research that has been maintained and passed from forest to forest.

One of the main utilities of SIMPPLLE is its stochastic nature. The model is run for multiple iterations to allow the manager to see a variety of possible projections, look for patterns, and adjust management responses. Managers cannot know with precision the specific types, locations, and extents of disturbances that will occur on the landscape. Therefore, SIMPPLLE will randomly assign fire, insect, and disease processes on the landscape in a manner consistent with the nature and probability of these disturbances.

The other utility of SIMPPLLE its spatially interactive nature. A process occurring on one site is dependent, to an extent, on the processes that occur on adjacent sites. For example, SIMPPLLE simulates fire by assigning fire starts with a probability consistent with historic records for the area and climate.

Each start is given the opportunity to grow. The direction, size, and the type of fire that spreads, is dependent on the surrounding vegetation, climate, elevational position, and wind direction. The fire process will stop according to the probability of a weather ending event, successful fire suppression, or natural barriers such as the treeline or water. SIMPPLLE will determine the effect of the fire by considering whether there are trees present capable of re-seeding/re-sprouting, whether the stand's fuel conditions have been reduced, and/or if there has been a change in size and/or species on the site.

A number of updates of the logic files and assumptions in SIMPPLLE were conducted to reflect the ecosystems and processes on the HLC NF. There remains uncertainty due to the ecological complexities and lack of ability to predict the future. Please refer to the planning record document, *Helena-Lewis & Clark NF SIMPPLLE Modeling for Forest Plan Revision* for more detailed metadata.

Modeling extent and time periods

The modeling extent covers the HLC NF administrative boundary, including inholdings, and a buffer onto adjacent lands (Figure 2). This area excludes non-FS grasslands between the island ranges because processes on these lands did not materially impact results. The extent includes adjacent lands to avoid modeling artifacts ("edge effects") which could artificially disrupt the behavior of disturbances.

For the NRV, the model was run for 30 iterations over 100 timesteps (1,000 years), using historic climate and disturbance data. It was important to create a range of random starting points, so that the analysis reflected conditions unaffected by modern influences. To accomplish this, each landscape was run for 50 periods. The output from that was then run for 119 periods. The 30 runs were done in 3 batches of 10, where for the first 19 periods there was a randomly selected climate, so there where 3 different climate streams. Only the results from the last 100 periods where used.

For the FEIS, the model was run for 30 iterations over 5 timesteps (50 years), using expected future climate, disturbance regimes, and projected management activities for each alternative. In addition, a timestep of zero was included, which reflected the disturbances for the 10 years prior to the date of the VMap data. Only 5 timesteps were run because that period captures several decades beyond the life of the forest plan, and uncertainty in results increases farther into the future. With the NRV analysis there was data to inform the climate scenario for each period, but into the future this calibration is more speculative.

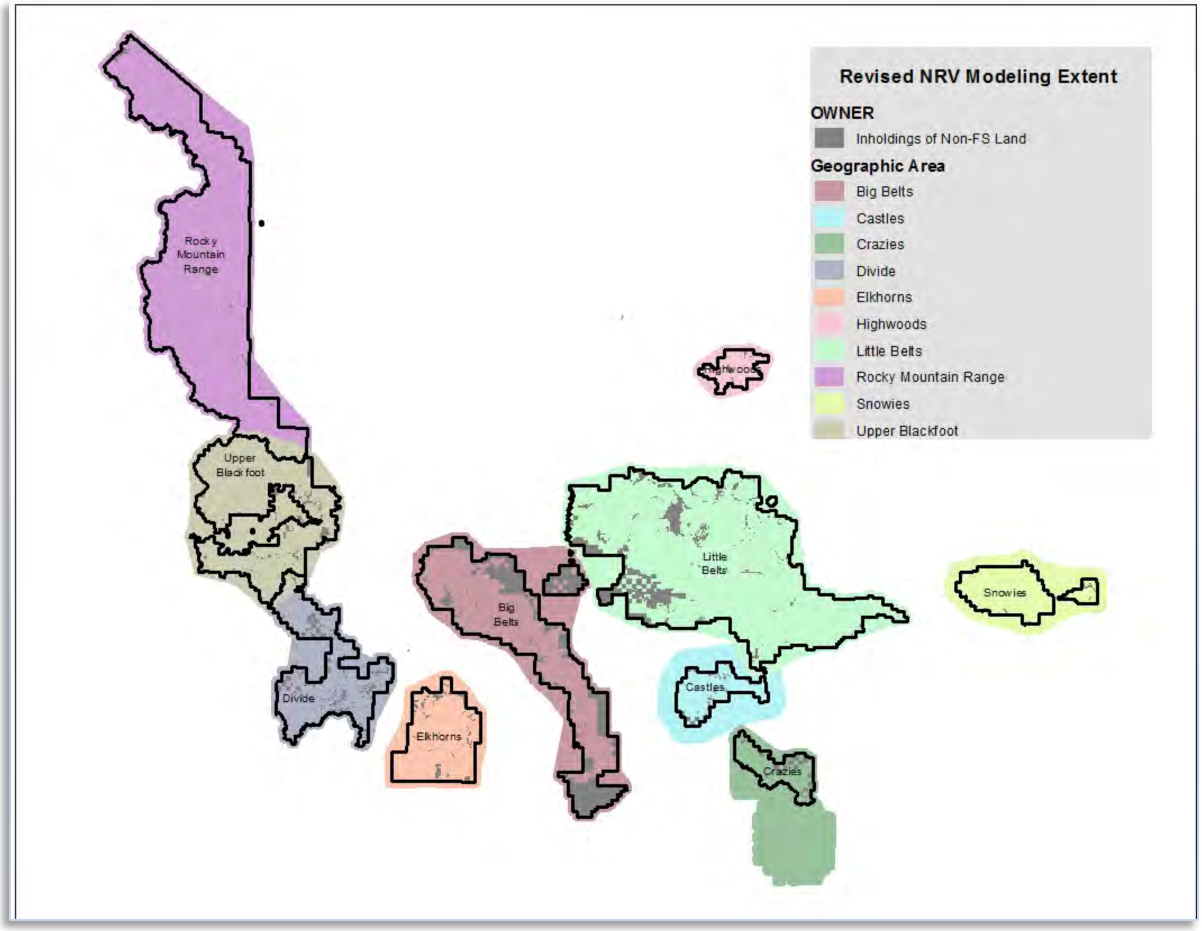


Figure 2. SIMPPLLE modeling extent

Vegetation classifications and crosswalks

The HLC NF uses consistent vegetation groupings based on the R1 Classification System. These classifications were crosswalked with SIMPPLLE attributes as part of input file compilation, post-processing of results, or both, as follows.

- Cover types were crosswalked into SIMPPLLE species labels and PRISM vegetation types. Cover type was applied at the post-processing phase of modeling. Assumptions were applied to assign species labels that were split across cover types based on PVT.
- Size class and density classes in the R1 Classification System are cross-walked directly to SIMPPLLE classifications. For SIMPPLLE, the VMap average diameter breaks were used to assign size class rather than the size class diameter breaks (e.g., the small size class was assigned to all polygons with less than 9” diameter, rather than those less than 9.9”). The diameter breaks for the size classes vary (by 1”) between the two classifications, but this difference is negligible. The R1 Classification system calculates size class based on the average basal area weighted diameter of the polygon. In SIMPPLLE, the class is determined based on successional pathways, and is more heavily influenced by the presence of large trees. This disparity is addressed in the analysis.
- Density class was assigned to match the R1 Classification System as closely as possible. The canopy cover breaks for density classes vary somewhat between the R1 Classification system and SIMPPLLE. The primary difference is that the low and medium tree cover classes are split apart in

the R1 Classification system but must be combined in SIMPPLLE. The break between density class 3 and 4 is also slightly different than the breaks in the R1 Classification system, but for the relative trends for programmatic modeling this relationship is sufficient.

- Vertical structure is not included as an attribute in VMap; therefore, FIA intensified grid plots were queried to determine the vertical structure for each habitat type group, dominance group and size class. For groups that indicated there was a multiple story condition the assignment to two story or multi story was determined by the species code. A species code with 2 species received a two-storied label, while assigned species codes of three or four species received the multi-storied label.

Compilation of the SIMPPLLE input layer

SIMPPLLE requires more detailed vegetation information than is provided by VMap; it is necessary to use a reasoned method to populate VMap polygons with data derived from FIA and FIA intensified grid plots, as well as other geospatial information.

- The VMap layer was transformed into a grid layer required by SIMPPLLE. The VMap polygon with the largest area intersecting the square polygon is used to assign attributes.
- Digital elevation model data was overlain to determine elevation for each pixel.
- Additional layers were overlain to provide attributes necessary for modeling and/or reporting, including GAs, ownership, fire occurrence zones, and WUI. For the HLC NF analysis, the WUI is mapped based on County Wildland Protection Plans (CWPPs) where available, and standard Hazardous Fuels Reduction Act (HFRA) definitions where CWPP maps are unavailable. The WUI will change over time as human developments and land use change.
- PVT was assigned to each polygon based on a detailed process to associate the R1 PVT layer to VMap, including the resolution of illogical combinations and adjustments to improve accuracy.
- Species, size class, and density were assigned based on VMap. Adjustments were made to improve the similarity of the SIMPPLLE landscape with the abundance of species and size classes measured on FIA plots.
- Rulesets were applied to ensure the model did not allow species to occur outside of their native geographic ranges.
- Vegetation changes resulting from management activities and wildfires that occurred after the VMap product was acquired were incorporated.
- The prevailing wind direction for all GAs was set to “west”.
- The model was calibrated so that results could be grouped by decade, ownership, GA, management area group, and broad PVT.

SIMPPLLE model calibration

Once the data was prepared and formatted for use in SIMPPLLE, a multitude of calibrations and assumptions were applied, as documented in “knowledge system files”. The knowledge system file initially imported for the HLC NF was taken from work done primarily west of the continental divide, and then calibrations and pathways done for previous east-side efforts were incorporated. After iterative reviews of test runs, additional calibrations were applied as follows:

Climate

- For the NRV analysis, it was necessary to depict climate conditions over the past 1000 years. The appropriate indicator of past climate for this application is the Palmer Drought Severity Index

(PDSI). PDSI has been used as an indicator for historic climate in other historical vegetation reconstructions (McGarigal & Romme, 2012). Data for the PDSI is for a set of gridded points covering the continental U.S. PDSI is presented as an annual value that has to be generalized to a decadal average for simulations in SIMPPLLE. Each decade was classified as dry, normal, or wet based on the annual value with the majority of occurrences.

- Future climate was modeled using assuming that all future time periods would experience a warmer/drier climate scenario. It was desirable to encompass the uncertainty associated with climate change. However, SIMPPLLE does not have the model structure to incorporate specific climate parameters that could be aligned with climate change scenarios. However, one of the primary manifestations of climate scenarios would be the extent of wildfire disturbances. Therefore, to encompass a range of possible outcomes that would be driven by climate scenarios, the model was formulated to project different magnitudes of wildfire, as described in the fire section below.

Successional pathways

- There were some species combinations on the HLC NF that were not represented in the SIMPPLLE model. For these, new pathways were developed using expert opinion from vegetation specialists.
- One of the initial model runs showed that limber pine was not trending in a believable manner; regeneration processes were modified to better capture its successional role. Seed production logic is updated to include all limber pine species mixes.
- Modifications to nonforested pathways were made. Altered grasses were not allowed to occur in the NRV, as they would not have been present prior to European settlement. Adjustments were made concerning the potential encroachment of conifers occurring on nonforested PVTs.
- Low severity fire is assumed to maintain it low density where it occurs; and light/moderate severity fire will decrease in density. Further, regeneration for certain species are set to low density in warmer climate periods.
- To avoid an unrealistic decline in spruce and fir on some PVTs, pathways were modified to allow shifts to spruce and fir based on seeding logic.
- To avoid an unrealistic decline in whitebark pine, producing seed logic was modified to include all species mixes with a whitebark component.
- To avoid an unrealistic decline in juniper on hot/dry sites, all pathways with Douglas-fir were modified to include a potential juniper component (pole size).
- To avoid an unrealistic decline in aspen in some PVTs, aspen pathways were modified to include conifer encroachment but not a complete shift to conifers.
- The geographic range of species was reviewed and updated based on data and local knowledge, including that aspen may occur in all GAs; no subalpine fir, whitebark, or lodgepole in the Little Snowies; cottonwood should occur in most GAs, especially the Snowies, Crazies, and Rocky Mountain Range; there should be little ponderosa pine on the Rocky Mountain Front; and there should be no whitebark pine in the Highwoods.
- The pathways for some specific species combinations on the cool moist PVT were reviewed to see what mechanisms lodgepole pine had to re-seed an area after fire. Adjustments were made to ensure that lodgepole pine had the opportunity to re-seed a burned area if a live seed source was present nearby or was present in the pixel prior to burning (serotinous seed source).
- The pathways for whitebark pine species combinations were checked for the ability of whitebark to re-seed after fire. Adjustments were made to ensure that whitebark pine has the opportunity to seed

in after a fire as long as a live seed source was present somewhere on the landscape (to reflect potential seed caching by Clark's nutcracker).

Fire

- A detailed fire size analysis was conducted. Historic records of fire starts were analyzed to identify areas where ignitions are more likely to occur. The data was used to spatially determine the probability of starts, as well as the number and placement of ignitions. Historic fire occurrence and size data used for calibrating fire probabilities in SIMPPLLE were derived from three sources:
    - Fire occurrence data from the FIRESTAT database was used for ignition points;
    - Large fire polygons where obtained from HLC NF spatial records and the Forest Activity Tracking System database;
    - The National Fire History Database was queried for fire occurrence and fire size on other land ownership and as a comparison to Forest records.
- The probability of weather-ending events was calibrated based on the fire history database. The model uses probabilities that fires of a given size will be extinguished before progressing into a larger size. Historic fire references, to the extent available, were used to evaluate NRV fire outputs.
- New fire spread logic developed by Keane and others was incorporated for the revised NRV and the FEIS, which better reflects the size and shape of how fire moves across the landscape.
- Fire suppression was modeled by correlating the most 2000-2017 fire occurrence/size data (which resulted from current day suppression tactics) and modifying the weather ending event model logic to represent those results.
- It is desirable to reflect a range of potential scenarios in the future modeling that reflect the likely effects and levels of uncertainty from a warming climate. However, SIMPPLLE addresses climate periods in general terms (i.e., warm/dry versus cool/moist), and associated process or pathway changes. Fire is one of the processes most sensitive to climate change, and the disturbance which results in the most rapid and substantial changes to vegetation. As a proxy for more detailed climate variables, it is the best available calibration available to better reflect the uncertainty in future conditions. A reasonable level of future fire to expect is two times (2x) the acres that have burned under the current fire regime, based on expert input and BASI; this information is summarized in the project record document, "*180823_FutureFireNRVConsiderations.docx*". It is appropriate to model fire at two levels (a minimum of 1x and 2x current levels) to get a range of variation. 15 runs were conducted with each scenario, analyzed together to depict a range of variation over 30 runs. To provide the baseline condition of "current fire regimes", the Monitoring Trends in Burn Severity (MTBS) initiative data was reviewed, as the most consistent and corporately available fire information. Based on this, the target decadal burn acres for all ownerships was a lower level of 179,000 acres (scenario 1); and a higher level of 357,000 acres (scenario 2).

Insects and Disease

- The model was calibrated to only allow insect and disease processes in applicable species groups. Mountain pine beetle pathways were added for limber pine, consistent with whitebark pine.
- Literature for historic insect and disease disturbances was reviewed to assist with the calibration of the NRV analysis, although the available sources were limited.
- The probability of a polygon having an insect outbreak was adjusted based on the latest available science for insect hazard ratings (Randall, Steed, & Bush, 2011). The best available science describing the expected mortality from mountain pine beetle (Randall, 2010) was used to help evaluate successional pathways for this insect and the validity of model results.

- Root disease was manually removed from illogical species types.
- Numerous adjustments were made to western spruce budworm logic.

Future treatments

The planned vegetation treatments modeled by PRISM are integrated into the SIMPPLLE modeling of future conditions by alternative.

- The planned acres for overstory removal after shelterwood harvest is manually adjusted to be 25% of the acres shown in PRISM, based on the typical management regime on the HLC NF.
- For lodgepole pine vegetation types, the size class had to be small (pole) or larger to be eligible to receive a harvest treatment. For all other vegetation types, the size class had to be medium or larger.
- Assumptions of the resulting condition (type/size/density) were developed for each activity. These same assumptions were used to modify SIMPPLLE following past and recent activities.

Patch analysis

A patch analysis was done in SIMPPLLE to describe early successional forests. Nonforested PVTs were not included in the analysis. Results were generated to show the average size for patches greater than 5 acres in size. By imposing the size minimum of 5 acres, the analysis effectively resulted in a 10-acre minimum patch size due to pixel size. The analysis was done in two ways: first, a patch was counted as a patch until it progressed out of the seedling/sapling size class. Second, the analysis was run based on patches only remaining for 1 time period after creation (10 years). In both cases, early successional forests were included in the calculation regardless of the cause of whether they were created by natural disturbances or forest management activities (such as harvest and/or prescribed burning). In the NRV analysis, all patches would have been created by natural disturbances.

Wildlife habitat

Biologists from the HLC, Lolo, and Flathead NFs developed a list of species for which it might be useful to model the NRV for their habitats; and for which SIMPPLLE was appropriate to use. The species' habitats that were modelled and the rationale for their selection are shown in Table 22.

Table 22. Terrestrial wildlife habitats modelled with SIMPPLLE

Species	Rationale/Utility for Modelling
Canada Lynx	Lynx are listed as threatened under the federal Endangered Species Act. Lynx are highly dependent on snowshoe hare, which in turn are dependent on certain seral stages of boreal (primarily spruce-fir) forest. The historic distribution of lynx across the HLC NF is not well understood but it appears that they have occupied only portions of the HLC NF, with some island ranges occupied only intermittently and others not at all. Understanding the NRV for these habitats may provide reference ranges of lynx habitat that the various GAs on the HLC NF are capable of maintaining.
Flammulated owl	Flammulated owls are identified as a Species of Conservation Concern (SCC) for the HLC NF and are known to occur in four of the ten GAs. They are highly dependent on large diameter, open ponderosa pine forests, which may be less prevalent than they were historically. Although modelling of the ponderosa pine cover type provides some information about potential habitat, the specific combination of cover type, tree size, and canopy cover queried from the model better approximates the estimated NRV of habitat for this species and for others that may require or use similar habitat.

Species	Rationale/Utility for Modelling
Lewis's woodpecker	Lewis's woodpeckers are identified as a Species of Conservation Concern (SCC) for the HLC NF and are known to occur in three of the ten GAs on the HLC NF. There are historic observations on three additional GAs. Similar to flammulated owls, Lewis's woodpeckers use mature, open, large-diameter Ponderosa pine with a significant snag component. Additionally, Lewis's woodpeckers may use large, old cottonwoods in riparian areas.
Elk	Management of elk habitat, and elk distribution on NF and adjoining lands have been issues of public interest for decades. Management and public attention have often focused on both security (distance from open roads) and hiding cover. There has been some question as to the impact that hiding cover on NFS lands may have on overall elk distribution, particularly during hunting season. Modelling the NRV may provide context for understanding whether there might be appropriate levels of hiding cover to manage for on NFS lands.

In the assessment phase, the northern goshawk was also identified as a species to model. Northern goshawks were identified in the 1986 Forest Plans as a Management Indicator Species for old growth, and they have been the focus of public concerns regarding habitat quality and availability. Information has become increasingly available, however, indicating that goshawks are not dependent on growth (Brewer, Bush, Canfield, & Dohmen, 2009; Clough, 2000; USFWS, 1998), and that they and their habitat may be more widespread and available than previously thought (Renate Bush & Lundberg, 2008; Samson, 2006). Initial model results indicated that the existing amount of goshawk nesting habitat on the HLC NF, and in all but one GA (Rocky Mountain Range) appear to be at or near the maximum estimated NRV. Based on consideration of this information we concluded that the northern goshawk does not require a fine-filter approach in forest planning, but is addressed through the coarse filter analysis of key ecosystem characteristics that include cover type, canopy, tree size and density, and others. We did not include northern goshawk nesting habitat in updated NRV modeling or in the FEIS.

There was agreement among biologists that, to the extent possible, consistency was desired across NFs and analysis processes given that the HLC NF, Lolo, and Flathead NFs have adjoining boundaries and that each is undergoing either forest plan revision or is part of a large landscape analysis process. However, there was also agreement that the species chosen for modelling and the specific habitat parameters used in queries on each NF might differ due to different vegetation conditions and habitat use. This may be particularly true of the HLC NF, the majority of which is east of the Continental Divide.

The HLC NF was a participant in developing the Eastside Assessment, which was an effort to improve habitat and vegetation models and analysis using information specific to NFs east of the Continental Divide. The assessment was intended to help specialists and decision-makers answer comprehensive management questions. The Eastside Assessment group envisioned using SIMPPLLE to predict species' habitat over time, under a variety of possible vegetation management scenarios. The Eastside Assessment group used data specific to, and gathered from, east-side forests, and incorporated the best available, most current science relevant to the entire HLC NF planning area to develop the parameter sets for modelling wildlife habitats. For the HLC NF forest plan revision process, therefore, we used SIMPPLLE queries based on parameters developed for the Eastside Assessment where possible. For species not considered in that effort, parameters were based on those discussed by the HLC, Lolo, and Flathead NF biologists and adjusted, where appropriate, to reflect vegetation conditions on the HLC NF.

In 2016 and early 2017 the Regional Office began working on improving consistency in how lynx habitat is mapped across the Region and incorporating recent science into mapping considerations. As a result, the HLC NF has adjusted the parameters used to model lynx habitat, which now differ slightly from those used in the Eastside Assessment and the lynx habitat queries used in the SIMPPLLE model.

Some information is provided here, in the form of references, regarding the BASI used to develop queries for wildlife habitat models. Also refer to the Helena and Lewis & Clark NF Forest Plan Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) for information and best available science regarding species' habitats.

Canada Lynx

There are four habitat elements modeled for Canada lynx: *potential habitat, stand initiation hare habitat, early stand initiation hare habitat, mature multistory habitat*, and *other habitat*. The analysis results include all ownerships in the administrative boundary of the HLC NF. After the initial NRV and DEIS, errors in model queries were discovered and corrected for the final NRV and FEIS analyses.

Potential habitat

Potential lynx habitat is a static layer depicting the areas on the landscape that have the potential to support habitat conditions used by lynx and their prey. The potential lynx habitat layer is based on habitat types, and was derived from VMap (2014 version) and Jones' PVT (Jones, 2004). Model outputs for each of the habitat categories were displayed as proportions of the total potential lynx habitat area. Updated potential lynx habitat mapping was conducted by the HLC NF between the DEIS and FEIS. This map was incorporated directly into the modeling for the FEIS.

Stand initiation hare habitat

Recent research (Cheng, Hodges, & Mills, 2015) has shown that forests in a small-diameter structural stage can produce high densities of snowshoe hares. The Northern Rockies Lynx Management Direction (U.S. Department of Agriculture, Forest Service, 2007) describes high and low density winter snowshoe hare habitat by trees per acre. High density regenerating forests are 5000+ trees per acre, with high density undergrowth in multistoried forests at 2500 + small trees per acre. Low density regenerating forest is 2500-5000 trees per acre and low-density undergrowth in multi-storied forests is 1000-2500 small trees per acre. Young forests with fewer than 1000 trees per acre may not provide enough cover for snowshoe hares (ibid). The only measure available in SIMPPLLE to reflect trees per acre and horizontal cover is density class (canopy cover). A plot analysis was conducted to help define stand initiation habitat. FIA intensified grid plots across the HLC NF provided the following information:

- All the seed/sap plots (<5" dbh) in the cool moist PVT across the HLC NF were summarized (72 plots), to see which canopy cover classes best aligned with more than 5,000 trees per acre.
    - 30 plots had a density >60% CC. 100% of these had more than 1000 trees per acre. 50% had more than 5000. This condition is reasonable to include as stand initiation habitat.
    - 15 plots had 40-59% CC. All but 2 had more than 1000 trees per acre, and 50% had more than 5000. This condition is also reasonable to include as stand initiation habitat.
    - 27 plots that had 0-39.9% CC. 56% of these plots had more than 1000 trees per acre, but only 19% had more than 5000. This condition should be excluded.

Based on this information, a threshold of 40% canopy cover was set to describe stand initiation hare habitat and mature multistory habitat (Table 23). Canopy cover is a proxy for horizontal cover; if trees are dense, then canopy is dense, and at this seral stage that likely means horizontal cover is also dense.

Table 23. Stand initiation hare habitat SIMPPLLE query

Habitat type group	Elevation	Canopy	Size class	Other query parameters
See potential lynx habitat	See potential lynx habitat	≥40%	0-5" (seedsap/pole)	Also include pixels between 21 and 50 years post-stand replacing fire or even-aged regeneration harvest.

Early stand initiation hare habitat

Early stand initiation habitat, which consists of seedling/sapling and pole forests that are not dense enough to meet the requirements for stand initiation habitat, and that are not tall enough for trees to protrude above the snow in winter may provide summer snowshoe hare habitat but is used much less, if at all, by hares in winter (Interagency Lynx Biology Team, 2013; U.S. Department of Agriculture, Forest Service, 2007). The SIMPPLLE model was queried as shown in Table 24 to estimate this condition.

Table 24. Early stand initiation hare habitat SIMPPLLE query

Habitat type group	Elevation	Canopy	Size Class	Other query parameters
See potential lynx habitat	See potential lynx habitat	<40%	0-5" (seed/sap, pole)	Also include pixels that are less than 20 years post-stand replacing fire or post-even-aged regeneration harvest.

Mature multistory lynx habitat

Multi-story habitat is optimal winter habitat for snowshoe hares, and therefore provides optimal habitat for lynx in the winter (ILBT, 2013; Kosterman, 2014; Squires, Decesare, Kolbe, & Ruggiero, 2010; U.S. Department of Agriculture, Forest Service, 2007). A plot analysis was conducted to assist with defining multistory habitat, based on the information from the NRLMD. All multistory plots (10" and greater size class; vertical structure 2, 3, or C) in the cool moist PVT on the HLC NF were summarized (104 plots).

- 51 plots had >60% CC. Of these, 84% had more than 1000 trees per acre and 61% had more than 2500. This condition is reasonable to include as multistory habitat.
- 47 plots had >40% CC. Of these, 72% had more than 1000 trees per acre but only 49% had more than 2500. Still reasonable to include, based on a 1000 trees per acre threshold.
- 6 plots that had <40% CC. Of these, 50% had more than 1000 trees per acre, and those same 50% had more than 2500.

Based on this data, a threshold of 40% canopy cover was set for mature multistory habitat (Table 25).

Table 25. Mature multistory habitat SIMPPLLE query

Habitat type group	Species Groups	Elevation	Stories	Canopy	Size class	Other query parameters
See potential lynx habitat	All except lodgepole pine (LP)	See potential lynx habitat	≥2	≥40%	≥10"	None

Other lynx habitat

Other habitat represents the matrix around the other lynx habitat categories, and other conifer habitat, including stem-exclusion stage, that does not currently provide hare habitat, but may be used by lynx for movement and foraging for alternate prey. It represents the remainder of the potential lynx habitat area that does not meet one of the other habitat definitions.

Flammulated owl

Flammulated owls are associated with open, mature and old growth xeric ponderosa pine and mixed ponderosa pine/Douglas-fir (Renate Bush & Lundberg, 2008; Cilimburg, 2006; Nelson, Johnson, Linkhart, & Miles, 2009; Samson, 2006). Based on a comparison of the outputs with the habitat estimated from FIA plots, we determined that only ponderosa pine dominated forests adequately represent flammulated owl nesting habitat. The model was queried as shown in Table 26.

Table 26. Flammulated owl nesting habitat SIMPPLLE query

Habitat type group	Species groups	Stories	Canopy	Size class	Other query parameters
A1, A2, B1, B2	PP, PP-DF, PP-DF-JUSC, PP-DF-PF, PP-PF	1-2	15-60%	≥15”	Species groups that at climax are going to have large, old, open ponderosa pine were selected.

Lewis’s woodpecker

Lewis’s woodpeckers are closely associated with open ponderosa pine forest, old-growth or large-tree stands that have been maintained by fire (MNHP-MTFWP). They may also rely on large, old cottonwood stands in riparian areas. Nesting habitat was queried from SIMPPLLE as shown in Table 27.

Table 27. Lewis’s woodpecker nesting habitat SIMPPLLE query

Habitat type group	Species groups	Canopy	Size glass	Notes and other query parameters
A1, A2, B1, B2, B3	DF, DF-ES, DF-JUSC, DF-LP, DF-LP-AF, DF-PF, DF-PF-ES, DF-PF-JUSC, DF-PF-LP, DF-PP-LP, PP, PP-DF, PP-DF-JUSC, PP-DF-PF, PP-PF, QA-DF, QA-DF-LP, CW, CW-ES-AF, L-DF, L-DF-AF, L-DF-ES, L-DF-LP, L-DF-PP	15-40%	>15”	Also include areas with low-moderate severity (non-lethal) fire in the past 20 years

Elk

Management of elk habitat on the HLC NF has included consideration of elk security, which is a concept that addresses vulnerability of elk to disturbance and to mortality specifically during elk hunting seasons. Hiding cover is one of several potential components of elk security. Hiding cover is defined in general as “vegetation capable of hiding 90 percent of a standing adult elk from the view of a human at a distance equal to or less than 200 feet” (Lyon & Christensen, 1992). Specific, functional definitions of hiding cover, using canopy as an indicator of horizontal cover, were included in the 1986 Forest Plans. Those definitions, along with analysis recommendations made in the Eastside Assessment process (U.S. Department of Agriculture, Forest Service, 2013) were used to inform the SIMPPLLE query (Table 28). Two types of elk hiding cover habitat were evaluated: spring/summer/fall, and winter. Results were reported forestwide and for the HLC NFS lands within elk analysis units. For spring/summer/fall habitat, the assumption is made that canopy cover results in a certain trees per acre that provide horizontal cover.

Table 28. Elk hiding cover habitat SIMPPLLE query

Habitat type group	Species groups	Canopy	Notes and other query parameters
All forested types	AF, DF-PF-AF, QA-LP, CW-ES-AF, DF-PF-LP, QA-LP-ES-AF, DF, DF-PP-LP, WB-AF, DF-AF, ES-AF, WB-DF, DF-ES, LP, WB-DF-AF, DF-ES-AF, LP-AF, WB-DF-ES-AF, DF-JUSC, LP-ES, WB-DF-LP, DF-LP, LP-ES-AF, WB-LP, DF-LP-AF, LP-PF, WB-LP-ES-AF, DF-LP-ES, PF-LP-AF, L-DF, DF-LP-ES-AF, PP-DF, L-DF-AF, DF-LP-PF, QA-DF, L-DF-LP, DF-PF	SSF: 40-60% Winter: All	Spring/Summer/Fall:None Winter: Limit to areas mapped by MTDFWP as winter range.

Desired conditions

The 2012 Planning Rule requires that forest plan direction provide for ecological integrity while contributing to social and economic sustainability. To achieve this, desired conditions have been developed for key vegetation components. Though the Plan provides direction for a relatively short period of time (15 years), desired conditions were developed with a long-term view due to the long-lived nature of tree species. To address the uncertainty in future conditions, desired conditions incorporate strategies that would maintain or improve the resilience of the ecosystem and promote the adaptability of vegetation. The desired conditions incorporate the survival strategies trees and other plant species.

Desired condition development and methodologies

This section discusses the factors and rationale applied in the development of desired conditions for vegetation in the Plan. Since the DEIS, changes have been made to desired conditions based on internal and public comment as well as an updated NRV analysis (appendix I of the EIS). The desired conditions are included as plan components and form the basis of the timber and vegetation future modeling to compare alternatives. Please see appendix D of the Plan for detailed definitions of each attribute.

The NRV shows the mean percentage for the attribute, with ranges around the 5 and 95 percentiles, rounded to the nearest percentage. Existing condition estimates are shown as the mean with ranges depicting the 90-confidence interval. The desired condition ranges are built based on the NRV ranges; however, rounding occurs to not place undue confidence on model precision. Generally, the ranges span at least 5% for uncommon elements and 10% for more common elements. For example, if the NRV predicted a range of 6-8%, the desired condition range may be 5-10%. In addition, either the lower bound, upper bound, or both of the modeled NRV ranges are adjusted in specific cases to account for BASI regarding the historic condition or potential future condition of the attribute. When such adjustments are made, in most cases, the desired condition ranges overlap either the high or low end of the NRV range. Specific literature used to support adjusted desired conditions is cited in each attribute section.

Some attributes cannot be modeled with SIMPPLLE (i.e., snags, old growth, large live trees, etc). For these elements, other resources are used to inform plan components.

NRV as a basis for desired conditions

An analysis of the NRV was a primary element that informed desired conditions. The NRV provides a frame of reference for ecological integrity and resilience. It reflects the conditions that have sustained the current complement of wildlife and plant species and provides context for understanding the natural diversity of vegetation and the processes that sustain it. Since the mid-1800s human presence and activities have increased dramatically in the planning area. NRV estimates provide a reference to conditions that might have occurred prior to these impacts. The intent of using the NRV to inform desired conditions is not to return to conditions that occurred at a single point in time, but rather to encompass the full range of conditions that were supported prior to substantial human influence.

The future will not be the same as the past. The NRV does not provide insight into conditions that may vary in the future, or other considerations relative to social demands placed on the ecosystem. Further, the analysis includes inherent uncertainty and it is appropriate to utilize additional resources, including literature, to ensure the "envelope" of vegetation conditions described by desired conditions will meet future ecological and social needs. Therefore, the desired conditions are not always equal to the NRV, because additional factors were considered as noted in the detailed sections below.

The directives (2015) recognize there may be other factors (social, economic or ecological) that lead the responsible official to determine that the NRV may not be an appropriate desired condition for certain characteristics. These considerations include maintaining conditions that contribute to long-term resilience given uncertainties in future climate and disturbances; sustaining stand structures or species compositions that provide habitat for at-risk wildlife or plant species; conserving rare structures or components; existing or anticipated human use patterns; the effects changing climate may have; and ecosystem services expected from forest lands (such as reduction of fire hazard). The following factors are considered in the development of vegetation desired conditions: generally manage vegetation to be within the NRV; maintain conditions that would contribute to long-term ecosystem resilience and adaptation to uncertainties of future climate and disturbances; sustain important wildlife habitat conditions; and consider social and economic factors.

Research indicates there is potential for ecological transformations to occur in temperate ecosystems, based on the potential for interrelated drivers such as chronic and acute drought, wildfire, and insect outbreaks to push ecosystems beyond their thresholds for resilience (Golladay et al., 2016; Millar & Stephenson, 2015). In some cases management intervention might be able to ease the transition to new forest states and minimize losses of ecosystem services (Millar & Stephenson, 2015). We do not have the capability to predict such possible shifts at the local scale. By basing the desired conditions around the NRV, with a focus on maintaining the full suite of ecosystem diversity and components that enhance resilience to disturbance, the Plan would guide management toward maintaining functioning ecosystems in the face of uncertainty.

Several recent studies have been conducted regarding the appropriateness of using the NRV to frame desired conditions (Hansen et al., 2018; Timberlake, Joyce, Schultz, & Lampman, 2018). In both cases, the authors found that using the NRV provided a solid and defensible base to inform future desired conditions.

- Hansen and others (2018) document the results of a workshop during which a variety of subject matter experts examined the ecosystems on the neighboring Custer-Gallatin NF and determined that "managing toward the NRV is a reasonable approach given the current relatively natural state of the forest ecosystem and projected future change." The authors examined the vulnerability of ecosystems on the Custer-Gallatin NF to climate change and delineated potential adaptation strategies, which are consistent with the recent work of the Northern Rockies Adaptation Partnership, which is the BASI for climate change in Region 1. The HLC NF supports similar ecosystems and utilizes similar information to frame desired conditions.
- Timberlake and others (2018) allow that NRV may help inform the desired future condition, but propose a worksheet format to help forest planners systematically address ecosystem integrity in the face of climate change by evaluating dominant ecosystem characteristics. The factors in these worksheets include an assessment of the NRV, climate change vulnerability, climate change

> information, and other stressors. Similar information has been summarized by the HLC NF in this document by incorporating information from BASI to frame and, in some cases, support desired condition ranges that are not the same as the NRV model outputs.

The issue of utilizing a historical range of variability in the context of climate change is addressed in *Climate Change Vulnerability and Adaptation in the Northern Rocky Mountains* (Halofsky et al., 2018b), as shown in Box 1. The HLC NF is consistent with the concepts presented, by considering the full range of NRV conditions to establish desired condition ranges (not precise targets) that are adjusted where need to reflect other BASI.

Box 1: From Halofsky et al 2018 Box 6.1 – Using Historic Range and Variability to Assess and Adapt to Climate Change

"To effectively implement ecosystem-based management, land managers often find it necessary to obtain a reference or benchmark to represent the conditions that describe fully functional ecosystems (Cissel et al. 1994; Laughlin et al. 2004). Contemporary conditions can be evaluated against this reference to determine status, trend, and magnitude of change, and to design treatments that provide society with valuable ecosystem services while returning declining ecosystems to a more sustainable condition (Hessburg et al. 1999; Swetnam et al. 1999). Reference conditions are assumed to represent the dynamic character of ecosystems and landscapes, varying across time and space (Swanson et al. 1994; Watt 1947).

The concept of historical range and variability (HRV) was introduced in the 1990s to describe past spatial and temporal variability of ecosystems (Landres et al. 1999), providing a spatial and temporal foundation for planning and management. HRV has sometimes been equated with "target" conditions (Harrod et al. 1999), although targets can be subjective and somewhat arbitrary; they may represent only one possible situation from a range of potential conditions (Keane et al. 2009). HRV encompasses a full range of conditions that have occurred across multiple spatiotemporal scales.

HRV represents a broad historical envelope of possible ecosystem conditions—burned area, vegetation cover type area, patch size distribution—that can provide a time series of reference conditions. This assumes that (1) ecosystems are dynamic, not static, and their responses to changing processes are represented by past variability; (2) ecosystems are complex and have a range of conditions within which they are self-sustaining, and beyond this range they make a transition to disequilibrium (Egan and Howell 2001); (3) historical conditions can serve as a proxy for ecosystem health; (4) the time and space d omains that define HRV are sufficient to quantify observed variation; and (5) the ecological characteristics being assessed for the ecosystem or landscapes match the management objective (Keane et al. 2009).

The use of HRV has been challenged because a warmer climate may permanently alter the environment of ecosystems beyond what was observed under historical conditions (Millar et al. 2007a). In particular, disturbance processes, plant species distribution, and hydrologic dynamics may be permanently changed (Notaro et al. 2007). However, a critical evaluation of possible alternatives suggests that HRV might still be the most viable approach in the near term because it has relatively low uncertainty.

An alternative to HRV is forecasting future variations of landscapes under changing climates by using complex empirical and mechanistic models. However, the range of projections for future climate from the commonly used global climate models may be greater than the variability of climate over the past three centuries (Stainforth et al. 2005). This uncertainty increases when we factor in projected responses to climate change through technological advances, behavioral adaptations, and population growth (Schneider et al. 2007). Moreover, the variability of climate extremes, not the gradual change of average climate, will drive most ecosystem response to climate mediated disturbance and plant dynamics (Smith 2011) that are difficult to project. Uncertainty will also increase as climate projections are extrapolated to the finer scales and longer time periods needed to quantify future range and variability (FRV) for landscapes (Araujo et al. 2005; Keane et al. 2009).

Given these cumulative uncertainties, time series of HRV may have lower uncertainty than simulated projections of future conditions, especially because large variations in past climates are already captured in the time series. It may be prudent to wait until simulation technology has improved enough to create credible FRV landscape pattern and composition, a process that may require decades. In the meantime, attaining HRV would be a significant improvement in the functionality of most ecosystems in the Northern Rockies, and would be unlikely to result in negative outcomes from a management perspective. As with any approach to reference conditions, HRV is useful as a guide, not a target, for restoration and other management activities.

There is literature that indicate a high likelihood of future scenarios wherein the suite of ecosystems present today and in the NRV are no longer resilient to change, and transform into novel ecosystems. In other words, conditions may shift outside of the NRV and ecosystem integrity may no longer be measured by that yardstick; and desired conditions built around NRV may not be achievable. The risks for species shift and loss of forest cover due to drought and disturbance are acknowledged; however, these scenarios are generally predicted to occur in the longer term (beyond the 15 year planning cycle), and are difficult if not impossible to quantify at the scale of a NF. The specific configuration of potentially new ecosystem conditions is not quantifiable due to the level of uncertainty associated with future climates, and any attempt to craft desired conditions to capture the suite of conditions that may be sustainable in 50+ years would be based on substantial guesswork and downscaling of larger modeling efforts.

The NRV for wildfire and insect activity places the analysis into context with historic regimes (see appendix I). Wildfire is, was, and will remain a dominant ecosystem driver. Given the importance of fire as a key ecosystem process, maintaining vegetation and forest diversity, sustaining fire adapted species and structures, and creating vegetation conditions that support and sustain native wildlife species in the short and long term are critical components of the Plan. Some GAs are still demonstrating the lack of fire that has occurred throughout the era of fire exclusion, and remain well below the NRV for acres burned; others are reflecting the trend of increasing fire activity with warming climates. It is likely that insect and disease occurrence may increase with continued warm/dry climates during the life of the Plan. However, the recent mountain pine beetle outbreak may preclude many areas from infestation for several decades.

For the purposes of desired conditions that apply over the next planning cycle, using the NRV with adjustments as documented in this report provide the most supported picture of conditions that would provide for ecosystem integrity, while promoting resilience to future changes to the extent feasible.

Hierarchy and scale of desired conditions

Desired conditions are developed at a scale that represents the broad-scale planning unit and can be monitored through time, while also capturing the unique contribution and condition of each GA. Most of the vegetation desired conditions are displayed as numeric ranges in chapter 2 (forestwide) or chapter 3 (GAs) of the Plan. Appendix C provides descriptions of management approaches and actions that are expected to be used to help achieve desired conditions. Desired conditions may be achieved through both natural processes and management activities. Those that are developed at the GA scale complement forestwide desired conditions and reflect the unique array of PVTs, disturbance history, and growth potential in each GA. Table 29 shows how vegetation conditions are addressed across scales.

Table 29. Organization of vegetation desired conditions in the Plan

Vegetation attribute	Chapter 2, forestwide	Chapter 3, GAs
Forested and nonforested cover types	X	X
Tree species distribution	X	X
Forest size class	X	X
Large-tree Structure	X	
Forest density class	X	X
Forest vertical structure	X	
Snags	X	
Downed woody debris	X	
Old growth	X	
Early successional patches	X	

Desired conditions for composition

Discussion/Summary

Cover types are assemblages of dominance groups that describe the dominant vegetation on a site (Milburn et al., 2015). *Tree species presence* is the percentage of the area that contains at least one live tree of the species.

The exclusion of fire since modern settlement has resulted in a higher proportion of late seral, shade tolerant species at the expense of shade-intolerant types. This is most evident in the warm dry broad PVT and in cover types where high frequency, low severity fires would have been common. Low elevation, dry forests have experienced the greatest magnitude of change in composition, structure and function because of fire suppression, forest management, and climate change (Hessburg & Agee, 2003; Hessburg, Agee, & Franklin, 2005; Westerling, Hidalgo, Cayan, & Swetnam, 2006). Still, even cover types adapted to long fire return intervals and stand-replacing severities such as lodgepole pine have changed because these forests also burned in low-to mixed-severity events historically which created variable age structures and patterns (Kashian, Turner, Romme, & Lorimer, 2005).

Table 30 below displays a matrix of the relationship between the existing condition and the desired condition ranges for species composition, for all cover types and associated tree species presence (or extent). These comparisons are made using the mean modeled values and do not account for the error bars around those means, which in some cases may extend into a different position relative to the desired range. Charts with error bars are available in the project record for all attributes for alternatives A and F.

The ponderosa pine cover type, and the presence of ponderosa pine, is consistently below the desired ranges, as is aspen; whereas the Douglas-fir cover type and presence is consistently above. When the desired trend of a cover type (where a certain species is dominant) varies from the extent or presence of the species, it indicates that there is a difference in the abundance of forests where the species dominates versus where it is present overall, potentially as a minor component. The variability in desired trends across the GAs underscores the importance of having forest plan components at multiple scales.

Based on the modeling, it would initially appear that nonforested or savanna areas may be similar or more prevalent today than historically; however, these types were more abundant during warm/dry climate periods. Therefore, a trend of maintaining or increasing nonforested types – and very low tree cover <10% on some forested types – is appropriate for the future desired condition. In one local example, this conclusion was demonstrated by a study in the Elkhorns GA which found that there has been a three-fold increase in the amount of closed-canopy forest at the expense of grass, shrub, and open tree stands compared to historical conditions (Barrett, 2005).

In the warm dry PVT, desired conditions would promote landscape patterns and large trees beneficial for wildlife, timber production, and seed sources. Open forest savannas should occur on the hottest, driest sites dominated by grass or shrubs with widely scattered trees (5 to 10% canopy cover). These areas blend into grass and shrublands and may be more prevalent in the future. Nonforested cover types will be promoted with future warm and dry climate. It is desirable to limit the encroachment of coniferous tree species onto nonforested PVTs. Increases or maintenance of ponderosa, limber, and aspen will be supported by future warm climate and fire. Ponderosa pine is highly drought tolerant, whereas Douglas-fir is likely to experience greater stress with drying conditions. The fact that the presence of Douglas-fir is within the desired range, but the Douglas-fir cover type is above the desired range, indicates that the dominance of dry forests should shift towards ponderosa pine, but Douglas-fir should remain a component of many forests where it currently occurs.

In cool moist, desired conditions would sustain multistory lynx habitat in spruce/fir cover types and provide the habitat diversity necessary for other wildlife species and stand conditions more resilient to future disturbance and climate change. Infrequent, large fires characteristic of this setting will favor these species over those with low fire resistance. In the cold PVT, desired conditions are to maintain the whitebark pine cover type, and increase its overall extent focusing on sites best suited (e.g. open ridges and harsher aspects). On sites where whitebark pine is capable of surviving, there should be a decrease in subalpine fir. Subalpine fir and Engelmann spruce dominate northerly and easterly aspects, swales, moist basins, and riparian areas. Some lodgepole pine cover types are desired, mainly on warmer sites, for species diversity and responses to fire.

Table 30. Matrix of existing condition (FIA) compared to desired condition at multiple scales – species composition

	Forestwide	Warm Dry	Cool Moist	Cold	Big Belts	Castles	Crazies	Divide	Elkhorns	Highwoods	Little Belts	Rocky Mtn	Snowies	Upper Blackfoot
Nonforested cover type	W/B	W/A	W	W/A	W	W	W	W	W	W	W	A	W	W/A
Aspen/Hardwood cover type	B	B	B	N	B	W/B	B	B	B	W/B	B	W	B	B
Aspen/Cottonwood presence	W/B	B	W	N	B	W/B	B	W	W/B	W	B	W	B	B
Ponderosa pine cover type	B	B	W	N	B	B	B	B	B	B	B	W/B	W	B
Ponderosa pine presence	B	B	N	N	B	B	B	B	B	B	B	B	W	B
Limber pine presence	W	W	W	W/B	W/B	B	B	W/B	W/B	B	W	W/B	W/A	W
RM Juniper presence	W/A	W	W/B	N	A	W	B	W	W/A	B	W	W	W	W
Douglas-fir cover types	A	A	A	W/A	A	A	A	A	W/A	B	A	W	A	A
Douglas-fir presence	W/A	W	A	W	W/B	A	A	W	W	B	A	W	A	W
Lodgepole pine cover type	W/A	A	W/A	B	W	W	B	A	W	A	A	W/A	B	W
Lodgepole pine presence	A	A	A	W	W	W/A	W	A	W	A	A	A	B	A
Western larch cover type	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Western larch presence	N	N	N	N	N	N	N	N	N	N	N	N	N	B
Spruce/fir cover type	W	N	B	B	W/B	W/B	W	W	A	W/B	B	B	W	B
Engelmann spruce presence	W	W/A	A	W/B	W/B	W/B	B	W	A	N	A	W	A	W
Subalpine fir presence	W/A	N	W/B	A	W/A	W/A	A	A	A	W/B	W/A	W	W	A
Whitebark pine cover type	W	N	W/B	W	W	W	W/A	B	B	N	B	W/B	N	B
Whitebark pine presence	W/B	N	W	B	W	W	W	W	W	N	W	W	B	W

W = within the DC range; A = above the DC range; B = below the DC range; N = not present or no DC for that scale. When the existing condition is at the boundary of the DC range, it is noted as W/A (at the upper end of the range) or W/B (at the lower end of the range). Items shaded in the dark gray tones and white font indicate conditions at the upper bound or above the desired range. Items shaded in light gray tones indicate conditions at the lower bound or below the desired range. Cells with no shading are within the desired ranges or are not present/applicable.

Cover type

Data and modeling considerations

The various nonforested cover types are not currently classified in the R1 Summary Database; therefore, they are lumped into one desired condition. In addition, the existing condition includes cover types labeled as "none", which include nonforested types and forested types that were recently disturbed.

Assumptions had to be made to translate SIMPPLLE species associations into cover types. This was done by comparing how the type corresponded to the dominance groups in VMap. For example, whitebark-spruce SIMPPLLE species ("WB-ES") occurred most often in spruce ("PIEN") dominance groups in VMap, so are classified into the Spruce-fir cover type. It's possible, however, that historically some WB-ES areas would have been dominated by whitebark (whitebark pine cover type). However, because SIMPPLLE does not track the abundance of each species, there is no way to know how much should be in each cover type. This classification method is problematic for species that have declined since NRV and are in low abundance or scattered in small patches and not well-represented by VMap. The result is that some unknown proportion of the indicated levels of Spruce Fir in the NRV include areas that should be classified into whitebark pine cover type. While whitebark pine is one of the most prominent examples of this potential error, similar errors could occur in other types, such as the relationship between Douglas-fir and ponderosa pine; and between aspen and conifers. Recognizing this weakness highlights the importance of using other BASI and professional judgement to interpret model results.

On the HLC NF, the Mixed Mesic Conifer cover type represents Douglas-fir dominated forests on productive sites, and Dry Douglas-fir represents Douglas-fir on dry sites. For the FEIS these cover types are combined because they are both dominated by Douglas-fir (with the distinction being the moisture regime of the site); at the forest planning level this distinction is not necessary to inform desired conditions. The combination of these groups is termed "Douglas-fir".

Correlation to warm/dry climate periods and other considerations

Because future climates are expected to be warm and dry, historic warm/dry climate periods were compared to the trend of cover types. Aspen/Hardwood is at the higher end of its range during these periods, while ponderosa pine declines. Dry Douglas-fir increases during warm/dry periods, and Mixed Mesic Conifer appears to peak. Lodgepole pine is not particularly responsive to climate periods. Spruce/fir declines while whitebark pine increases. Dry nonforested cover types in particular increased in warm/dry periods. NRV indicates that forested cover types encroached into nonforested PVTs at times; however, this happened less during warm/dry periods. Ponderosa pine and limber pine are likely do better than Douglas-fir in drought. The lodgepole pine cover type is not expected to drastically change, but the whitebark pine cover type may see species dominance shifts (Halofsky et al., 2018b).

NRV compared to existing condition

The following tables display the existing condition versus NRV for cover type.

Table 31. Cover type, NRV versus existing condition – forestwide

	NF	AS/HW	PP	DF	LP	SpFir	WBP
NRV	7-9	0.6-1	22-26	15-21	18-20	22-26	1-1.2
Existing	14 (11-16)	1 (0.4-2)	8 (6-10)	29 (25-35)	27 (24-30)	13 (10-15)	4 (2-5)

NF = nonforested; AS/HW = aspen/hardwood; PP = ponderosa pine; DF = Douglas-fir; LP = lodgepole pine; SpFir = spruce/fir; WBP = whitebark pine. Values are percentages of total NFS lands of the scale of interest, rounded to the nearest whole number unless the value is small enough to require showing decimal to the tenth place.

Table 32. Cover type, NRV versus existing condition – forestwide by PVT

PVT		NF	AS/HW	PP	DF	LP	SpFir	WBP
Warm dry	NRV	0.1-3	0.6-1	54-62	31-39	4-5	N/A	N/A
	Existing	13 (10 -17)	1 (0.3-2)	16 (12-20)	52 (42-61)	16 (12-21)	0.4 (0.4-1)	0
Cool moist	NRV	3-7	0.2-0.6	4-5	8-16	27-32	45-55	0-0.1
	Existing	10 (6-14)	2 (0.2-3)	2 (0.6-4)	23 (17-29)	35 (29-42)	19 (14-24)	2 (0.6-4)
Cold	NRV	0-0.3	0.1-0.4	0	2-5	42-47	43-48	5-7
	Existing	11 (7-16)	0	1 (1-2)	5 (2-8)	37 (29-44)	27 (21-34)	12 (7-16)

See footnote for Table 31.

Table 33. Cover type, NRV versus existing condition by GA

GA		NF	AS/HW	PP	DF	LP	SpFir	WBP
Big Belts	NRV	11-14	0.7-1.3	41-47	20-27	8-10	8-11	0.5-1
	Existing	21 (18-28)	0	9 (5-12)	41 (31-50)	8 (5-12)	5 (2-7)	3 (1-6)
Castles	NRV	10-11	0	31-35	9-14	34-39	5-9	2-3
	Existing	15 (6-23)	2 (2-6)	0	35 (19-56)	35 (23-46)	6 (1-12)	4 (4-8)
Crazies	NRV	10-13	0-0.1	16-18	5-8	25-35	18-27	2-5
	Existing	19 (9-32)	0	0	34 (14-55)	14 (5-24)	21 (10-34)	5 (5-12)
Divide	NRV	8-11	1-2.4	21-27	22-29	24-26	9-13	2.5-3
	Existing	8 (5-12)	1 (1-3)	0	40 (31-51)	37 (29-42)	10 (7-14)	1 (1-3)
Elkhorns	NRV	18-20	0.5-1.4	16-22	16-23	23-27	6-10	4-5
	Existing	23 (15-31)	1 (1-3)	1 (1-4)	19 (13-33)	23 (14-30)	17 (10-26)	4 (3.6-7)
Highwoods	NRV	17-20	4-6	35-45	19 -31	8-9	3-5	0
	Existing	37 (21-52)	3 (3-10)	0	12 (11-30)	31 (16-46)	3 (3 -10)	0
Little Belts	NRV	4-6	0.1-0.2	30-34	15-22	19-22	20-24	0.5-1
	Existing	8 (6-9)	0.4 (0.4-1)	9 (7-11)	39 (34-44)	29 (26-32)	11 (9-13)	1 (0.6-2)
RM Range	NRV	6-7	1-1.4	8-10	10-17	12-16	39-46	0.3-0.7
	Existing	21 (15-27)	3 (1-5)	2 (0.2-4)	15 (7-22)	20 (15-27)	22 (16-28)	5 (2-8)
Snowies	NRV	6-8	1-2	20-23	15-21	19-25	20-28	0.2-1
	Existing	9 (4-14)	1 (1-3)	22 (15-30)	37 (24-51)	10 (5-16)	20 (13-27)	0
Upper Blackfoot	NRV	4-8	0.2-0.4	19-25	16-25	23-28	20-26	1-2
	Existing	16 (12-20)	0.4 (0.4-1)	2 (0.6-4)	33 (26-42)	26 (20-30)	10 (7-14)	1 (0.7-2)
	In addition, there is 0% (0-0.1%) western larch mixed conifer existing. The NRV shows only 0.1% at 95th quartile.							

See footnote for Table 31.

Forestwide cover type desired conditions

The subsequent figures show the desired condition for cover type reflected in plan component FW-VEGT-DC-02. Only cover types with a desired range of at least 1% are included; other types may occur at incidental levels. Estimates are rounded to the nearest whole number unless the value is less than 1%, in which case it is rounded to the nearest 10th. The totals do not necessarily equal 100% due to non-vegetated areas (water or rock). The following adjustments from the NRV were applied:

- The desired conditions for the aspen cover type are slightly higher than the NRV, because this type is not as well represented in the data due to its scattered nature (often present in stringers overtopped by conifers), which makes it difficult to detect with plots or remote sensing. Literature sources indicate that aspen has decreased from the historic condition due to factors such as fire suppression (Bartos, 2001; Campbell & Bartos, 2000; Shepperd, 1996).
- Most nonforested cover types would occur on nonforested PVTs and on the warm dry PVT where they are created and maintained by natural disturbance. Nonforested cover types were most prevalent during the warm and dry climate periods in the NRV; therefore, management at the upper end of the natural range is appropriate given future climate. The ability of the model to depict historic grasslands is limited as the model recruits trees onto sites with a forested PVT, whereas anecdotal knowledge and literature would indicate that more areas may have been maintained in a nonforested in the past based on presence of species such as sagebrush. The upper range of the desired condition for nonforested cover types is higher than the NRV, based on BASI that indicates these types were more prevalent historically and likely to be promoted by a warming climate in the future (Halofsky et al., 2018a, 2018b, 2018c, in press; Heyerdahl, Miller, & Parsons, 2006; Means, 2011). These include savanna or ecotones with sparse trees and grass/shrublands. Forestwide ranges of nonforested cover types indicate that the existing condition is just below the desired range; however, for each of the forested PVTs, nonforested communities are generally within or at the upper end of the desired range. This indicates that the desired increases in nonforested types at the forestwide scale would primarily occur on nonforested PVTs, in addition to potentially moving higher within the desired range in the warm dry forested PVT.
- The bounds of the desired condition range for spruce/fir are adjusted down based on information that this type is more prevalent today than it was historically, and post-fire regeneration of this species will not be promoted by warmer and drier climates (Halofsky et al., 2018b; Urza, Sibold, & Gilliam, 2016). In addition, it is likely that some of this type should be classified as whitebark pine in the NRV due to limitations in classification for modeling.
- The whitebark pine ranges overlap but are slightly higher than the NRV ranges due to limitations in the classification (wherein some of this type is lumped into spruce/fir) as well as BASI indicating that this species was more prevalent historically (Halofsky et al., 2018b, in press; Keane et al., 2012; U.S. Department of the Interior, 2010; Wong & Daniels, 2016).
- The future modeling does not detect a measurable abundance of ponderosa pine on the cool moist PVT. However, a desired condition is included to encompass its known presence based on plot data, and to allow for potential movement onto these sites as a result of warm and dry climate conditions.

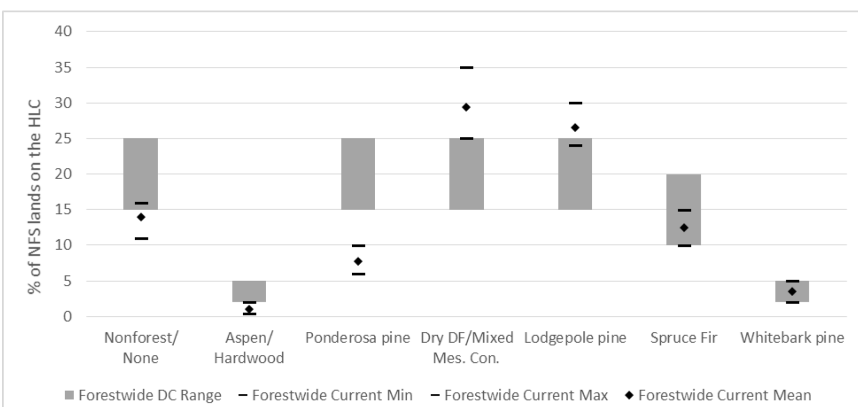


Figure 3. Forestwide cover type desired conditions compared to existing condition

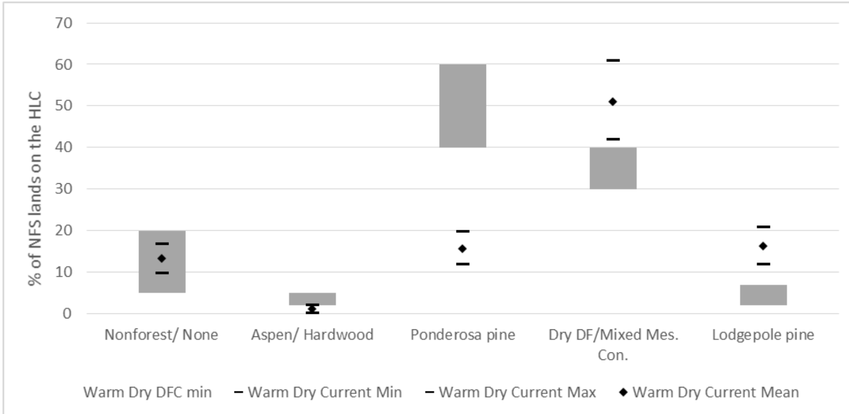


Figure 4. Warm dry PVT cover type desired conditions compared to existing condition

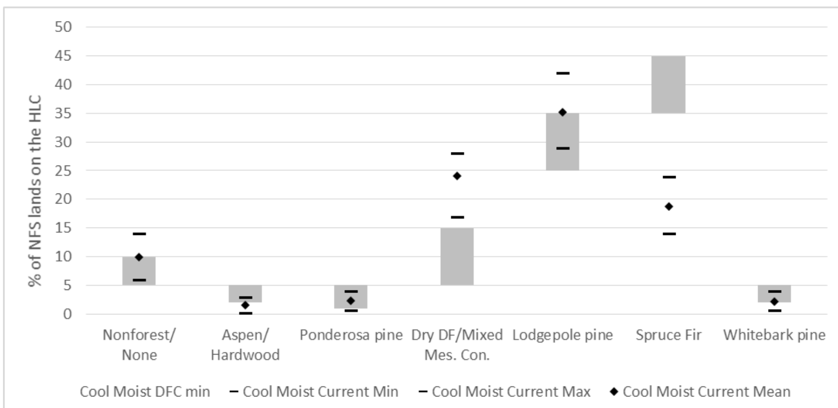


Figure 5. Cool moist PVT cover type desired conditions compared to existing condition

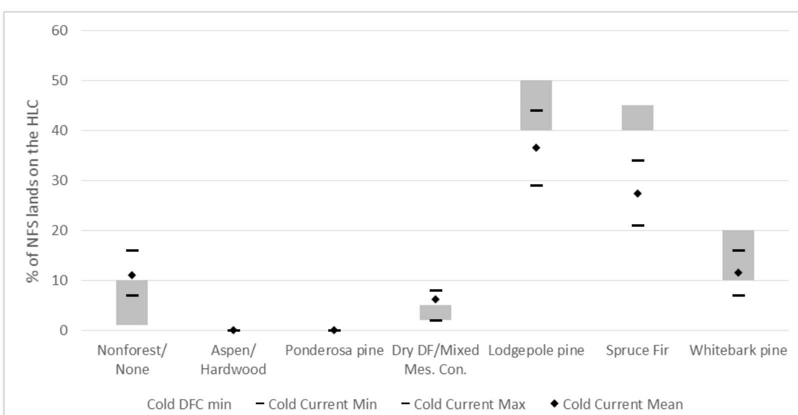


Figure 6. Cold PVT cover type desired conditions compared to existing condition

Nonforested plant community desired conditions

Nonforested plant communities are combined into the nonforested cover type. However, within this group there are distinct community types, which are addressed qualitatively as follows.

- *Xeric grasslands*: The desired condition is to have high diversity of tall and medium height, cool and warm season grasses (e.g., bluebunch wheatgrass, green/Columbia/western needlegrass), and short grasses (e.g., Sandberg bluegrass). There should a variety of forbs in varying amounts, and the diversity of plant species present allows for drought tolerance. Individual species varies greatly in the amount of production depending on growing conditions. Vegetation should have strong and robust root systems that allow production to increase with favorable growing conditions. This plant community provides for soil stability and a properly functioning hydrologic cycle. Plant litter is a common component and is available for soil building and moisture retention. Plant litter is well distributed with little movement off-site and natural plant mortality is typically low. Bare ground is present because of the warm dry nature of sites but at low amounts.

- *Mesic grasslands*: The desired condition is to have a variety of mesic forbs, dense cover, and high species richness characterized by long lived, moderately deep rooted cool and warm season grass species (e.g., rough fescue, Idaho fescue, blue gramma, tufted hairgrass, etc.). Shrubs may be present with minor cover and introduced species are rare. Bare ground should typically be low (less than 3%) across most sites with litter being a common component and available for soil building and moisture retention. Plant litter movement is expected to be limited with plant litter being properly distributed and rarely moving off-site.

- *Mesic shrublands:* The desired condition is that shrub species such as mountain big sagebrush and mesic deciduous shrubs (e.g., snowberry, ninebark, serviceberry) are dominant overstory species with graminoid species (e.g., Idaho fescue, mountain brome) and mesic forbs (e.g., cinquefoil, prairie smoke) dominating the understory. Canopy cover may vary, but should typically be moderate to high, and may result in lower cover of understory species.

- *Xeric shrublands:* The desired condition is to support shrub species such as Wyoming big sagebrush, basin big sagebrush, low sagebrush and black sagebrush. Overstory species vary by location and site type. The understory should typically be dominated by graminoid species such as needle-and-thread, Sandberg bluegrass and bluebunch wheatgrass. Canopy cover varies depending on the site and growing conditions but should typically low to moderate. Bare ground is present in higher amounts relative to mesic shrubland sites.

- *Riparian/wetland:* Riparian vegetation should be comprised of a mosaic of plant communities dominated by species that tolerate periodic flooding and a seasonally high water table. Trees may be present along with riparian shrubs and herbaceous species. In wide valley bottoms, the vegetation typically should be a mosaic of all lifeforms with patterns reflecting the meander patterns of the stream/river. Dominant shrubs may include mountain alder, various species of willows, river birch, dogwood, hawthorn, chokecherry, rose, silver buffaloberry, Rocky Mountain maple and/or snowberry. A wide variety of herbaceous species including, grasses, sedges, rushes, spikerushes, bulrushes, and forbs should be present in the understory. In wetlands, the vegetation complex should be represented by a mosaic of herbaceous and woody plant communities that provide excellent erosion control. Herbaceous species may be dominated by cattails, sedges, rushes, spikerushes or bulrushes. Bryophytes, including sphagnum, are well represented in fens.

- *Alpine and rocky habitats:* Vegetation cover should typically be low to moderate. The plant communities are dominated by a number of shrubs, forbs and graminoids including: arctic willow (turf community), mountain avens, (cushion plant community), mountain heather and moss-heather (snow bed communities). In rocky habitats, vegetation may be sparse or lacking.

- *Xeric ecotones and savannas:* It is desirable to promote the open character of forest savannas (0-5% canopy cover of widely spaced, generally large diameter fire-tolerant conifers) and a dominance of grass and shrub communities in xeric ecotones, particularly given expected warm and dry climate conditions. These areas are present on both nonforested and warm dry PVTs.

Geographic area cover type desired conditions

The following figures display the cover type desired conditions for each GA, which are enumerated for each GA in chapter 3 of the Plan. Using the logic presented in the forestwide desired condition section, the upper end of the desired condition for the nonforested cover type is higher than the modeled NRV, on some GAs where warm dry PVTs are abundant. In these cases, the desired condition for ponderosa pine is adjusted down accordingly.

The confidence interval for existing conditions at the GA scale can be wide for the small GAs that have few plots. The upper and lower bounds of the estimate should be considered when comparing to the desired condition range. For example, the Highwoods has a mean nonforested cover type abundance that is above the desired range; however, the bounds of the confidence interval are quite wide and encompass the range. Therefore, it cannot be concluded with certainty that the Highwoods is above the desired range.

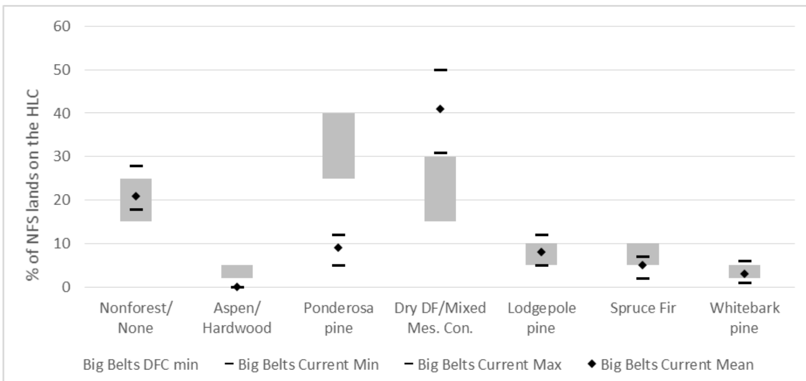


Figure 7. Big Belts GA cover type existing and desired conditions

Maintenance of nonforested cover types (including grasslands, shrublands, and savannas) is important in the Big Belts GA. Although not found on plots, aspen is known to occur. While the existing condition is similar, the desired condition indicates a higher level of the ponderosa pine cover type than the forestwide range. Historic records (Janssen, 1949) indicate a loss of low elevation ponderosa pine. Ponderosa pine restoration is particularly important in this GA. As a result, the need to reduce the Douglas-fir cover type relative to the 2018 condition is pronounced. There is less of the lodgepole pine cover type than the forestwide average, and the desired trend is to maintain 2018 levels. There is relatively little of the spruce/fir cover type present, and the 2018 condition is at the low end of the desired range. The proportion of the whitebark pine cover type existing and desired is similar to forestwide ranges.

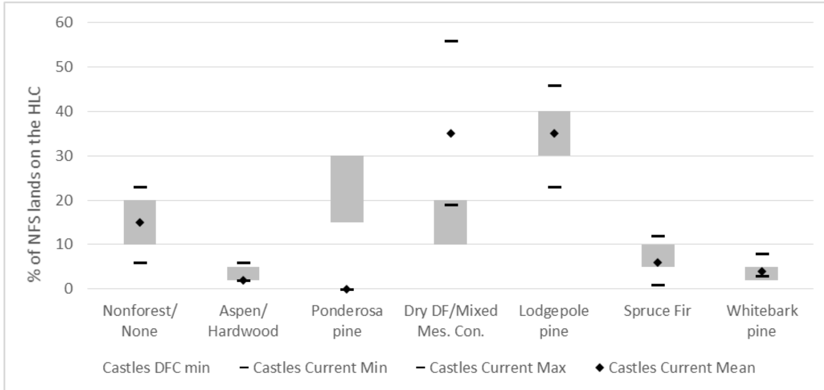


Figure 8. Castles GA cover type existing and desired conditions

In the Castles GA, limber pine savannas may be a focus within nonforested cover types. This GA contains opportunities for aspen restoration. For the ponderosa pine cover type, the lower bound of the desired condition is lower than the NRV to be more achievable. Ponderosa pine and limber pine do occur in the GA; promoting these species to become dominant is emphasized. The 2018 proportions for Douglas-fir dominated cover types indicate a desired decrease (to favor ponderosa pine). There is more of the lodgepole pine cover type present than forestwide, and maintenance relative to the 2018 condition is desired. There is relatively little of the spruce/fir cover type present in this GA, and the 2018 condition is at the low end of the desired condition. The proportion of the whitebark pine cover type existing and in the NRV is similar to forestwide ranges.

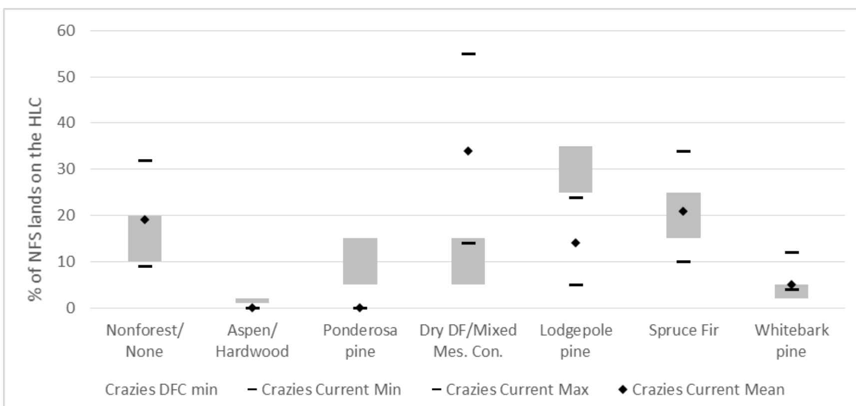


Figure 9. Crazies GA cover type existing and desired conditions

The Crazies GA has a relatively high proportion of nonforested cover types, including alpine areas. There is none of the aspen/hardwood cover type, although aspen is present and encouraging its dominance in some areas is desirable. There is also none of the ponderosa pine cover type found on plots, but there are limber pine and ponderosa pine individuals that could become more dominant. The need to decrease the Douglas-fir types is important (to favor ponderosa pine or lodgepole pine depending on the site). There is a smaller proportion of the lodgepole pine cover type present than forestwide, and desired condition indicates that increasing it is appropriate. The existing proportion and NRV range of the spruce/fir cover type is higher in this GA than the forestwide average. The proportion of the whitebark pine cover type existing and in the NRV is similar to forestwide ranges.

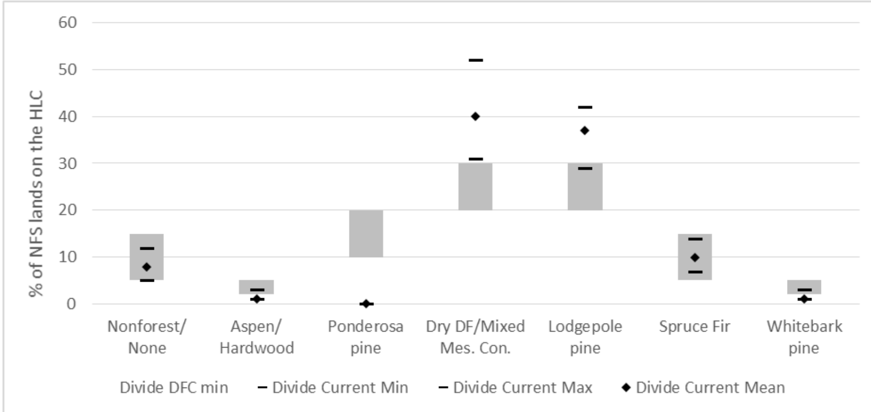


Figure 10. Divide GA cover type existing and desired conditions

In the Divide GA, open savannas may be a focus in the eastern portions. The desired trend of the aspen/hardwood cover type is similar to forestwide. Although the ponderosa pine cover type is not present, ponderosa and limber pine do occur. Promoting this type east of the continental divide is important. Decreasing the Douglas-fir types in this GA is important (primarily to promote the ponderosa pine cover type). Slightly decreasing the lodgepole pine type relative to the 2018 condition may be appropriate, to favor spruce/fir, Douglas-fir, ponderosa pine, or whitebark pine. Overall maintenance of spruce/fir relative to the 2018 condition is desired, although some reductions within the desired range may be warranted if needed to increase whitebark pine.

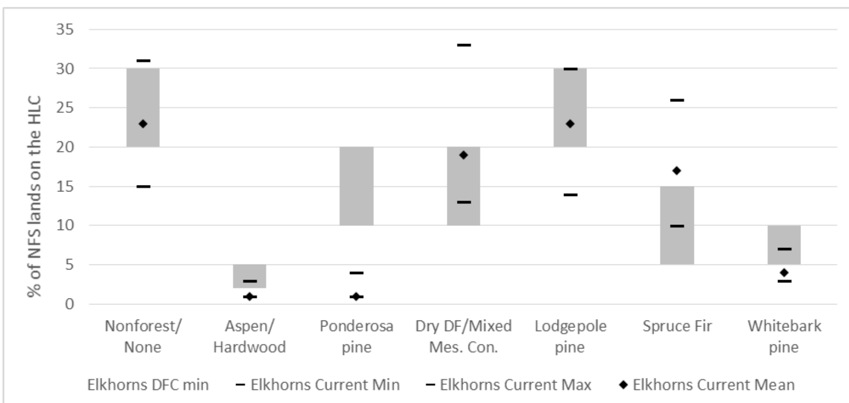


Figure 11. Elkhorns GA cover type existing and desired conditions

In the Elkhorns GA, nonforested and savannas are a focus in the low elevations; note the wide range of variability around the existing condition estimate. The existing and desired proportion of the aspen/hardwood cover type is similar to forestwide. The existing proportion of the ponderosa pine cover type is lower than forestwide, although ponderosa and limber pine occur. Restoration of this cover type is important in this GA, especially in the northwestern portion. The indicated decrease in Douglas-fir types is important but less pronounced in this GA than forestwide; note the wide range of uncertainty in the existing condition estimate. The lodgepole pine cover type desired trends are similar to the forestwide levels. In this GA, the need to decrease this type may be important to promote whitebark pine.

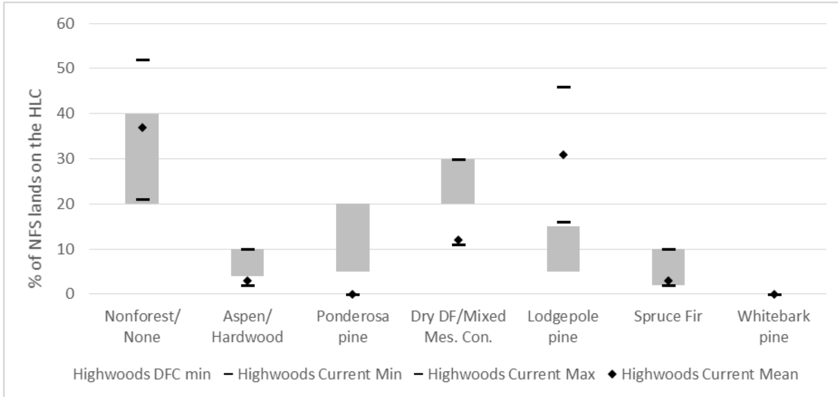


Figure 12. Highwoods GA cover type existing and desired conditions

In the Highwoods GA, the abundance of nonforested cover types is due to disturbance and extent of nonforested PVTs. The desired condition adjustments for this GA account for this and reflect the importance to elk and mountain goat populations. There is more aspen present and reflected in the desired range than forestwide. There is none of the ponderosa pine cover type present, but limber and ponderosa do occur. The desired condition for that type is lower than the NRV range to account for the increases in the nonforested type. Unlike most other GAs, there may be a need to increase the Douglas-fir type, which may occur with decreasing lodgepole pine on dry sites where Douglas-fir is more fire resistant and drought tolerant. The existing and desired proportions of the spruce/fir type are lower than the forestwide averages. No whitebark pine is present or expected in this GA.

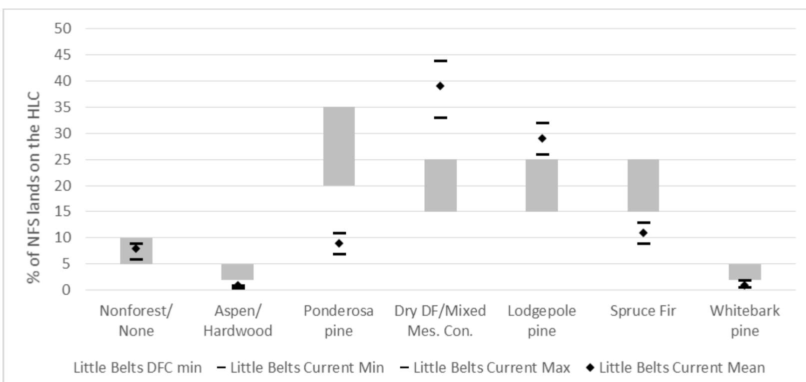


Figure 13. Little Belts GA cover type existing and desired conditions

In the Little Belts GA, open savannas a focus in some parts of the GA but there is relatively little of the nonforested over type present or expected. Similar to forestwide, it is desirable to promote aspen and ponderosa pine cover types, and to decrease Douglas-fir and lodgepole pine. Similar to forestwide, it is desirable to increase spruce-fir and whitebark pine cover types.

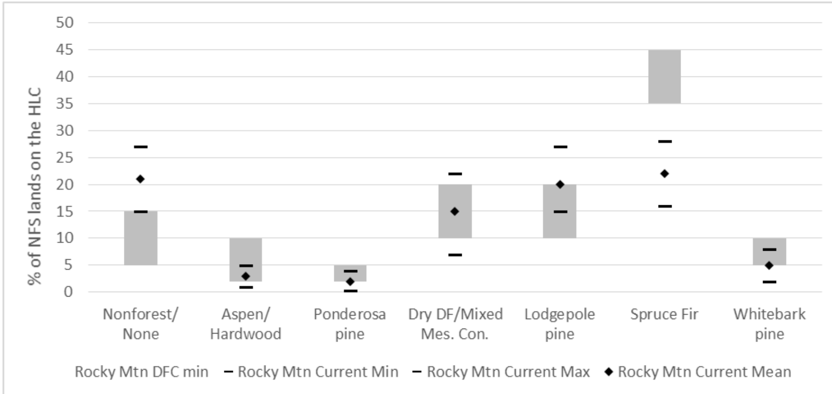


Figure 14. Rocky Mountain Range cover type existing and desired conditions

In the Rocky Mountain Range GA, the need to decrease nonforested cover types is related to recent fire areas that have not yet reforested. Maintenance of the aspen/hardwood type is particularly important in this GA, which contains more of these species than many other landscapes. There is little of the ponderosa pine cover type, and these areas are generally dominated by limber pine rather than ponderosa pine. There is relatively little of the Douglas-fir cover types, and the amounts are within the desired range. There is a smaller proportion of the lodgepole pine cover type than forestwide. The desired condition indicates that maintaining or slightly decreasing it is appropriate. The existing proportion of the spruce/fir cover type is relatively high in this GA, and increasing this type is appropriate (likely in burned areas). The proportion of whitebark pine is higher in this GA than forestwide.

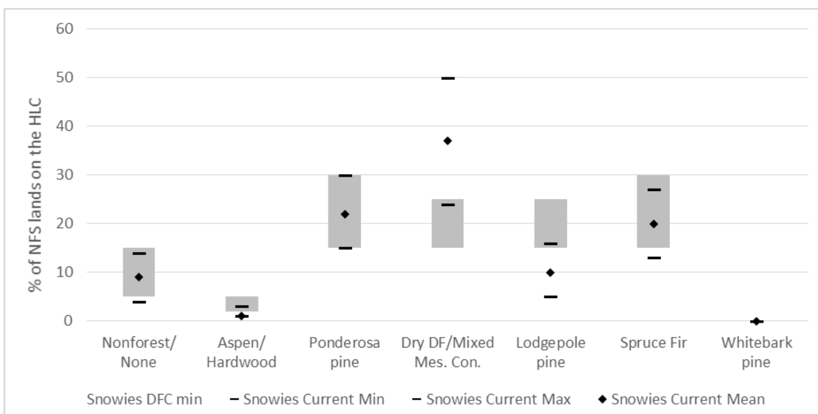


Figure 15. Snowies GA cover type existing and desired conditions

In the Snowies, GA, the narrow NRV range for the nonforested cover type is expanded for the desired condition to account for future variability. However, this is a primarily forested GA. The existing and desired levels for the aspen/hardwood cover type are consistent with the forestwide averages. There are relatively high levels of the ponderosa pine cover type, found in the Little Snowies. The existing and desired proportions of the Douglas-fir types are similar to the forestwide ranges. There relatively little of the lodgepole pine type, indicating that it is appropriate to increase this type in this GA. The spruce/fir type is relatively abundant (primarily in the Big Snowies), and maintenance of this level is appropriate in this GA. Whitebark pine is not present or expected.

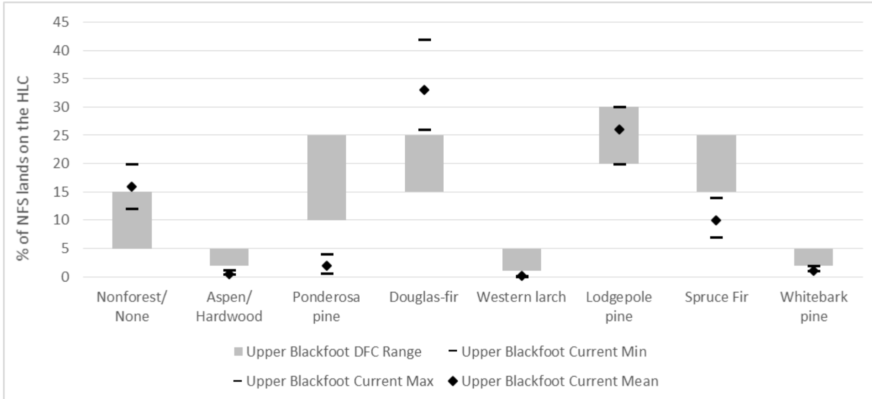


Figure 16. Upper Blackfoot GA cover type existing and desired conditions

In the Upper Blackfoot GA, the need to decrease nonforested cover types is related to recent fire areas that have not yet reforested. The desired trend for the aspen/hardwood type is consistent with forestwide ranges. There is little of the ponderosa pine cover type present on NFS lands, although ponderosa pine and limber pine do occur. The desired trend of the Douglas-fir types is similar to forestwide ranges. The western larch type occurs in small amounts in this GA, and opportunities to promote it are desired. The lodgepole pine is present to a similar degree as forestwide, and the desired condition indicates a need to generally maintain this level. The desired condition indicates slight increases in spruce/fir may be appropriate, which may coincide with the regeneration of burned forest.

Tree species presence

Data and modeling considerations

Existing condition data (FIA) can track the presence of at least 1 tree of a species on the plot. In SIMPPLLE, species presence is determined by inclusion in the species label (PP-DF would indicate both ponderosa pine and Douglas-fir are present). Species presence in the NRV may not capture the minor or rare presence of all species in highly diverse areas, since the labels only include the top 1 to 4 species in a pixel. Both data sources will add up to more than 100% of the area summarized because multiple species are often present on a given acre/plot/pixel.

Correlation to warm/dry climate periods and other considerations

Douglas-fir presence generally declines during warm/dry periods. This differs from the trend seen for the Douglas-fir cover type – while Douglas-fir may still dominate these areas, components of other species such as ponderosa pine become more prevalent. Subalpine fir declines during warm/dry periods. Rocky mountain juniper also declines in warm dry periods; even though it is drought-hardy, it likely decreases due to increased fire that favors grass/shrublands. Whitebark pine presence also decreases during warm/dry periods, although the whitebark cover type increases – this could be due to the fact that whitebark individuals spreading into the cool moist types decrease during times of drought and are more limited to cold sites where they can dominate. Lodgepole pine generally increases during warm/dry periods, while Engelmann spruce decreases and likely becomes more confined to moist areas. Limber pine tends to increase with warm/dry. Ponderosa pine tends to decrease, potentially due to losses from fire. Aspen tends to increase with warm/dry conditions, likely due to increased fire.

Additional considerations for tree species presence include:

- **Limber pine:** When dominant, limber pine contributes to the ponderosa pine cover type. It may be a component in other types and at a wide range of elevations. These trees can be present in savannas, as well alongside whitebark pine. It is subject to the same stressors and risks as whitebark pine.

BASI suggests that limber pine expanded with fire exclusion and is now less viable with drought (Halofsky et al., 2018b), which contrasts the NRV modeling; it might be most viable at the lower end of range especially in nonforested PVTs.

- **Rocky Mountain juniper:** Climate and fire may limit this species to ecotones. The NRV did not reflect measurable amounts of this species on the cool moist and cold PVTs although it does occur. When dominant this species can contribute to extent of the ponderosa pine cover type. This species can encroach into nonforested cover types on the warm dry PVT and nonforested PVTs.
- **Ponderosa pine:** The desired condition and NRV reflect the importance of drought-tolerant ponderosa pine. BASI suggests that ponderosa pine will be promoted by drought (Halofsky et al., 2018b), and should be managed at the higher end of range in warm dry PVTs.
- **Douglas-fir:** Douglas-fir may be stressed with future climate, but in some areas would be the most drought-tolerant and fire-resilient tree species available. Decreases in cool moist reflect the role of climate and disturbances which favor lodgepole pine. Douglas-fir may be at lower end of range in warm dry types (in favor of ponderosa pine); lower densities would improve resilience.
- **Aspen & Cottonwood:** Aspen should be featured in riparian types. It should respond well to increased disturbance but may be limited by moisture availability. Cottonwood may be less common than it was historically, but conversely may struggle with future climate (Halofsky et al., 2018b). Cottonwood occurs more extensively outside of NFS lands in the planning area.
- **Western larch:** Western larch is vulnerable to warming and may migrate to higher elevations.
- **Engelmann spruce:** Engelmann spruce will struggle with drought, and is likely to be confined to moist sites and riparian areas especially in the warm dry PVT. Where dominant this species contributes to the Spruce/Fir cover type. It can reduce resiliency by creating canopy layers, but also provides important habitat particularly in the cool moist PVT.
- **Lodgepole pine:** Lodgepole pine is expected to decrease in warm dry sites but expand into cool, wet sites, resulting in little overall net change. In the cold PVT, lodgepole can be a competitor of whitebark pine.
- **Subalpine fir:** Subalpine fir declines in the NRV during warm/dry periods, and is expected to be less tolerant to drought than its competitors, such as whitebark pine in the cold PVT. Where dominant this species contributes to the Spruce Fir cover type. It is not drought tolerant, so could decrease to favor Douglas-fir and lodgepole pine in cool moist although it could expand in cold.
- **Whitebark pine:** Whitebark pine is expected to become more confined to the cold PVT. While the effects of climate may vary, the ability of whitebark to compete and regenerate is dependent on fire disturbances. Whitebark pine needs restoration because of the exotic disease blister rust, and effects of climate will vary; maintain/increase in cold.
- More fire and drier climate may result in more ecotones that contained species such as limber pine, juniper, ponderosa pine, and Douglas-fir shifting to nonforested conditions.

NRV compared to existing condition

The following tables display the existing condition versus NRV for tree species presence.

Table 34. Tree species presence – NRV versus existing condition – forestwide

	PSME	ABLA	JUSC	PIAL	PICO	PIEN	PIFL2	PIPO	POTR
NRV	39-42	23-27	7-8	8-9	21-24	17-19	11-12	25-27	2-3
Existing	46 (43-50)	27 (24-27)	5 (4-7)	11 (9-14)	38 (35-42)	23 (20-26)	11 (9-13)	7 (5-9)	2 (1-3)

PSME = Douglas-fir; ABLA = subalpine fir; JUSC = juniper; PIAL = whitebark pine; LAOC = western larch; PICO = lodgepole pine; PIEN = Engelmann spruce; PIFL2 = limber pine; PIPO = ponderosa pine; POPUL = cottonwood; POTR = aspen.

Table 35. Tree species presence – NRV versus existing condition – by PVT

PVT		PSME	ABLA	JUSC	PIAL	PICO	PIEN	PIFL2	PIPO	POTR
Warm Dry	NRV	73-77	N/A	17-19	N/A	7-10	1-2	19-20	64-70	2-4
	Existing	70 (65-75)	0.4 (0.4-1)	12 (9-15)	2 (0.6-3)	24 (19-29)	5 (3-7)	16 (12-20)	17 (13-21)	2 (1-4)
Cool Moist	NRV	27-33	47-57	N/A	3-4	29-34	32-36	9-11	0	2-3
	Existing	43 (37-49)	42 (36-49)	0.7 (0.7-2)	10 (6-14)	52 (45-58)	42 (36-49)	9 (6-13)	0.4 (0.4-1)	3 (1-5)
Cold	NRV	10-13	43-49	0	39-41	48-54	35-39	4-5	0	0
	Existing	15 (9-20)	54 (47-61)	0.2 (0.2-1)	31 (24-38)	51 (44-59)	32 (25-39)	5 (2-9)	0	0

See footnote for Table 34.

Table 36. Tree species presence – NRV versus existing condition – by GA

GA		PSME	ABLA	JUSC	PIAL	PICO	PIEN	PIFL2	PIPO	POTR
Big Belts	NRV	59-63	8-11	7-10	4-5	13-17	7-9	6-7	48-52	3-5
	Existing	49 (42-54)	15 (10-19)	12 (21-17)	6 (3-9)	16 (12-21)	4 (1-6)	3 (1-6)	10 (6 -13)	1 (0.3-3)
Castles	NRV	24-27	5-10	3-5	5-6	37-42	3-5	40-42	23-26	0-0.1
	Existing	48 (38-62)	15 (7-24)	2 (1.9-6)	19 (10-28)	44 (32-56)	2 (1.9-6)	15 (6-23)	6 (6-12)	2 (2-6)
Crazies	NRV	13-16	18-27	1.4-4	17-20	28-39	15.1-21.2	23.9-27.3	4.6-5.9	0.0.2
	Existing	45 (30-58)	45 (33-60)	0	21 (11-35)	33 (20 -46)	12 (2-21)	12 (4-23)	0	0
Divide	NRV	48-52	10-13	9-12	4-5	29-33	7-10	5-6	30-35	3-6
	Existing	53 (46-59)	23 (18-29)	3 (0.6-5)	8 (4-11)	59 (53-65)	13 (10-19)	2 (1-3)	3 (0.6-5)	6 (3-9)
Elkhorns	NRV	34-38	6-11	7-12	9-10	29-34	5-8	6-7	23-27	1-2
	Existing	28 (20-38)	29 (19-37)	5 (1-9)	14 (6-20)	32 (22-41)	20 (11-27)	1 (1-4)	1 (1-4)	2 (2-5)
Highwoods	NRV	53-57	3-5	5-9	0	9-12	3-6	16-18	31-40	6-9
	Existing	34 (19-50)	3 (3-10)	0	0	46 (30 -62)	0	3 (3-10)	0	3 (3-10)

GA		PSME	ABLA	JUSC	PIAL	PICO	PIEN	PIFL2	PIPO	POTR
Little Belts	NRV	39-42	21-25	8-9	6-7	21-24	16-18	19-21	31-34	0.5-1
	Existing	59 (56-62)	23 (21-26)	4 (3-5)	10 (8-12)	43 (40-46)	27 (24-30)	24 (21-26)	8 (6-10)	1 (0.3-2)
Rocky Mtn	NRV	27-33	40-47	3-4	14-15	15-19	29-32	5-6	8-10	2-4
	Existing	29 (23-35)	36 (29-43)	3 (0.4-5)	14 (9-20)	32 (26-40)	33 (27-40)	5 (2-8)	0	5 (2-8)
Snowies	NRV	41-44	20-28	3-5	9-10	25-33	16-20	5-6	23-25	6-9
	Existing	62 (54-70)	19 (13-27)	2 (2-4)	1 (1-2)	18 (12-25)	48 (39-56)	26 (19-34)	26 (19-34)	2 (2-5)
Upper Blackfoot	NRV	42-47	21-27	7-10	7-8	27-32	15-18	8-10	25-29	0.5-1
	Existing	45 (40-51)	34 (28-39)	2 (0.6-4)	7 (3-9)	46 (40-51)	15 (11-19)	9 (7-13)	1 (1-3)	1 (0.2-3)
	The Upper Blackfoot also contains WL on 1% (1.1-2.1), with a NRV of 0.1%.									

See footnote for Table 34.

Forestwide tree species distribution desired conditions

The following figures display the desired condition for tree species distribution forestwide and by broad PVT, which are enumerated in FW-VEGF-DC-01 in the Plan. The following specific adjustments and rationale also apply:

- The desired condition of Rocky Mountain juniper is adjusted to be lower than the NRV, due to BASI that indicates it is more prevalent than it was historically, particularly on lands that were maintained in a nonforested condition due to frequent fire; and future climate/fire regimes may promote nonforested communities (Kitchen, 2010).
- The upper bound of the desired range for aspen is higher than NRV because BASI indicates aspen and cottonwood have decreased from historic (Bartos, 2001; Halofsky et al., 2018b, in press). Cottonwood may struggle with expected drought. Aspen is the more common of these two species on the HLC NF; but in both cases existing data does not represent them well due to their scattered, isolated distribution. They are combined for ease in quantifying.
- The desired upper bound for whitebark pine is above the NRV to account for the importance of this species as a proposed species under the Endangered Species Act, and BASI that indicates it has decreased from its historic condition (Halofsky et al., 2018b, in press; Keane et al., 2012; U.S. Department of the Interior, 2010; Wong & Daniels, 2016).
- The desired condition for ponderosa pine on the cool moist PVT is slightly higher than NRV to allow for the possibility that it may compete at higher elevations in the future (Halofsky et al., 2018b).

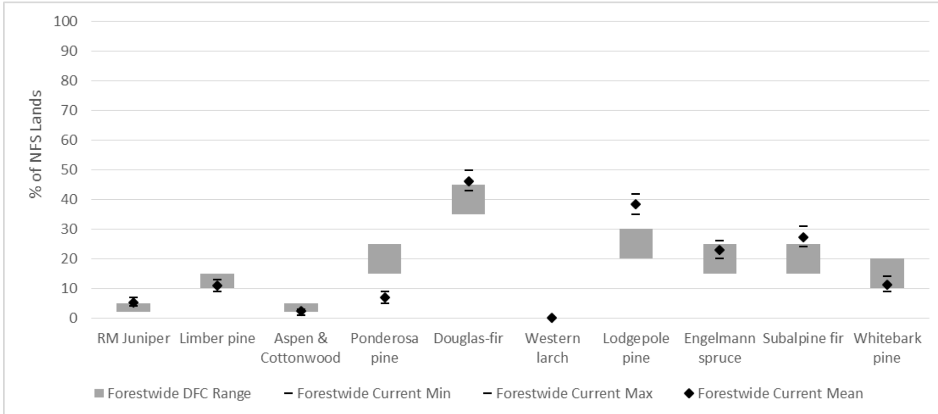


Figure 17. Forestwide tree species presence existing and desired conditions

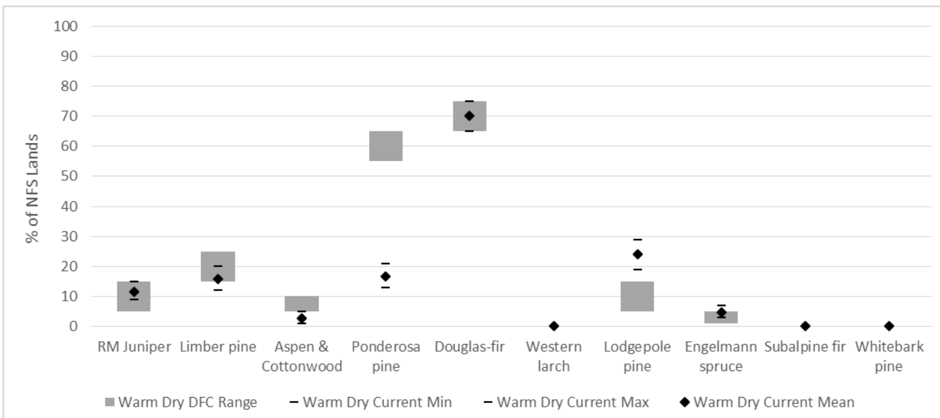


Figure 18. Warm dry PVT tree species presence existing and desired conditions

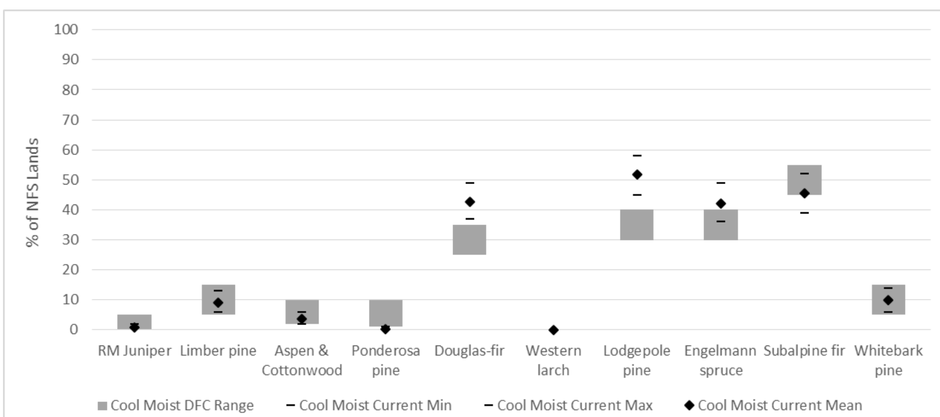


Figure 19. Cool moist PVT tree species presence existing and desired conditions

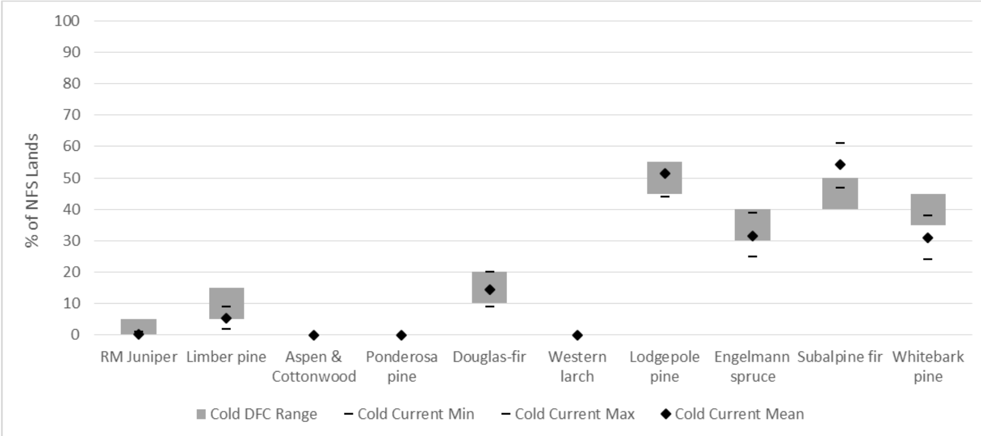


Figure 20. Cold PVT tree species presence existing and desired conditions

Geographic area tree species distribution desired conditions

Species presence desired conditions are also developed for each GA, as shown in chapter 3 of the Plan. Additional species may occur in minor amounts. Refer to the discussion under forestwide desired conditions for rationale regarding the variance of desired ranges from NRV. The same assumptions used to develop the desired conditions forestwide for all species apply to the GA components. Other applicable GA-level considerations, if any, are described below.

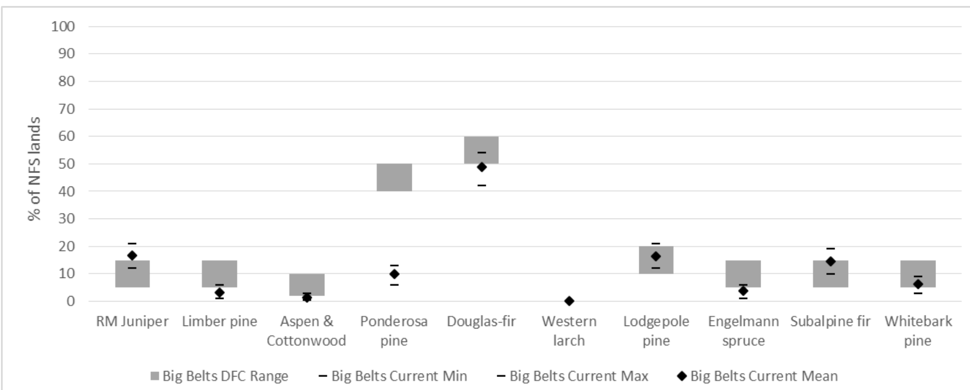


Figure 21. Big Belts tree species presence existing and desired conditions

In the Big Belts GA, limber pine should be promoted, while the extent of Rocky Mountain juniper should be reduced, especially in warm dry PVTs areas to enhance the resilience of dry forests, savannas, and grass/shrublands. Ponderosa pine should also be promoted, considering that open savanna structures may be appropriate. Douglas-fir should be maintained or promoted where it does not compete with ponderosa or limber. Aspen should be promoted when opportunities arise. Engelmann spruce is relatively uncommon in this GA and confined to moist sites. The extent of lodgepole pine is currently within the desired range. Subalpine fir should be reduced particularly where competing with whitebark pine.

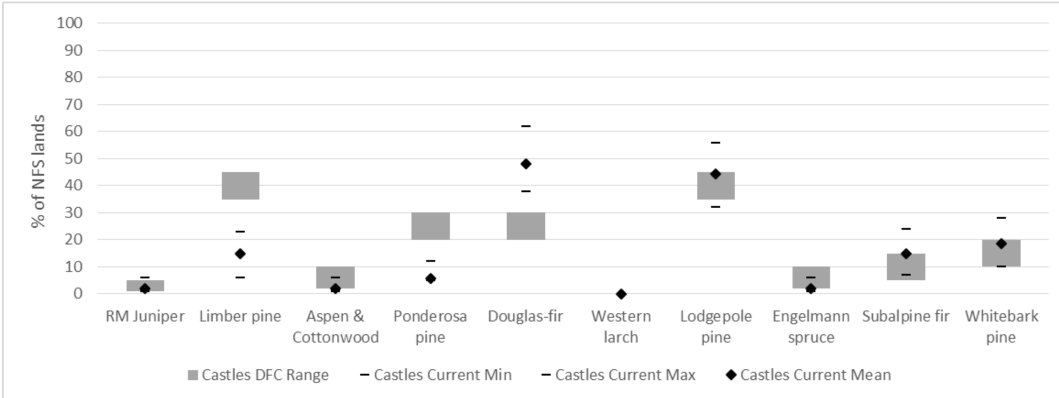


Figure 22. Castles tree species presence existing and desired conditions

Limber pine and ponderosa pine should be promoted on the warm dry PVT. Rocky Mountain juniper should be maintained at densities and locations that do not detract from the resilience of dry forests, savannas, and grass/shrublands. The extent of Douglas-fir should be decreased. Promote aspen when opportunities arise and maintain or promote Engelmann spruce. Lodgepole pine is at the upper end of the desired range. Generally maintain or decrease subalpine fir, with the goal of maintaining whitebark pine.

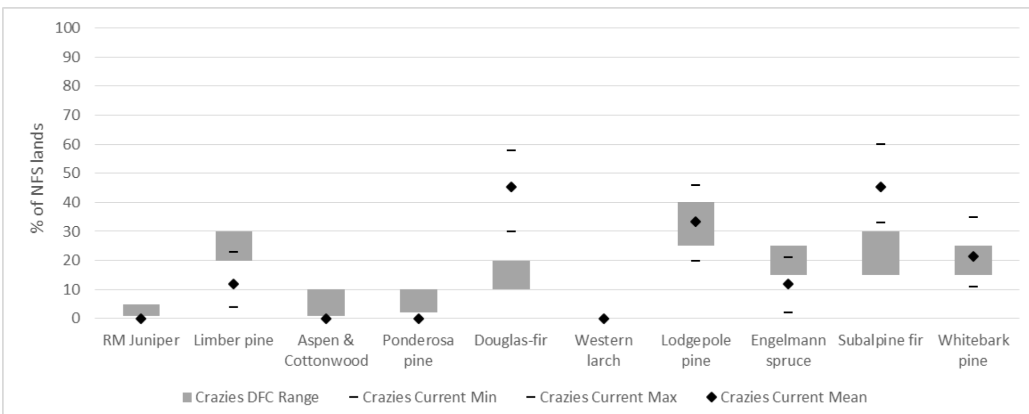


Figure 23. Crazies tree species presence existing and desired conditions

In the Crazies GA, the desired conditions indicate a need to increase extent of limber pine. Maintain Rocky Mountain juniper where opportunities arise; this species is rare. Increase extent of ponderosa pine on suitable sites; this species is also rare in this GA. Decrease Douglas-fir, especially where competing with limber or ponderosa. Promote aspen as opportunities arise. Increase the extent of Engelmann spruce on suitable (moist) sites. Generally maintain the extent of lodgepole pine. Decrease extent of subalpine fir, to favor lodgepole or whitebark pine. Maintain and promote whitebark pine.

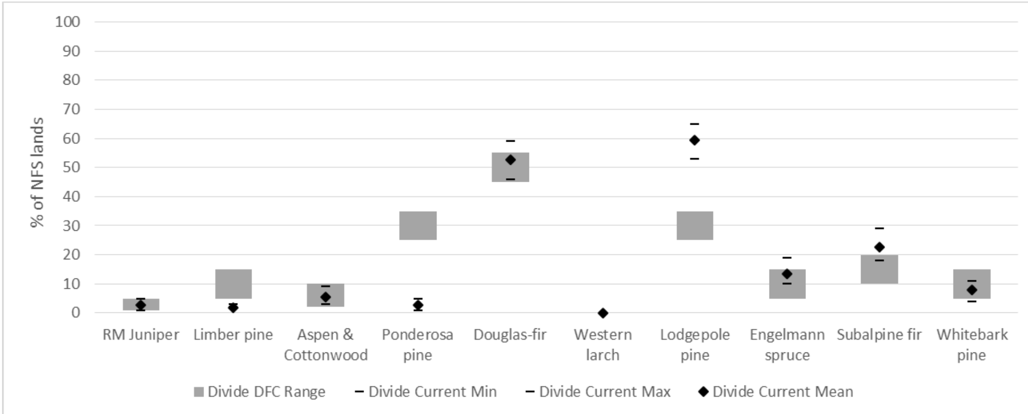


Figure 24. Divide tree species presence existing and desired conditions

In the Divide GA, slightly increase limber pine within the extent of its range (east of the Continental Divide). Maintain juniper where it does not detract from nonforested communities. Focus on increasing ponderosa pine on the warm dry PVT, east of the divide. Maintain or slightly decrease Douglas-fir to favor ponderosa pine. Maintain and promote aspen, which is particularly prevalent. Slightly decrease Engelmann spruce. Decrease lodgepole pine where it competes with ponderosa pine, aspen, or whitebark pine. This species is particularly prevalent in this GA. Decrease extent of subalpine fir, especially where it competes with whitebark. Maintain or increase whitebark pine, focusing in cold PVTs.

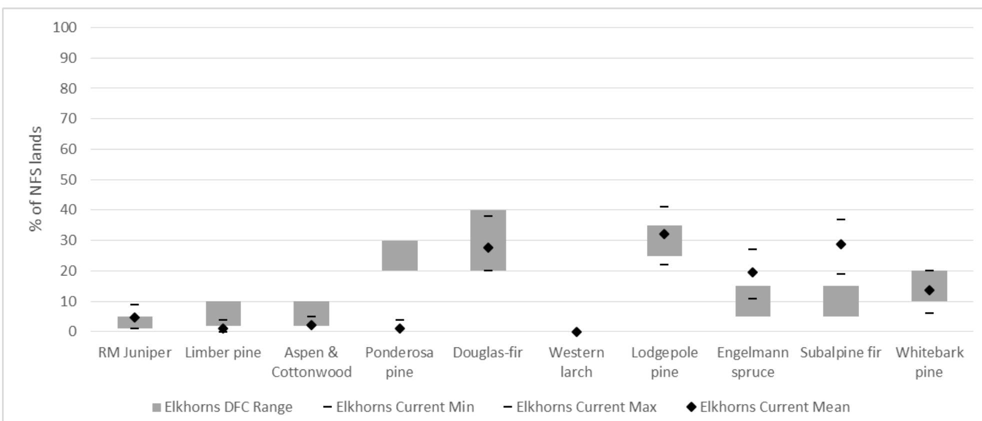


Figure 25. Elkhorns tree species presence existing and desired conditions

In the Elkhorns GA, the DCs indicate a need to slightly increase limber pine extent; this should be focused on sites most suited to forest vegetation or as very open savannas, rather than nonforested types. Decrease and maintain juniper in densities and locations that do not detract from resilience of dry forests and nonforested types. Increase extent of ponderosa pine on the warm dry PVT. Generally maintain extent of Douglas-fir, potentially as a minor component in areas dominated by ponderosa pine. Promote aspen as opportunities arise. Decrease Engelmann spruce, especially where it competes with whitebark pine. Generally maintain extent of lodgepole pine. Decrease subalpine fir, where it competes with whitebark or lodgepole. Maintain and promote whitebark pine as opportunities arise.

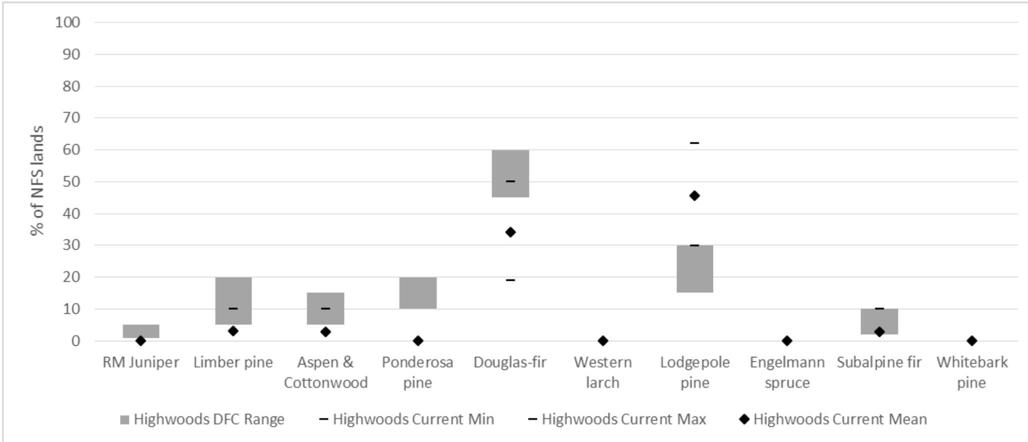


Figure 26. Highwoods tree species presence existing and desired conditions

In the Highwoods, the extent of limber pine should be increased on suitable sites. The lower bound of the desired range is adjusted down from the NRV to account for the needs of mountain goat habitat connectivity that is declining in parts of the GA due to limber encroachment (Mello, 1978; Rice & Gay, 2010). Increase extent of juniper; species is rare but known to occur in this GA. Increase ponderosa pine; species is rare but known to occur. The desired condition is below the NRV because suitable sites will be limited. There is a need to increase extent of Douglas-fir in this GA. This may be the most long-lived and fire resilient species available on some dry sites. Increase the extent of aspen. Decrease lodgepole pine but the species should remain common. The desired range is adjusted above the NRV to account for this species being more viable than ponderosa pine on many sites. Maintain extent of subalpine fir.

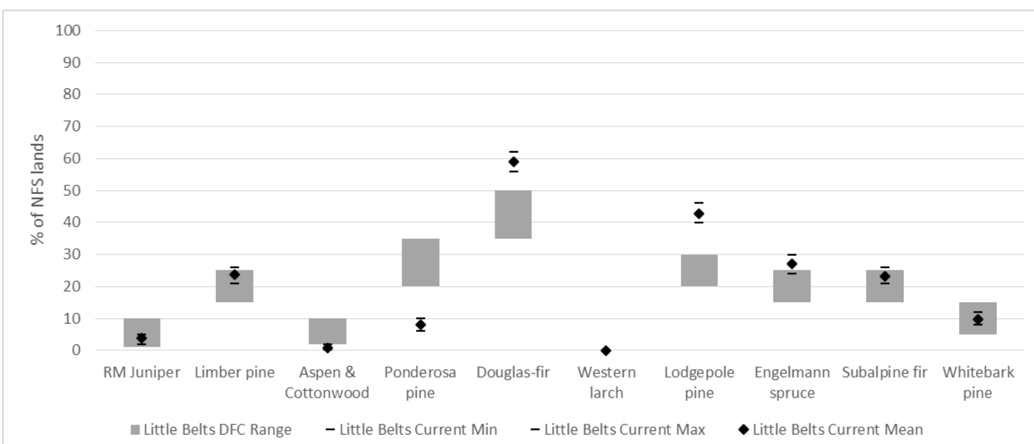


Figure 27. Little Belts tree species presence existing and desired conditions

The Little Belts are similar to the overall Forest depiction of tree species presence. Generally maintain extent or slightly decrease limber pine on dry sites. Maintain juniper at densities and locations that do not detract from extent and resilience of dry forests, savannas, and grass/shrublands. Increase extent of ponderosa pine as opportunities arise. Decrease extent of Douglas-fir primarily to favor ponderosa pine. Promote aspen where opportunities arise. Decrease Engelmann spruce, especially where it competes with whitebark pine. Decrease extent of lodgepole pine. Generally maintain or slightly decrease extent of subalpine fir. Generally maintain and promote whitebark pine where opportunities arise.

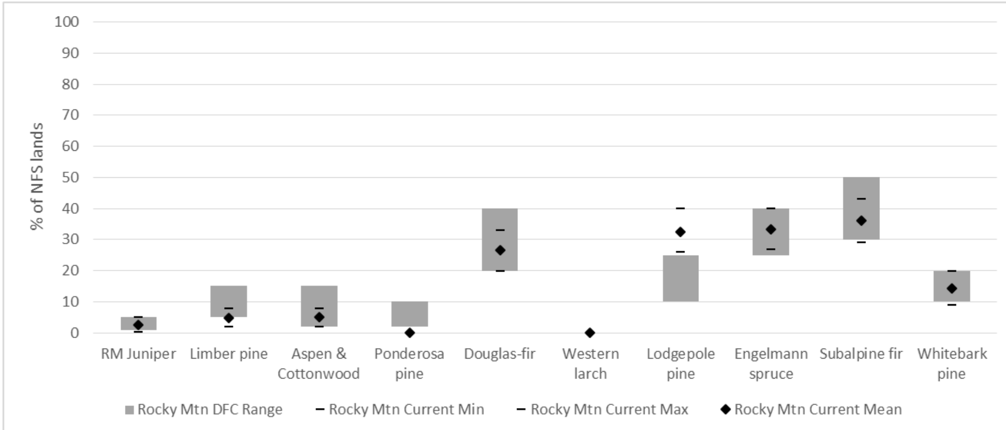


Figure 28. Rocky Mountain Range tree species presence existing and desired conditions

In the Rocky Mountain GA, promote limber pine. Maintain juniper, where it does not detract from nonforested types. Maintain and promote ponderosa pine where possible. Generally maintain extent of Douglas-fir. Promote aspen where possible. Generally maintain extent of Engelmann spruce; this GA has more of this species than most other areas. Decrease extent of lodgepole pine to favor other species diversity in burned areas. Generally maintain extent of subalpine fir. Generally maintain and promote whitebark pine where opportunities arise.

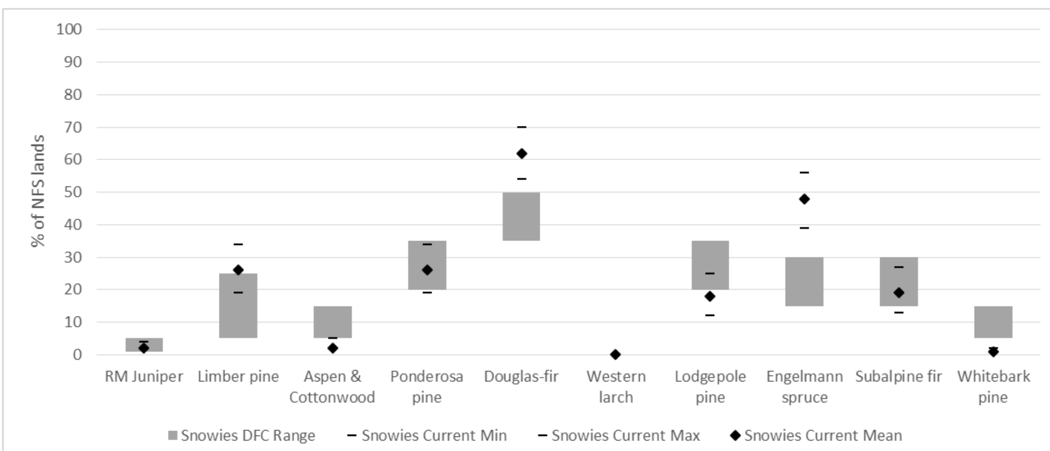


Figure 29. Snowies tree species presence existing and desired conditions

In the Snowies GA, the upper bound of the desired condition for limber pine is higher than NRV to reflect BASI that this species is less abundant than historically (Means, 2011). Maintain extent of juniper, where it does not detract from nonforested types. Maintain the extent of ponderosa pine - the Little Snowies is unique for its ponderosa pine community. Decrease Douglas-fir, especially where it reduces resilience of ponderosa. Increase the extent of aspen when opportunities arise. Decrease Engelmann spruce, especially where it competes with whitebark pine. Increase lodgepole pine, where it may be more resilient than spruce/fir. Generally maintain extent of subalpine fir. Increase extent and promote whitebark pine where opportunities arise.

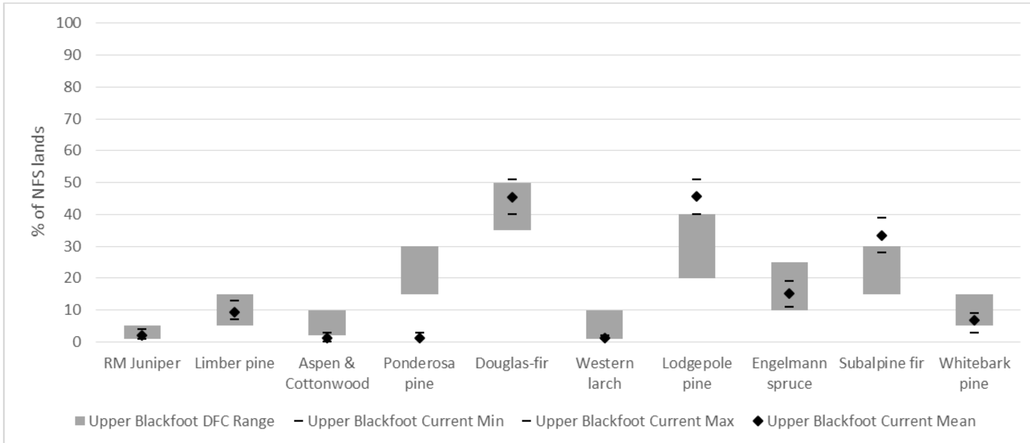


Figure 30. Upper Blackfoot tree species presence existing and desired conditions

In the Upper Blackfoot GA, the desired conditions indicate a need to maintain the extent of limber pine and juniper where they do not detract from nonforested types. Increase extent of ponderosa pine and aspen where opportunities arise. Generally maintain extent of Douglas-fir. Generally maintain extent of Engelmann spruce. Decrease extent of lodgepole pine, especially where competing with whitebark. Maintain western larch on suitable sites. The desired condition for western larch is slightly higher than NRV to reflect the existing levels which are desirable for diversity. Decrease subalpine fir, especially where it competes with whitebark pine. Maintain extent of whitebark pine. The upper bound of the desired condition for whitebark pine is adjusted up from NRV to reflect the existing amount which is desired given its proposed species status under the Endangered Species Act.

Desired conditions for structure and pattern

Discussion/summary

Forest size class is an indicator of the seral stage. Modeling indicates that large and very large size classes were at the lower end of the NRV range during warm/dry periods; this level still exceeds the existing condition. The seedling/sapling class fluctuates according to the size and frequency of stand replacing disturbance. Substantial proportions of the forest should be in the mid-successional stages of development (small to medium), where they can remain for long periods. Less dense forests or those on more productive sites may transition to large size class quickly, while higher density forests or those on harsh growing sites may take longer. Some cover types (such as lodgepole pine) may remain in the small and medium classes their entire lifespan. Many stands of all species will never achieve a very large size class, due to growing conditions and/or disturbances. A limited amount of the very large forest size class is possible based on the species and growing conditions found on the HLC NF.

Density class and vertical structure further describe landscape diversity in structure. The NRV analysis indicated that the low/medium canopy cover class was common, especially on the warm dry broad PVT. Many forests on the cool moist PVT also had low/medium density, which were likely forests in their early and mid-successional stages or older forests where disturbances opened up the canopy. In all types, the shift toward higher densities reflects the impacts of fire exclusion and the increased abundance of shade tolerant species. Low/medium density forests were at the higher end of their natural ranges during warm/dry periods, whereas medium/high and high density forests were at the lowest end. Vertical structures vary by cover type and disturbance regime; for example, lodgepole pine tends to be maintained in a 1-story condition by stand-replacing disturbance and regeneration ecology, whereas spruce/fir may be more likely to develop a multi-storied condition.

The abundance, average, and range of sizes of *early successional forest patches* (transitional and seedling/sapling size classes) is the key ecosystem characteristics to represent landscape pattern. Large fires would typically be associated with warm climatic periods and drought conditions.

The matrix below (Table 37) displays the relationship between the existing conditions and the desired conditions for structure and pattern. These comparisons are made using mean values and do not account for the error bars. Charts with error bars are available in the project record for alternatives A and F. Large-tree structure, vertical structure, early successional openings, old growth, snags, and coarse woody debris were not summarized by GA, because there are no GA desired conditions. There is less variability in structure than there is for species composition. The small tree size class is consistently above the desired condition, and the large and very large size classes (along with large-tree structure) are consistently below. The high-density class is commonly above the desired range and the lower density classes below.

In warm dry PVT, large and very large sizes forests would have been relatively open or clumpy patch mosaics, with the large trees generally being long-lived species capable of surviving moderate or low severity fire when mature. In sheltered riparian areas, groves of large Engelmann spruce could develop. The warm dry PVT is the most substantially departed from the NRV due to fire exclusion. These sites also historically supported more open forests. A variety of structure classes would be appropriate depending on the site. Single-storied forests are common, but in some cases may represent forests where low severity disturbance has not opened up the canopy to allow for understory trees to establish in a widely spaced distribution. Promoting multi-storied, yet open, forests would be desirable in some of these areas.

In cool moist PVTs, the need to increase large size classes is less pronounced because many areas are dominated by lodgepole pine, which naturally does not reach large sizes. In areas with large size classes, a fire tolerant large diameter overstory tree layer would typically exist (Douglas-fir) atop a more dense mid and understory tree layer. Large, old Engelmann spruce and subalpine fir could occur in moist settings. The abundance of the high-density class may be indicative of dense understories of shade tolerant trees developing under lodgepole pine in the absence of fire, and/or with the release of these components due to mountain pine beetle infestation. A single storied condition is naturally abundant, reflecting the traits of lodgepole pine. Multi-storied forests are also important and are likely found in spruce/fir cover types.

In cold PVTs, the very large tree class is within the desired range, because the harsh conditions and species present on these sites make the achievement of a very large size difficult. Whitebark pine was historically the large tree component. Large subalpine fir and Engelmann spruce would develop in moist sites. In the past, fire promoted more open and uneven-aged whitebark pine forests. Single storied forests are likely dominated by lodgepole or whitebark pine, while spruce and fir would grow in a multistoried condition. Single-storied forests are at the high end of their natural abundance during warm/dry periods while two and multi-storied conditions are at the low end. A focus on increased resiliency through decreased density is important. The overabundance of high-density forests may reflect the shift from whitebark pine to spruce and fir with fire exclusion and other threats facing whitebark pine.

Forestwide and in all PVTs except cold, the current average seedling/sapling patch size is greater than the NRV mean and the 95th percentile range. In cold, the current average patch size is at the upper end of this range. In the future, reductions in patch size could occur where increased resiliency and landscape diversity results in stand-replacing disturbances that are more limited in time and space. Conversely, the impacts of climate change and increases in wildfires could result in a continuation of larger patch sizes.

Table 37. Matrix of existing condition (FIA) compared to desired condition at multiple scales – structure and pattern

	Forestwide	Warm Dry	Cool Moist	Cold	Big Belts	Castles	Crazies	Divide	Elkhorns	Highwoods	Little Belts	Rocky Mountain	Snowies	Upper Blackfoot
Seedling/Sapling size class	W	W/A	W	W	W	W	W	W	W/A	W/B	W	A	W	W
Small tree size class	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Medium tree size class	W/A	A	W	W	W/A	W	W	W	W	A	W/A	W	W/A	W
Large tree size class	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Very large tree size class	B	B	B	W/B	B	W/B	W/B	B	B	B	B	B	B	B
Large-tree structure (large)	B	B	B	B	N	N	N	N	N	N	N	N	N	N
Large-tree structure (Vlarge)	B	B	B	W/B	N	N	N	N	N	N	N	N	N	N
NF/Low/Med density class	W/B	W/B	W/B	B	W	W	B	B	B	B	B	W	B	W
Medium/High density class	W/B	W	B	B	W/B	W	W	W	W	W	B	B	B	W
High density class	A	W	A	A	W/A	W	W/A	A	A	A	A	A	A	W
Single-storied structure[1]	N	A	A	W	N	N	N	N	N	N	N	N	N	N
2-storied structure[1]	N	A	W	W/B	N	N	N	N	N	N	N	N	N	N
Multi-storied structure[1]	N	B	B	B	N	N	N	N	N	N	N	N	N	N
Early successional forests	A	A	A	W/A	N	N	N	N	N	N	N	N	N	N

W = within the DC range; A = above the DC range; B = below the DC range; N = not present or no DC for that scale.
When the existing condition is right at the boundary of the DC range, it is noted as W/A (at the upper end of the range) or W/B (at the lower end of the range).
[1]Vertical structure is shown relative to the NRV; there are no quantitative DCs for this; rather, it is addressed qualitatively as it relates to density class.
Items shaded in the dark gray tones and white font indicate conditions at the upper bound or above the desired range. Items shaded in light gray tones indicate conditions at the lower bound or below the desired range. Cells with no shading are within the desired ranges or are not present/applicable.

Forest size class

Data and modeling considerations

The way SIMPPLLE and the R1 Classification System define size class is not the same. The R1 Classification System assigns a size class based on the average basal area-weighted diameter. With this method, plots classified in a size class may be dominated by trees that are smaller and/or larger than the assigned size class. Conversely, in SIMPPLLE, average stand diameter is assigned based on the age of the stand, using assumptions of how long each seral stage takes to progress into the next. These assumptions were crafted using professional expertise and reflect the largest, but not necessarily dominant, trees in the stand. For example, a stand with an overstory of large trees with high ingrowth of small trees may be classified as small by the R1 Classifier but classified as a large in SIMPPLLE. The result of this is that the presence of large trees has a greater influence on the stand being classified into a large tree size class in SIMPPLLE than in the R1 Classification System, and therefore the NRV is not directly comparable to the existing condition.

To account for this, the large and very large size classes are adjusted from the NRV. The attribute of *large-tree structure* estimated on plots is more analogous to how size class is classified in SIMPPLLE (see appendix D of the Plan for large-tree structure definitions). The relationship between large tree structure and size classes on FIA plots is used to create an adjustment factor for SIMPPLLE size class. Currently, most large-tree structure occurs in plots with smaller average size classes. Some proportion (but not all) of such areas may be classified as large size classes in SIMPPLLE. Table 38 shows the proportions of smaller size classes that could be classified as larger classes in SIMPPLLE, and the adjustment used on model results to be more comparable to the existing condition. These adjustments were applied to in the tables in this section and are labeled “NRV adjusted”.

Table 38. SIMPPLLE size class adjustments

R1 classification size class	% w/ large tree structure (FIA)	% w/ very large tree structure (FIA)	Proportion that could be mis-classified	SIMPPLLE Adjustment
Seedling/ Sapling	4%	4%	8%	Increase 5%
Small Tree	37%	16%	53%	Increase 25%
Medium Tree	42%	35%	77%	Increase 40%
Large Tree	7%	19%	26%	Decrease 40%
Very Large Tree	<1%	11%	11%	Decrease 30%

In addition, the desired conditions for size class only include forested areas; therefore, the percentages in the tables do not add up to 100%. Roughly 14% of the Forest total does not have a forest size class assigned in the existing condition. The ranges and confidence intervals around size class are large due to high variability (disturbances). Therefore, there is less uniqueness at the GA scale than with composition.

Correlation to warm/dry climate periods and other considerations

The seedling/sapling size class (<5” dbh) tends to increase and then fall during warm/dry periods, in response to increased fire and subsequent growth into small trees. The small tree size class (5-9.9” dbh) consistently increases during warm/dry periods. The medium tree class (10-14.9” dbh) is generally at the lowest end of its NRV range during warm/dry periods, and the large tree (15-19.9” dbh) and very large tree (20”+dbh) size classes decline and are at the lower end of their ranges during these times.

NRV and existing condition values

The tables below display adjusted NRV size class data versus the existing condition.

Table 39. Forest size class, NRV versus existing condition – % forestwide

	Seed/sap	Small tree	Medium tree	Large tree	Very large tree
NRV adjusted	1-15	4-18	4-20	23-28	9-24
Existing	13 (10-17)	39 (36-42)	21 (19-24)	5 (4-7)	2 (1-3)

Table 40. Forest size class – NRV versus existing condition – % by PVT

PVT		Seed/sap	Small tree	Medium tree	Large tree	Very large tree
Warm dry	NRV Adjusted	1-9	2-9	2-8	22-38	14-40
	Existing	11 (7-15)	36 (31-41)	25 (21-29)	9 (6-12)	4 (2-6)
Cool moist	NRV Adjusted	1-22	5-27	6-32	20-27	9-23
	Existing	12 (7-18)	42 (36-48)	24 (20-29)	4 (2-7)	0.2 (0.2-0.7)
Cold	NRV Adjusted	2-33	7-40	5-45	26-41	2-5
	Existing	22 (14-30)	44 (37-51)	14 (9-18)	1 (0.1-3)	0.2 (0.2-0.9)

Table 41. Forest size class - NRV versus existing condition – % of GA

GA		Seed/sap	Small	Medium	Large	Very large
Big Belts	NRV Adjusted	1-14	3-15	3-16	19-29	11-31
	Existing	7 (4-11)	31 (24-36)	18 (14-23)	8 (5-11)	2 (0.7-5)
Castles	NRV Adjusted	0.7-19	2-23	2-26	26-35	6-15
	Existing	7 (2-13)	50 (39-62)	7 (2-14)	13 (6-23)	4 (4-9)
Crazies	NRV Adjusted	0.7-22	2 -24	3-27	21-32	3-8
	Existing	5 (5-12)	43 (28-55)	10 (2-20)	12 (2-21)	5 (5-16)
Divide	NRV Adjusted	2-22	7-27	5-25	19-25	9-26
	Existing	17 (11-25)	46 (39-52)	17 (12-21)	6 (3-9)	3 (1-6)
Elkhorns	NRV Adjusted	1-21	6-26	4-26	15 -22	6-18
	Existing	21 (9-34)	29 (19-37)	9 (4-16)	7 (2-13)	0
Highwoods	NRV Adjusted	0.6-12	2-13	2-11	18-32	10-30
	Existing	0	23 (9-37)	23 (10-38)	3 (3-10)	0
Little Belts	NRV Adjusted	1-15	3-19	4-22	25-33	9-26

GA		Seed/sap	Small	Medium	Large	Very large
	Existing	10 (7-13)	46 (43-49)	26 (24-29)	5 (4-7)	2 (0.7-3)
RM Range	NRV Adjusted	1-13	4-16	3-17	22-28	8-21
	Existing	21 (16-27)	29 (24-33)	16 (13-20)	1 (0.3-3)	0
Snowies	NRV Adjusted	0.7-20	3-24	4-28	20-29	7-23
	Existing	14 (9-23)	47 (39-56)	27 (19-34)	1 (1-3)	1 (1-3)
Upper Blackfoot	NRV Adjusted	2-20	4-24	5-27	21-27	9-25
	Existing	17 (12-25)	30 (25 - 35)	18 (14-22)	7 (4-10)	0 (0.4-1)

Forestwide forest size class desired conditions

The following series of figures show the desired conditions for size class, forestwide and by PVT, as enumerated in FW-VEGF-DC-02. Desired ranges take into account the size class adjustment and warm/dry climate. Nonforested areas are not included; therefore, proportions do not add up to 100%. The array of size classes should occur on forested PVTs, and not as encroachment into nonforested areas. Overall, in most areas a shift toward large size classes is warranted. This may be achieved through succession as small and medium trees grow larger; as well as through disturbances or management that reduce density and increase growth rates and/or remove smaller trees. Shifts from the larger size classes into the seedling/sapling class may result from stand-replacing disturbance or vegetation management.

Forestwide, the desired conditions call for an increase in the large and very large size classes, with corresponding decreases in the small class and, to a lesser degree, medium. In the warm dry PVT, seedling/sapling and small classes should be present but limited relative to the other PVTs, because larger tree remnants would be left by natural disturbance regimes or management that imitates them. Still, small trees would remain abundant. In the cool moist PVT, smaller size classes should be prevalent due to abundance of lodgepole pine. There is wide variability because of the high severity, low frequency disturbance regime. Size class distribution is important to ensure disturbances occur at a natural scope and scale. In the cold PVT, the NRV is very wide. The proportions are currently heavy to the small class likely due to the preponderance of spruce and fir on these sites, and mortality of whitebark pine.

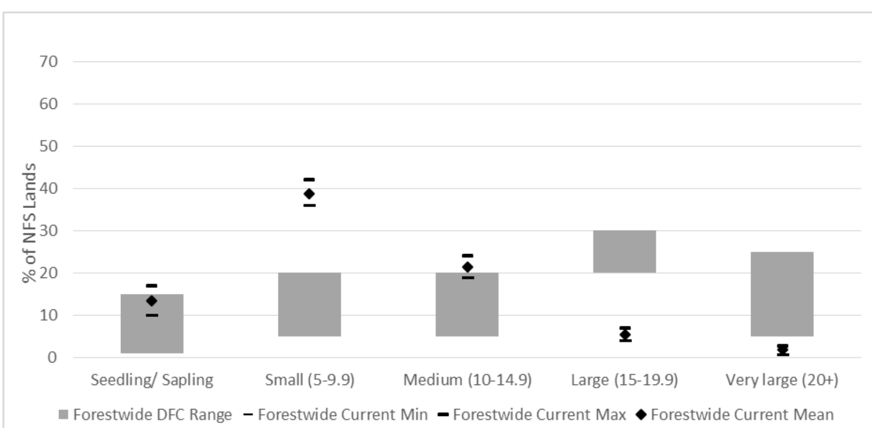


Figure 31. Forestwide forest size class existing and desired conditions

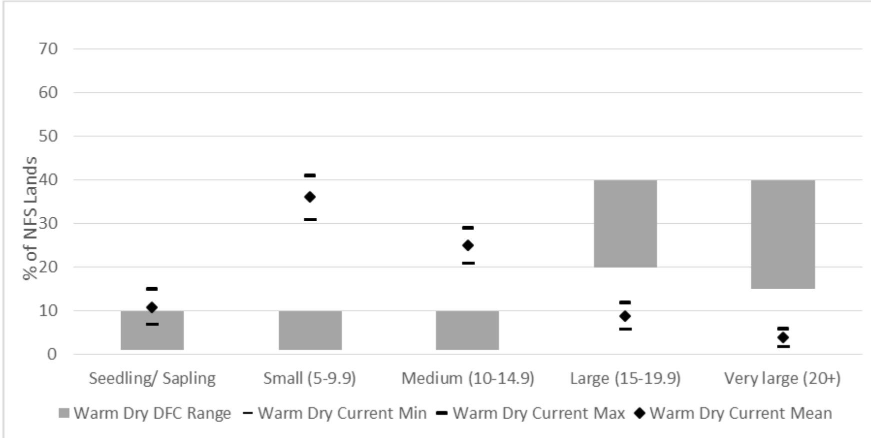


Figure 32. Warm dry PVT forest size class existing and desired conditions

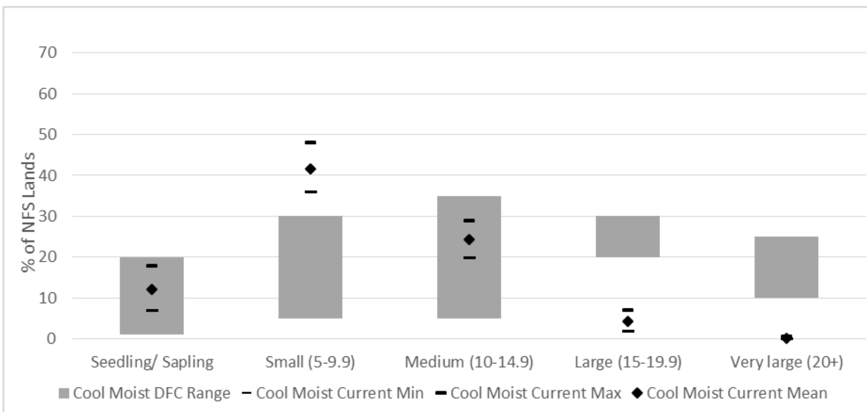


Figure 33. Cool moist PVT forest size class existing and desired conditions

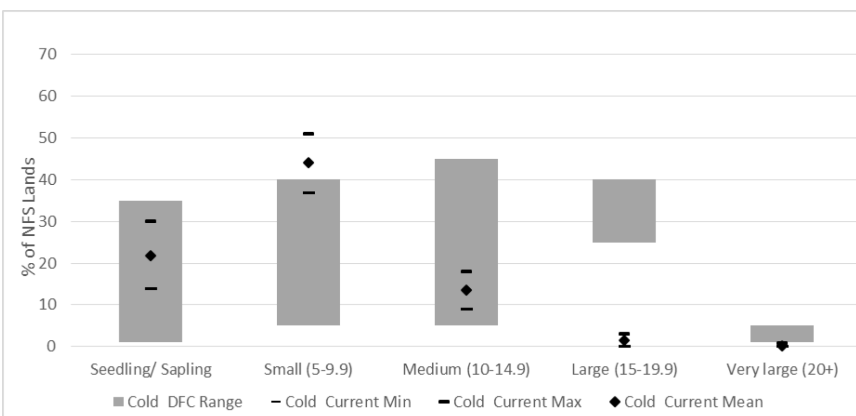


Figure 34. Cold PVT forest size class existing and desired conditions

GA quantitative size class desired conditions

There was relatively little variance across GAs with respect to the NRV for size class distribution, and they are similar to forestwide ranges. This indicates that primary differentiation in size class is responsive to PVT rather than topographical location. Nevertheless, GA-level plan components are provided in chapter 3, as shown in the following series of figures, to ensure that the array of size classes and associated habitat conditions are provided in each GA. In most GAs, it is desirable for the large size classes to increase, along with decreases in the small and/or medium size classes.

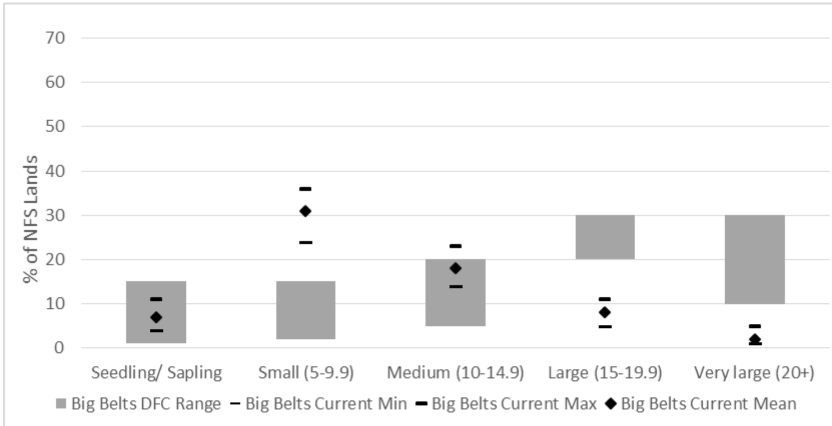


Figure 35. Big Belts size class existing and desired conditions

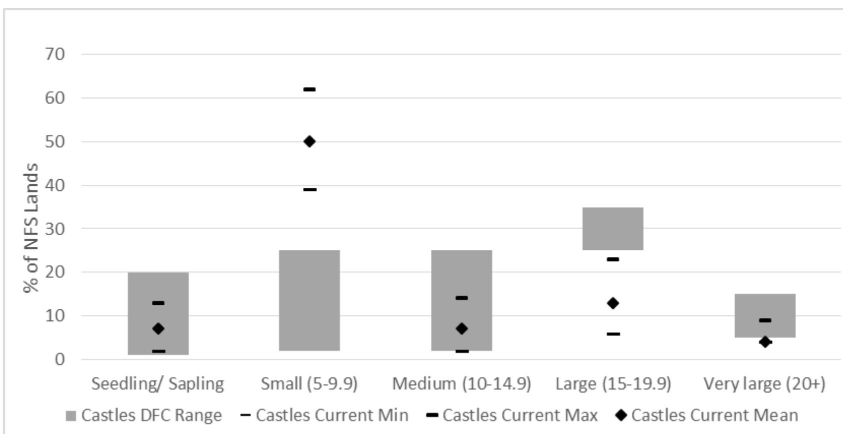


Figure 36. Castles size class existing and desired conditions

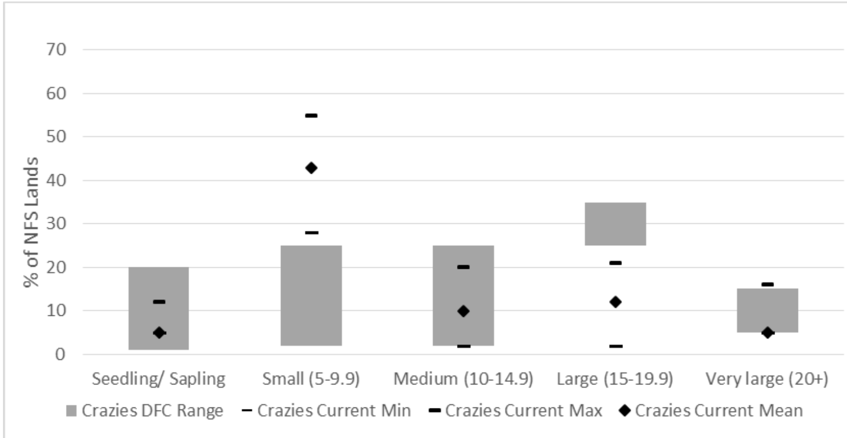


Figure 37. Crazies size class existing and desired conditions

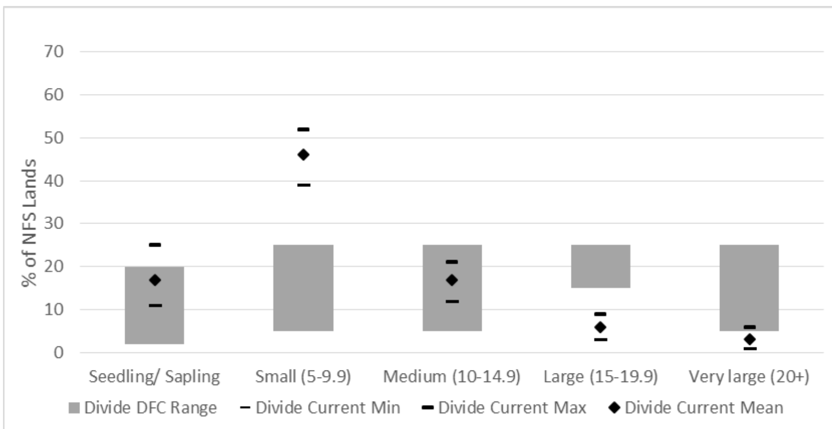


Figure 38. Divide size class existing and desired conditions

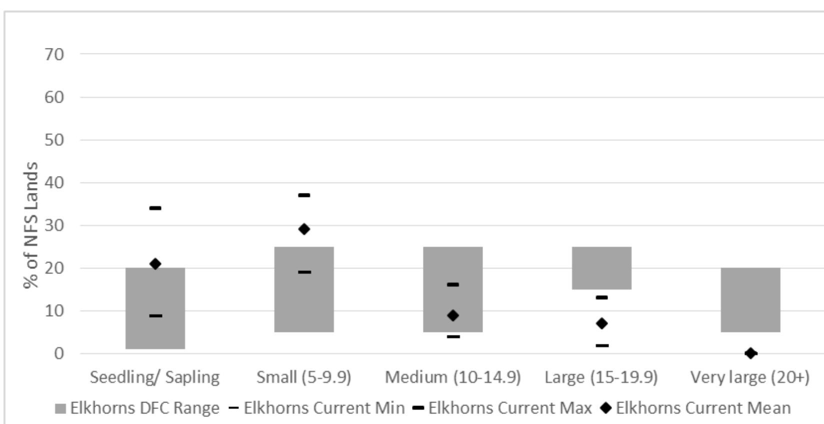


Figure 39. Elkhorns size class existing and desired conditions

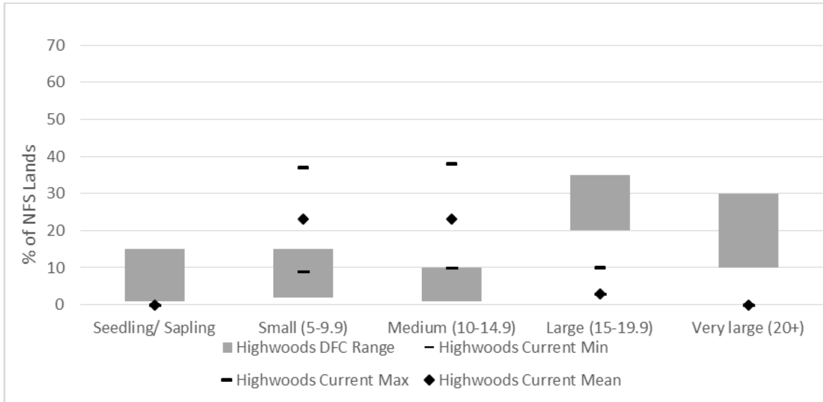


Figure 40. Highwoods size class existing and desired conditions

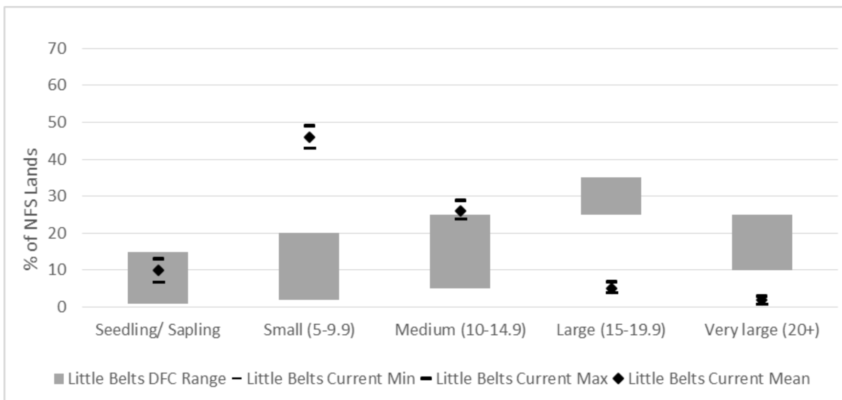


Figure 41. Little Belts size class existing and desired conditions

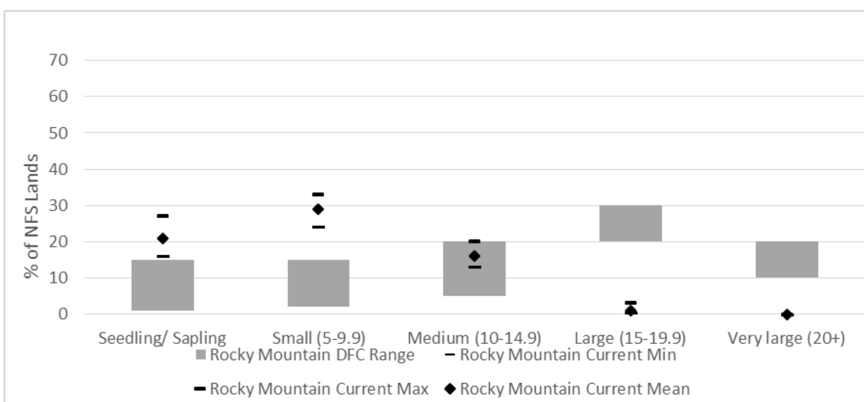


Figure 42. Rocky Mountain size class existing and desired conditions

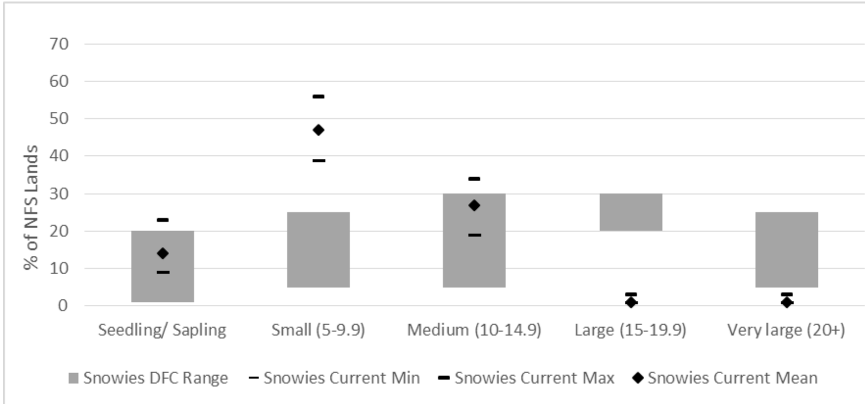


Figure 43. Snowies size class existing and desired conditions

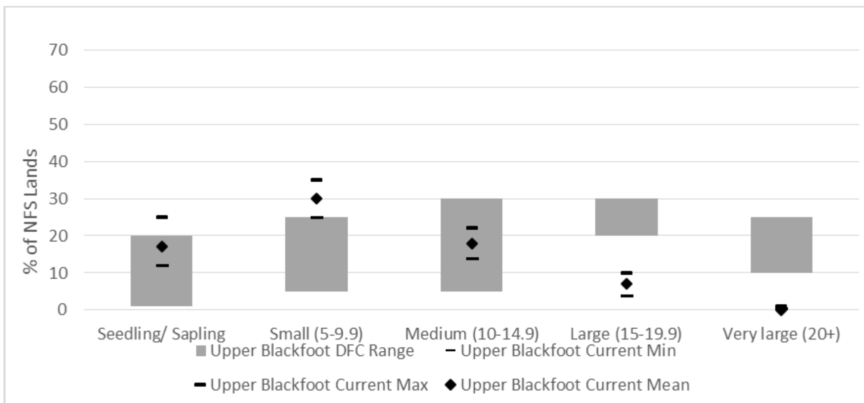


Figure 44. Upper Blackfoot size class existing and desired conditions

Large-tree structure

Data and modeling considerations

Large-tree structure (as defined in appendix D of the Plan) identifies where large and very large trees are present in sufficient numbers to contribute to key ecosystem processes. This structure may occur within any forest size class. Based on FIA data, currently forestwide a large-tree structure is found in 2% of the seed/sap class; 20% of the small tree class; 81% of the medium tree class; 90% of the large tree class; and 100% of the very large tree class. SIMPPLLE does not track these classes explicitly. However, as discussed in the size class section, this attribute can be directly compared to the SIMPPLE NRV outputs for large and very large tree size classes.

Correlations to warm/dry climate periods and other considerations

The large and very large tree size classes generally decline and are at the low end of their NRV ranges during warm/dry climate periods, likely due to fire. We expect more fires and insect outbreaks; these components provide key seed sources to contribute towards resiliency to disturbances and drought.

NRV and existing condition values

Table 42 compares existing condition of the large-tree structure versus the NRV. A small number of these components occur on nonforested PVTs in the R1 summary database (3%); but SIMPPLLE did not assign size class to these areas, so this amount is excluded from the comparison.

Table 42. Distribution of large-tree structure, existing condition versus NRV

PVT		Large	Very large
Forestwide	NRV	38-47	13-34
	Existing	14 (12-16)	7 (6-9)
Warm dry	NRV	37-64	19-57
	Existing	16 (13-19)	13 (9-16)
Cool moist	NRV	34-45	13-33
	Existing	16 (12-20)	5 (3-7)
Cold	NRV	43-68	3-7
	Existing	9 (6-13)	2 (0.5-3)

Forestwide large-tree structure desired conditions

The following figures display the desired condition of large-tree structure forestwide by broad PVT, as enumerated in FW-VEGF-DC-04. The desired ranges are derived from the NRV modeling of the large and very large size classes. This attribute complements desired size class distributions which indicate that the large/very large size classes should be increased; however, this metric underscores the importance of promoting large trees even in stands that classify into a smaller size class.

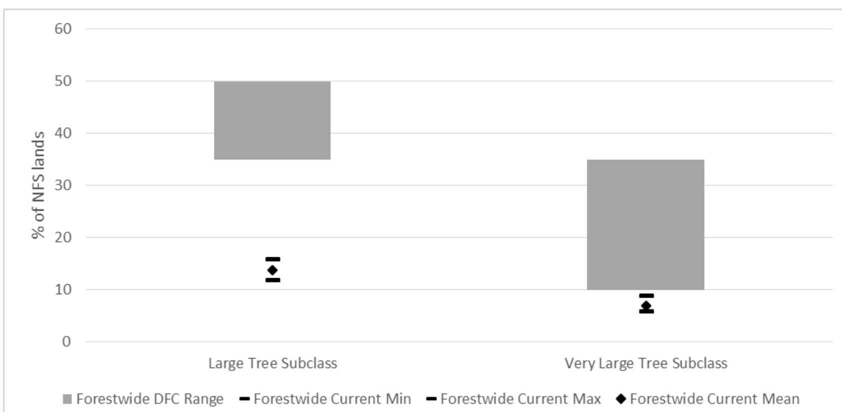


Figure 45. Forestwide large-tree structure existing and desired conditions

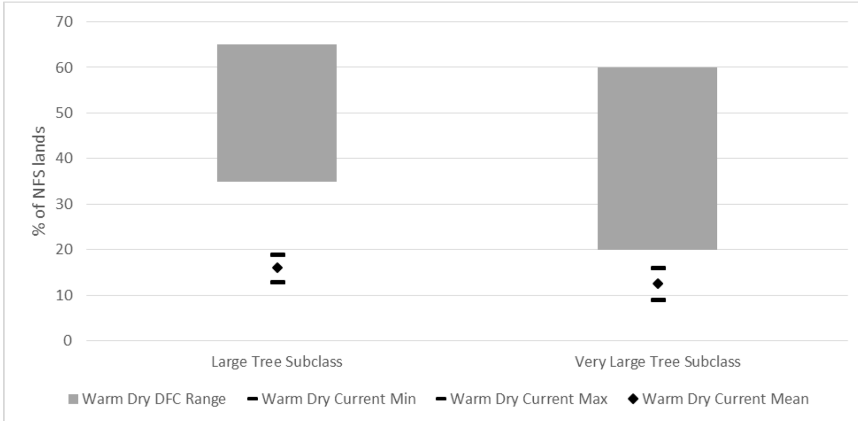


Figure 46. Warm dry PVT large-tree structure existing and desired conditions

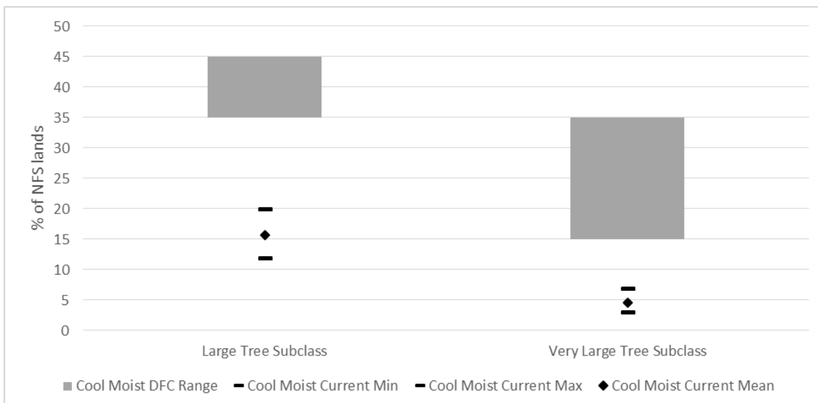


Figure 47. Cool moist PVT large-tree structure existing and desired conditions

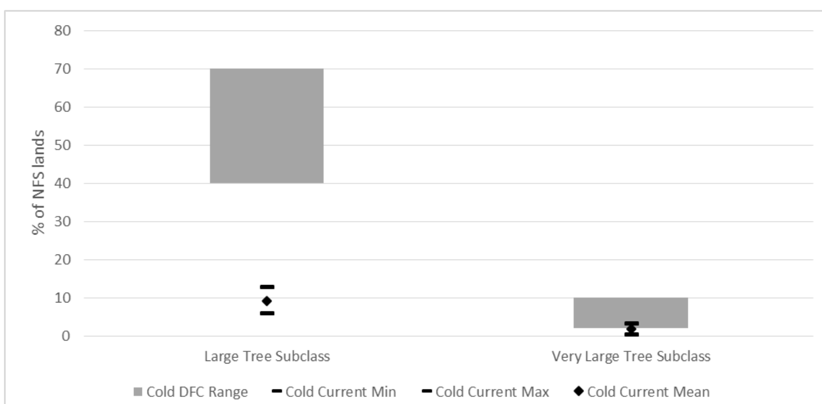


Figure 48. Cold PVT large-tree structure existing and desired conditions

To ensure the DCs can be met, as well as to contribute to future snags, a guideline was developed (FW-VEGF-GDL-01) to retain large and very large trees at the project level. The data source used is Bollenbacher (2008) which describes the mean quantities of large and very large live trees using periodic FIA data. The estimates used are the mean numbers of large and very large live trees found in wilderness and roadless areas across Eastern Montana in plots with a 1-4.9” size class, by snag analysis group as measured by periodic FIA plots (Table 4b on page 47 of Bollenbacher et al 2008). The Eastern Montana zone was used because the wilderness/roadless sample on the HLC NF did not have adequate data. Using plots in a seedling/sapling size class reflects conditions after a stand-replacing disturbance, which would be a minimum of large/very large trees that should exist after management activities.

Density Class

Data and modeling considerations

The R1 Summary Database classifies density class according to percent canopy cover. However, estimates of canopy cover from FIA plots are based on an algorithm that uses assumptions regarding species, tree size, and trees per acre; it is not based on field measurements of canopy cover. There are known deficiencies with the accuracy of this algorithm. In contrast, the VMap more directly estimates canopy cover using aerial imagery. Therefore, because it is more accurate than plot data for this attribute, the VMap condition for density class (as listed in the starting condition for the SIMPPLLE model) is used to estimate the existing condition rather than FIA plot data. There are no confidence intervals associated with these estimates. The low (10-24.9% canopy cover) and medium (25-39.9%) density classes are combined for the purposes of the forest plan revision, because there are no meaningful ecological thresholds that must be distinguished between them (e.g., specific habitat conditions). These density classes are also combined the nonforested density class (<10% canopy cover) because the classes cannot be consistently separated between the data sources (FIA plots, VMap, and SIMPPLLE).

Correlation to warm/dry climate periods and other considerations

Low tree and medium tree cover tend to be at the highest end of their ranges during warm/dry climate periods, whereas medium high and high tree cover tend to be at the lowest end. There is also a desire to increase resilience to wildfire and insects, which may warrant promoting for lower densities (or at low end of range for higher density classes) especially in the warm dry PVT. Very open savannas, a proportion of nonforested, are important to maintain. Higher densities are also important for wildlife hiding cover and specific habitats, such as lynx habitat in the cool moist PVT.

NRV and existing condition values

The following table displays existing condition versus NRV for density class.

Table 43. Density class– NRV versus existing condition

		NF/low/medium	Med/high	High
Forestwide	NRV	16-41	35-46	21-47
	Existing	26	27	48
Warm Dry	NRV	14-47	22-47	21-59
	Existing	26	29	45
Cool Moist	NRV	9-31	39-48	23-51
	Existing	22	20	58
Cold	NRV	10-41	48-60	12-33
	Existing	14	21	65
Big Belts	NRV	15-48	32-49	18-48
	Existing	33	29	39
Castles	NRV	11-36	33-46	25-54
	Existing	28	46	26

		NF/low/medium	Med/high	High
Crazies	NRV	19-47	31-42	21-46
	Existing	25	29	46
Divide	NRV	14 -49	32-50	17-49
	Existing	18	39	43
Elkhorns	NRV	17-45	32-48	20-45
	Existing	15	34	52
Highwoods	NRV	10-40	33-49	23-53
	Existing	10	33	57
Little Belts	NRV	13-37	33-45	23-53
	Existing	15	25	61
Rocky Mountain	NRV	20-43	35-43	20-44
	Existing	38	17	45
Snowies	NRV	16-47	34-49	18-46
	Existing	18	19	63
Upper Blackfoot	NRV	14-43	39-53	16-43
	Existing	28	41	31

Forestwide forest density class desired conditions

The following figures show desired conditions for density class, forestwide and by broad PVT, as enumerated in FW-VEGF-DC-03. To take into account the desired resiliency and expected future climate and drought, the following adjustments were made relative to the NRV to define the desired conditions based on BASI that indicates lower forest densities will be crucial to resilience and drought tolerance in the future (Halofsky et al., 2018b; Vose, Clark, Luce, & Patel-Weynand, 2016): the upper and lower bounds of nonforested/low/medium are adjusted up 10%; the upper and lower bounds of the high class are adjusted down 10%; and the desired range for medium is rounded to encompass a range of at least 20% to provide for variability given the adjustments made to the other size class.

Forestwide, it is desirable to reduce the high cover class by increasing the medium/high class in productive forests and low/medium density dry forests and/or nonforested areas. In the warm dry PVT, promote nonforest and open density forests, and reduce high density. In the cool moist PVT, promote medium/high cover class while decreasing high. Forests with high cover class include lynx habitat. Maintain nonforested/low/ medium forests or increase within the desired range to promote resilience. In the cold PVT, increase the lower density classes and decrease high, focusing on whitebark pine.

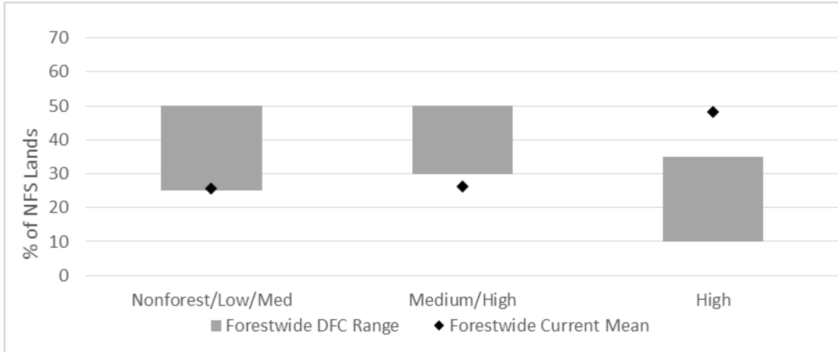


Figure 49. Forestwide forest density class existing and desired conditions

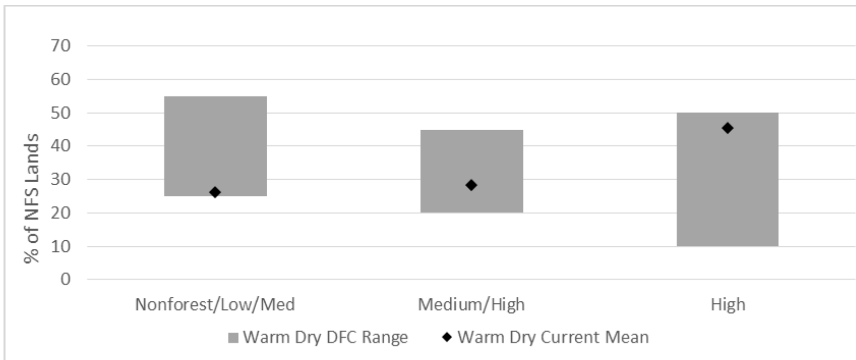


Figure 50. Warm dry PVT forest density class existing and desired conditions

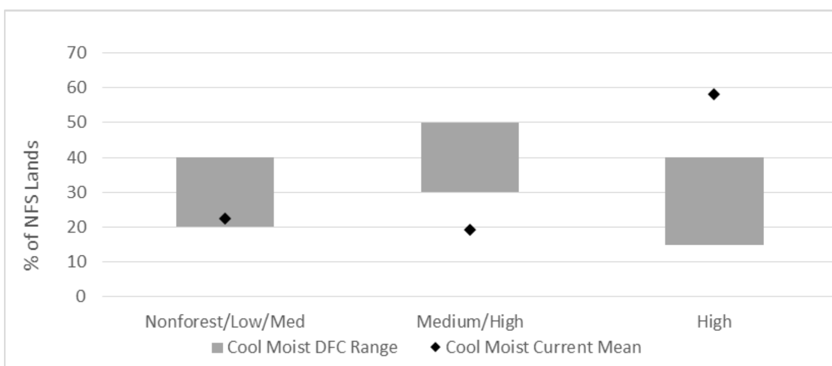


Figure 51. Cool moist PVT forest density class existing and desired conditions

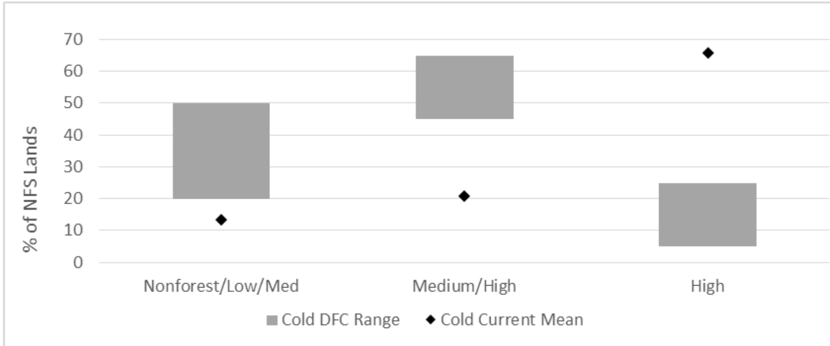


Figure 52. Cold PVT forest density class existing and desired conditions

GA forest density class desired conditions

The figures below show the density class DCs at the GA scale. The bounds are adjusted as described for the forestwide ranges. There is relatively little variance across GAs, and they are similar to the forestwide ranges. This would indicate that density is responsive to PVT rather than spatial location. Nevertheless, GA-level desired conditions are provided in chapter 3 of the Plan so that the array of density classes and associated habitats are present within each GA.

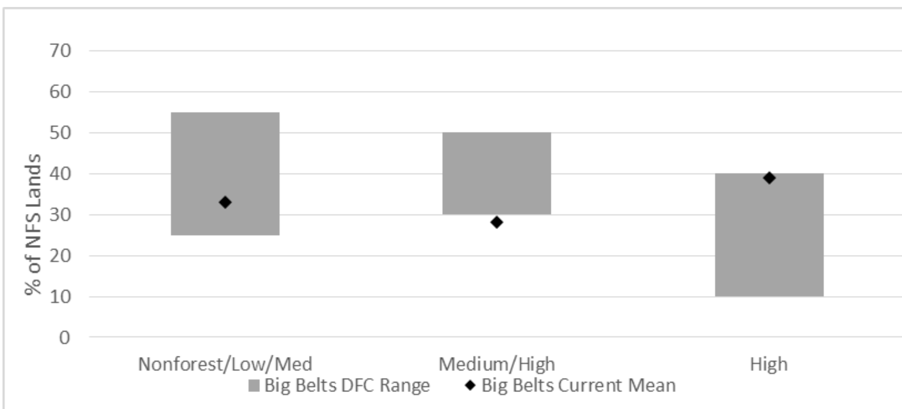


Figure 53. Big Belts density class existing and desired conditions

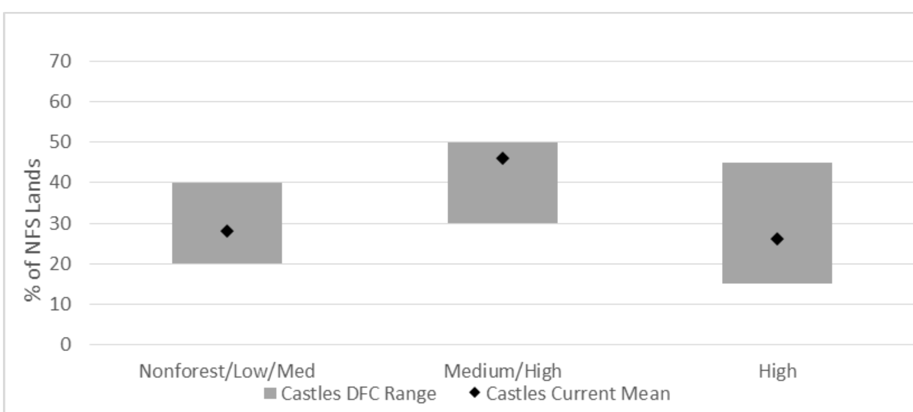


Figure 54. Castles density class existing and desired conditions

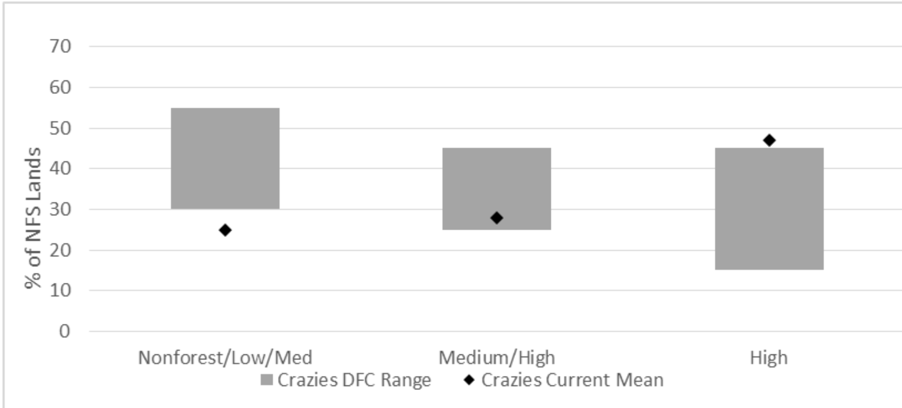


Figure 55. Crazies density class existing and desired conditions

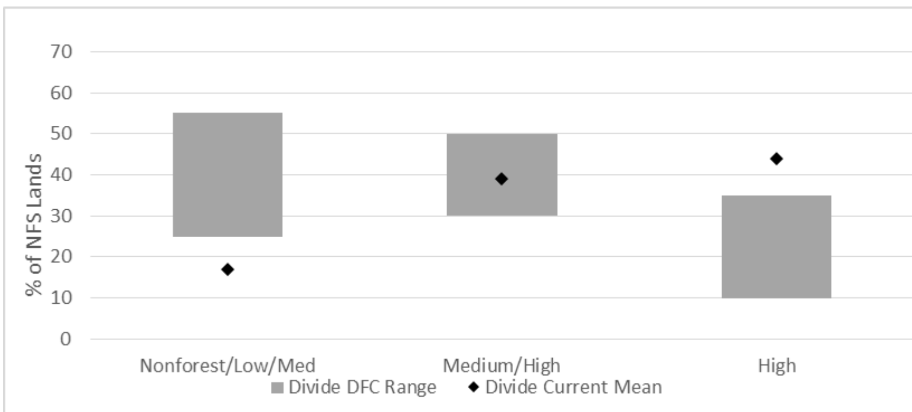


Figure 56. Divide density class existing and desired conditions

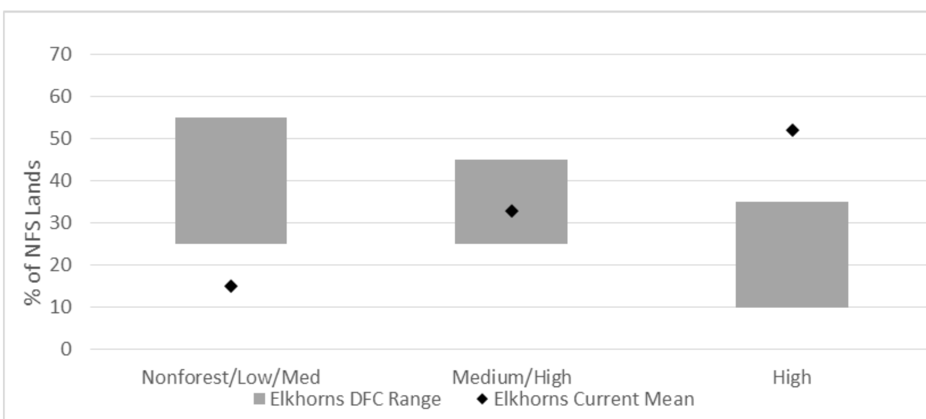


Figure 57. Elkhorns density class existing and desired conditions

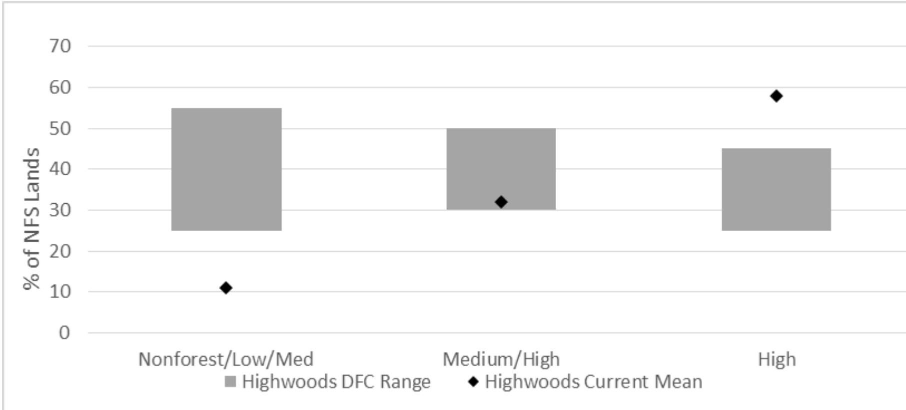


Figure 58. Highwoods density class existing and desired conditions

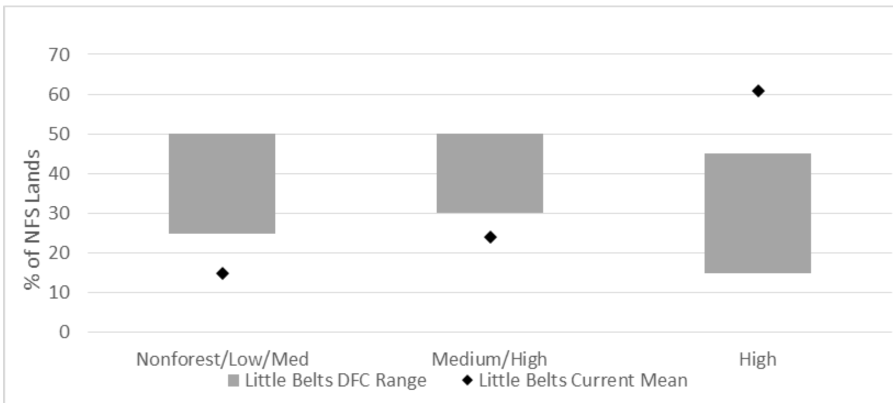


Figure 59. Little Belts density class existing and desired conditions

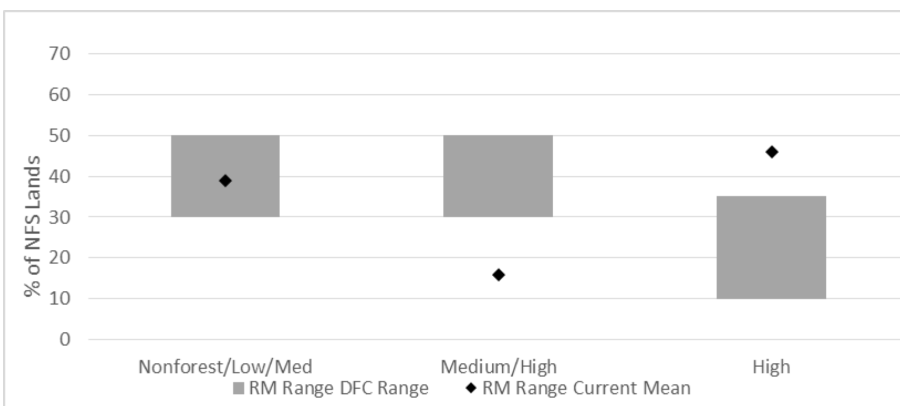


Figure 60. Rocky Mountain Range density class existing and desired conditions

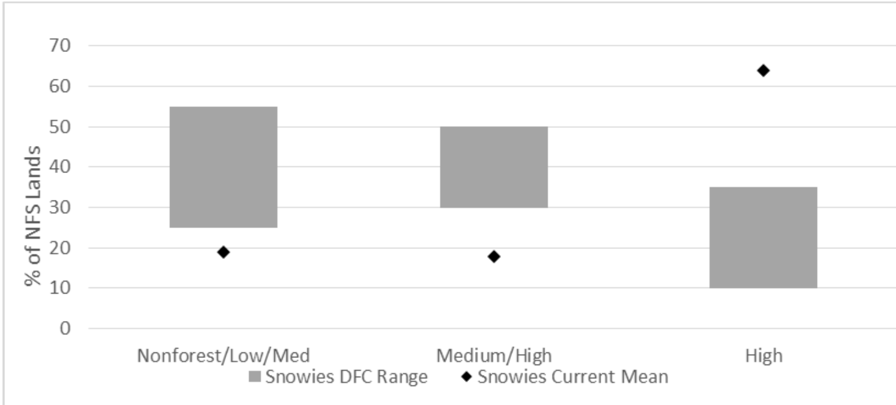


Figure 61. Snowies density class existing and desired conditions

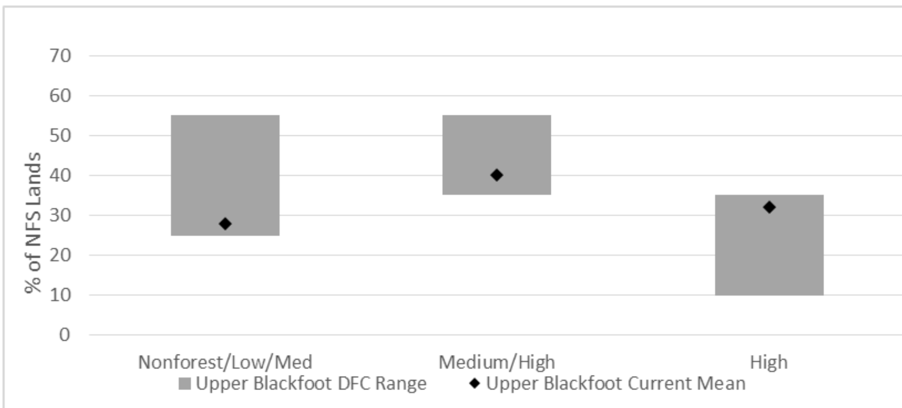


Figure 62. Upper Blackfoot density class existing and desired conditions

Forest vertical structure

Data and modeling considerations

SIMPPLLE derives vertical structure based on assumptions tied to species composition and time since disturbance, whereas the R1 Summary Database calculates vertical structure based on trees per acre in different size classes. Generally speaking, these should be comparable, given that calibrations were done to the SIMPLLE input file to match existing vertical structure distributions. The crosswalk from SIMPPLLE labels is as follows: Seed/Sap and Single Story = 1; Two Story = 2; Multi Story = 3 and C (continuous). Non-forested areas (or “none”) are excluded.

Correlations to warm/dry climate periods and other considerations

Single-storied forests (seed/sap and single-storied) increase and are at the high end of their NRV ranges during warm/dry periods. Two storied conditions tend to be at the low and but increasing during warm dry periods. Multi-storied conditions decrease and are at the low end of their NRV range during warm/dry periods. There is a desire for more open densities and less layering for resiliency (when stand density is high); but also, multi-story conditions are important for certain wildlife habitats.

NRV and Existing condition values

Table 44 compares the existing condition to the NRV for vertical structure class.

Table 44. Forest vertical structure – NRV versus existing condition

PVT		1	2	3 or C
Warm dry	NRV	8-20	4-7	74-86
	Existing	60 (55-64)	12 (9-15)	13 (10-17)
Cool moist	NRV	14-48	5-16	49-64
	Existing	54 (48-59)	9 (6-12)	20 (16-25)
Cold	NRV	12-65	5-19	46-62
	Existing	58 (51-64)	5 (3-9)	18 (13-24)

It was determined that a quantitative desired condition for this attribute is not necessary, as forest structures should develop as appropriate in the framework of the desired conditions defined for cover type, species presence, size class, and density class. The NRV indicates that an increase in multistoried conditions may be warranted even in warm/dry types – this would likely correspond to open, uneven-aged stands as opposed to dense multistoried stands as would be expected to develop on more moist sites. These considerations for vertical structure are blended into the descriptions for FW-VEGT-DC-01.

Desired conditions for landscape pattern (early successional forest openings)

Data and modeling considerations

An analysis of seedling/sapling forest patches ("forest openings") was done to address landscape pattern. The dominance of grass, forbs, shrubs and short trees in early successional forests creates a patch with strong contrast (e.g., forest "edge") and is distinctly different from the adjacent small, medium, large or very large forest size class patches. Not only does this allow for more accurate detection and measurement of the patch and resulting landscape patterns, but the seedling/sapling patch type is also meaningful for evaluation of wildlife habitat, forest cover, and connectivity. The larger trees and denser forest cover present in the adjacent small to very large forest size class patches provide the connectivity of habitat important to many wildlife species. Early successional stages also represent the crucial initiation point of forest development and thus greatly influence potential future conditions and patterns.

An analysis of NRV for patch size of early successional forest was conducted using SIMPPLLE. The depiction of early seral forest patches includes the seedling/sapling size class and grass/shrub/forb communities on forested PVTs, which are in transition from a recent disturbance but are expected to reforest. The existing condition is based on the SIMPPLLE input file. The minimum patch size considered was 10 acres based on the pixel sizes of the data layer.

For the NRV modeling, the analysis was conducted in two ways. First, an opening was included in the calculation for as long as it remained in the seedling/sapling size class. This provides the ecological picture of the extent and duration of openings. This is the analysis that is pertinent to the effects discussed in the environmental consequences section. Second, the analysis was run assuming that a patch is no longer an opening beyond 10 years after its creation. This provides for assessing appropriate patch sizes for even-aged harvest entries as required by the National Forest Management Act. Only natural disturbances created forest openings in the NRV analysis.

Correlations to warm/dry climate periods and other considerations

The largest patches are correlated with warm/dry climate periods.

NRV and existing condition values

Table 45 shows the NRV and existing condition of early successional forest patches; patches are included for as long as they remain in the seedling/sapling size class.

Table 45. NRV and existing condition of early successional forest patches >10 acres

	Forestwide	Warm dry	Cool moist	Cold
NRV – average acres	78 (45-119)	45 (30-70)	64 (44-84)	59 (39-84)
NRV – area weighted mean acres1	3,824 (160-12,973)	646 (46-2,703)	930 (142-2,664)	496 (73-1,482)
Existing Condition – average acres	163	91	133	76

[1] The area weighted mean patch size calculation is based on each patch getting a weight based on the size of the patch, with the bigger patches getting more weight.

NFMA requires that limits be placed on the maximum opening size allowed for even-aged regeneration timber harvest. In this context, a seedling/sapling patch would be considered a timber opening temporarily until regeneration is established. Therefore, the analysis was run to include seedling/sapling patches only for the first period (10 years) after their creation (Table 46).

Table 46. NRV of early successional forest patches >10 acres, with a 10 year limit of duration

	Forestwide	Warm dry	Cool moist	Cold
NRV – average acres	82 (30-151)	43 (27-77)	67 (28-110)	51 (0-93)
NRV – area weighted mean acres[1]	3,066 (40-14,051)	406 (34-1,695)	804 (31-2,864)	346 (0-1,357)

[1] The area weighted mean patch size calculation is based on each patch getting a weight based on the size of the patch, with the bigger patches getting more weight.

Forestwide desired condition

The desired condition integrates the results of the NRV analysis to encourage the continued presence of early successional forest openings in appropriately sized patches across the landscape. However, a qualitative component was developed, rather than quantitative, to capture the full range of diversity in a more general way, and to include all successional stages. This approach is appropriate given the uncertainty in factors that influence model results for the NRV of average landscape patch size, as compared to the context for existing patch sizes, which varies by GA.

Maximum size of regeneration harvest openings standard

The NRV analysis of patch sizes created for 1 period (Table 46) was used to inform a standard for maximum patch size of even-aged regeneration harvest for the HLC NF (FW-TIM-STD-08), to contribute to desired landscape patterns. The modeling shows that a maximum opening greater than 40 acres would reflect natural landscape patterns; the forestwide NRV average patch size is well above the NFMA limit of 40 acres. As described in FW-VEGF-DC-08, classifying areas by PVT is meaningful because different disturbance regimes are associated with each, and so to the desired landscape pattern should vary. However, to the extent that PVTs are present in small patches, the area of a large contiguous patch could be artificially reduced in the summarization process. For example, if a large warm dry seedling/sapling patch is separated by a small cool moist strip (e.g., a riparian area), it would be summarized as two smaller patches. Therefore, the forestwide patch number is used to inform FW-TIM-STD-08 because it avoids the issue of PVT mapping artificially reducing the functional patch size. Not requiring a PVT breakdown when applying the standard also improves simplicity for implementation, as well avoids the issue of PVT mapping being used to create larger contiguous openings that would functionally represent a single opening. A maximum even-aged regeneration harvest opening size limit of 75 acres is used in FW-TIM-STD-08. This value represents a point below the average but within the range of the forestwide NRV number, and does not exceed the maximum end of the range for any single PVT. The maximum opening number does not reflect the high end of historical conditions, but rather a midpoint.

Desired conditions for special components (old growth, snags, and coarse woody debris)

Discussion

Other special vegetation components include old growth, snags, and coarse woody debris. These attributes cannot be modeled with SIMPPLLE, and therefore the development of desired conditions varies from the composition and structure attributes discussed in previous sections.

Because old growth definitions are based in part on the presence of large trees, a correlation can be drawn with the presence of large-tree structure. This concept is also similar to how large and very large size classes are modeled in SIMPPLLE. The NRV range of large-tree structure and large/very large size classes would indicate that past amounts of old growth were likely higher than the existing condition, especially in the warm dry broad PVT. The use of exact values as desired conditions is unadvisable given the wide span of assumptions used.

Snags (standing dead trees) are naturally irregularly distributed. Fire is a dominant process that creates snags, especially in smaller diameter classes. Snags are also created by competition, insects, and diseases. Bark beetles tend to create snags in the largest trees available. The availability of large snags depends on the growth of large trees. Desired conditions for snags (by snag analysis groups) are designed to reflect the conditions that would be expected to occur under natural disturbance regimes.

The development of plan components for downed woody debris is complex, because different amounts, sizes, and distributions are meaningful for different resources (e.g., wildlife, fuels, and soils). The desired condition for downed wood is to maintain amounts that contribute to forest structural diversity, soil ecological function, and habitat, focusing on coarse woody debris because larger downed wood is more valuable to ecosystem function than smaller debris. The desired conditions are based on the best available science (J. K. Brown, Reinhardt, & Kramer, 2003). The ecosystem conditions described in the paper are relevant but are based on data west of the continental divide and therefore adjustments using local data were appropriate.

Old growth

Data and modeling considerations

There is no means to determine a statistically sound, quantifiable estimate of the NRV for old growth based on the current accepted definition (Green et al., 1992), because the characteristics can be determined only through site specific inventory. Old growth definitions can be applied and estimated reliably for the current condition with the R1 summary database.

Other adjustments and considerations

All vegetation desired conditions contribute to the long-term persistence of old growth. Lodgepole pine old growth is the least valuable type due to the natural short-lived nature of that species. There is no known BASI to quantify the NRV condition of old growth abundance, distribution, or patch size specific to the landscapes on the HLC NF. Without this information, a quantitative old growth DC or guideline is difficult to develop; and it is unknown what the appropriate scale to consider old growth would be (forestwide, GA, watershed, etc).

NRV and existing condition values

Because old growth definitions are based in part on the presence of a certain number of large trees, a correlation can be drawn with *large-tree structure*, which can be compared to large and very large size classes in SIMPPLLE for NRV. However, because other attributes are needed to define old growth, only a proportion of areas with large-tree structure are actually old growth, as shown in Table 47. Nearly half (44%) of the plots with large-tree structure are old growth.

Table 47. Proportion of plots estimated to be old growth forestwide

Large/very large tree structure	% old growth
Large tree structure	20% (14-26)
Large or very large tree structure	24% (17-31)
Large or very large tree structure not present	5% (4-7)

The way large-tree structures are identified is similar to the way SIMPPLLE defines the large/very large size class. Therefore, in rough terms, about half of the areas in the unadjusted large and very large size classes in the NRV may have been old growth, as postulated in Table 48. It is likely that there is also less old growth on the landscape than in the NRV, especially in the warm dry PVT.

Table 48. Existing old growth and potential NRV (44% of the large/very large size classes)

Scale	Existing condition (FIA)	Potential NRV
Forestwide	11% (9-13)	20-25%
Warm dry	8% (6-11)	33-52%
Cool Moist	14% (10-19)	11-19%
Cold	15% (11-20)	28-40%

Other adjustments and considerations

Distribution of old growth across forested PVTs and cover types is desired to support the full range of ecosystem diversity and wildlife species habitat needs.

Old growth desired condition

The old growth desired condition as shown in FW-VEGF-DC-05 does not include a quantitative value, due to the limitations of the analysis described above. Rather, a desire to maintain and increase old growth on the landscape is addressed qualitatively, including a distribution across the Forest and in every GA. To help achieve the desired condition, guideline FW-VEGF-GDL-04 was developed.

Snags

Data and modeling considerations

The SIMPPLLE model does not provide a quantified NRV for snags. NRV ranges were derived from Bollenbacher and others (2008), and (R. Bush & Reyes, 2020), using snag estimates inside wilderness and roadless areas as an indicator of the NRV. As noted by Bollenbacher and others (2008), this is the best available data to provide context for the potential historical condition of snags. Three snag classes are included: medium (10+); large (15+) and very large (20+). *Snag analysis groups* (warm dry PVT, cool moist PVT, cold PVT, and lodgepole pine dominance groups) are used. These groups are consistent with the BASI for snags on eastside forests in Region 1 (Bollenbacher et al 2008; Bush & Reyes 2020).

Other adjustments and considerations

In the future, we expect larger pulses of snags with more fires and insect outbreaks. The Assessment showed a comparison between the wilderness and the "front country", which indicated that there are fewer medium snags in the front country, but the amounts of large and very large were comparable. Fewer medium snags may be related to cutting of dead lodgepole pine after the pine beetle outbreak from firewood cutting and roadside hazard tree removal. Plan components consider the impacts of firewood cutting in roaded areas, which results in snag losses or reduced distribution in these areas. Literature sources reviewed in development of snag conditions and guidelines include (Bate, Wisdom, & Wales, 2007; Bollenbacher et al., 2008; Bull, Parks, & Torgersen, 1997; Franklin, Berg, Thorburgh, & Tappeiner, 1997; Harris, 1999). The quantitative plan components are based on the most local data (Bollenbacher et al., 2008). The specific per-acre recommendations from Bull and others (1997) are not appropriate to use for the HLC NF because it reflects very different ecosystem conditions found in the Pacific Northwest, in terms of tree species, tree size, disturbance regimes, and appropriate distribution.

NRV and existing condition values

The tables below compare existing snag data to the best depiction of NRV. By snag analysis group, the NRV is represented by snags in wilderness/roadless areas on the HLC NF measured by periodic FIA plots prior to the mountain pine beetle outbreak.

Table 49. Snags per acre –existing condition versus NRV – forestwide by snag analysis group

Scale		Medium 10-14.9"+	Large 15-19.9"+	Very large 20"+
PICO	NRV	12.9 (8.1-18.3)	2.0 (0.8-3.4)	0.2 (0.0-0.6)
	Existing	11.9 (9.1-15.0)	1.3 (0.7-2.0)	0.1 (0-0.2)
Warm dry	NRV	4.3 (2.0-7.0)	1.1 (0.3-2.2)	0.2 (0.0-0.4)
	Existing	6.8 (4.9-8.9)	2.2 (1.3-3.3)	0.8 (0.4-1.2)
Cool moist	NRV	12.3 (8.3-16.8)	2.4 (1.4-3.5)	0.4 (0.1-0.8)
	Existing	15.1 (11.5-19.1)	3.4 (1.9-5.1)	1.0 (0.4-1.8)
Cold	NRV	13.4 (6.6-21.9)	2.3 (1.1-3.7)	0.9 (0.2-1.8)
	Existing	18.4 (12.9-24.7)	4.3 (2.4-6.7)	0.9 (0.3-1.6)

Source: Bollenbacher (2008) supplemental tables (2017) for NRV (periodic) and existing condition (Hybrid 2011).

Table 50. Snag distribution (% area with snags) – existing condition versus NRV – forestwide by snag analysis group

Scale		Medium 10-14.9"+	Large 15-19.9"+	Very large 20"+
PICO	NRV	14.6 (9.7-19.8)	5.0 (2.5-7.9)	1.5 (0.2-3.4)
	Existing	22.22 (17.48-27.11)	4.12 (2.03-6.54)	0.36 (0.36-1.04)
Warm dry	NRV	7.6 (4.4-11.3)	3.9 (1.6-6.8)	1.6 (0.3-3.1)
	Existing	16.86 (13.08-20.74)	7.13 (4.65-9.78)	3.57 (1.87-5.41)
Cool moist	NRV	19.7 (14.6-25.1)	9.6 (6.0-13.5)	2.9 (0.9-5.3)
	Existing	31.03 (24.43-38.00)	9.20 (5.11-13.74)	2.87 (0.81-5.34)
Cold	NRV	19.5 (11.8-27.7)	9.5 (4.7-15.0)	5.3 (1.6-9.7)

Scale		Medium 10-14.9"+	Large 15-19.9"+	Very large 20"+
	Existing	29.54 (21.66-37.55)	11.39 (6.13-17.21)	3.38 (0.69-6.66)

Source: Bollenbacher (2008) supplemental tables (2017) for NRV (periodic). Existing condition from Hybrid 2011.

Snag desired condition

The snag desired condition is enumerated in FW-VEGF-DC-06. The existing and desired ranges are derived from Bush & Reyes 2020. The desired snags per acre are consistent with the NRV, based on the 90% confidence interval around the mean of snags found in wilderness and roadless areas on the HLC NF, as measured by periodic FIA plots which represent conditions prior to the mountain beetle outbreak. The existing condition is shown as a mean with 90% confidence interval for those same areas, based on the Hybrid 2011 FIA dataset. The desired distribution reflects the proportion of the snag analysis group across the HLC NF that contains one or more snags in the indicated size class.

To ensure the desired condition can be met and provide for viability of snag dependent species in the managed landscape, a guideline (FW-VEGF-GDL-02) is developed to retain snags at the project level. Using the same data as the desired condition, minimum retention numbers for the guideline are based on upon the lower bound of the 90% confidence interval around the mean snags present.

Downed woody debris

Data and modeling considerations

For wildlife habitat, downed wood of the largest sizes is the most valuable, and the most meaningful measure is percent cover of downed wood. However, this measure is not available in our data sources. For both fuels and soils considerations, a common measure is tons/acre of woody material greater than 3" diameter; this is quantifiable with FIA data in the R1 summary database. 3" is also the minimum size for coarse woody debris used in the BASI used to develop the desired condition (J. K. Brown et al., 2003).

Downed woody debris is not modeled w/ SIMPPLLE. NRV is represented by FIA queries for quantities and distribution within wilderness/roadless areas on the HLC NF. All estimates are done in spreadsheets because the R1 Summary Database Estimator does not currently provide the necessary groupings (multi-grouping functionality to split out both broad PVT and wilderness/IRA is not yet available in the summary database estimator tool). Both quantity and distribution of woody debris are important.

Other adjustments and considerations

Drier conditions and more fires might mean less downed wood, and/or wider swings in amounts/distributions. For fuels management purposes, generally the minimum quantities needed to meet other resource needs is desired in areas of elevated fuel concern (such as WUI areas). In many cases these areas are also in the warm dry PVT, where natural fuel levels are also lower, and therefore resource desires are complementary. In the short term, a pulse of coarse woody debris is expected to be recruited as trees killed in the recent mountain pine beetle outbreak fall to the forest floor. Recent fire areas will also be sources of woody debris.

The BASI for coarse woody debris on the HLC NF was reviewed (J. K. Brown et al., 2003; Graham et al., 1994). Brown et al 2003 provides information that is helpful to inform our understanding of the NRV and appropriate DC, while Graham et al is more specifically used to guide the development of a guideline for coarse woody debris retention in vegetation management areas.

NRV and existing condition values

Table 51 was developed to compare NRV (wilderness/roadless) and existing condition in terms of large woody debris distribution (>3" diameter) using queries done with Hybrid 2007. There is no appreciable difference in the distributions in wilderness/roadless areas versus the landscape as a whole. 30 to 50% of the landscape has no woody debris present, and that distribution is greatest on cool moist broad PVT. Most of the woody debris present is <10 tons/acre.

Table 51. Distribution of large woody debris (1000-fuels or >3" dbh)

Scale		CWD distribution (Presence)				
		>=0 tons/ac	>=5 tons/ac	>=10 tons/ac	>=20 tons/ac	>=40 tons/ac
Forestwide	Wild/IRA	56%	26%	14%	6%	2%
	Existing	55%	25%	15%	6%	2%
Warm dry	Wild/IRA	59%	19%	4%	0%	0%
	Existing	57%	17%	6%	1%	0%
Cool moist	Wild/IRA	64%	42%	26%	10%	3%
	Existing	65%	43%	28%	11%	3%
Cold	Wild/IRA	52%	23%	17%	11%	5%
	Existing	51%	24%	16%	9%	3%

Table 52 shows an approximation of the NRV (in wilderness and roadless) compared to the existing condition of woody debris >3" diameter. Existing condition numbers are from the Hybrid 2011 dataset, as is the NRV forestwide. For the broad PVTs, queries done in excel on Hybrid 2007 data are used for NRV. The existing condition is similar to the NRV forestwide and in the warm dry PVT, but slightly less in cool moist and cold.

Table 52. NRV and existing tons/acre of woody debris >3" diameter by broad PVT

Scale	Tons/ac >3" diameter	
	In wilderness/IRA	Existing condition
Forestwide	5.6 (4.8-6.6)	5.2 (4.6-5.9)
Warm dry	3.4	3.4 (2.7-4.2)
Cool moist	10.6	7.2 (5.8-8.8)
Cold	10.3	7.0 (5.3-8.9)

Downed woody debris desired condition

The desired condition for downed woody debris is enumerated in FW-VEGF-DC-07. The desired conditions are based on the best available science (J. K. Brown et al., 2003). Brown and others (2003) take into account many considerations of woody debris, including wildlife habitat, soil nutrient cycling, fire hazard and behavior, soil heating, and historic quantities. The ecosystem conditions described in the paper are relevant but are based on data west of the continental divide and therefore some adjustments using local data were appropriate. Snag analysis groups are not used by Brown and others (2003). The publication is based on habitat type groups and does not break out the lodgepole pine cover type. Therefore, for consistency the desired condition is based on potential vegetation groups rather than snag analysis groups.

Brown and others (2003) identified optimum ranges of coarse woody debris to provide biological benefits without creating an unacceptable fire hazard. The range that best meets resource needs is 5 to 20 tons per acre for the warm dry PVT and 10 to 30 tons per acre for other types. The amount and distribution of coarse woody debris in roadless and wilderness areas was also used to inform the narrative of desired trends, because this reflects conditions on landscapes that have been influenced minimally by human activities. For the HLC NF the average amounts in these areas are slightly lower than the optimum described by Brown and others (2003). The natural range of downed wood in the warm dry types on the HLC NF is lower because these areas include open savannas, where grass and shrubs dominate. Therefore, the lower end of the range described by Brown and others (2003) is adjusted downward to account for the unique conditions on the HLC NF as indicated by FIA data in the wilderness and roadless areas. The desired average tons/acre are not applicable to every forest stand, but rather as broad scale averages. There is no desired condition for nonforested PVTs, as there is generally no source of downed wood (i.e. trees) in those areas.

To ensure the desired condition can be met, a guideline (FW-VEGF-GDL-06) was developed to retain downed wood at the project level. The data source used is Graham et al 1994. Although this study uses primarily data taken from western Montana, Idaho, and Arizona, the ecosystems studied are relevant to the HLC NF and there is no more local research available. The analysis provided recommended woody debris tons/acre by habitat type; those found in MT and on the HLC NF were reviewed. The drier Douglas-fir types tended to have a range starting at a minimum of 5 tons/acre and the moist subalpine fir types tended to have a range starting at a minimum of 10 tons/acre. These levels are consistent with the lower end of the desired ranges. It is logical that by providing for these minimums in vegetation treatment units, management will not preclude achievement of the forestwide desired average. Higher amounts of downed wood can be expected in unmanaged areas, which dominate the HLC NF.

Identification of lands suitable for timber production

The National Forest Management Act directs that, "*the Secretary shall identify lands within the management area which are not suited for timber production, considering physical, economic, and other pertinent factors to the extent feasible*." The 2012 Planning Rule directives (USDA, 2015) provide guidance regarding the identification of lands as not suited and suited for timber production. Per this direction, lands suitable for timber production have been identified for each alternative using the methodologies described in this section; maps are included in appendix A. During plan implementation, site-specific suitability would be validated at the project level.

Timber harvest is the removal of trees for wood fiber use and other multiple-use purposes. *Timber production* is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (U.S. Department of Agriculture, Forest Service, 2012). In addition to the identification of lands suitable for timber production, lands that are unsuitable for timber production, but where timber harvest may occur, were also identified. Criteria for determining lands not suitable for timber production are assessed with two-steps:

1. Identify lands that are not suited for timber production based on legal and technical factors. These lands do not vary by alternative and are identified in the assessment or prior to development of alternatives. This is a preliminary classification. After subtracting the lands that are not suited from the total of NFS lands, the remaining lands are lands that *may be suited for timber production*.
2. From the lands that *may be suited* for timber production, identify the lands that are suited for timber production based on their compatibility with the land area's desired conditions and objectives for those lands. This is done for each alternative.

The calculation of timber metrics is dependent upon timber suitability land classifications (Box 2).

Box 2: Summary of timber suitability classifications and associated timber metrics

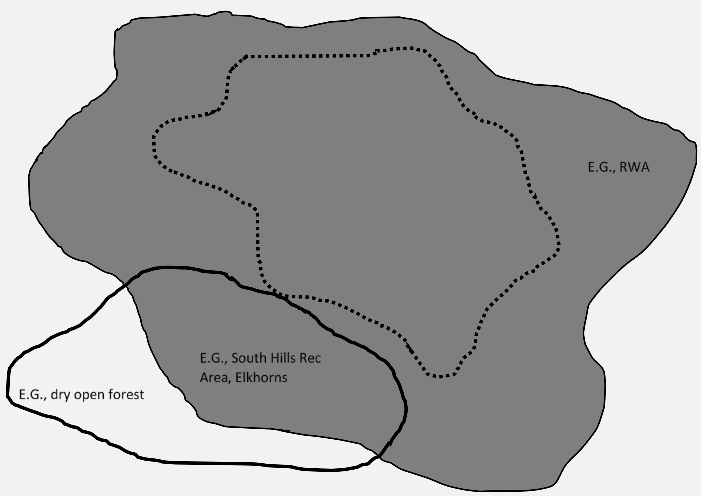
A. *Lands that May be Suited for Timber Production*  Includes all lands that meet the technical NFMA criteria. Does not vary by alternative. Provides the area from which lands suitable for timber production may be selected.

B. *Lands that Are Suited for Timber Production*  A subset of Lands that May be Suited, where timber production is a primary or secondary purpose consistent with other resource objectives. Varies by Alternative.

C. *Lands Unsuitable for Timber Production, where Harvest Can Occur*  Lands where harvest is permitted, but are not suitable for timber production. Varies by Alternative. May include lands outside of those areas that May be Suited for timber production (for example, very dry or low productivity forests).

Sustained Yield Limit (SYL) is calculated from all Lands that May be Suited for timber production (A). It is a limit on harvest. It includes lands that are not suitable in an alternative.

Projected Timber Sale Quantity (PTSQ) and Projected Wood Sale Quantity (PWSQ) are calculated from all lands where harvest may occur (B + C).



Lands that may be suitable for timber production

Table 53 defines the technical factors used to identify that lands that are not suited for timber production. These lands were subtracted from the total NFS acreage, and the remaining areas are those that *may be suited for timber production*. The determination of lands that may be suited for timber production provides the first step and basis for determining the lands that are suited for timber production, and it is the landbase used to calculate the sustained yield limit.

Table 53. Criteria for the lands that may be suited for timber production

Technical factor (36 CFR 219.11(a))	Summary of description (FSH 1909.61.1)
(i) Statute, Executive Order, or Regulation prohibits timber production; or (ii) The Secretary of Agriculture or Chief of the Forest Service has withdrawn the land from timber production.	Timber production may be prohibited on certain lands by statute, Executive order, regulation, or where the Secretary of Agriculture or Chief of the FS has withdrawn the land from timber production.

Technical factor (36 CFR 219.11(a))	Summary of description (FSH 1909.61.1)
(iv) The technology is not currently available for conducting harvest without causing irreversible damage to soil, slope, or other watershed conditions.	Lands not suited because technology to harvest timber without causing irreversible damage is not currently available may include areas where soils, geology, or other physical site conditions are such that harvest may cause irreversible damage, or where tree regeneration and growth is severely inhibited.
(v) There is no reasonable assurance that such lands can be adequately restocked within 5 years after regeneration harvest.	The Responsible Official should identify criteria for what constitutes adequate restocking after final regeneration harvests for timber production. Specific land types, soil types, and vegetative conditions should be evaluated for appropriate management systems to assess if reasonable assurance exists that the lands can be regenerated to achieve adequate restocking 5 years after final regeneration harvest.
(vi) The land is not forest land	Lands less than 10% occupied by trees or that formerly had tree cover but are developed for nonforest uses (e.g., agriculture, improved roads, recreation areas, powerlines). Lands that were formerly occupied by tree cover, but do not have tree cover, should be identified as nonforest unless the land will be regenerated in the near future. Canopy cover of live trees at maturity may be used to estimate if an area is at least 10% occupied. Unimproved roads, trails, intermittent or small perennial streams, and clearings may be included as forest if < 120' wide.

A spatial analysis was conducted to methodically subtract unsuitable lands from the total land area based on the legal or technical factors. The areas were eliminated in the order shown in Table 54; therefore, factors that were eliminated first may encompass conditions that would have been eliminated in later steps. Due to the resolution of data sources, there are likely inclusions of suitable lands in unsuitable areas and vice versa.

Table 54. Exclusions from lands that may be suitable for timber production

Factor	Areas eliminated	Acres
	Total NFS lands	**2,883,227**
36 CFR 219.11(a) (i) and (ii)	Designated wilderness	564,082
	Designated wild and scenic rivers	0
	Rocky Mountain Front Conservation Management Area	196,132
	Wilderness study areas	168,268
	Research natural areas	11,919
	Tenderfoot Experimental Forest	7,671
	Inventoried roadless areas	1,010,643
	Total acres eliminated for this factor	*1,958,714*
36 CFR 219.11(a) (vi)	Administrative sites and campgrounds[1]	166
	Roads, railroads, and utility corridors[2]	19,805
	Water bodies and streams >120' wide	927
	Nonforest lifeforms[3]	148,374
	Total acres eliminated for this factor	*169,271*
	Areas with soil stability or damage concerns[4]	15,156

Factor	Areas eliminated	Acres
36 CFR 219.11(a) (iv) and (v)	Areas with low growth/regeneration potential[5]	72,957
	Total acres eliminated for this factor	*88,113*
	Lands that may be suitable for timber production	**667,129**

1 The latest administrative site and campground layers were utilized, applying a 200’ buffer.
2 All roads not planned for decommissioning are assumed to be “improved”. Line files provided by Northwestern Energy were used. A 33’ width buffer was applied to roads, corridors, and railroads.
3 Nonforest lifeforms were depicted by VMap classes of water, sparse, herb, shrub, or urban; or Ecoclass of Scree; unless recent fires or harvest had occurred, and the potential vegetation type was forested.
4 Average slopes >80%; severe slump/mass failure risk; or percent slope >50% and bedrock type of slide deposits.
5 Areas with a potential vegetation type of sparse, limber pine, whitebark pine, subalpine larch, juniper, alpine, poplar/aspen, or ripdecid; or a tree growth composite index of 5 or 6 unless recently disturbed; or a tree growth composite index of 4 and dominated by juniper, whitebark pine, limber pine, or tree canopy <10% unless recently disturbed. These areas were also reviewed and modified with input from local resource specialists.

Lands that are suitable for timber production, by alternative

The identification of lands that are suitable for timber production in each alternative is based on compatibility with desired conditions and objectives (USDA, 2015) (Table 55), and are a subset of the lands that may be suited described above. These lands are identified based on the desired conditions, goals, and objectives developed for the Plan and for each FEIS alternative.

Table 55. Criteria for identification of lands suited for timber production

Factor	Description in FSH 1909.61.2
36 CFR 219.11(a) (iii) Timber production would not be compatible with the achievement of desired conditions and objectives established by the Plan	The Responsible Official should consider the following to determine if timber production is compatible with the desired conditions and objectives of the Plan: Timber production is a desired primary or secondary use of the land; Timber production is anticipated to continue after desired conditions have been achieved; A flow of timber can be planned and scheduled on a reasonably predictable basis; Regeneration of the stand is intended; Timber production is compatible with the desired conditions or objectives for the land designed to fulfill the requirements of 36 CFR 219.9 to 219.10.

Lands suitable for timber production were mapped for the initial proposed action, which was made available for public scoping. Timber harvest, volume outputs, and lands suitable for timber production were identified as a key or significant issue based on the public comments received. Therefore, it was one element that drove the development of alternatives, as described in Table 56.

Table 56. Determination of lands suitable for timber production by alternative

Alternative	Considerations and rationale
Alternative A, no action	Suitability for timber production was mapped as defined in the 1986 Forest Plans and updated to reflect the regulatory changes that have occurred since then. The primary change incorporated was the removal of suitability where IRAs were established. It was also updated to be consistent with the new may be suited layer in terms of the technical factors (e.g., forested lands), because it is based on new data. RMZs are excluded west of the Divide (consistent with RHCAs under INFISH).
All action alternatives	The following areas were excluded from lands suitable for timber production, because timber production is not compatible with other resource plan components and would not be a primary or secondary management objective: • Eligible wild and scenic river corridors

Alternative	Considerations and rationale
	• Inner and outer RMZs • Elkhorns Wildlife Management Unit • Missouri River and Smith River corridors • Tenderfoot land acquisition area • The Badger-Two Medicine area • Cultural/historical sites: Alice Creek Historic District, Chinese/Robertson Wall, Mann Gulch Historic District, Lincoln Gulch Historic District • RWAs (*amount/location varies by alternative*) • Areas with poor access and low harvest feasibility, indicated by ROS Primitive or Semi-Primitive Non-motorized (*amount/location varies by alternative*)
Alternatives B, C, and D	Additional areas eliminated from lands suitable for timber production included the Highwoods GA, Snowies GA, and the Dry Range portion of the Big Belts GA due to marginal productivity and limited feasibility; and the South Hills Recreation Area because timber production would not be a primary or secondary management objective.
Alternative E	The South Hills Recreation area is not in this alternative; the lands that may be suited in this area are included as suitable for timber production. Also keep suitability in those portions of the Highwoods, Snowies, and Dry Range (Big Belts) GAs that may be suited.
Alternative F	Retain timber suitability in the Dry Range of the Big Belts GA and in the Little Snowies portion of the Snowies GA, as in Alt E. Eliminate suitability from the South Hills Recreation area as in Alts B/C/D.

The following tables provide the acres and percent of land area determined to be suitable for timber production by alternative, at the forestwide scale and for each GA.

Table 57. Lands suitable for timber production by alternative (acres and percent)

Land classification category	Alt A	Alt B/C	Alt D	Alt E	Alt F
A. Total NFS lands in the planning area	2,883,227	2,883,227	2,883,227	2,883,227	2,883,227
B. Lands not suited for timber production due to legal or technical reasons.	2,216,098	2,216,098	2,216,098	2,216,098	2,216,098
C. Lands that may be suited for timber production (alternatives A and B)	667,129	667,129	667,129	667,129	667,129
D. Total lands suited for timber production because timber production is compatible with the desired conditions and objectives established by the Plan	**414,936 (14%)**	**356,633 (12%)**	**348,586 (12%)**	**384,199 (13%)**	**368,814 (13%)**
E. Lands not suited for timber production because timber production is not compatible with desired conditions and objectives established by the Plan (alternatives C and D)	252,193	310,496	318,543	282,930	298,315
F. Total lands not suited for timber production (alternatives B and E)	2,468,291 (86%)	2,526,594 (88%)	2,534,641 (88%)	2,499,028 (87%)	2,514,413 (87%)

Table 58. NFS land suitable for timber production by GA and alternative (acres and percent)

GA	Alternative A		Alternatives B/C		Alternative D		Alternative E		Alternative F	
Big Belts	43,538	14%	53,937	17%	53,879	17%	55,476	18%	54,701	17%
Castles	17,743	25%	15,084	22%	14,601	21%	15,084	22%	15,084	22%
Crazies	12,826	22%	5,353	9%	4,971	9%	5,701	10%	5,353	9%
Divide	70,095	35%	53,152	26%	50,866	25%	61,299	30%	54,387	27%
Elkhorns	0	0%	0	0%	0	0%	0	0%	0	0
Highwoods	1,170	3%	0	0%	0	0%	741	2%	0	0
Little Belts	208,968	26%	187,412	23%	182,573	23%	187,417	23%	187,412	23%
Rocky Mountain	1,683	<1%	0	0%	0	0%	0	0%	0	0
Snowies	16,028	14%	0	0%	0	0%	14,425	12%	9,531	8%
Upper Blackfoot	42,887	13%	41,696	12%	41,696	12%	44,056	13%	42,348	13%

Lands unsuitable for timber production, where harvest can occur

Lands where harvest is not permitted include designated wilderness, wilderness study areas, research natural areas, and recommended wilderness (RWA). Harvest may occur on the remainder of lands unsuitable for timber production for other multiple use purposes, although it may be constrained by plan components. Constraints which are limiting include those applied to IRAs, which make up a large percentage of the unsuitable lands. For this reason, lands where harvest may occur are summarized including and excluding IRAs. Other lands where harvest is permitted that would be particularly constrained or limited include wild and scenic river corridors, RMZs, and primitive and semi-primitive non-motorized ROS settings. The summary of lands where harvest can occur includes nonforested vegetation, because it may be possible that harvest could occur in sparsely forested areas.

In alternative A, the management areas where harvest is never allowed include N-1, P-1, and P-3 on the Helena NF; and M, N, P, and Q on the Lewis and Clark NF. Updates were made to incorporate wilderness additions that would apply to this alternative (Rocky Mountain Range GA). For the action alternatives, there are no management areas, but land allocations where harvest can never occur as listed above were excluded. Table 59 shows a summary of all lands unsuitable for timber production, and the proportions thereof where harvest may occur, including and excluding IRAs. Table 60 shows this information by GA.

Table 59. NFS lands unsuitable for timber production where harvest may occur by alternative (acres/% of all NFS lands)

	Including IRAs	Excluding IRAs
Alternative A	1,654,916 (57%)	521,619 (18%)
Alternative B/C	1,654,935 (57%)	571,126 (20%)
Alternative D	1,455,781 (50%)	551,631 (19%)
Alternative E	1,749,318 (61%)	548,815 (19%)
Alternative F	1,673,853 (58%)	561,696 (19%)

Table 60. NFS lands unsuitable for timber production where harvest can occur by GA and alternative (acres and percent)

Geographic Area	Alternative A		Alternatives B/C		Alternative D		Alternative E		Alternative F	
	Total	Without IRAs	Total	Without IRAs	Total	Without IRAs	Total	Without IRAs	Total	Without IRAs
Big Belts	222,578 (71%)	92,867 (29%)	214,231 (68%)	81,824 (26%)	191,939 (61%)	81,548 (26%)	228,062 (72%)	80,887 (26%)	213,692 (68%)	81,110 (26%)
Castles	51,966 (75%)	22,584 (32%)	54,625 (78%)	25,243 (36%)	24,502 (35%)	23,517 (34%)	54,625 (78%)	25,243 (36%)	54,625 (78%)	25,243 (36%)
Crazies	44,842 (78%)	7,300 (13%)	52,315 (91%)	14,767 (26%)	27,728 (48%)	12,403 (22%)	51,966 (90%)	14,419 (25%)	52,315 (91%)	14,767 (26%)
Divide	115,817 (57%)	68,459 (34%)	116,003 (57%)	82,055 (40%)	90,134 (44%)	77,043 (38%)	140,112 (69%)	76,092 (38%)	114,072 (56%)	82,749 (41%)
Elkhorns	161,251 (100%)	86,501 (54%)	161,251 (100%)	86,501 (54%)	156,745 (97%)	86,494 (54%)	161,251 (100%)	86,501 (54%)	159,673 (99%)	86,501 (54%)
Highwoods	42,291 (97%)	1,487 (4%)	42,291 (100%)	2,657 (6%)	42,291 (100%)	2,657 (6%)	41,545 (98%)	1,911 (5%)	42,291 (100%)	2,657 (6%)
Little Belts	510,015 (63%)	153,500 (19%)	516,156 (64%)	174,139 (22%)	424,378 (53%)	164,030 (20%)	530,620 (66%)	174,114 (22%)	530,646 (66%)	174,139 (22%)
Rocky Mountain Range	290,086 (37%)	30,467 (4%)	324,932 (42%)	32,245 (4%)	324,932 (42%)	32,245 (4%)	324,932 (42%)	32,245 (4%)	324,932 (42%)	32,245 (4%)
Snowies	13,289 (11%)	4,238 (4%)	22,241 (19%)	19,786 (17%)	22,244 (19%)	19,786 (17%)	14,892 (13%)	5,841 (5%)	14,084 (12%)	10,520 (9%)
Upper Blackfoot	203,953 (61%)	54,216 (16%)	150,892 (45%)	51,908 (16%)	150,892 (45%)	51,908 (16%)	201,314 (60%)	51,563 (15%)	167,524 (50%)	51,763 (16%)

Results

PRISM model results

Budget

The PRISM model was run both with and without a constrained budget, to display the possible outcomes of a scenario in which budgets were unlimited but all resource constraints and desired conditions applied. The "unconstrained budget" runs represent a theoretical ecological maximum amount of timber harvest that could occur in the Plan and still be consistent with all plan components. The figure below displays how much additional funding would be needed, above the foreseeable budget level of approximately $5.32M/year, to achieve the outcomes displayed in the unconstrained budget scenario. The amount needed in the early decades is greater than that in the later decades. The alternatives are generally similar, although alternative E tends to require the most additional funding and alternative A the least.

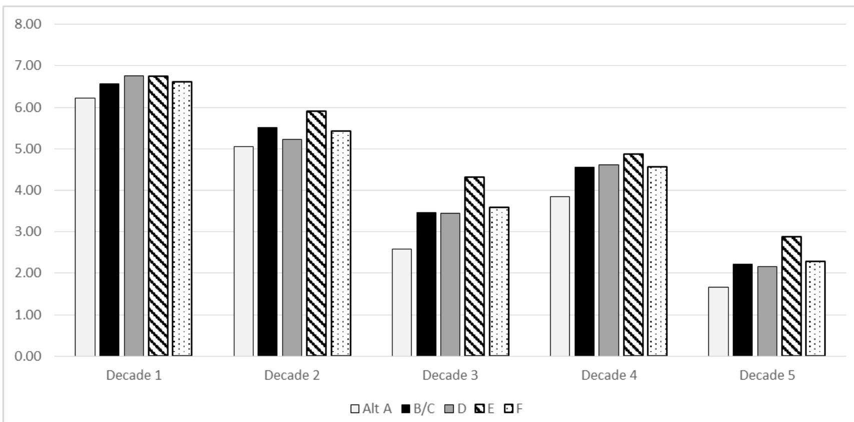


Figure 63. $(M) needed per year above constrained budget to achieve unconstrained model outcomes

Acres of vegetation treatments

Timber Harvest

Harvest modeled in PRISM is of two general types: even-aged regeneration, and non-regeneration. The model scheduled treatments based on the condition of the landscape and the ability of treatments to move the forest towards the desired conditions, while considering all constraints.

Table 61 displays the total harvest acres by alternative projected to occur (on both lands suitable and unsuitable for timber production) in the first 2 decades of the planning period. Figure 64 displays this information for 5 decades. Under the constrained budget scenario, alternative E harvests the least number of acres. This is because alternative E achieves its objective of maximizing timber production by harvesting fewer, but higher volume, acres, whereas the other alternatives harvest more, but lower volume acres, to achieve their objective of maximizing the desired condition. Preferred alternative F represents a compromise between these two approaches. Although all desired conditions had an influence, the primary desired conditions that influenced the model to schedule harvest were increasing ponderosa pine and the large tree size class, because these desired conditions are different than the existing condition. Alternative E was modeled to maximize timber production as a priority in addition to achieving desired conditions; this was done to provide a range of possible management emphases. Under an unconstrained budget scenario, all alternatives are fairly similar, with alternative E harvesting the most acres. This is because without a budget constraint, alternative E can schedule additional harvests that both maximize timber production and achieve desired conditions.

Table 61. Average annual acres treated by treatment type by alternative, decades 1 and 2, with and without a reasonably foreseeable budget constraint

Type and decade of harvest		Alt A	Alts B/C	Alt D	Alt E	Alt F
Even-aged regeneration harvest	Decade 1 Constrained	2004	2139	2070	1396	2279
	Decade 1 Unconstrained	3213	3195	3119	3464	3255
	Decade 2 Constrained	957	847	887	1919	1760
	Decade 2 Unconstrained	1362	1423	1320	1557	1426
Other harvest	Decade 1 Constrained	67	37	31	739	0
	Decade 1 Unconstrained	1039	1781	1747	2000	1686
	Decade 2 Constrained	1959	2000	2000	0	950
	Decade 2 Unconstrained	2099	2000	2000	2000	2000
Total harvest	Decade 1 Constrained	2072	2176	2101	2134	2279
	Decade 1 Unconstrained	4252	4976	4867	5464	4942
	Decade 2 Constrained	3461	2847	2887	1919	2709
	Decade 2 Unconstrained	4,599	3423	3320	3557	3426

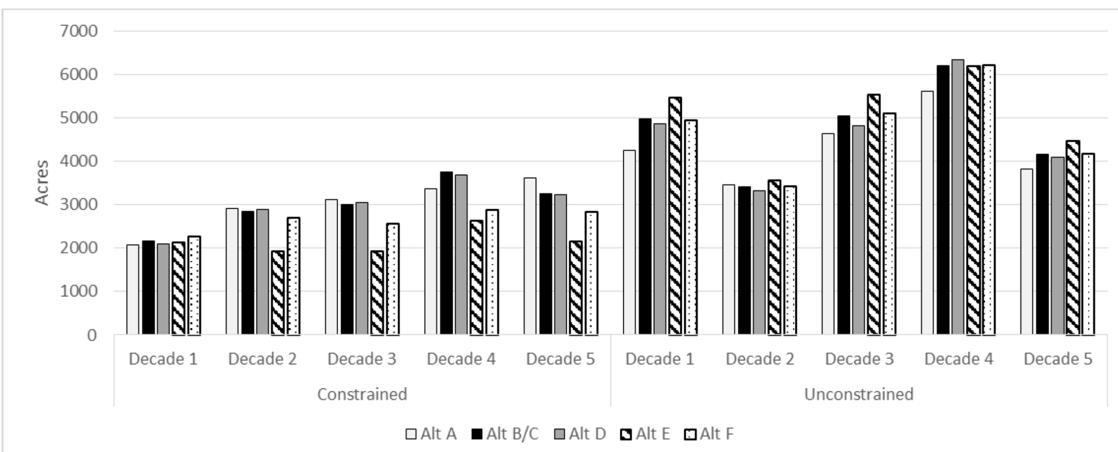


Figure 64. Harvest average acres per year by decade, by alternative, with and without budget constraint

The model predicts a mix of even-aged regeneration harvest and other harvest (intermediate and uneven-aged harvest). The ratio of these harvest types varies by decade, depending on the most optimum solution identified by the model. PRISM generally projected a higher proportion of even-aged regeneration harvest as opposed to intermediate harvest. This was in part due to the desired conditions specified which are not always translated intuitively by the model. For example, a 2-aged shelterwood harvest is a common prescription used on the HLC NF, wherein a very open overstory is retained indefinitely, but the stand is classified as a regeneration harvest because a new cohort is established. Based on yield table information, the model considers the residual overstory to contribute to a large size class condition. Therefore, the model could efficiently meet a large size class desired condition while also producing timber volume, and it selected this prescription fairly frequently. In practice, intermediate harvests are often utilized to meet a large size class desired condition, by removing smaller trees and retaining a fully stocked stand dominated by larger trees. During plan implementation, the appropriate prescription and type of harvest for a stand would be determined site-specifically during project design and analysis, based on the suite of desired conditions in the Plan.

Figure 65 displays the projected acres of timber harvest by type for a five-decade period, on lands both suitable and unsuitable for timber production, assuming a reasonably foreseeable budget. The model tends to schedule regeneration harvest more-so than other types of harvest, as the most rapid method to achieving the prescribed desired conditions.

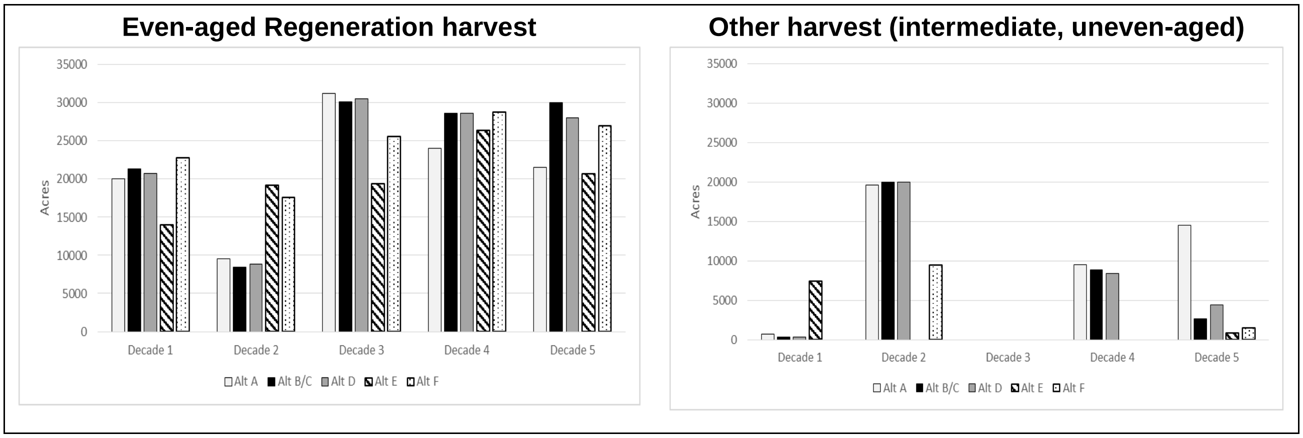


Figure 65. Harvest average acres per year by decade, alternative, and harvest type, reasonably foreseeable budget

Prescribed burning

Prescribed burning was also scheduled by PRISM. Two types are included: low severity burning as an intermediate treatment or site preparation activity within a harvest prescription; and ecosystem burning that occurs as its own stand-alone prescription which could occur with a variety of severities depending on the vegetation conditions. The total acres include both types. Under the constrained budget scenario alternatives B/C and D, followed by F, burn the most acres while alternative E burns the least (Table 62, Figure 66).

Table 62. Average annual acres burned by alternative, decades 1 and 2

	Alt A	Alts B/C	Alt D	Alt E	Alt F
Decade 1 constrained	3,018	3,072	3,108	3,019	3,165
Decade 1 unconstrained	10,000	10,000	10,000	10,000	10,000
Decade 2 constrained	4,264	4,247	4,015	2,813	3,565
Decade 2 unconstrained	10,000	10,000	10,000	10,000	10,000

Burning includes prescribed burning in harvested stands, and stand-alone ecosystem burning in forested types.

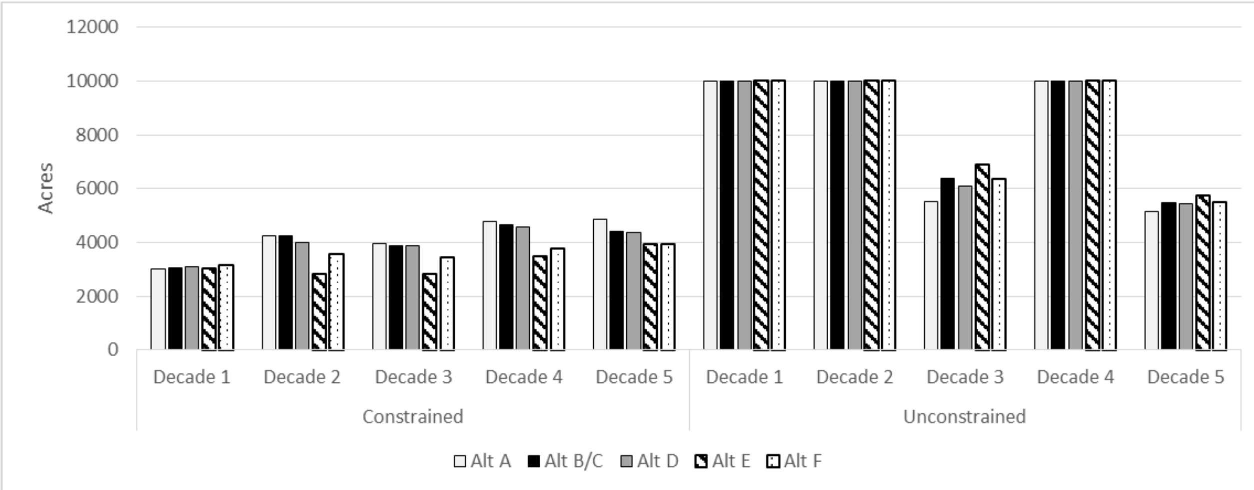


Figure 66. Prescribed burning average acres/year by decade, by alternative, with and without a budget constraint

The figures below display the acres of prescribed fire in forested types projected to occur in lands suitable versus unsuitable for timber production, with and without a budget constraint. The model tends to schedule burning associated with timber harvest. However, this is the result of several attributes of the vegetation desired condition and does not take into account other desired conditions in the Plan. Under a constrained budget, alternative E tends to apply less burning due to its objective of utilizing its budget to maximize timber outputs. Alternative A tends to apply the most burning, followed by B/C and D. The amount burning in lands suitable versus unsuitable for timber production is relatively even. However, in an unconstrained budget scenario, the model places more burning on unsuitable lands, because it has the funds to do so after also achieving desired timber outputs. Under this scenario, it varies by decade and land classification as to which alternative applies the most burning.

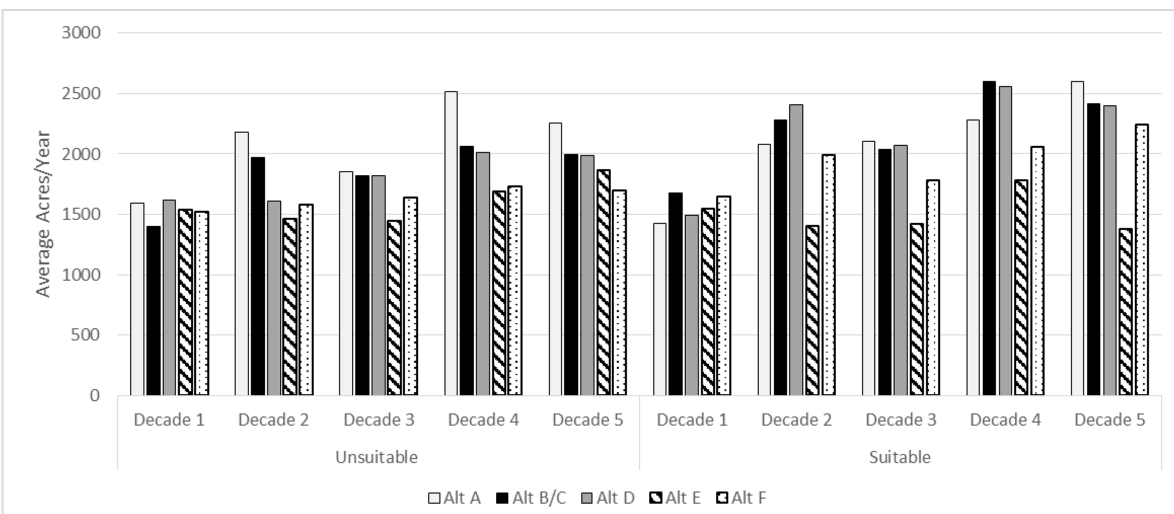


Figure 67. Prescribed burning on lands suitable versus unsuitable for timber production, by alternative and decade – with a constrained budget

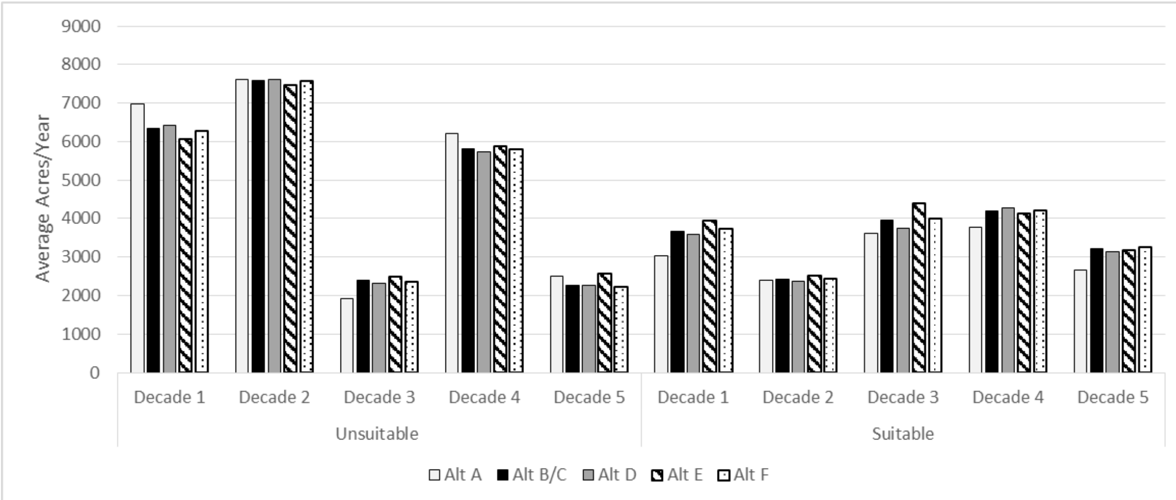


Figure 68. Prescribed burning on lands suitable versus unsuitable for timber production, by alternative and decade – with an unconstrained budget

Sustained yield limit

PRISM provides an estimate of the sustained yield limit, as required by the 2012 Planning Rule and associated directives. The sustained yield limit is the amount of timber meeting applicable utilization standards that can be removed from a forest annually in perpetuity on a sustained yield basis from all lands that may be suitable for timber production. It does not include potential salvage or sanitation harvest that may occur in response to disturbances. It is not limited by desired conditions, other plan components (resource constraints), or the HLC NF's fiscal capability or organizational capacity. Sustained yield limits must be calculated for each proclaimed forest; these values are reflected in FW-TIM-STD-07 (Table 63).

Table 63. Sustained yield limit for the HLC NF

	SYL – mmcf	SYL - mmbf
Helena National Forest	5.75	31.21
Lewis & Clark National Forest	4.95	26.36
HLC combined forest	10.7	57.57

The projected timber sale quantity may not exceed this amount, unless a departure limit is specified by the responsible official for the first decade or two of the Plan to achieve multiple-use management objectives. However, the projected timber sale quantity does not approach sustained yield limit under any alternative or budget scenario due to other resource constraints.

Timber volume outputs: PTSQ and PWSQ

PRISM provides estimates of the timber volume outputs expected to be sold during the life of the Plan, as required by the 2012 Planning Rule and associated directives. Projected timber sale quantity (PTSQ) is the volume of timber that meets sawlog specifications. Projected wood sale quantity includes the PTSQ timber volume plus other wood products such as nonsaw and biomass and firewood. Neither of these estimates includes potential salvage or sanitation harvest. Estimates are shown with and without a budget constraint (Table 64, Figure 69).

Table 64. Average annual projected timber and wood sale quantities by alternative – decades 1 and 2

Category	Decade	Alt A		Alts B/C		Alt D		Alt E		Alt F	
		mmcf	mmbf	mmcf	mmbf	mmcf	mmbf	mmcf	mmbf	mmcf	mmbf
With a reasonably foreseeable budget constraint											
Timber Products[1] A1. Lands suitable for timber production	1	3.37	16.21	3.72	17.76	3.55	17.03	4.43	21.61	3.98	19.05
	2	3.30	15.51	3.86	18.13	4.11	19.32	4.44	21.88	4.22	19.99
Timber Products[1] A2. Lands not suitable for timber production	1	1.33	6.28	1.13	5.47	1.32	6.30	2.27	11.21	1.72	8.25
	2	1.40	6.57	0.99	4.55	0.76	3.49	2.26	11.08	1.48	7.03
Projected Timber Sale Quantity[1] (PTSQ, A1 + A2)	1	4.70	22.49	4.85	23.23	4.87	23.33	6.70	32.82	5.70	27.30
	2	4.70	22.07	4.85	22.68	4.87	22.81	6.70	32.96	5.70	27.03
Other Wood Products[2] B. All lands	1	2.06	3.37	2.07	3.48	2.08	3.50	2.36	4.92	2.21	4.10
	2	2.06	3.31	2.07	3.40	2.08	3.42	2.36	4.94	2.21	4.05
Projected Wood Sale Quantity[3] (PWSQ, A1+A2+B)	1	6.76	25.86	6.92	26.71	6.95	26.83	9.06	37.74	7.91	31.40
	2	6.76	25.38	6.92	26.09	6.95	26.23	9.06	37.91	7.91	31.08
Without a reasonably foreseeable budget constraint											
Timber Products[1] A1. Lands suitable for timber production	1	5.38	25.46	5.47	25.88	5.33	25.19	6.08	28.76	5.66	26.78
	2	3.79	18.01	5.32	25.56	5.24	25.15	5.51	26.50	5.28	25.37
Timber Products[1] A2. Lands not suitable for timber production	1	1.82	8.59	2.42	11.54	2.39	11.35	2.62	12.44	2.27	10.82
	2	3.41	16.41	2.57	12.28	2.48	11.86	3.19	15.32	2.65	12.62
Projected Timber Sale Quantity1 (PTSQ, A1 + A2)	1	7.20	34.05	7.89	37.41	7.71	36.54	8.70	41.20	7.93	37.60
	2	7.20	34.42	7.89	37.83	7.71	37.01	8.70	41.82	7.93	37.98
Other Wood Products[2] B. All lands	1	2.43	5.11	2.54	5.61	2.51	5.48	2.66	6.18	2.54	5.64
	2	2.43	5.16	2.54	5.67	2.51	5.55	2.66	6.27	2.54	5.70
Projected Wood Sale Quantity[3] (PWSQ, A1+A2+B)	1	9.63	39.16	10.43	43.03	10.22	42.02	11.36	47.38	10.47	43.24
	2	9.63	39.58	10.43	43.51	10.22	42.57	11.36	48.10	10.47	43.68
Amount annual budget would need to increase[4]	1	$6.22 M		$6.57 M		$6.76 M		$6.75 M		$6.62 M	
	2	$5.06 M		$5.52 M		$5.23 M		$5.9 M		$5.42 M	

1 Projected timber sale quantity (PTSQ) includes volumes (other than salvage or sanitation) that meet timber product utilization standards.
2 Other Wood Products - Fuelwood, biomass, and other volumes that do not meet timber product utilization standards (small diameter 3 -7 inches).
3 Projected wood sale quantity consists of the projected timber sale quantity as well as other woody material such as fuelwood, firewood, or biomass.
4 This displays the amount of money needed per year above the current budget constraint of $5.322M to achieve the projected volume outputs.

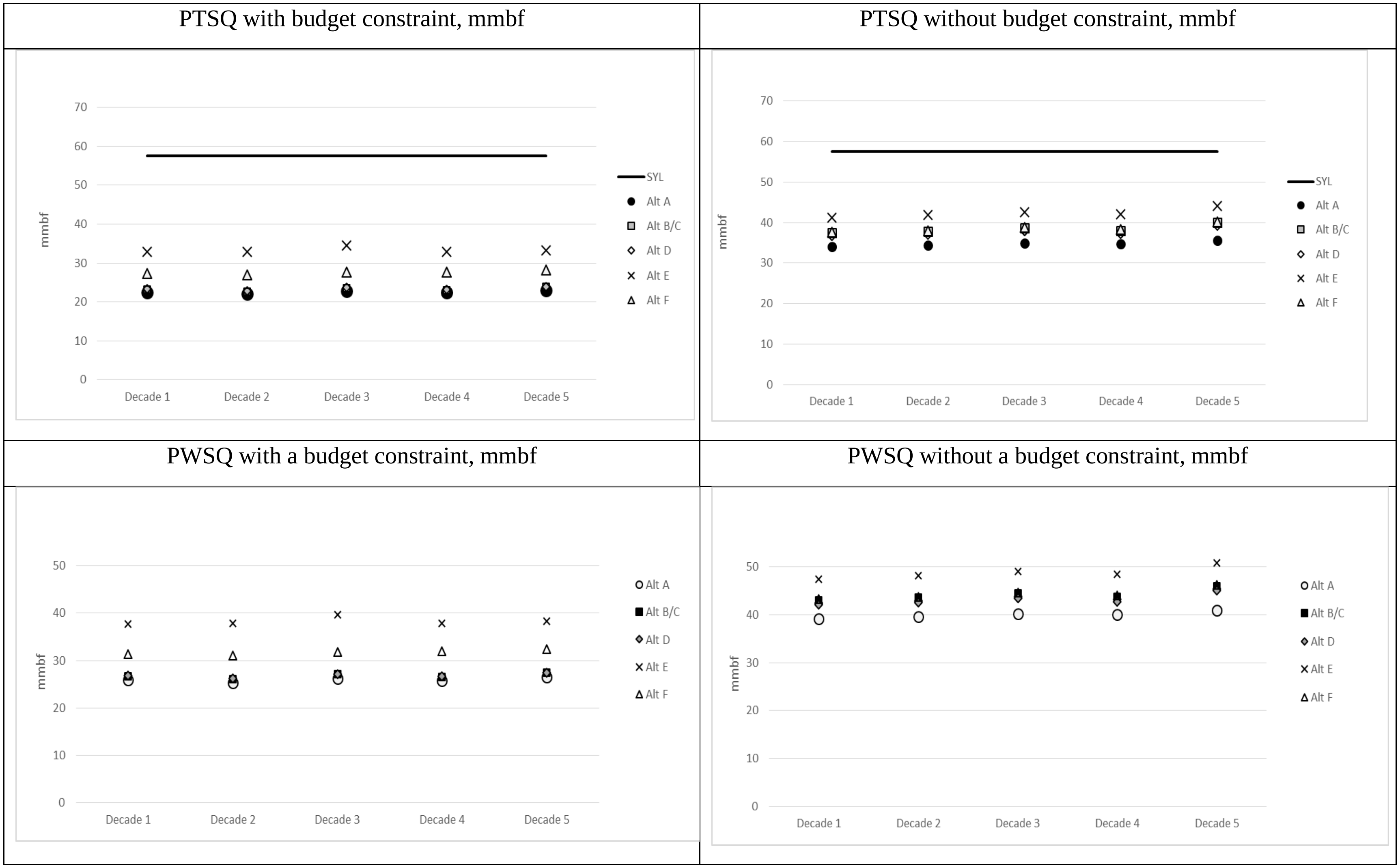


Figure 69. Projected timber sale quantities (average annual mmbf) by alternative

Departure score

In the PRISM model, every acre that is not within the desired condition minimum and maximum is assigned a "penalty point"; these points are totaled together to determine a "departure score" from the desired condition. Penalty points can accrue in any time period in the model. The objective is to minimize total penalty points, and therefore have the lowest departure score possible. The departure scores provide a relative comparison of how well treatments in PRISM contribute to terrestrial vegetation desired conditions. The desired conditions utilized by PRISM are vegetation type (cover type by PVT), size class, and density class. The many other desired conditions in the Plan are not represented by this model. The departure scores indicate that with respect to vegetation desired conditions, under the constrained budget alternative E results in the poorest condition. Alternatives A, B/C, and D are all similar, and alternative F performs slightly less well but much better than alternative E. However, when the budget limitation is removed, all alternatives perform similarly well, because the model was able to assign actions that both met the timber goals (as in alternative E) and maximized the attainment of desired condition. Under this scenario, alternative A performs the poorest, and alternative E is the best. Preferred alternative F, as well as B/C and D, perform only slightly more poorly than alternative E.

Hazard to disturbances

Hazard to several disturbances was assessed in the PRISM model, utilizing hazard ratings applied to yield tables. The results do not include the iterative modeling with climate and disturbances that SIMPPLLE provides. Results reflect the hazard to these disturbances based on stand characteristics, and do not indicate expected acres affected (refer to SIMPPLLE model results).

The hazard of stand replacing fire in forested vegetation types was estimated using the fire and fuels (FFE) extension of the Forest Vegetation Simulator. The budget constraint does not substantially impact this attribute; while fire hazard is likely reduced in areas treated by harvest or fire, the difference in acres treated between the constrained and unconstrained runs are minor in comparison to the entire landbase (Figure 70).

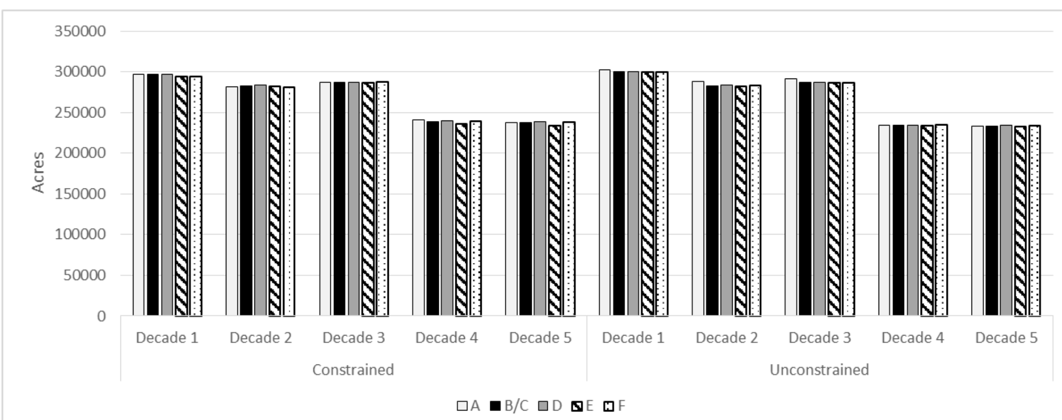


Figure 70. Acres with high hazard of stand replacing fire by alternative, with and without a budget constraint

Hazard to bark beetles (mountain pine beetle in lodgepole pine and Douglas-fir beetle) and defoliators (western spruce budworm) were developed using the Forest Vegetation Simulator (Randall & Bush, 2010). Figure 71 shows that the hazard to Douglas-fir beetle generally increases over time, as large Douglas-fir forests are promoted, but is variable depending on alternative and budget scenario. The hazard to mountain pine beetle in lodgepole pine (Figure 72) tends to decrease over time, with all alternatives being similar and not a large variance between the constrained and unconstrained budget scenarios, although the unconstrained scenario results in slightly lower acres of high hazard in decades 4 and 5. The hazard to mountain pine beetle in ponderosa pine (Figure 73) is more sensitive to alternative and budget scenario, with lower acres with a high hazard resulting from the unconstrained budget scenario. Overall the hazard increases slightly over time but not to a great degree. High hazard to western spruce budworm (Figure 74) declines over time under all alternatives and budget scenarios, due in part to vegetation treatments but likely to natural processes to a greater degree. All alternatives are similar to one another. The unconstrained budget run results in a slightly lower number of acres with high hazard to this pest than the constrained budget run, indicating there is some influence from vegetation treatments.

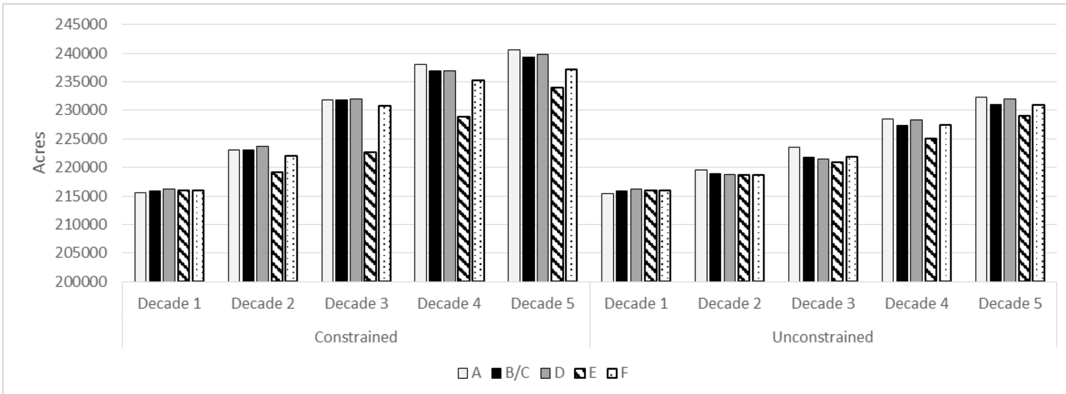


Figure 71. Acres with high hazard to Douglas-fir beetle infestation by alternative, with and without a budget constraint

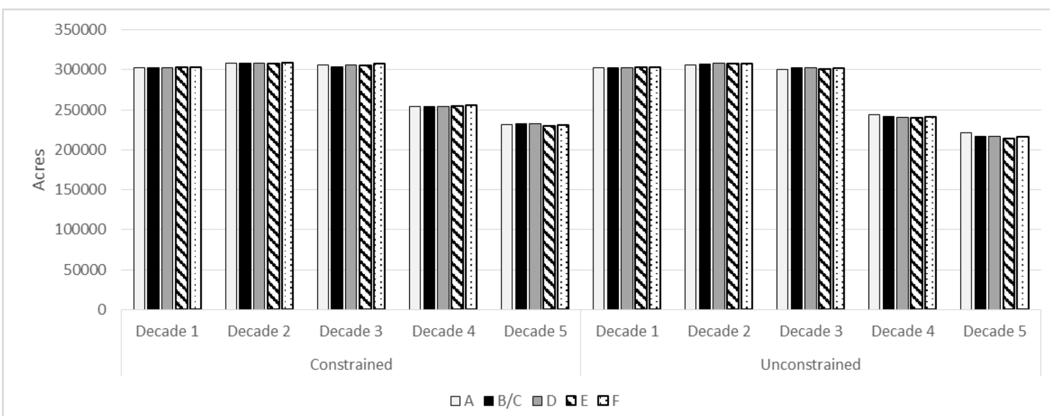


Figure 72. Acres with high hazard to mountain pine beetle infestation in lodgepole pine by alternative, with and without a budget constraint

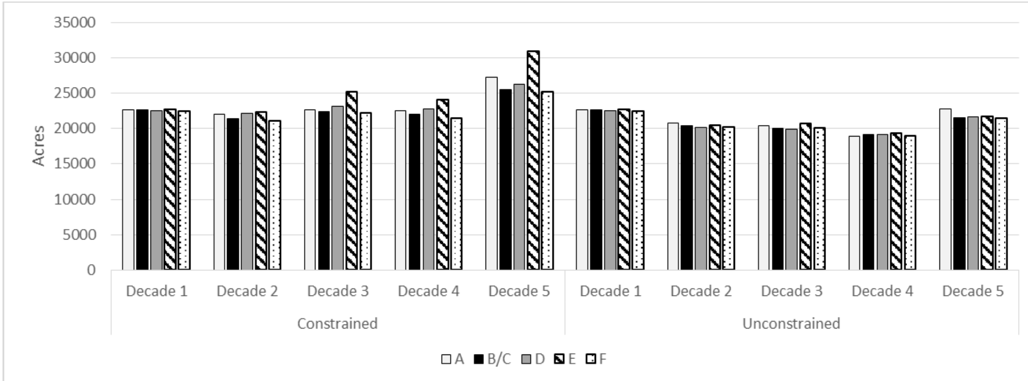


Figure 73. Acres with high hazard to mountain pine beetle infestation in ponderosa pine by alternative, with and without a budget constraint

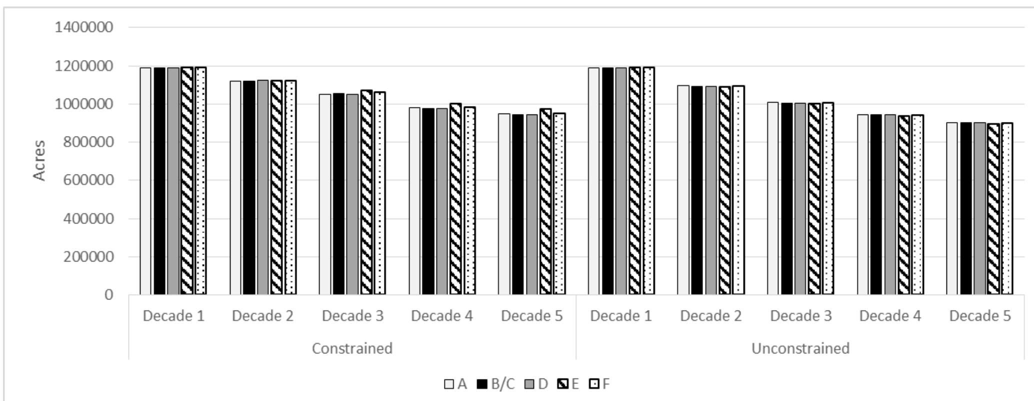


Figure 74. Acres with high hazard of defoliation by alternative, with and without a budget constraint

Sensitivity analysis

Sensitivity analysis is conducted to examine the trade-offs caused by constraints and determine if the PRISM model is working correctly. Eight runs were made to test the major features and the effect of constraints. The sensitivity analysis runs used the data from alternative B, but results would be similar for all alternatives. All runs were made with the objective to move towards vegetation desired future condition. Table 65 describes the sensitivity analysis runs. Runs 1 through 6 are hierarchical, each building on the parameters included in the previous run to assess the incremental effect of adding constraints. Runs 7 and 8 isolate the effects of lynx and budget, respectively, against the baseline.

Table 65. Type, description, and purpose of sensitivity analysis modeling runs

Run	Description and purpose
1	Baseline run. Model included only harvest flow and ending inventory constraints. The purpose of this run is to provide for comparison of the effect of other constraints.
2	Includes parameters for Run 1, plus the Management Area Group (MAG) treatment intensity constraints. These constraints ensured that the model focused harvest intensity in the appropriate areas (i.e., lands suitable for timber production).
3	Includes parameters for Runs 1 & 2, plus opening limits. The opening limits were designed to ensure harvests were distributed appropriately across the landscape.

Run	Description and purpose
4	Includes parameters for Runs 1, 2, & 3, plus lynx constraints. Lynx constraints were designed to ensure the Northern Rockies Lynx Management Direction is followed.
5	Includes parameters for Runs 1, 2, 3, & 4, plus additional operational limits (such as the minimum/maximum acres possible for burning, the appropriate silvicultural mix).
6	Includes parameters for Runs 1, 2, 3, 4, & 5 plus adds the budget constraint.
7	Includes parameters for Run 1 (baseline), plus the lynx constraints. This was done to isolate and understand the impact of lynx direction given no other model constraints.
8	Includes parameters for Run 1 (baseline), plus the budget constraint. This was done to isolate and understand the impact of the reasonably foreseeable budget constraint.

The results of the sensitivity analysis are displayed by comparing selected outputs. For most attributes, the budget and management area group (i.e., land allocations) constraints were the most constraining factor. For all outputs, runs 2 and 3 were identical, indicating that the opening limitations were not constraining. Therefore, run 3 is not compared in detail.

Departure score

The first attributes compared is the departure score (Figure 75). This score indicates the amount of penalty points incurred by the run. The points are accumulated over all 15 decades. The best (lowest) score is attained under the baseline run (#1), with the most flexibility in management and no constraints.

- Management area group constraints (run 2 versus 1) reduce attainment of desired condition 39% compared to the baseline.
- Lynx constraints (run 4 versus 2) incrementally reduce the attainment of desired condition an additional 0.56%. Lynx constraints independent of other variables (run 7 versus 1) reduce attainment of desired condition 0.07% compared to the baseline.
- Operational constraints (run 5 versus 4), incrementally reduce attainment of desired condition an additional 6.7%.
- Budget constraints (run 6 versus 5) incrementally reduce attainment of desired condition an additional 18%. Budget constraints independent of all other variables (run 8 versus run 1) reduce attainment of desired condition 38% compared to the baseline.
-

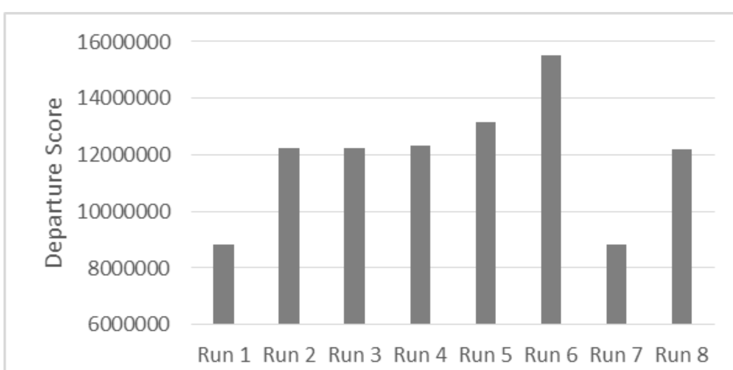


Figure 75. Departure score across PRISM sensitivity runs

Projected timber sale quantity

The second attribute compared was projected timber sale quantity (PTSQ) (Figure 76). The summary compares the impact of constraints on the PTSQ estimated for Decade 1 of the planning period. Budget and management area constraints are the most influential. The impacts of lynx constraints are very minor.

- Management area group constraints (run 2 versus 1) reduce PTSQ 19% compared to the baseline.
- Lynx constraints (run 4 versus 2) incrementally reduce PTSQ 1.36%. Lynx constraints independent of other variables (run 7 versus 1) reduce PTSQ 0% compared to the baseline.
- Operational constraints (run 5 versus run 4) incrementally reduce PTSQ 2.68%.
- Budget constraints (run 6 versus 5) incrementally reduce PTSQ an additional 42%. Budget constraints independent of other variables (run 8 versus run 1) reduce PTSQ 54%.

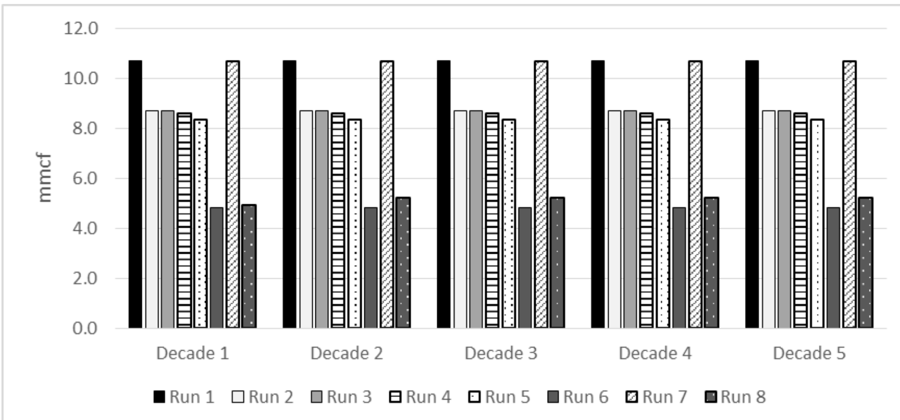


Figure 76. Projected timber sale quantity across PRISM sensitivity runs

Projected harvest acres

The following summary compares the impact of constraints on the projected harvest acres estimated for Decade 1 of the planning period (Figure 77). Budget and management area constraints are the most influential.

- Management area group constraints (run 2 versus run 1) reduce harvest acres 16.26%.
- Lynx constraints (run 4 versus 2) incrementally reduce harvest acres 3.42%. Lynx constraints independent of other variables (run 7 versus 1) reduce harvest acres 0% compared to the baseline.
- Operational constraints (run 5 versus run 4) decrease the harvest level by 7.46%.
- Budget constraints (run 6 versus 5) incrementally reduce harvest acres 67.39%. Budget constraints independent of all other variables (run 8 versus run 1) reduce harvest acres 61.64%.

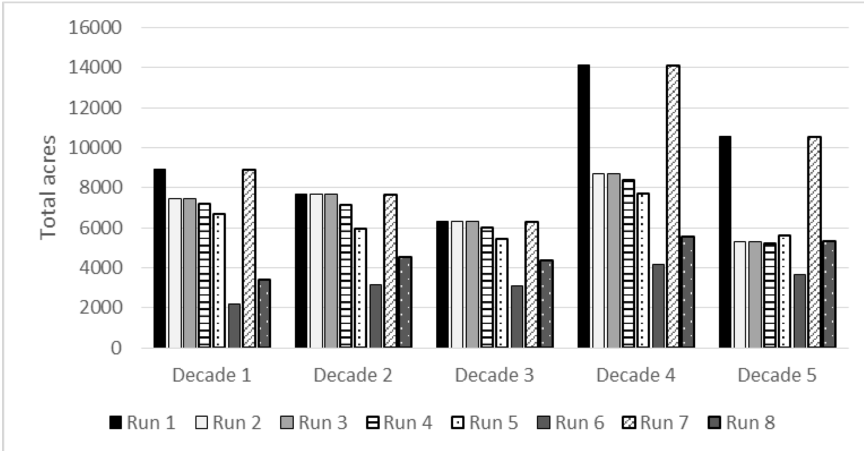


Figure 77. Projected harvest acres across PRISM sensitivity runs

Projected prescribed burning acres

The following summary (Figure 78) compares the impact of constraints on the projected burning acres estimated for Decade 1 of the planning period. Budget and operational constraints are the most influential. Constraints that may limit harvest (i.e. lynx) result in increased burning.

- Management area group constraints (run 2 versus run 1) decrease burning acres 35.18%.
- Lynx constraints (run 4 versus 2) incrementally increase burning acres 3.79% in Decade 1. Lynx constraints independent of other variables (run 7 versus 1) increase burning acres 0.78%.
- Operational constraints (run 5 versus run 4) incrementally decrease burning by 74.92%.
- Budget constraints (run 6 versus 5) incrementally reduce burning acres 69.28%. Budget constraints independent of all other variables (run 8 versus run 1) reduce burning acres 88.85%.

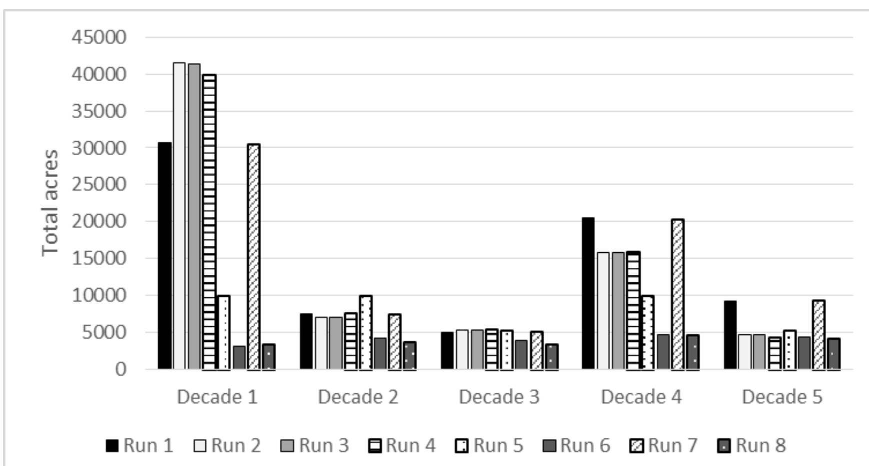


Figure 78. Projected prescribed burning acres across PRISM sensitivity runs

Budget

The total management costs, or how much of budget was used, was also evaluated. The addition of management constraints results in lower costs compared to the baseline scenario, because the amount of activities that can be done becomes limited. However, none of these constraints reduce the management costs below the budget limitation that is applied in runs 6 and 8. The following summary compares the impact of constraints on the budget for Decade 1 of the planning period (Figure 79). Runs 6 and 8 are identical because they both employ the reasonably foreseeable budget constraint.

- Management area group constraints (run 2 versus run 1) increases budget used by 15% compared to the baseline scenario.
- Lynx constraints (run 4 versus 2) incrementally reduces budget used by 3.19%. Lynx constraints independent of other variables (run 7 versus 1) reduce costs 2.45% compared to the baseline.
- Operational constraints (run 5 versus run 4) incrementally decreases budget used by 52.93%.
- Budget constraints (run 6 versus 5) incrementally reduce budget used 61%. Budget constraints independent of all other variables (run 8 versus run 1) reduce budget used 79.44%.

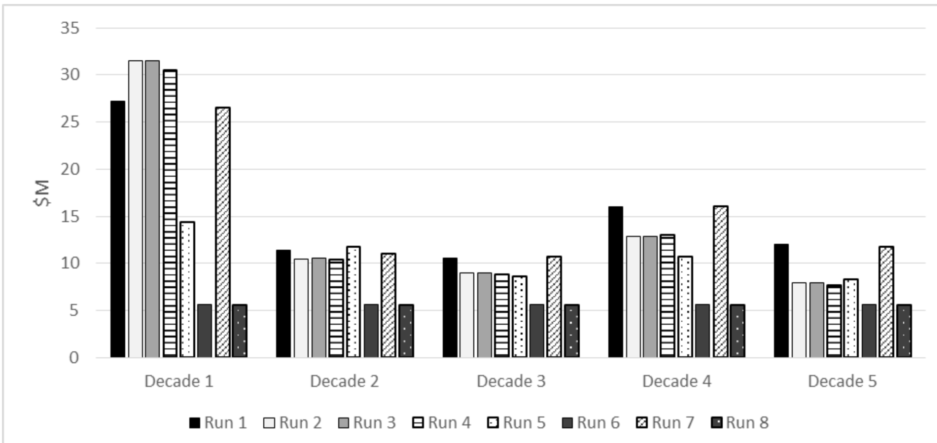


Figure 79. Comparison of projected budget used across PRISM sensitivity runs

SIMPPLLE model results

The following section provides the detailed outputs from the SIMPPLLE model. The following additions or changes are incorporated relative to how SIMPPLLE results were presented in the DEIS:

- There is a modeled alternative labeled as “FUN”, or “alternative F, unconstrained”. This alternative represents alternative F, with a timber schedule that is unconstrained by budget. This was done to provide analysis to support the footnotes provided in FW-TIM-OBJ-01 and 02, disclosing the potential levels of harvest that could be accomplished if budgets were not constrained.
- Additional scales of analysis are addressed: inside/outside of wildland/urban interface (WUI) areas; and inside/outside of managed landscapes. Managed landscapes are defined as those areas that are not wilderness, RWA, IRA, or other land allocations that prohibit or substantially limit harvest. The WUI is mapped based on County Wildland Protection Plans (CWPPs) where available, and standard Hazardous Fuels Reduction Act (HFRA) definitions where CWPPs are unavailable. The WUI will change over time as human developments and land use change.
- In addition to individual tree species presence, other composition and structural attributes are displayed at the GA scale, because desired conditions were quantified for them in the Plan (cover type, size class, and density class).

In the Composition and Structure/Pattern sections, box and whisker charts are provided to compare alternative A and F. The other alternatives are not included in these charts due to complexity; rather, these two alternatives are selected to provide a snapshot of the statistical variability surrounding the estimates. In the other charts, the mean for all alternatives is shown to provide a complete comparison of alternatives. In most cases, there is little variance across alternatives. Additional box and whisker plots, along with all of the raw data and statistical information, can be found in the project record.

Disturbances

Disturbances play a key role in the ecosystems of the HLC NF. SIMPPLLE is used to estimate the probable extent and severity of wildfire, insects, and disease in the future, taking into account climate, vegetation treatments, and fire suppression. The SIMPPLLE model projected that in the future, assuming warm/dry climate conditions persist, western spruce budworm will impact the most acres overall, followed by wildfire and bark beetles (Figure 80). The alternatives are similar, except that alternative F-UN projects slightly fewer acres impacted overall. The average acres projected vary by decade and do not imply an "even flow" of acres over time. Disturbance estimates have a high level of uncertainty.

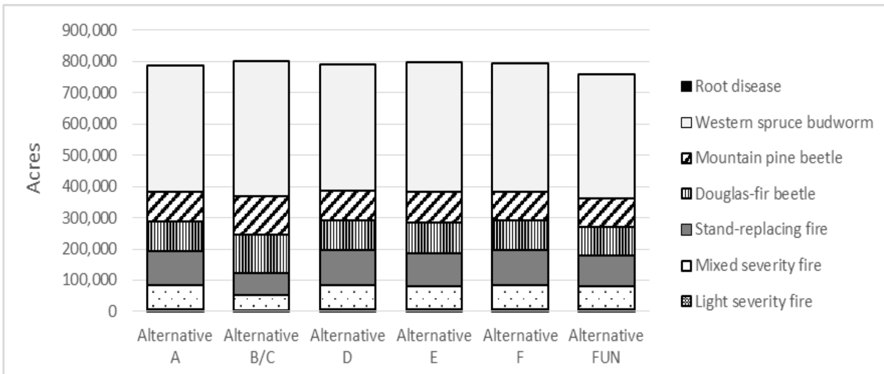


Figure 80. Average acres impacted by disturbance over 50 years, by alternative

Wildfire

Low severity fire does not feature prominently, partly because the model categorizes grass fires as "stand replacing". Alternatives E and F-UN tend to have the least acres burned (Figure 81). The model indicates that that a higher percentage of managed landscapes are burning as compared to unmanaged landscapes (Figure 82). Similarly, a higher % of WUI areas burn as compared to non-WUI areas (Figure 83). Figures 84-86 show mean acres burned with low, medium and high severity fire forestwide by alternative, compared to NRV.

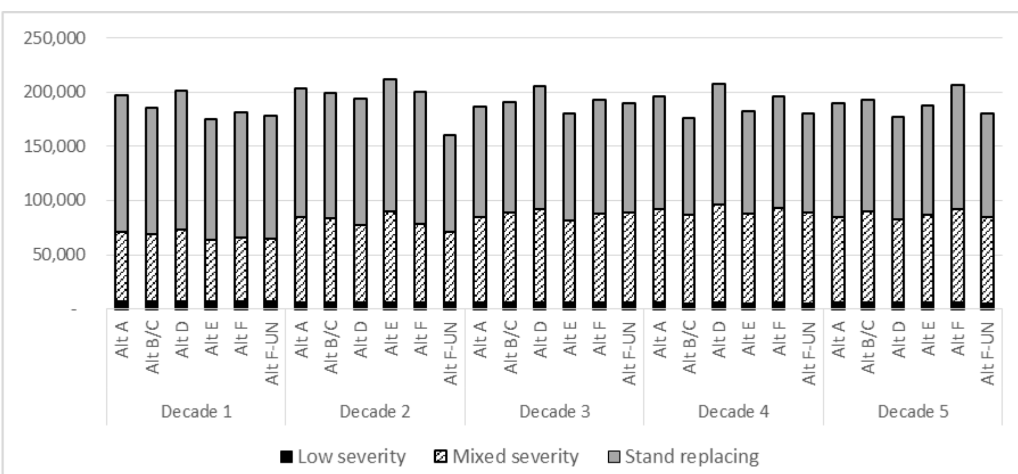


Figure 81. Total wildfire acres burned by type, average for decade, by alternative

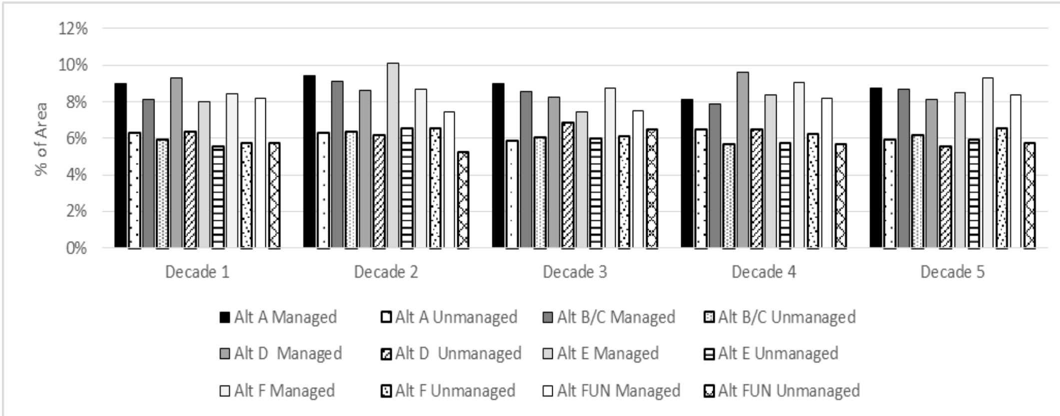


Figure 82. Percent of HLC NF burned by decade and alternative, in managed versus unmanaged landscapes

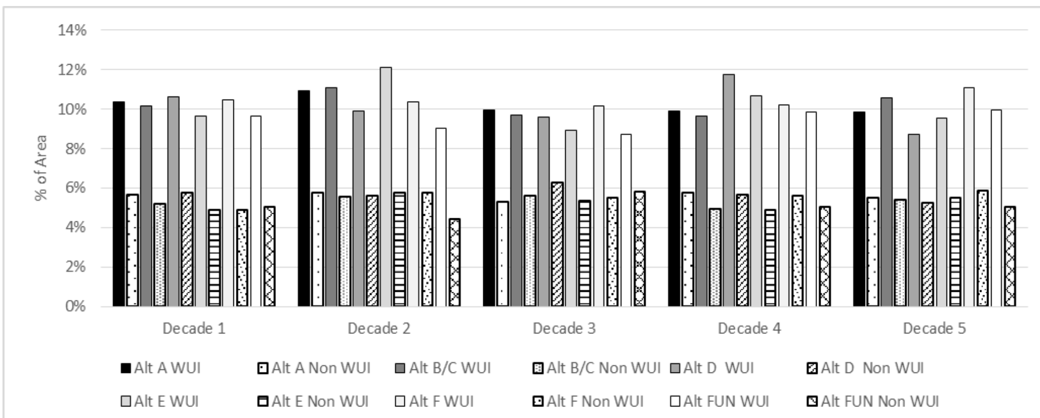


Figure 83. Percent of HLC NF burned by decade and alternative, in WUI versus Non-WUI areas

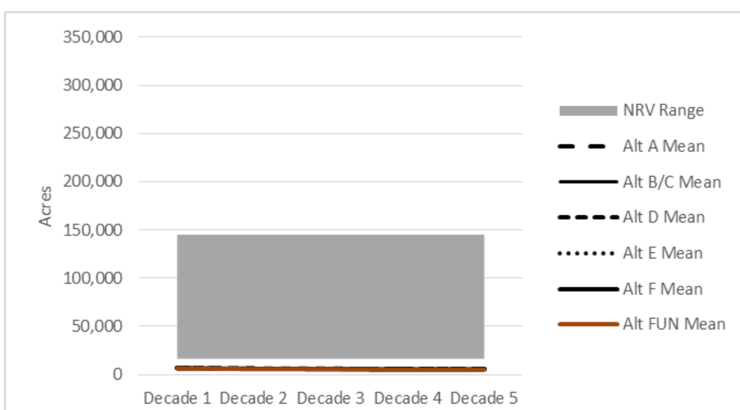


Figure 84. Mean acres per burned with low severity fire forestwide by alternative, compared to NRV

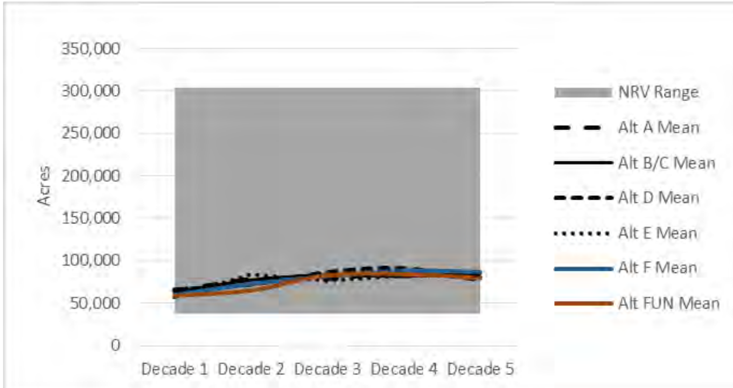


Figure 85. Mean acres burned with mixed severity fire forestwide by alternative, compared to NRV

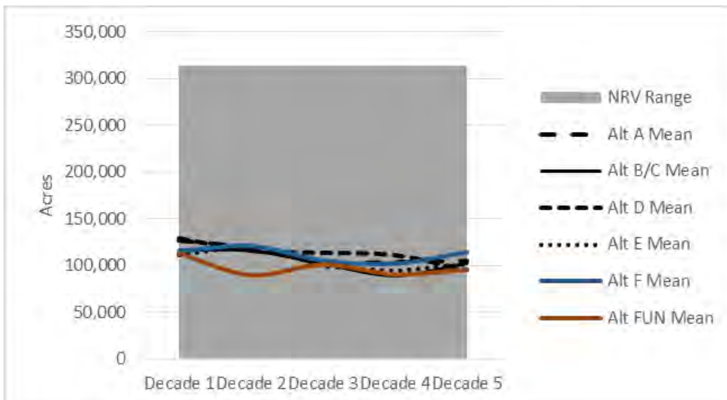


Figure 86. Mean acres burned with stand-replacing fire forestwide by alternative, compared to NRV

The percent of each GA burned (all fire types) by alternative was also assessed:

- 8 to 14% of the Big Belts is predicted to burn each decade.
- 4 to 16% of the Castles is predicted to burn each decade.
- 1 to 3% of the Crazies is predicted to burn each decade.
- 7 to 15% of the Divide GA is predicted to burn each decade.
- 7 to 18% of the Elkhorns is expected to burn each decade.
- 2 to 13% of the Highwoods GA is predicted to burn in each decade.
- While only 3 to 5% of the Little Belts GA is predicted to burn in a given decade, the total acres burned is greater than most other GAs due to the large size of this GA.
- A relatively small percentage of the Rocky Mountain Range GA is predicted to burn in each decade (2-5%) but given its large size it is one of the main contributors to total acres burned.
- 3 to 11% of the Snowies GA is predicted to burn each decade.
- 8 to 13% of the Upper Blackfoot GA is predicted to burn each decade; this along with its relatively large size results in it being one of the major contributors to the overall acres burned on the Forest.

Insects and disease

Root disease is known to occur on the HLC NF, but those that cause substantial damage or mortality (such as Armillaria) are fairly uncommon. While a small proportion of acres affected by root disease were estimated in the NRV and DEIS, no measurable occurrences were projected in the FEIS modeling. This may be due to the minor area affected by root disease.

As shown in the following figures (Figures 87-92), Western spruce budworm is predicted to influence the greatest number of acres over the next 5 decades, although it decreases in Decade 4. Mountain pine beetle remains present but at fairly steady levels, probably in part due to the recent outbreak that has reduced the amount of susceptible forests. An outbreak of Douglas-fir beetle is predicted to occur in Decade 2 and decrease thereafter.

The model projects that a higher percentage of managed landscapes and WUI will being infested as compared to unmanaged landscapes and non-WUI areas, particularly in the earlier decades. All of these pests are also less likely to occur in cold PVT areas, which are most often found in unmanaged and non-WUI areas. In the later decades, the proportions level off and are similar in managed versus unmanaged areas, and in WUI versus non-WUI areas.

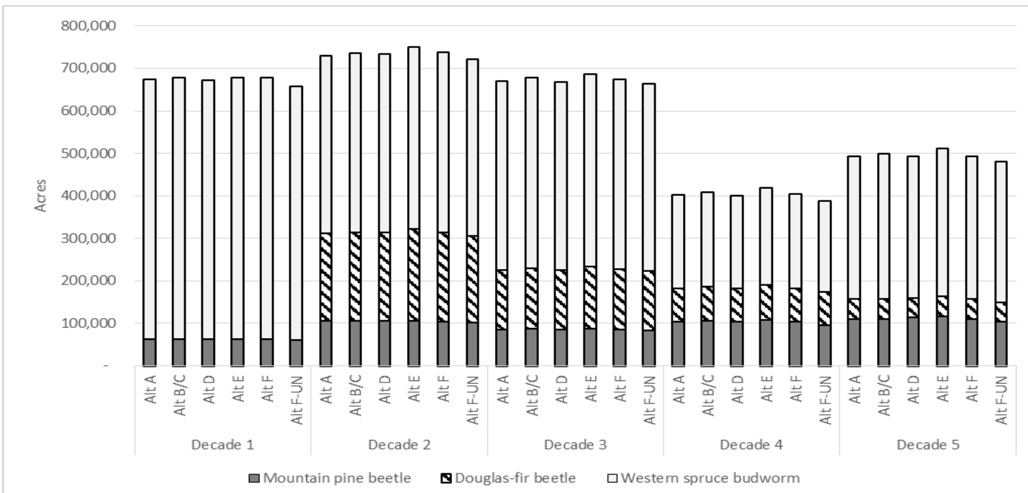


Figure 87. Total acres per decade infested by insects, by alternative, across five decades

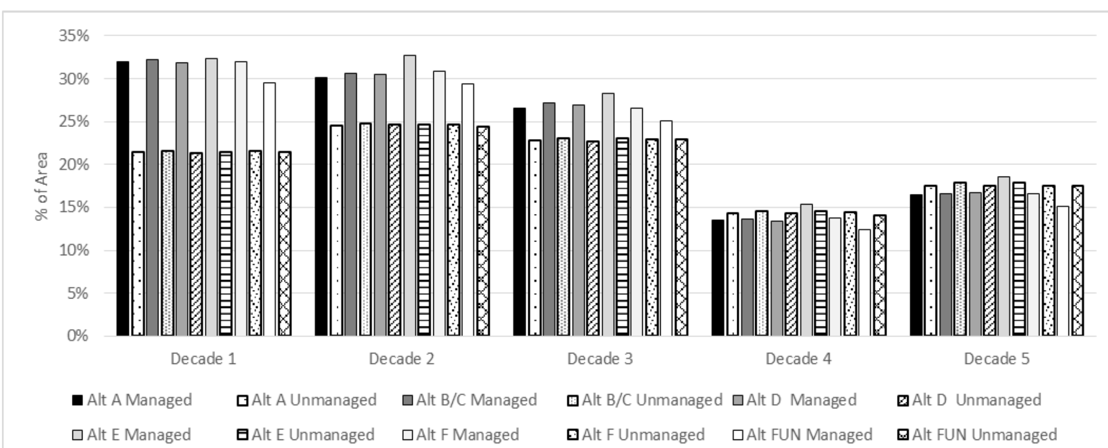


Figure 88. Percent of HLC NF infested by insects by decade and alternative, in managed versus unmanaged landscapes

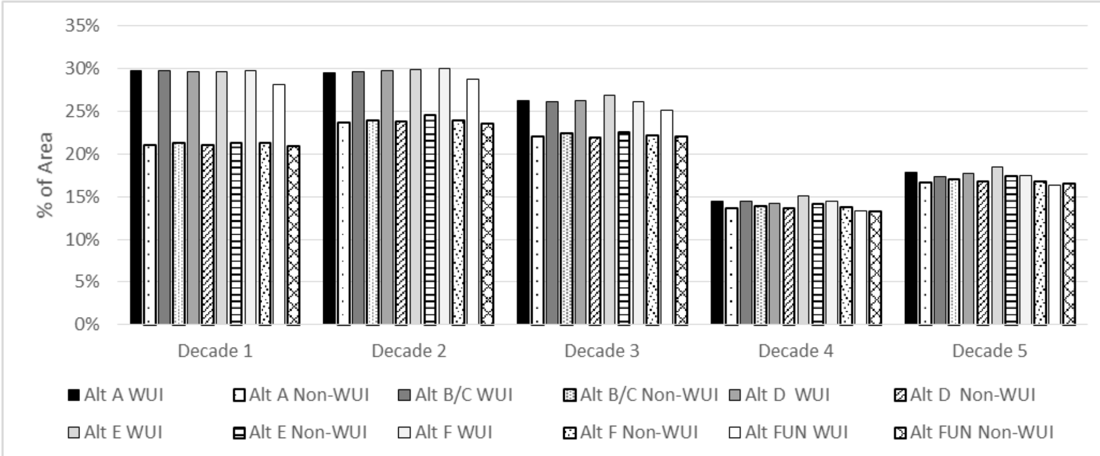


Figure 89. Percent of HLC NF infested by insects, by decade and alternative, in WUI versus Non-WUI lands

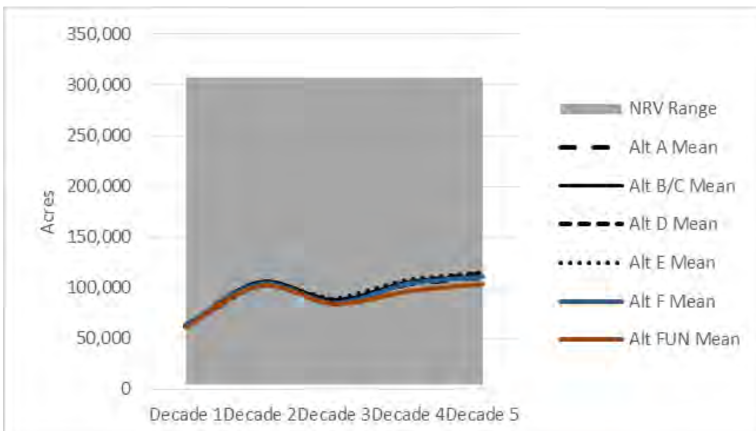


Figure 90. Mean acres infested by mountain pine beetle forestwide by alternative, compared to NRV

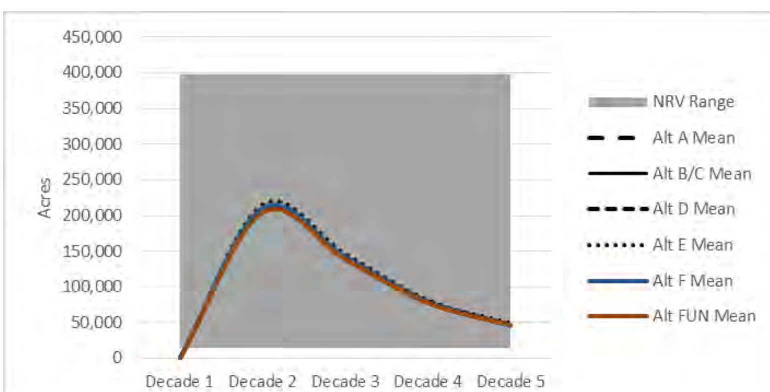


Figure 91. Mean acres infested by Douglas-fir beetle forestwide by alternative, compared to NRV

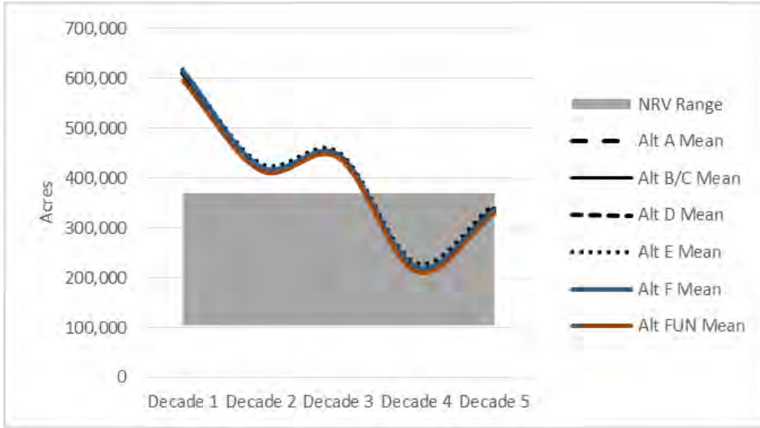


Figure 92. Mean acres infested by Western spruce budworm forestwide by alternative, compared to NRV

The area infested by insects was also assessed by GA; all alternatives are fairly similar:

- The Douglas-fir beetle is projected to be most active on the Big Belts and Little Belts, with some activity on all other GAs as well.
- The mountain pine beetle is expected to be most active in the Castles, with some activity present in all GAs; although the Crazies is expected to have very little.
- Western spruce budworm is prevalent on all GAs, with the Crazies expected to have the least activity and the Big Belts, Castles, Highwoods, Little Belts, and Snowies having the most activity.
- The Crazies is expected to be minimally impacted by insects overall. The GAs expected to be most impacted by insects are the Big Belts, Castles, Highwoods, Little Belts, and Snowies.

Composition and structure summary

The following matrices (Table 66 and Table 67) display the future condition at decade 5 (50 years) compared to the desired condition range for each composition and structural attribute, and each scale of interest. These comparisons are made using the mean modeled values and do not account for the error bars around those means, which in some cases may extend into a different position relative to the desired range. Charts with error bars are available in the project record for all attributes for alternatives A and F. These matrices can be compared to those displayed in the desired condition section of this appendix, which compared the existing condition to the desired ranges, to assess the relative movement over time relative to these goals. All alternatives are substantially similar in this regard.

Table 66. Matrix of projected condition at decade 5 (SIMPPLLE) compared to desired condition– species composition

	Forestwide	Warm Dry	Cool Moist	Cold	Big Belts	Castles	Crazies	Divide	Elkhorns	Highwoods	Little Belts	Rocky Mtn	Snowies	Upper Blackfoot
Nonforested cover type	W	W/A	W/A	W/A	W/A	W/A	W/A	W	W	W	A	A	W	A
Aspen/hardwood cover type	B	B	W/B	N	B	W/B	B	B	W/B	W/B	B	W	B	B
Aspen/cottonwood presence	W	B	W	N	W/B	W/B	B	W	W	W	B	W	B	W/B
Ponderosa pine cover type	W	B	W	N	B	W	W	B	B	W	W	W	W	W/B
Ponderosa pine presence	B	B	N	N	B	B	W/B	B	B	B	B	W/B	W	B
Limber pine presence	W/B	W	W	W/B	W/B	B	B	W/B	W/B	W/B	W/A	W/B	W/A	W
RM Juniper presence	A	W/A	W/B	N	A	A	W/B	W	A	A	W	W	W	W
Douglas-fir cover types	W	B	W	W/A	W	W	A	W	W	B	W	W/B	A	W/A
Douglas-fir presence	W	B	A	W	W/B	A	A	W/B	W	B	W	W	A	W
Lodgepole pine cover type	W/A	A	A	W	W	W	B	A	W	A	A	W/A	B	W/A
Lodgepole pine presence	A	A	A	W/B	W	W	W	A	W	W	A	W/A	B	W/A
Western larch cover type	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Western larch presence	N	N	N	N	N	N	N	N	N	N	N	N	N	B
Spruce/fir cover type	W	N	B	B	W/B	W/B	W/B	W	W/A	W/B	B	B	W	B
Engelmann spruce presence	W	W/A	A	W/B	W/B	W/B	B	W	A	N	W/A	W	A	W
Subalpine fir presence	A	N	W	W	W/A	W	A	W/A	A	W	W/A	W	W	W/A
Whitebark pine cover type	W	N	W/B	W	W	W	A	B	W/B	N	B	W	N	W/B
Whitebark pine presence	W/B	N	W	B	W	W	W	W	W	N	W	W	B	W

W = within the DC range; A = above the DC range; B = below the DC range; N = not present or no DC for that scale. When the existing condition is right at the boundary of the DC range, it is noted as W/A (at the upper end of the range) or W/B (at the lower end of the range). Items shaded in the dark gray tones and white font indicate conditions at the upper bound or above the desired range. Items shaded in light gray tones indicate conditions at the lower bound or below the desired range. Cells with no shading are within the desired ranges, or are not present/applicable.

Table 67. Matrix of projected condition at decade 5 (SIMPPLLE) compared to desired condition– structure and pattern

	Forestwide	Warm Dry	Cool Moist	Cold	Big Belts	Castles	Crazies	Divide	Elkhorns	Highwoods	Little Belts	Rocky Mountain	Snowies	Upper Blackfoot
Seedling/sapling size class	W/A	A	W	W	A	A[2]	W	A	A	W	W/A	W	A	W
Small tree size class	W	W	W	W	W	W/A	A	W	W/B	B	W	W	B	W
Medium tree size class	W/A	A	W	W	W/B	B	B	W	W	W	W/B	A	A	W
Large tree size class	B	W/B	B	B	W/B	W/B	W/B	B	W/B	B	B	B	B	B
Very large tree size class	B	B	B	W/B	B	W/B	W/B	B	B	B	B	B	B	B
Large-tree structure (large)	B	W/B	W	B	N	N	N	N	N	N	N	N	N	N
Large-tree structure (Vlarge)	W/B	B	B	W/B	N	N	N	N	N	N	N	N	N	N
NF/low/med density class	W/A	A	W	W/A	A	A	A	W/A	W	W	A	W/A	W/A	A
Medium/high density class	W/B	W/B	W	B	B	W/B	W/B	W/B	W/B	W	W/B	W/B	W/B	B
High density class	W	W/B	W	W	W/B	B	W/B	W	W	B	W/B	W	W	W/B
Single-storied structure[1]	N	A	W	W	N	N	N	N	N	N	N	N	N	N
2-storied structure[1]	N	A	W	W/A	N	N	N	N	N	N	N	N	N	N
Multi-storied structure[1]	N	B	W/B	B	N	N	N	N	N	N	N	N	N	N
Early successional forests	W	A	W/A	W	N	N	N	N	N	N	N	N	N	N

W = within the DC range; A = above the DC range; B = below the DC range; N = not present or no DC for that scale.
When the existing condition is right at the boundary of the DC range, it is noted as W/A (at the upper end of the range) or W/B (at the lower end of the range).
[1]Vertical structure is shown relative to the NRV; there are no quantitative DCs for this; rather, it is addressed qualitatively as it relates to density class.
[2] There is some separation of alternatives for seedling/sapling size class in the Castles. Alt E results in conditions within the desired range; all other alternatives are above the desired range, with alt F-UN the highest. Items shaded in the dark gray tones and white font indicate conditions at the upper bound or above the desired range. Items shaded in light gray tones indicate conditions at the lower bound or below the desired range. Cells with no shading are within the desired ranges, or are not present/applicable.

Vegetation composition

The following section is organized by cover type. Each cover type section includes the trends for the cover type, and the presence of the individual species that may be dominant within that cover type.

Nonforested cover type

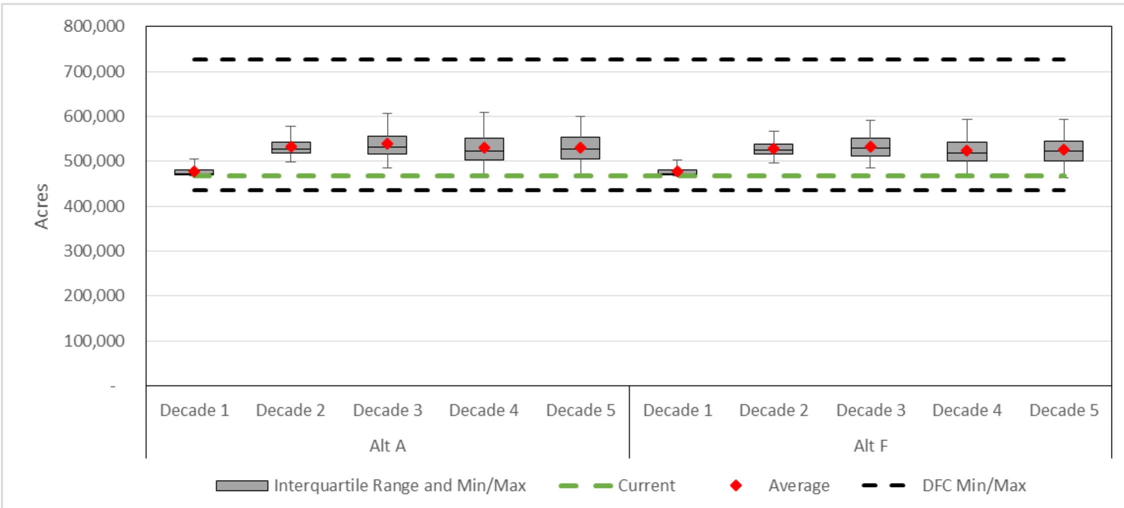


Figure 93. Nonforested cover type abundance (total acres) over 5 decades, alternatives A and F

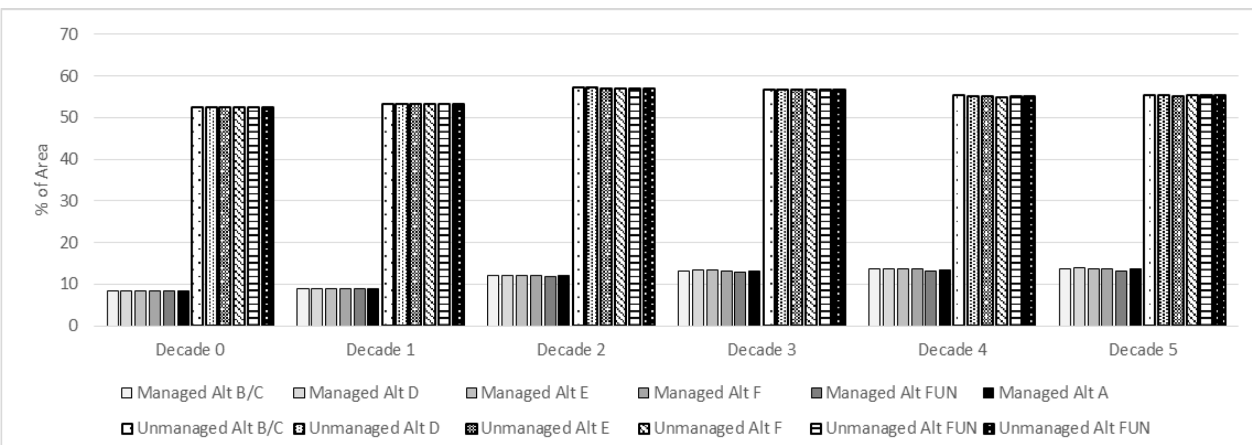


Figure 94. Nonforested cover type abundance in managed versus unmanaged landscapes, forestwide

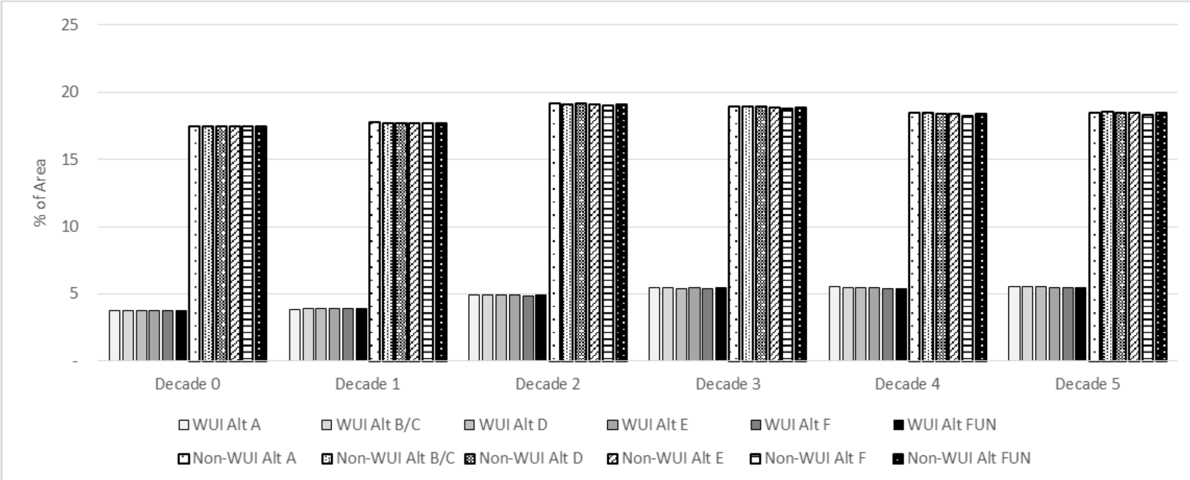


Figure 95. Nonforested cover type abundance in WUI versus Non-WUI areas, forestwide

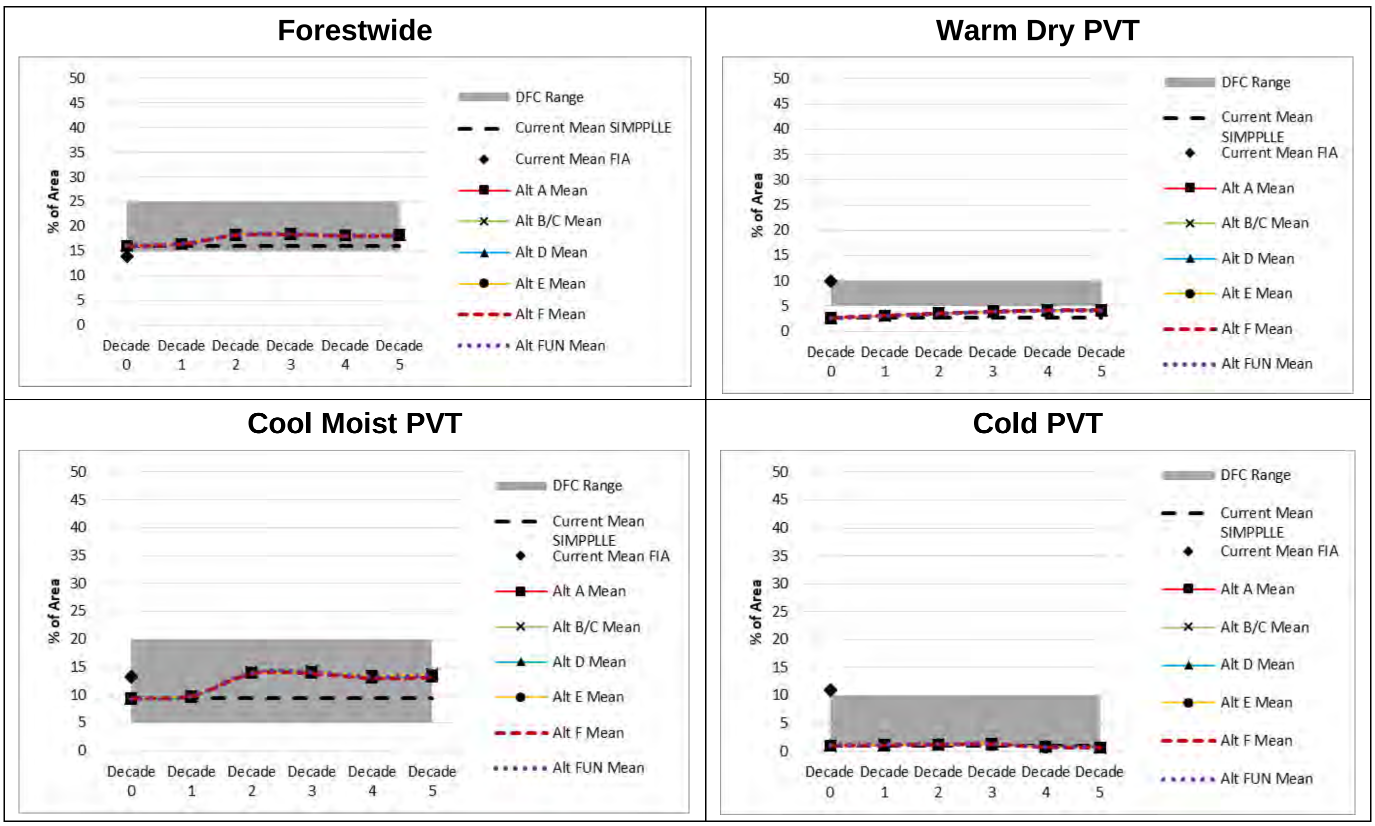
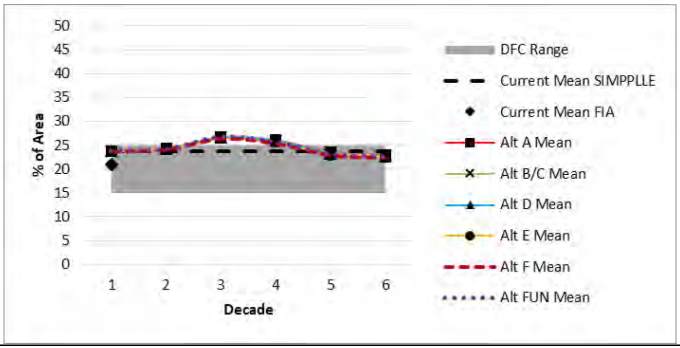


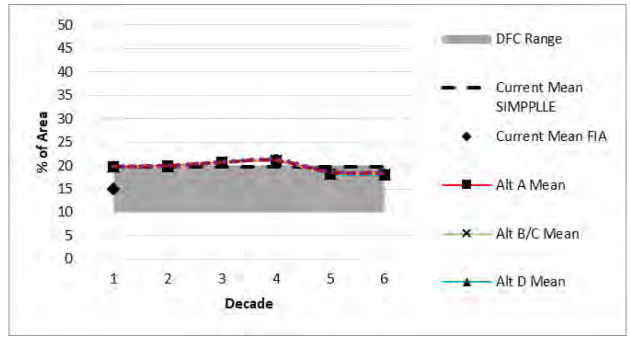
Figure 96. Nonforested cover type abundance (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 97, displays the nonforested cover type abundance (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.

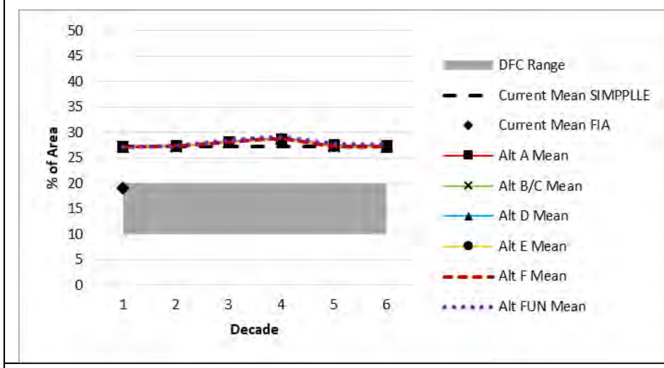
Big Belts



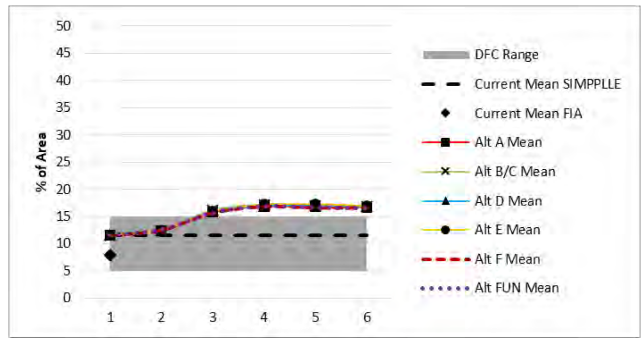
Castles



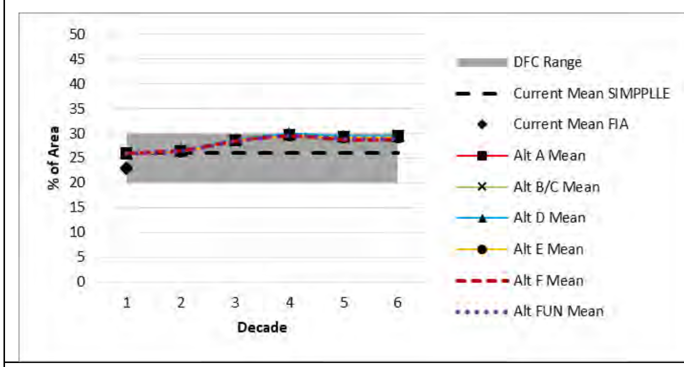
Crazies



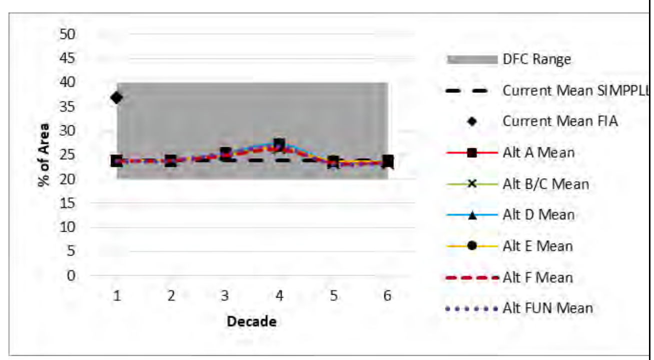
Divide



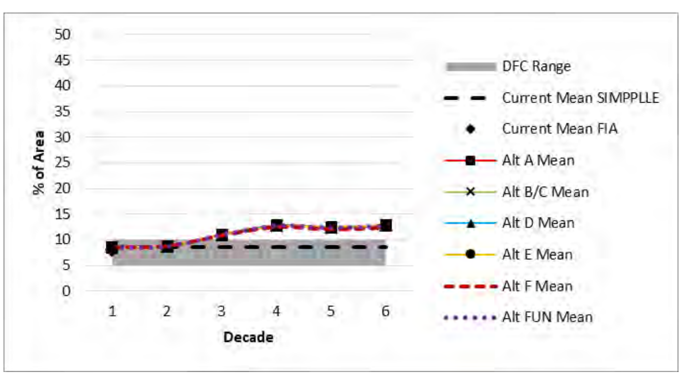
Elkhorns



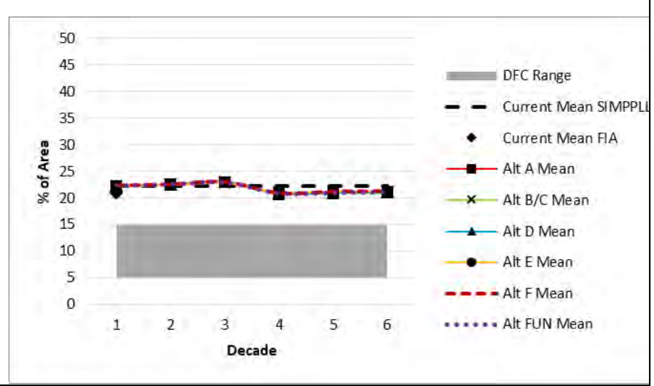
Highwoods



Little Belts



Rocky Mountain Range



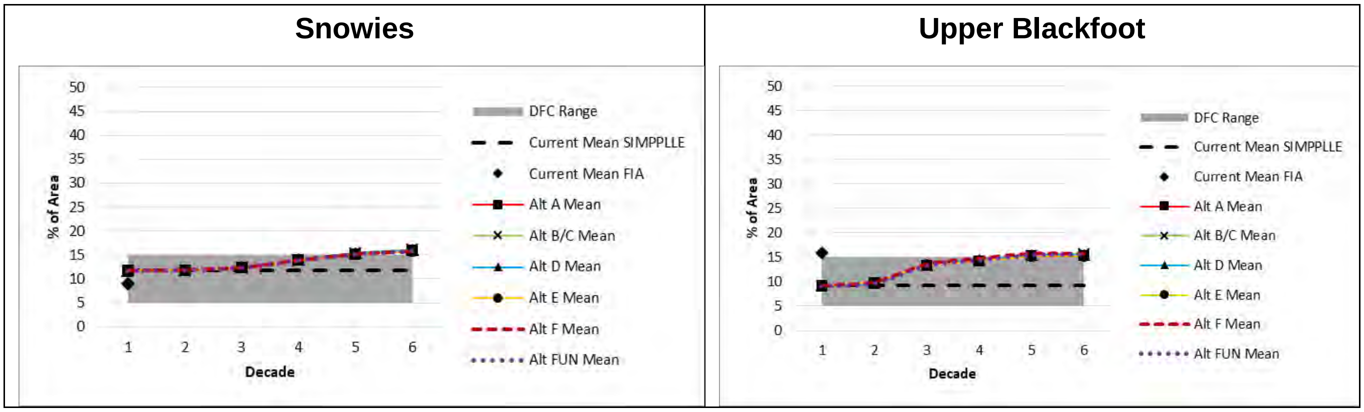


Figure 97. Nonforested cover type abundance (% of total area) over 5 decades by alternative, by GA

Ponderosa pine cover type and presence of associated species (ponderosa pine, limber pine, Rocky Mountain juniper)

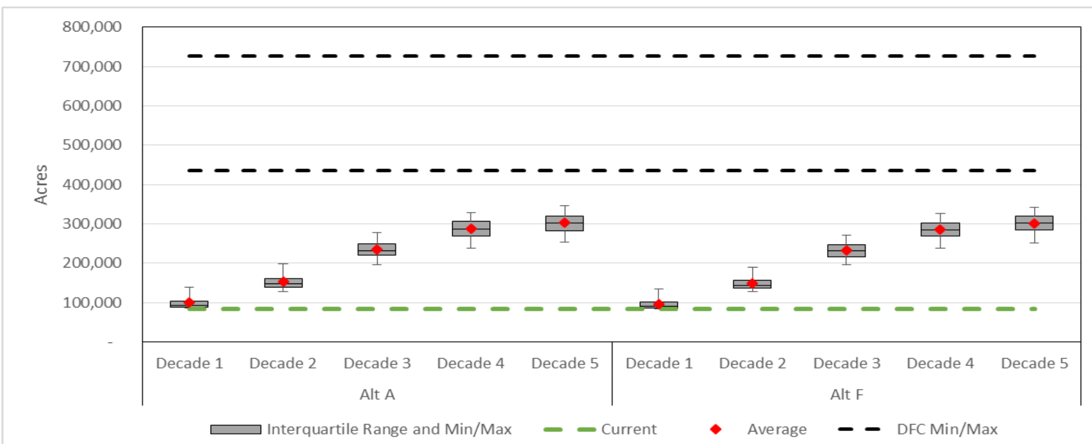


Figure 98. Ponderosa pine cover type abundance (total acres) over 5 decades, alternatives A and F

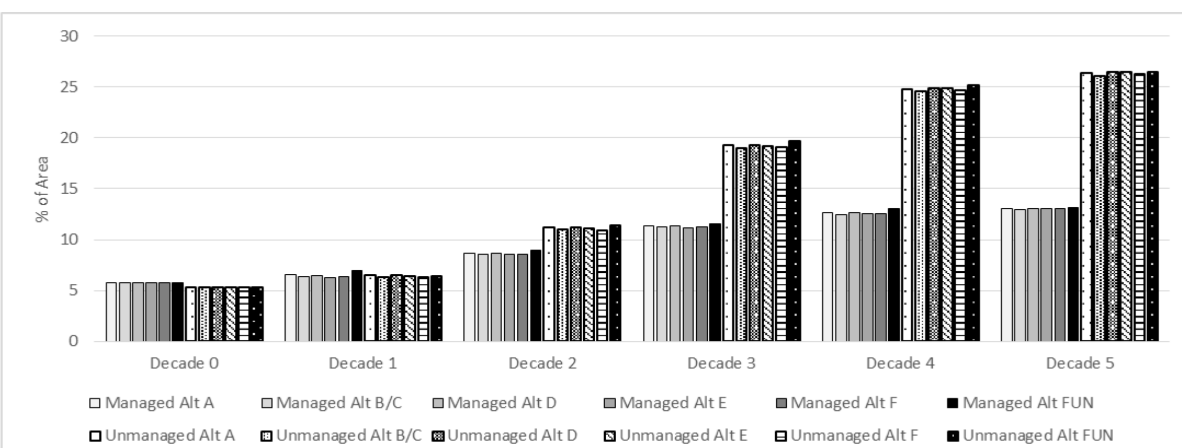


Figure 99. Ponderosa pine cover type abundance in managed versus unmanaged landscapes, forestwide

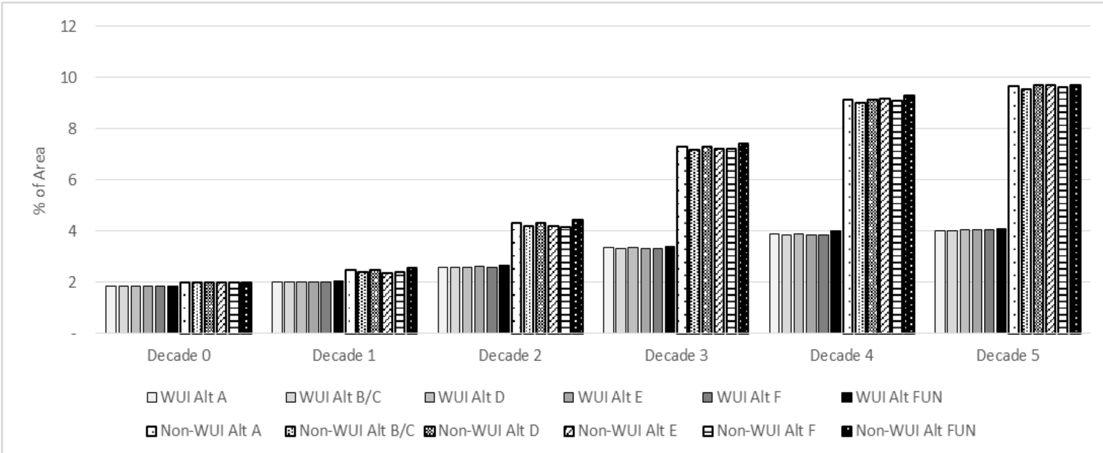
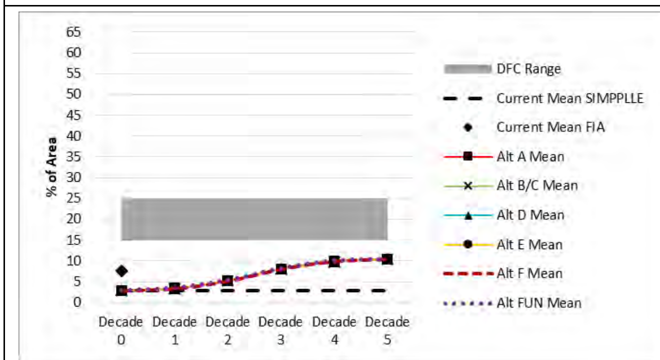
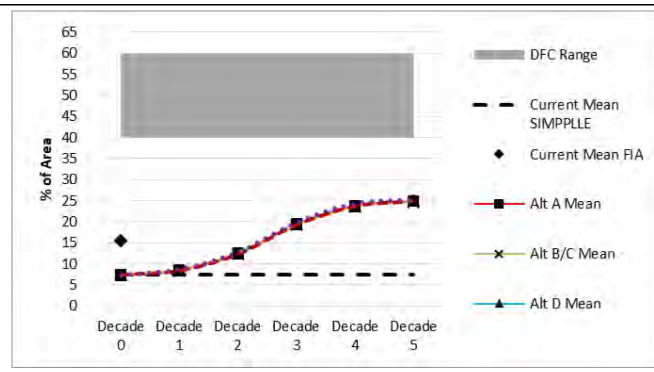


Figure 100. Ponderosa pine cover type abundance in WUI versus non-WUI areas, forestwide

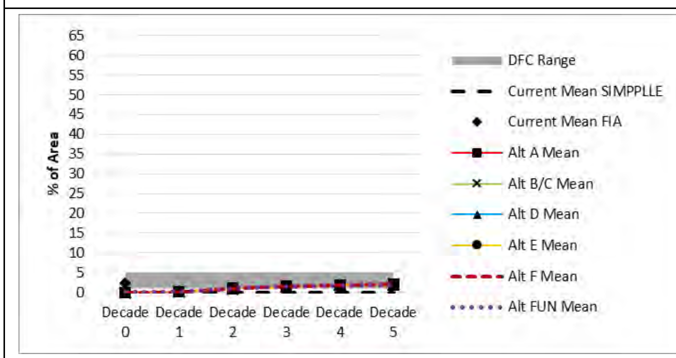
Forestwide



Warm Dry PVT



Cool Moist PVT



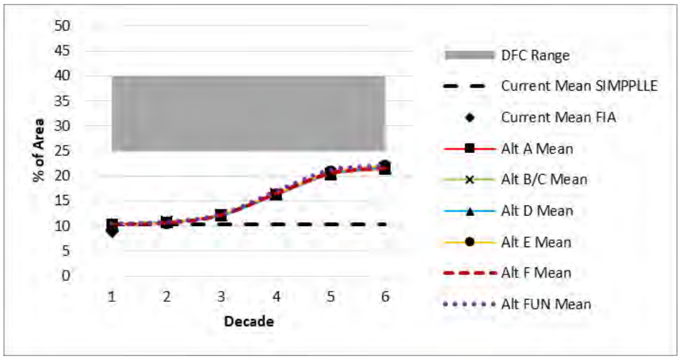
Cold PVT

N/A

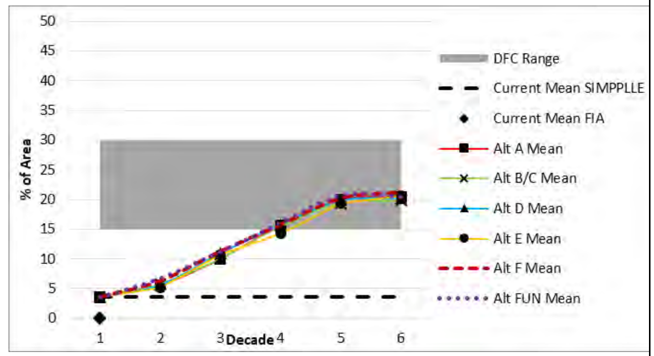
Figure 101. Ponderosa pine cover type abundance (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 102, displays the ponderosa pine cover type abundance (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.

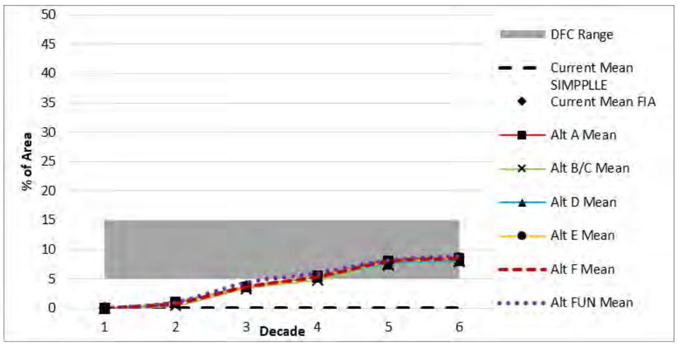
Big Belts



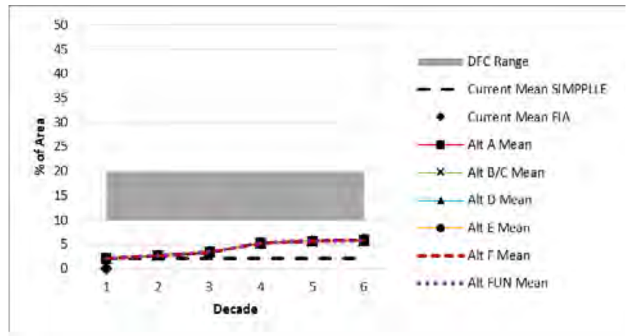
Castles



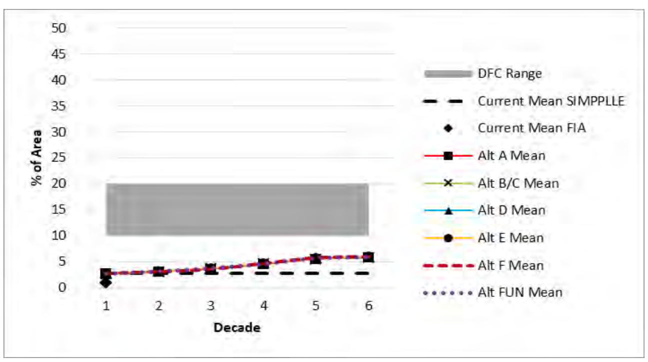
Crazies



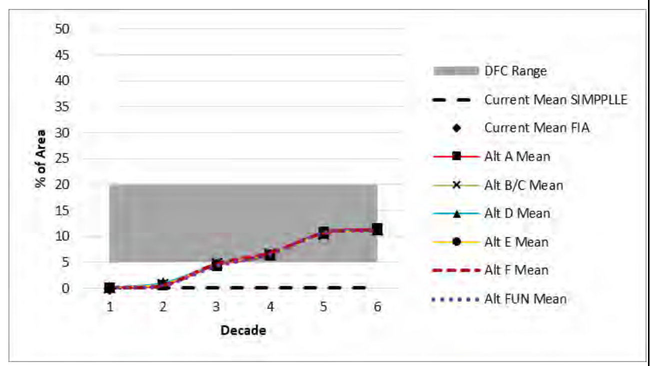
Divide



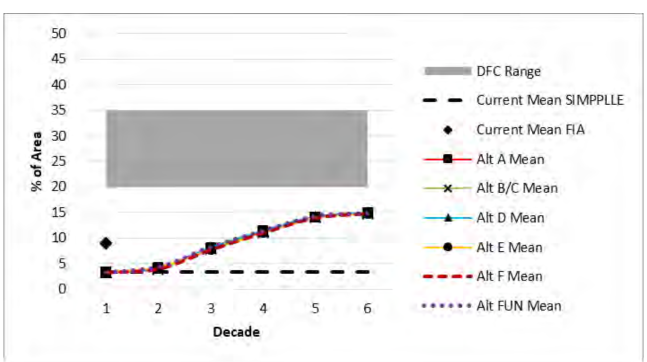
Elkhorns



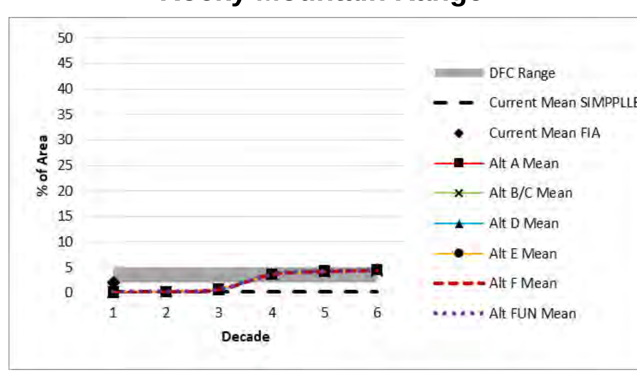
Highwoods



Little Belts



Rocky Mountain Range



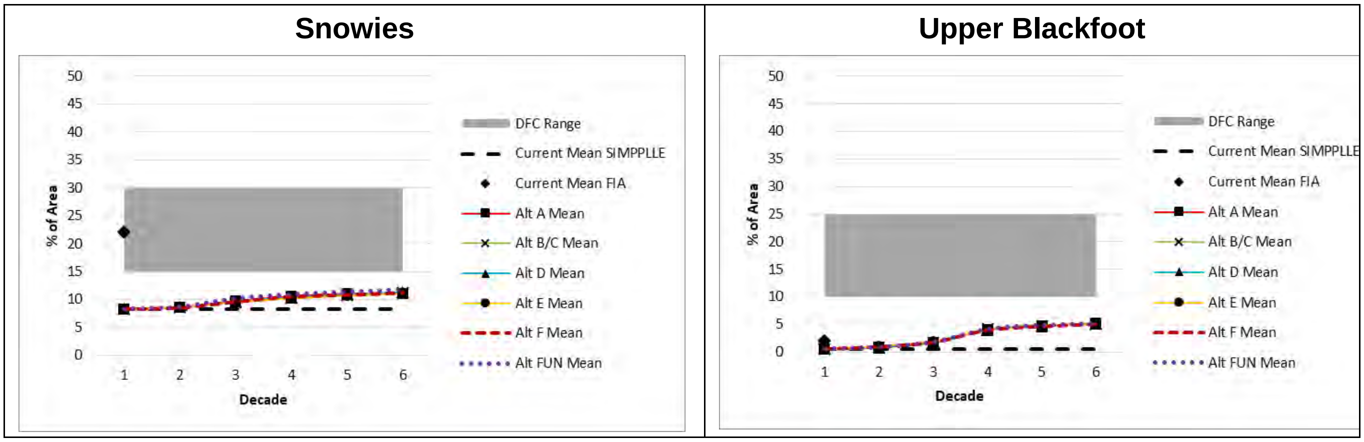


Figure 102. Ponderosa pine cover type abundance (% of total area) over 5 decades by alternative, by GA

Ponderosa pine presence

Figure 103. Ponderosa pine presence (total acres) over 5 decades, alternatives A and F

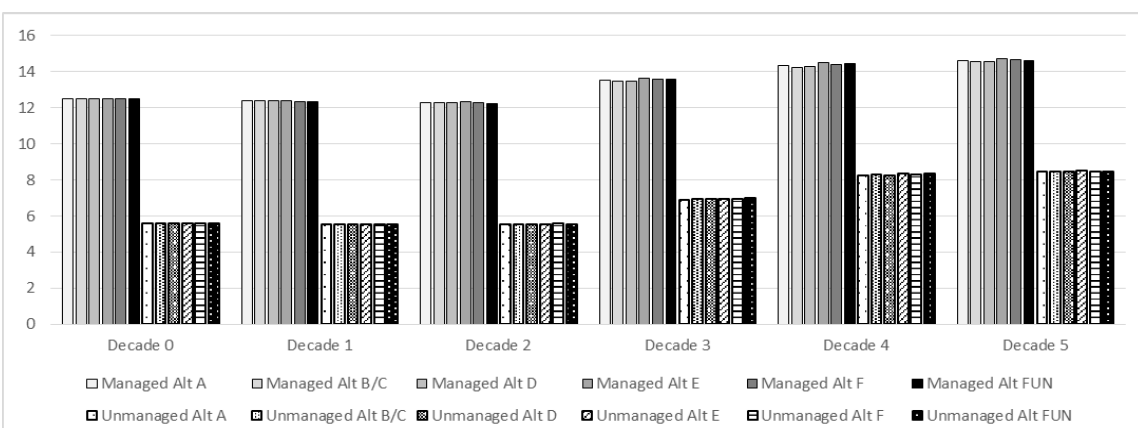


Figure 104. Ponderosa pine presence in managed versus unmanaged landscapes, forestwide

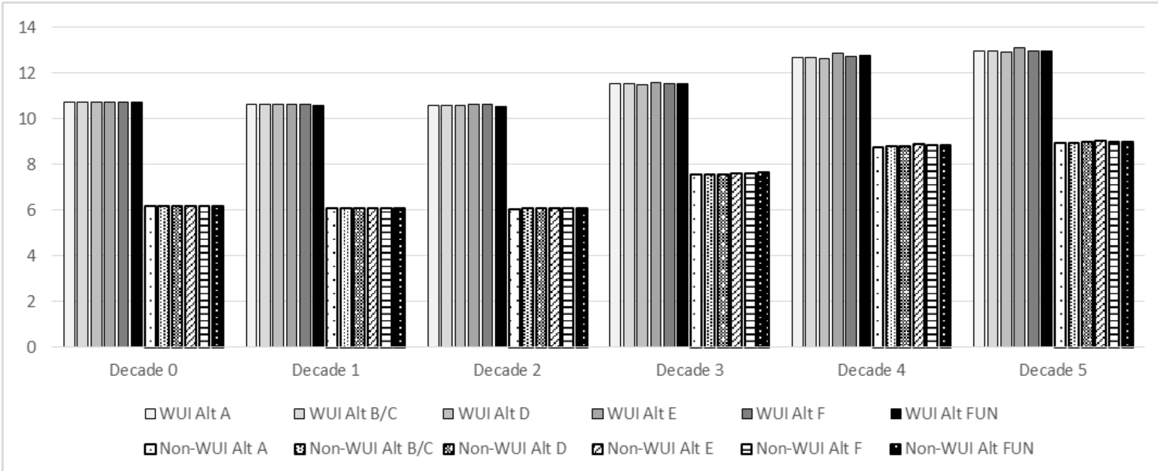


Figure 105. Ponderosa pine presence in WUI versus non-WUI areas, forestwide

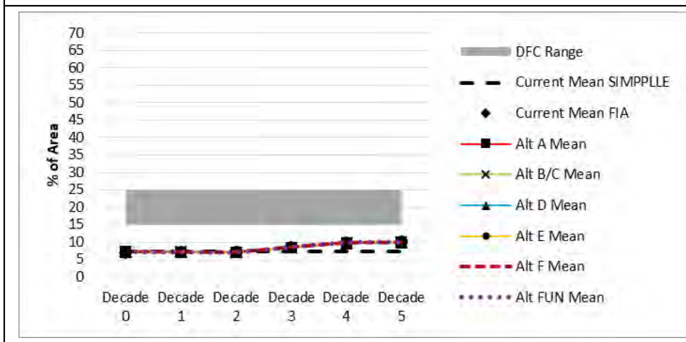
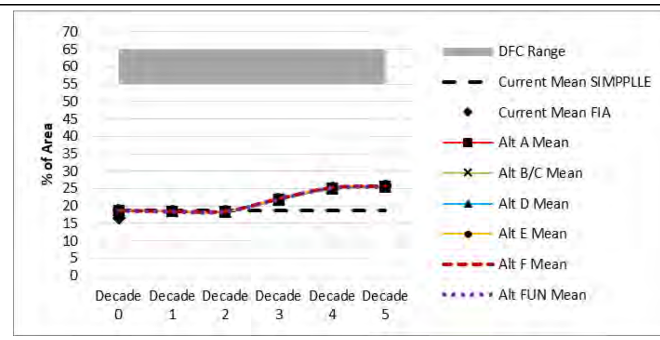
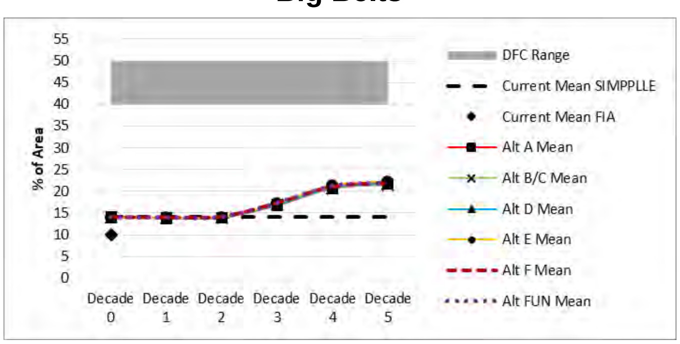
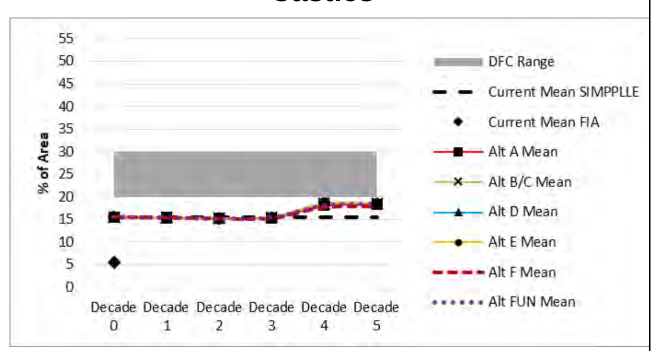
Forestwide	Warm dry PVT
	
Cool Moist PVT	**Cold PVT**
N/A	**N/A**

Figure 106. Ponderosa pine presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 107, displays the ponderosa pine presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.

Big Belts	Castles
	

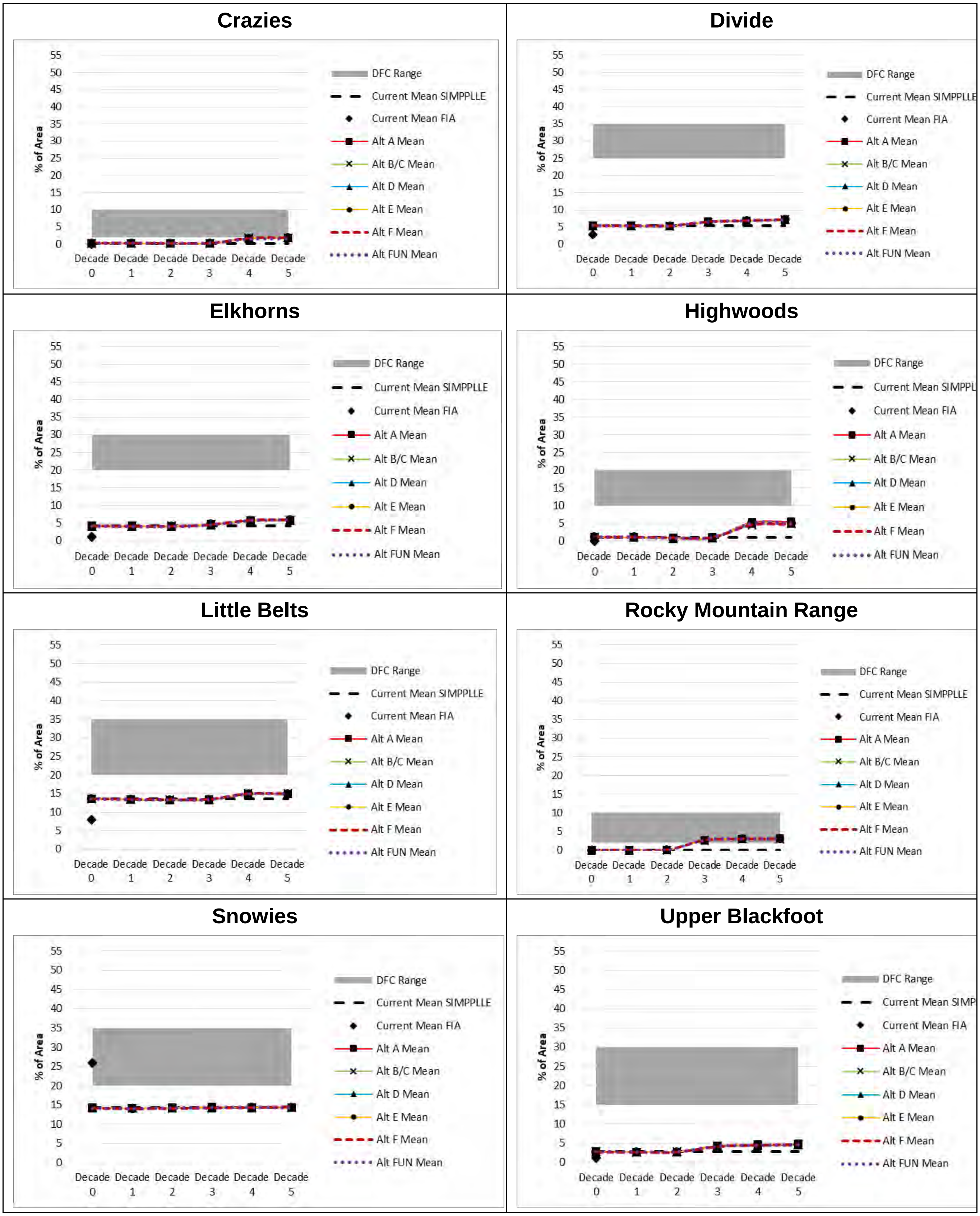


Figure 107. Ponderosa pine presence (% of total area) over 5 decades by alternative, by GA

Limber pine presence

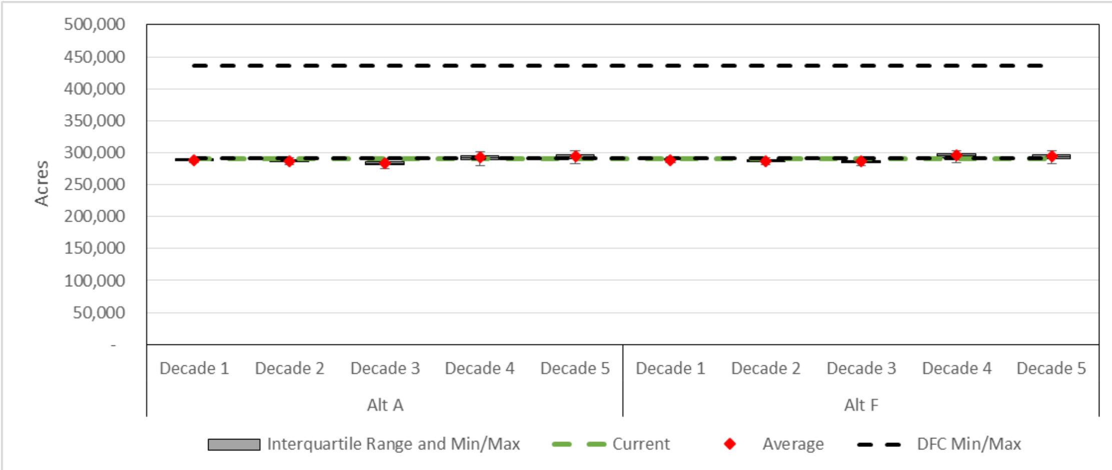


Figure 108. Limber pine presence (total acres) over 5 decades, alternatives A and F

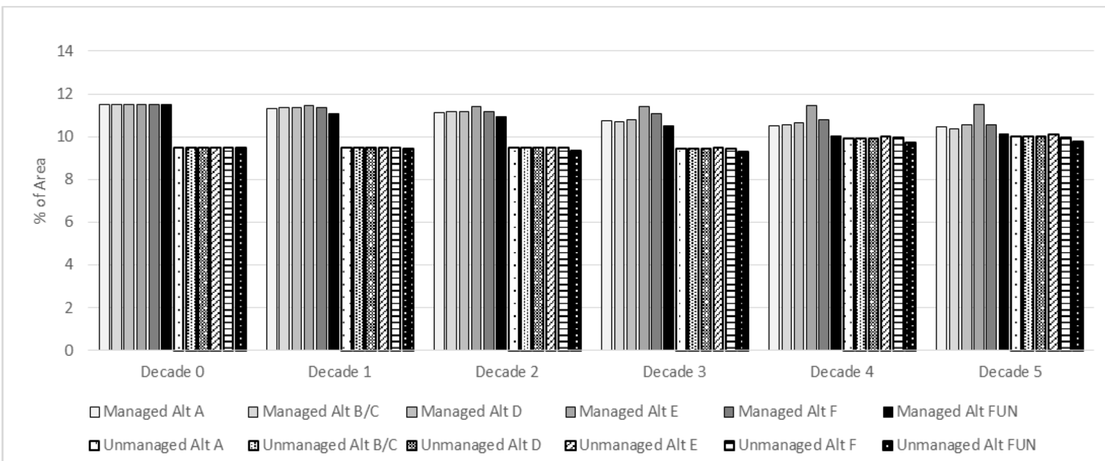


Figure 109. Limber pine presence in managed versus unmanaged landscapes, forestwide

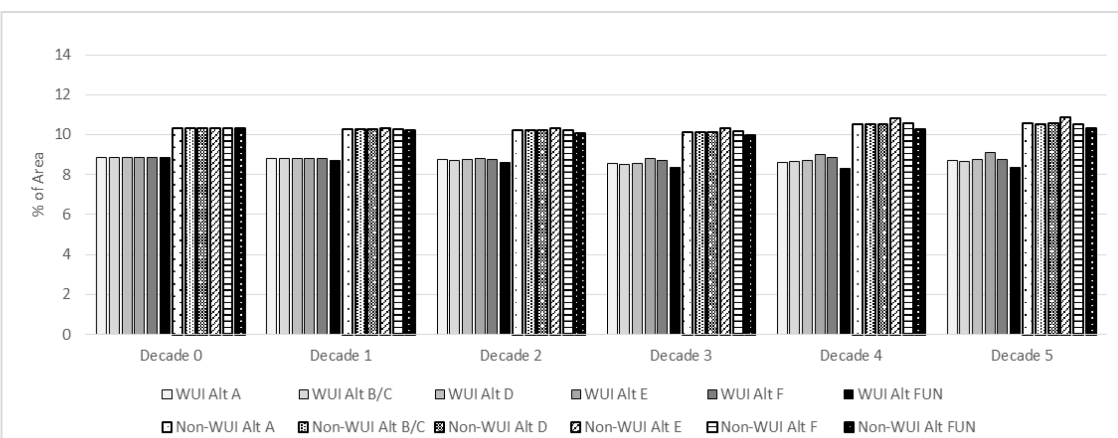


Figure 110. Limber pine presence in WUI versus Non-WUI areas, forestwide

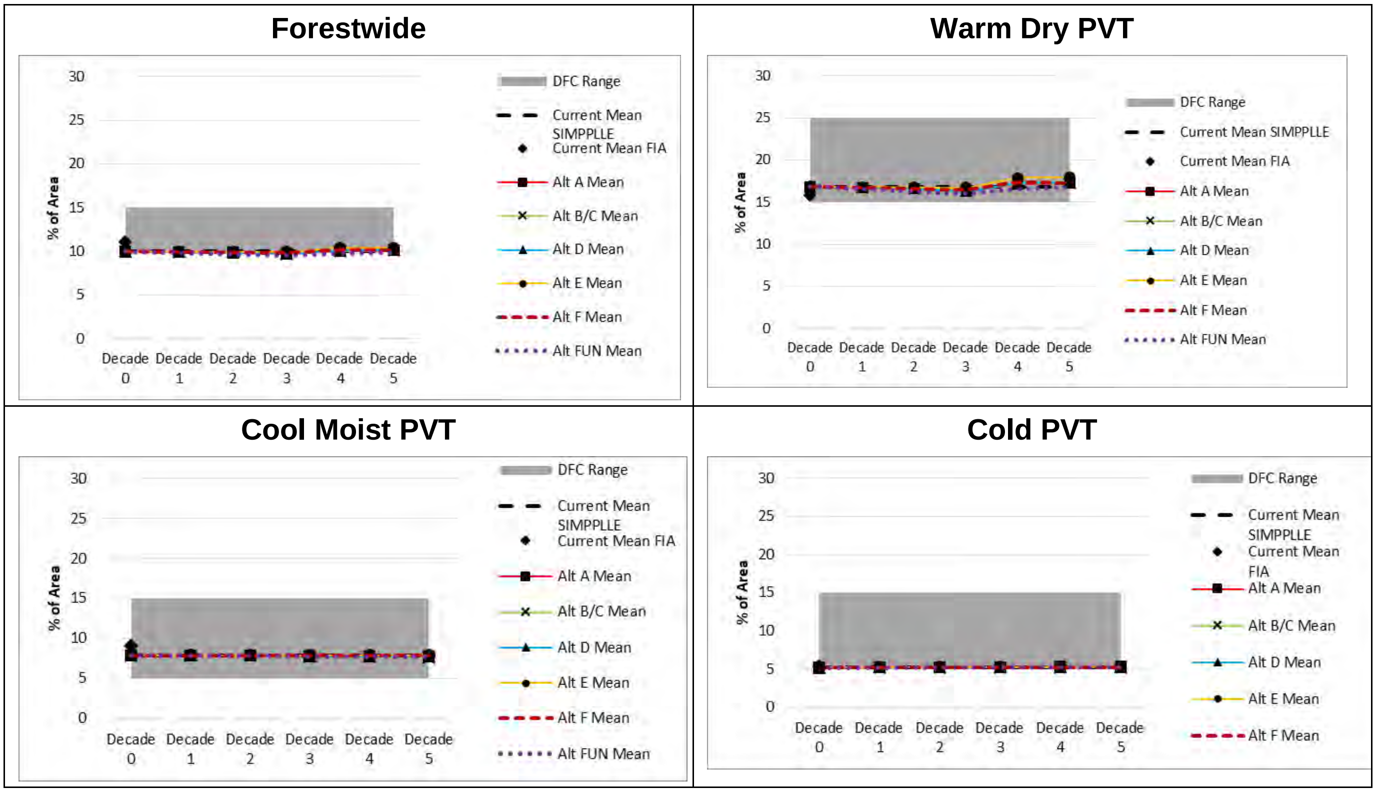
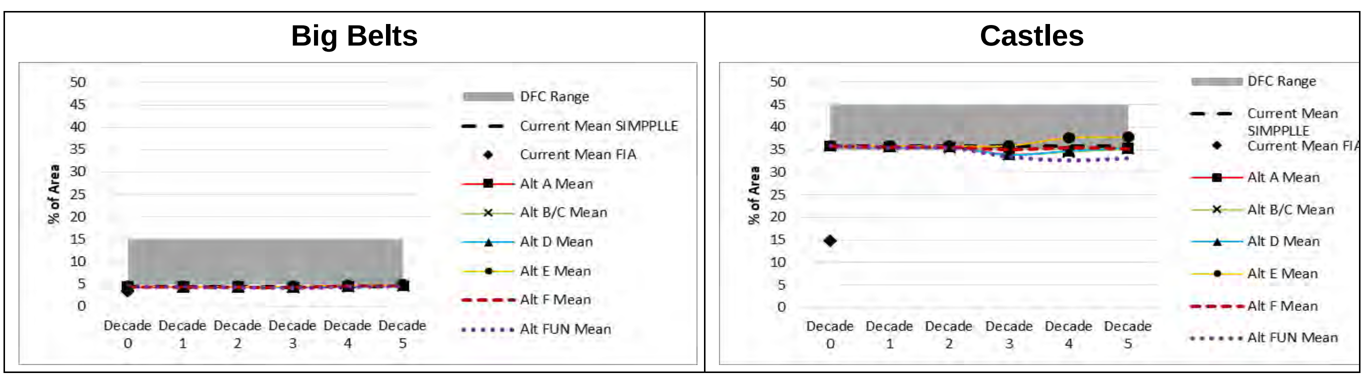


Figure 111. Limber pine presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 112, displays limber pine presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



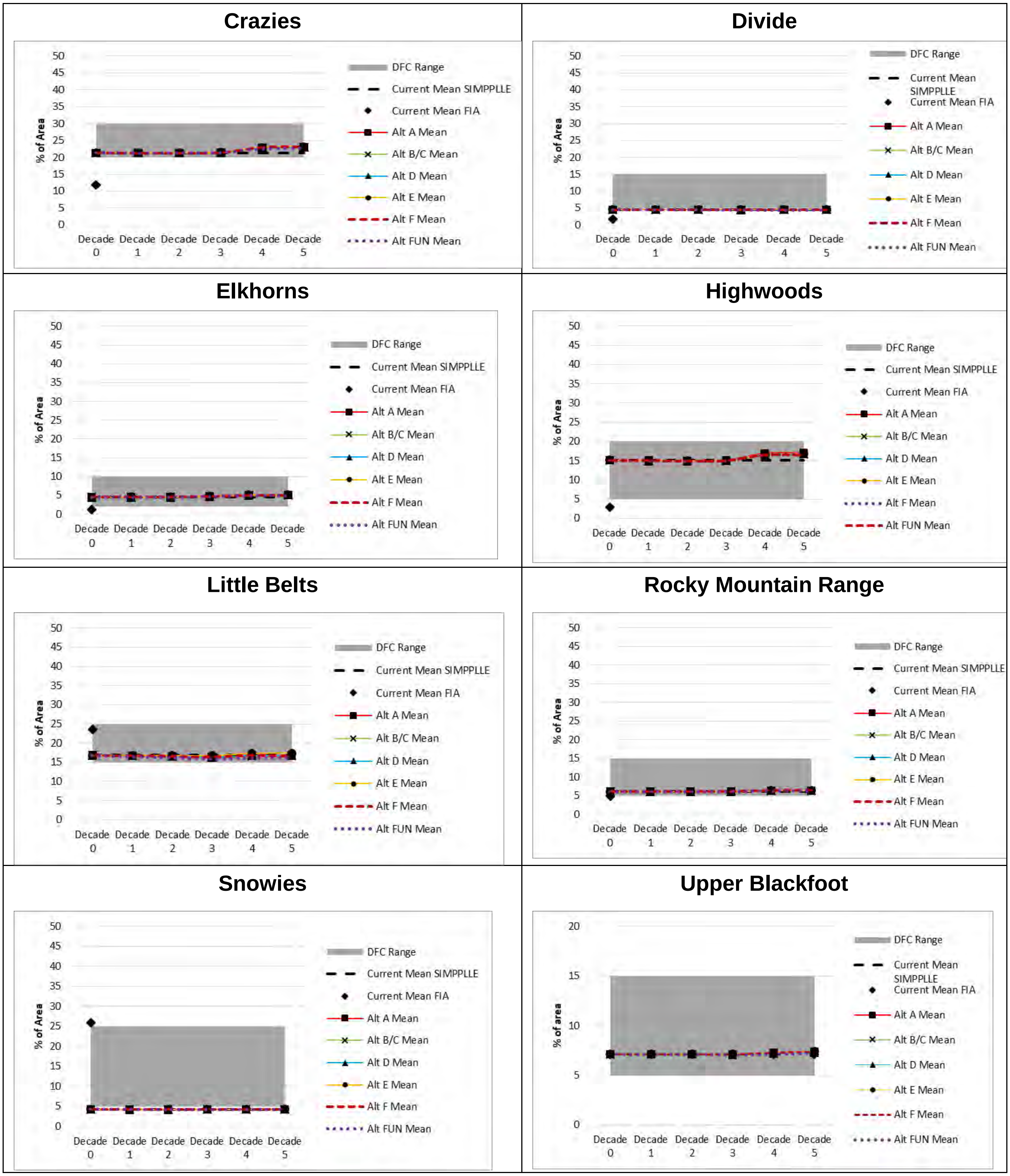


Figure 112. Limber pine presence (% of total area) over 5 decades by alternative, by GA

Rocky mountain juniper presence

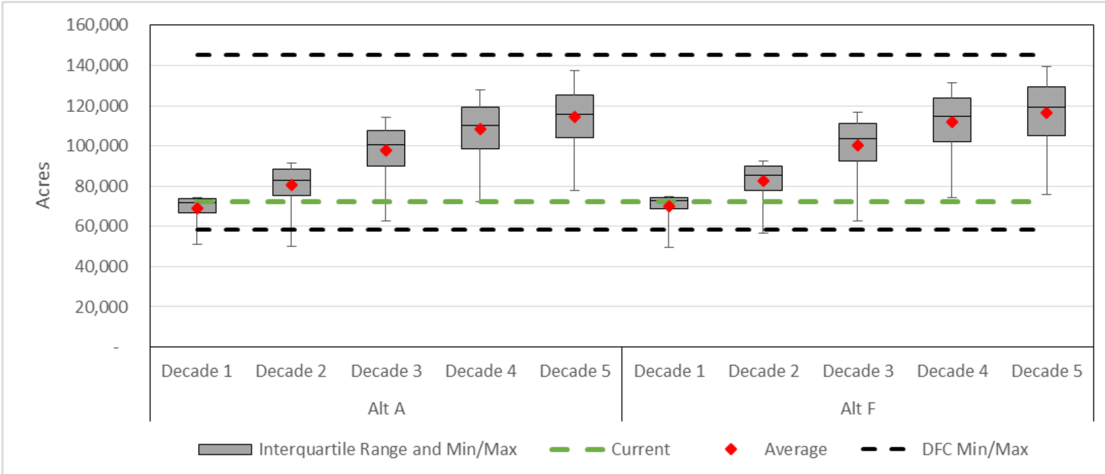


Figure 113. Rocky Mountain juniper presence (total acres) over 5 decades, alternatives A and F

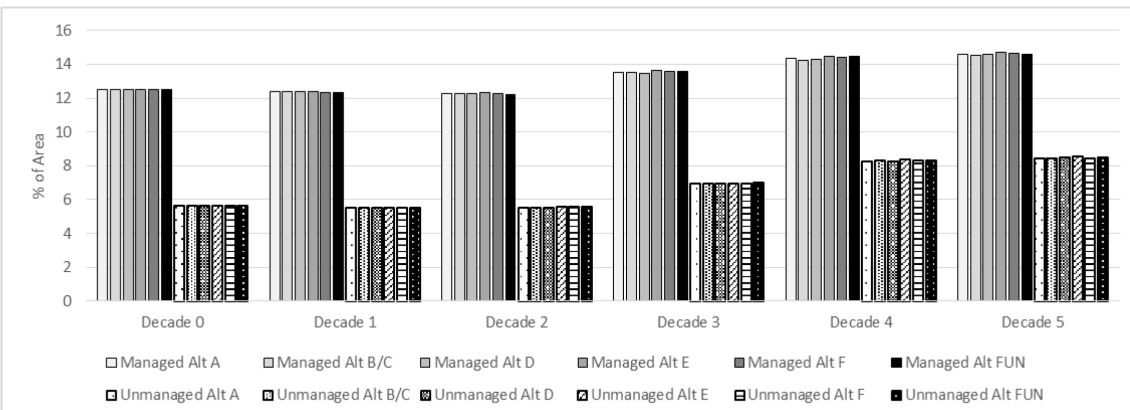


Figure 114. Rocky Mountain juniper presence in managed versus unmanaged landscapes, forestwide

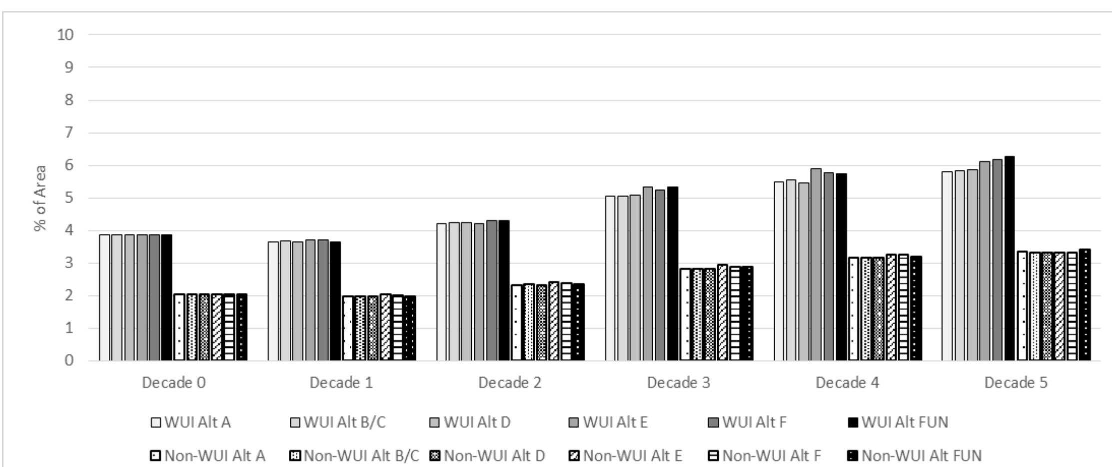


Figure 115. Rocky Mountain juniper presence in WUI versus Non-WUI areas, forestwide

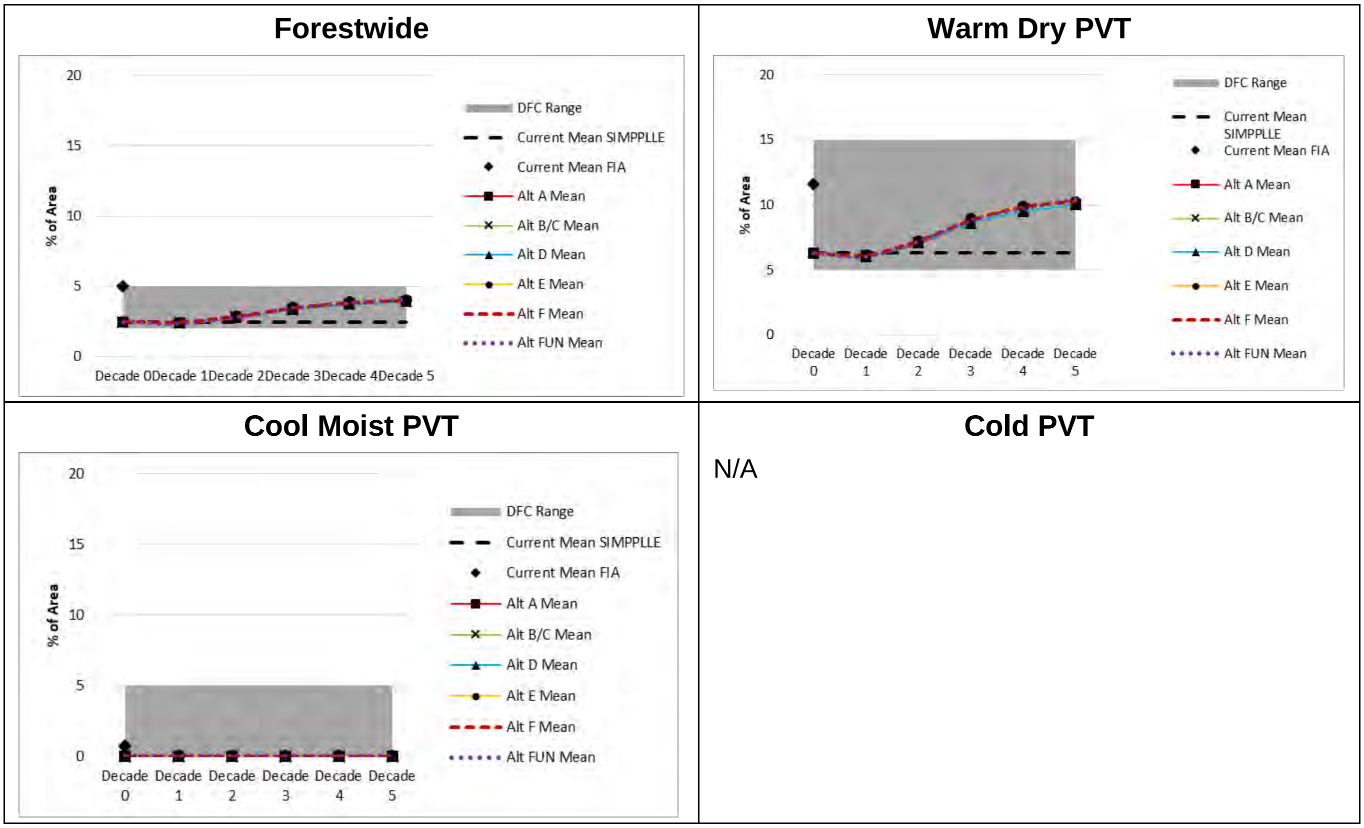
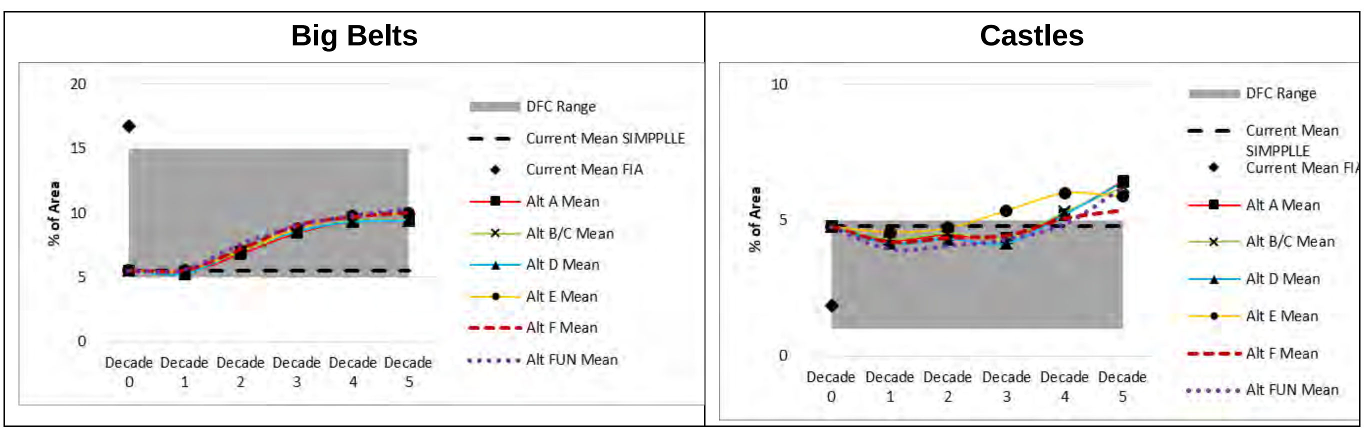


Figure 116. Rocky Mountain juniper presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 117, displays Rocky Mountain juniper presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



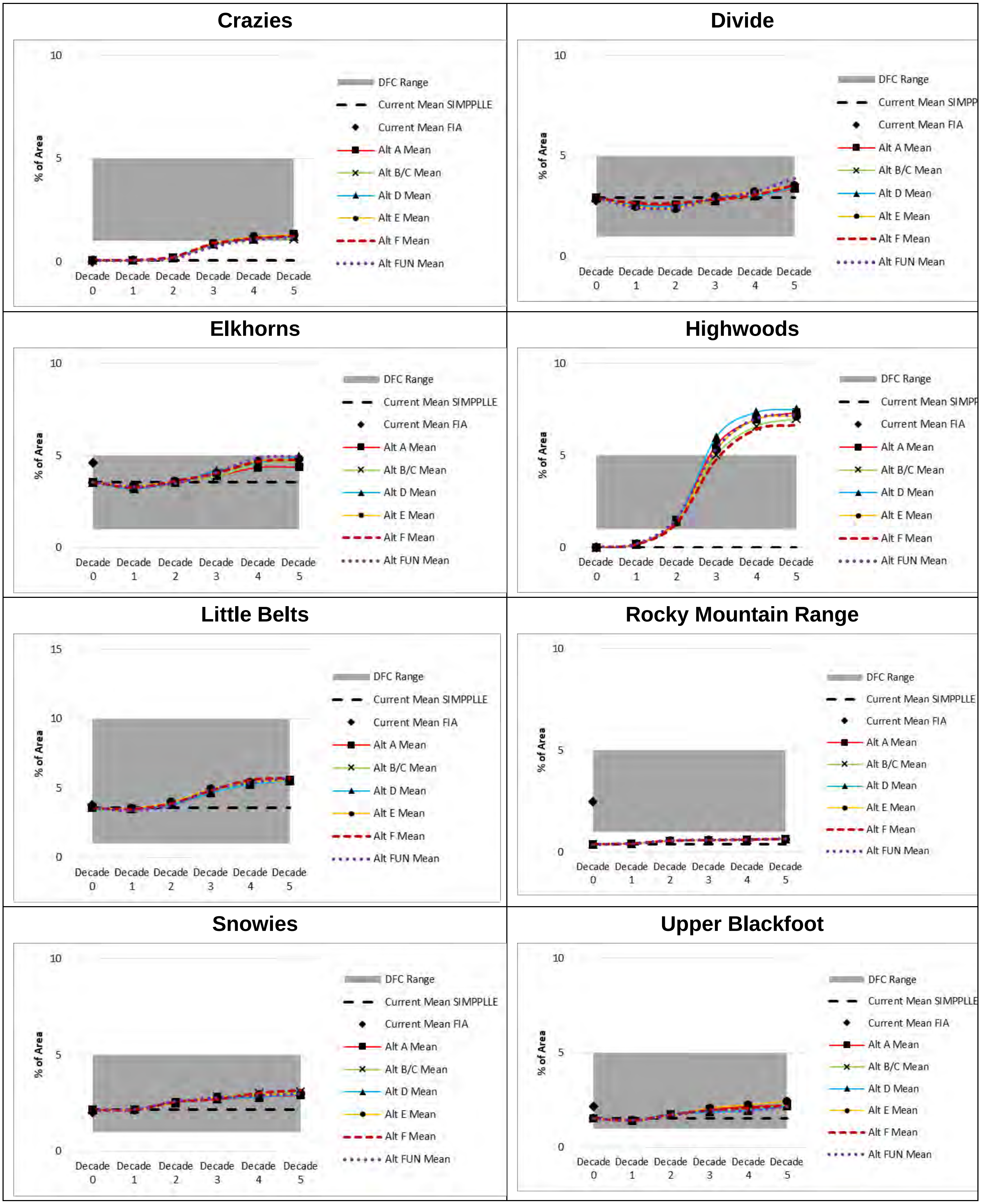


Figure 117. Rocky Mountain juniper presence (% of total area) over 5 decades by alternative, by GA

Aspen/hardwood cover type and presence of aspen

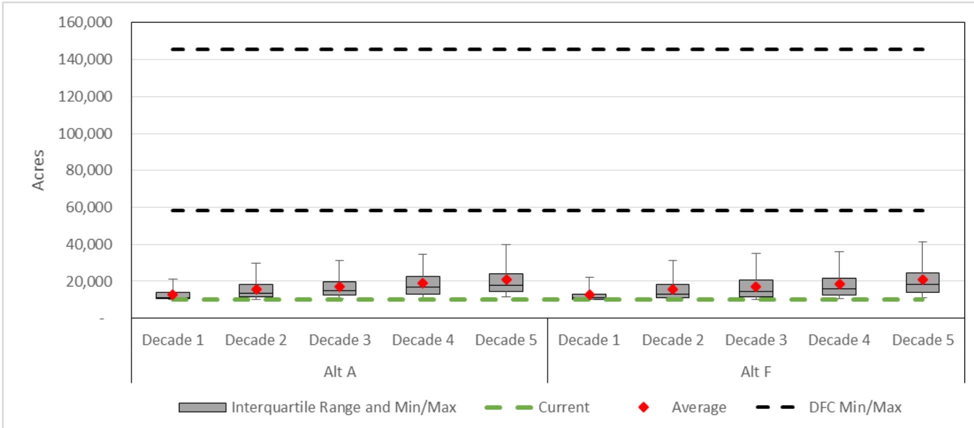


Figure 118. Aspen/hardwood cover type (total acres) over 5 decades, alternatives A and F

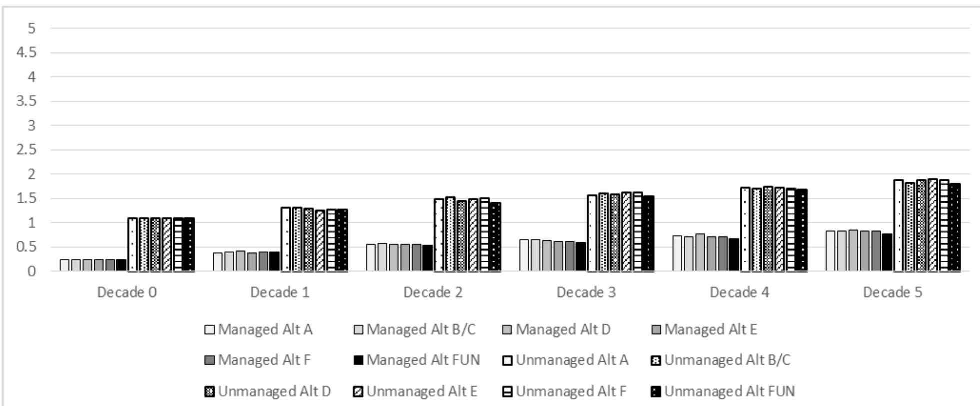


Figure 119. Aspen/hardwood cover type in managed versus unmanaged landscapes, forestwide

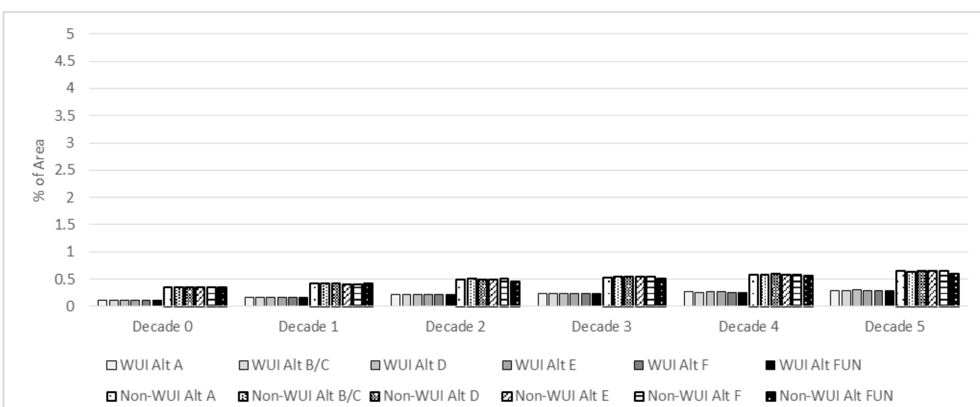


Figure 120. Aspen/ hardwood cover type in WUI versus non-WUI areas, forestwide

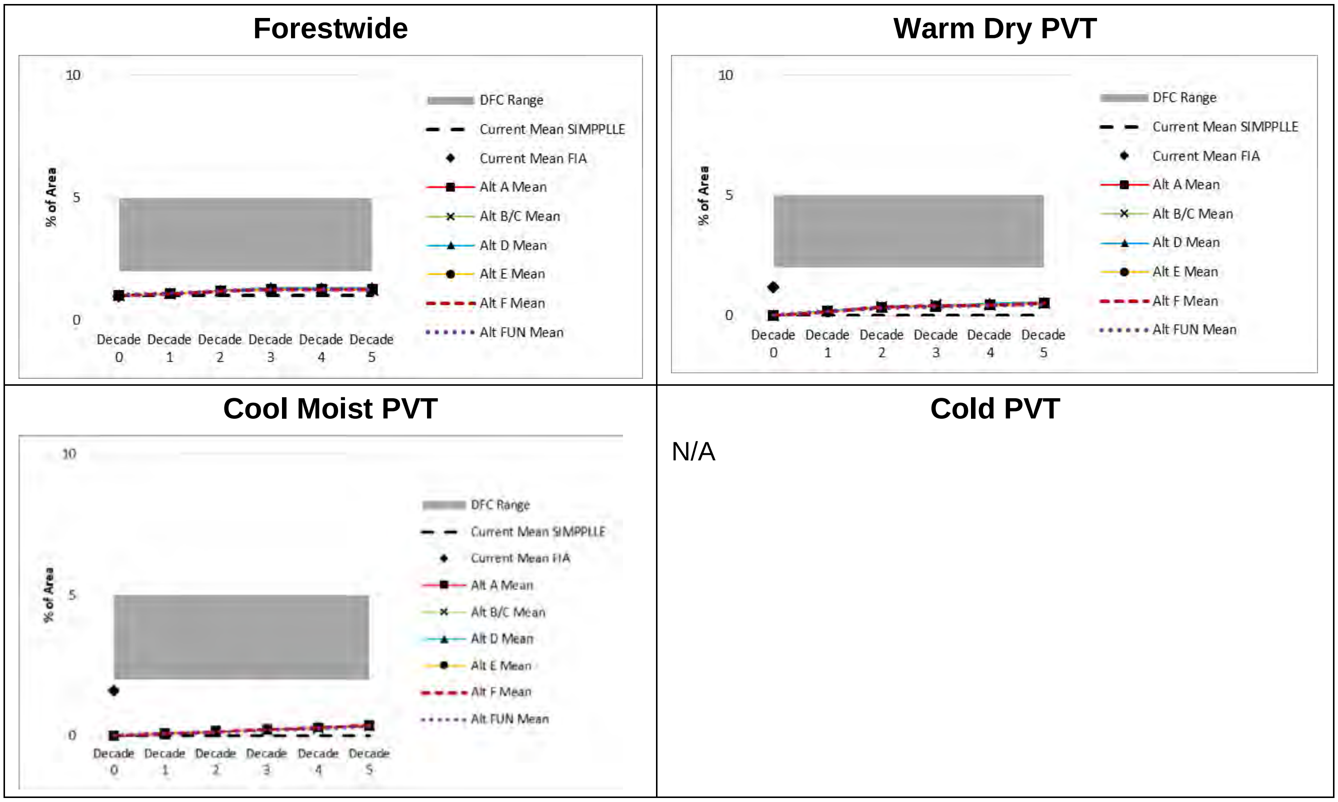
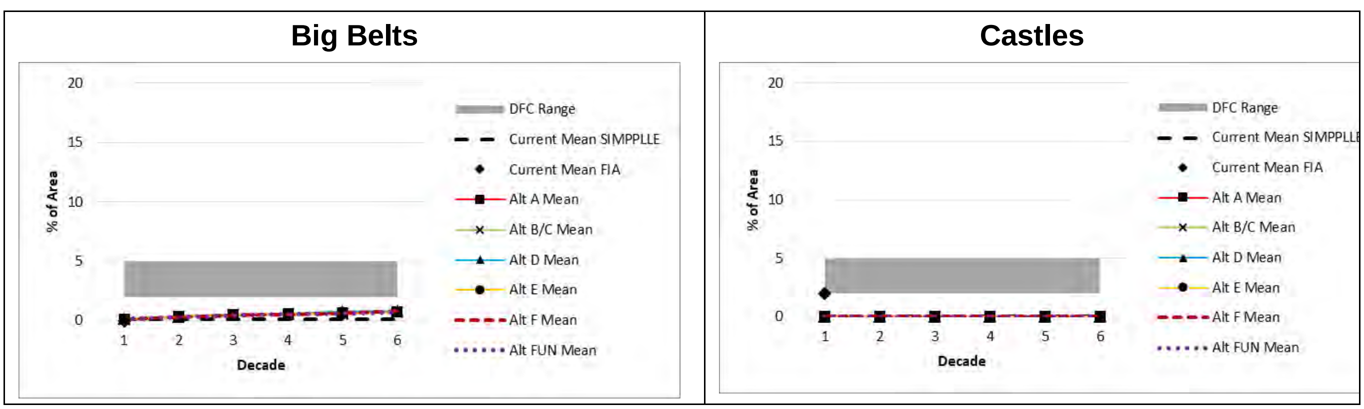


Figure 121. Aspen/hardwood cover type (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 122, displays aspen/hardwood cover type (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



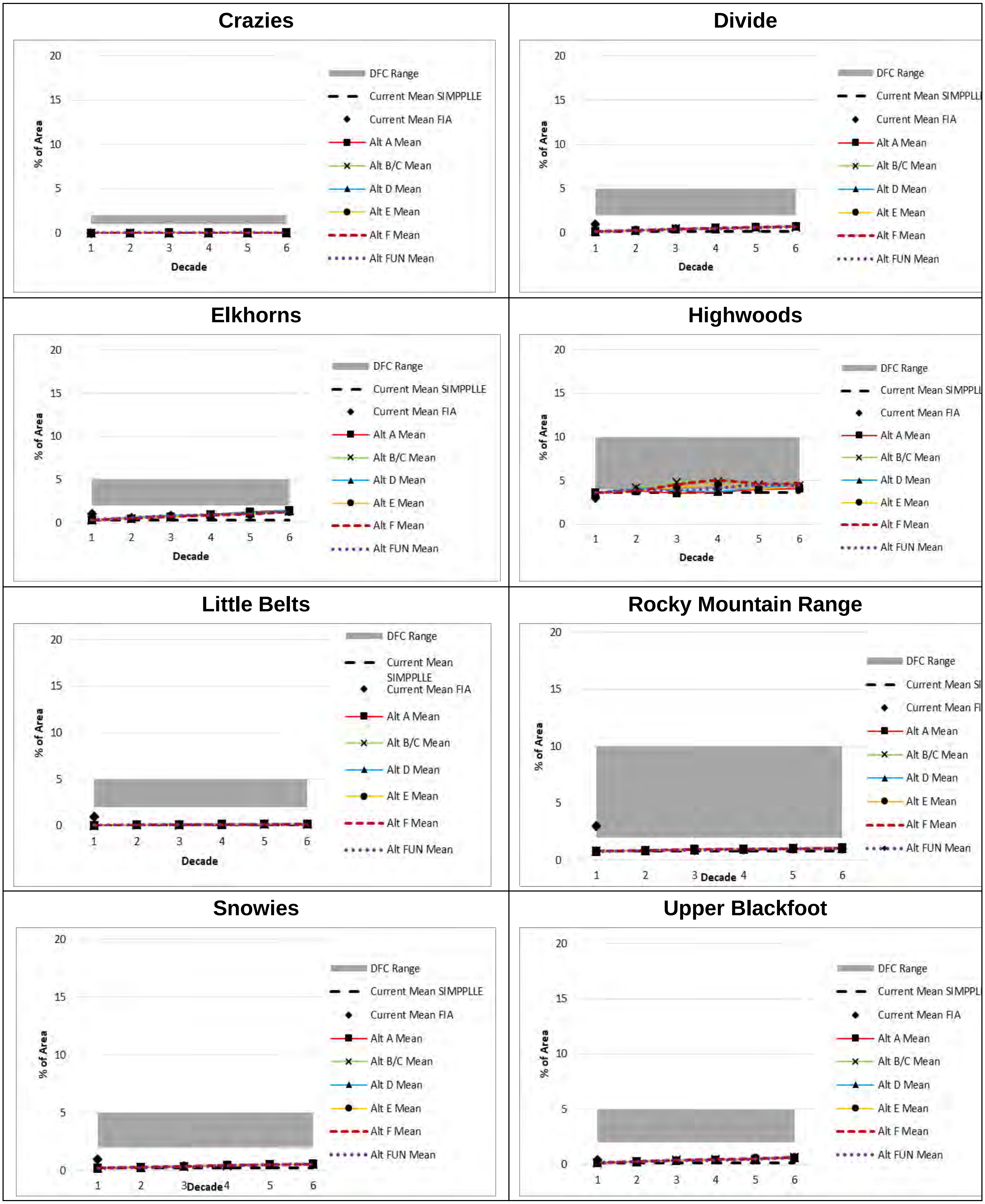


Figure 122. Aspen/hardwood cover type (% of total area) over 5 decades by alternative, by GA

Aspen or cottonwood presence

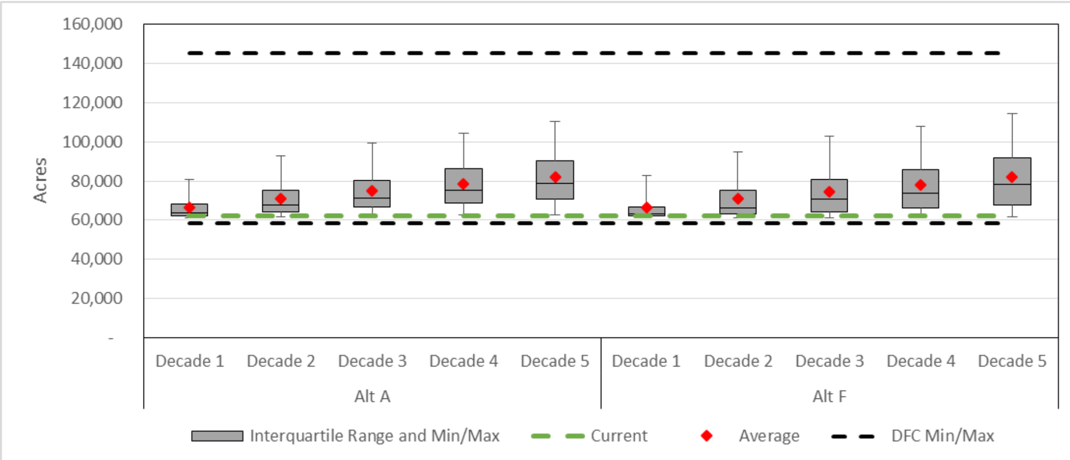


Figure 123. Aspen presence (total acres) over 5 decades, alternatives A and F

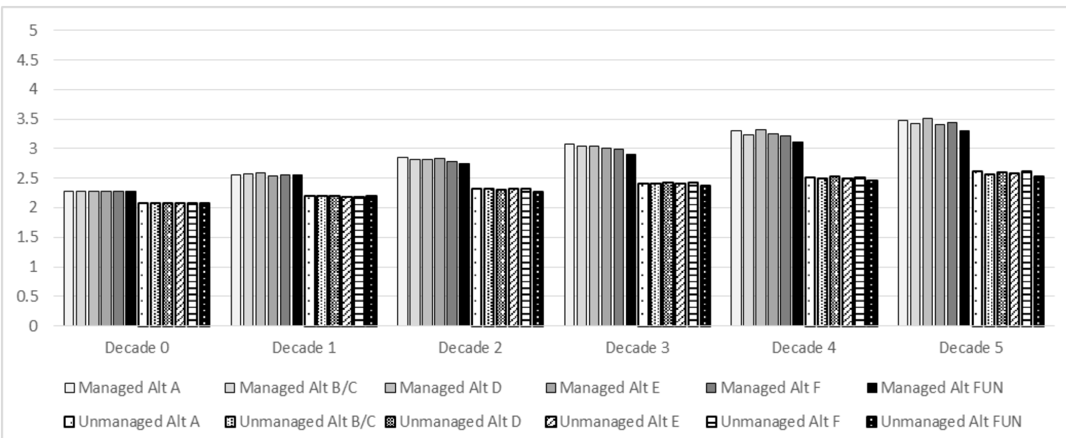


Figure 124. Aspen presence in managed versus unmanaged landscapes, forestwide

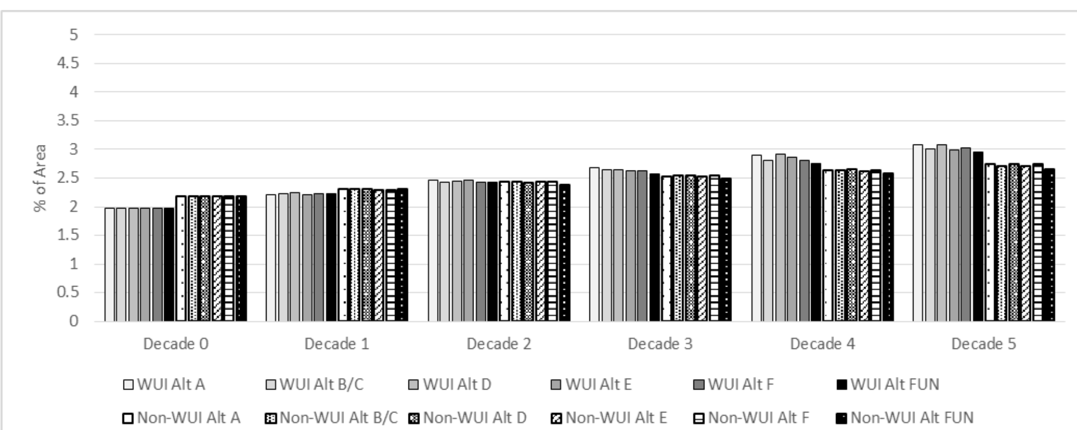


Figure 125. Aspen presence in WUI versus Non-WUI areas, forestwide

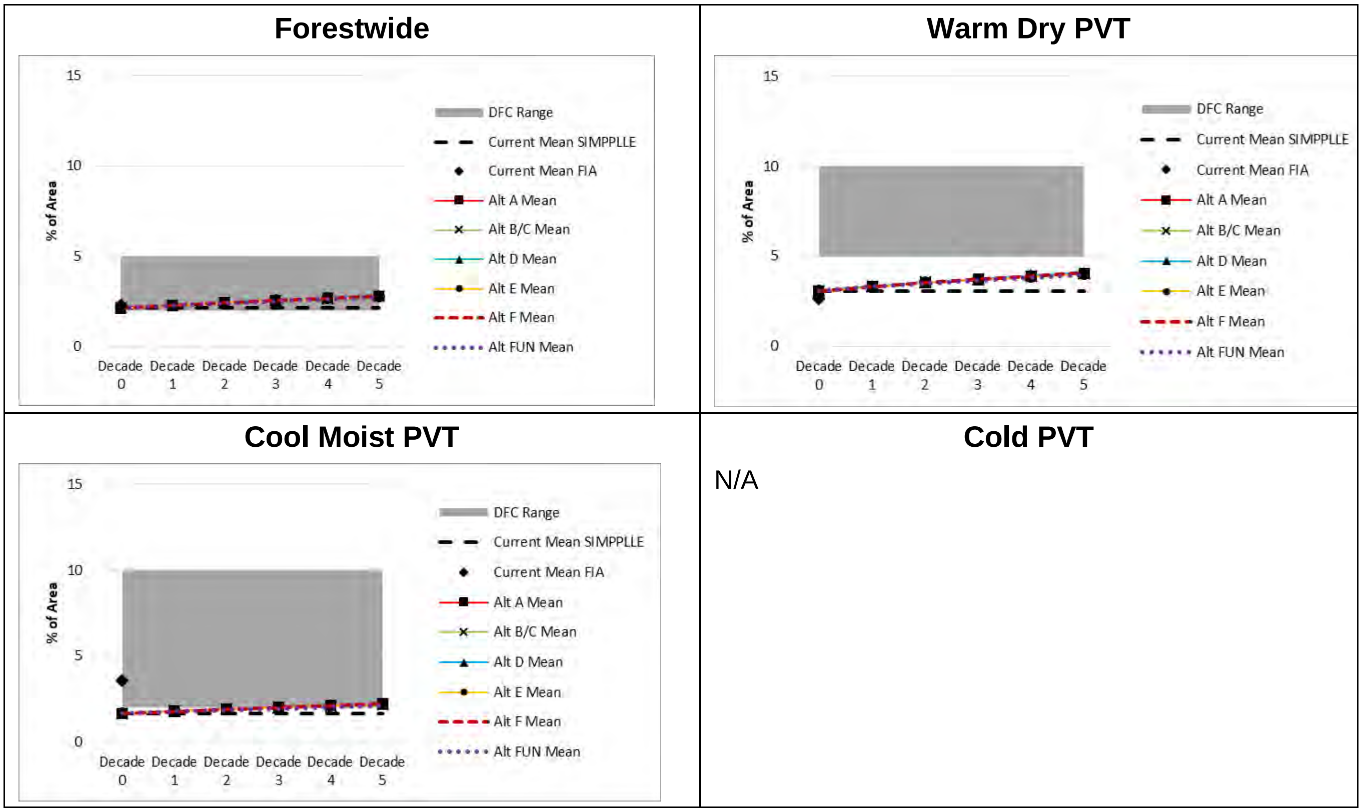
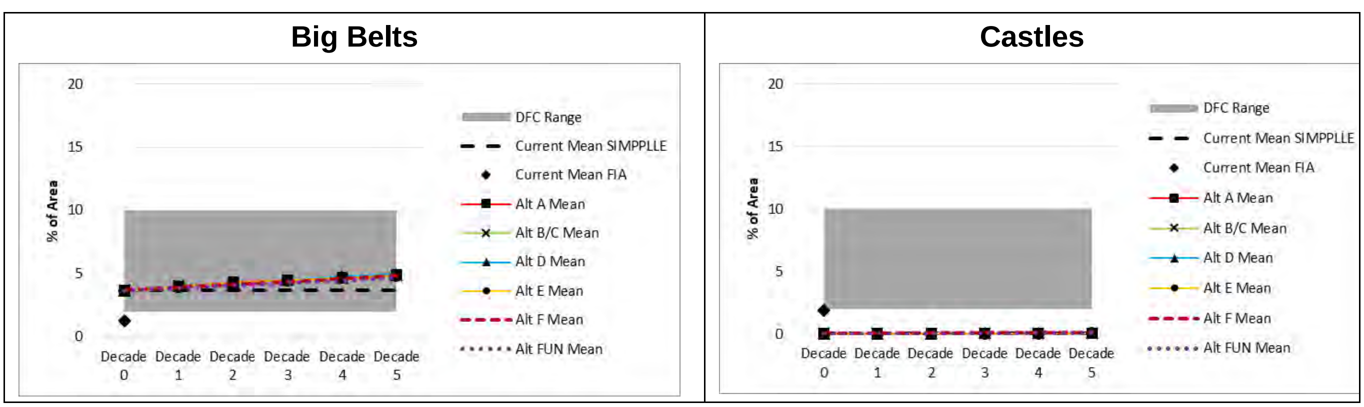


Figure 126. Aspen presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 127, displays aspen presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



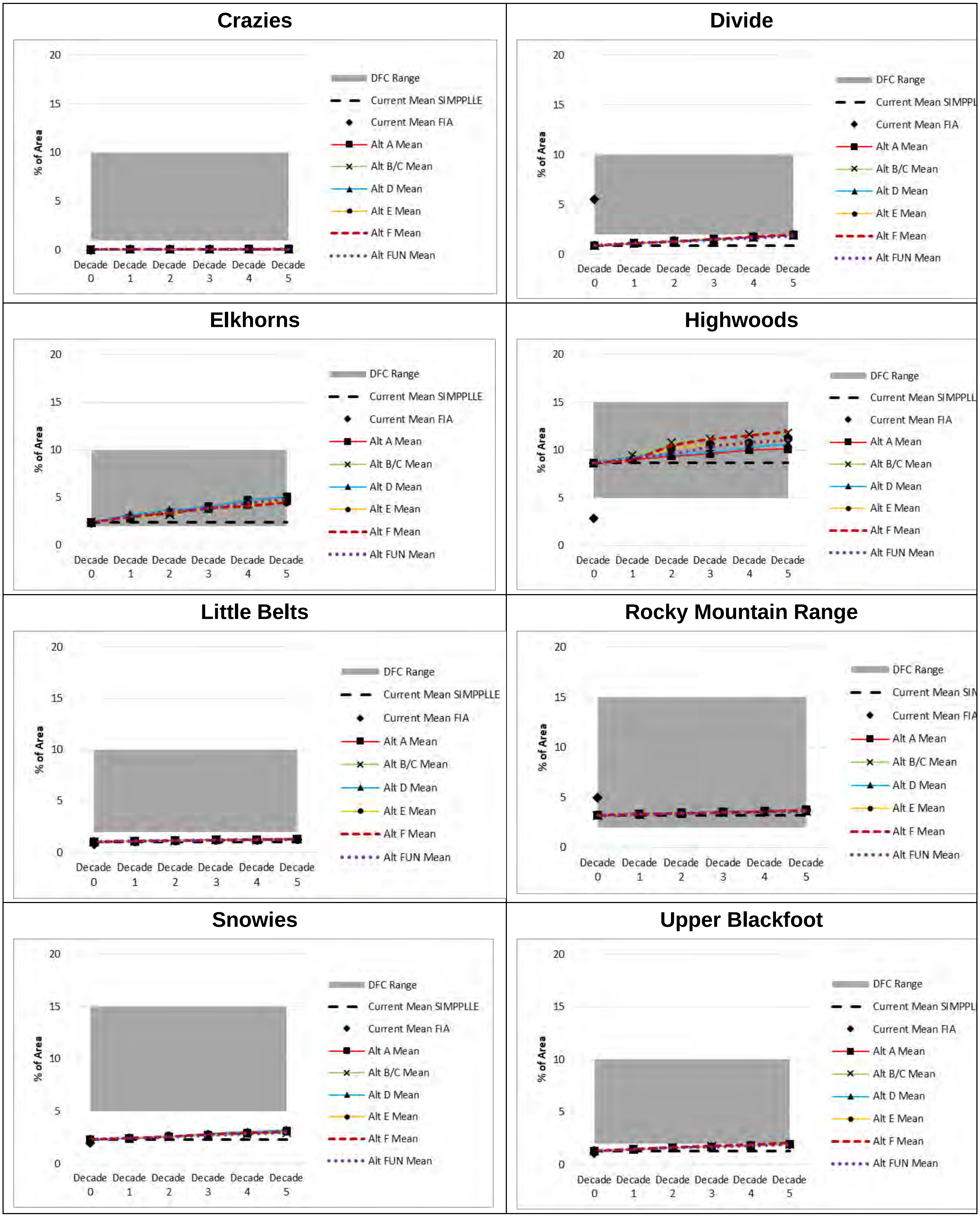


Figure 127. Aspen presence (% of total area) over 5 decades by alternative, by GA

Douglas fir cover type and presence of Douglas-fir

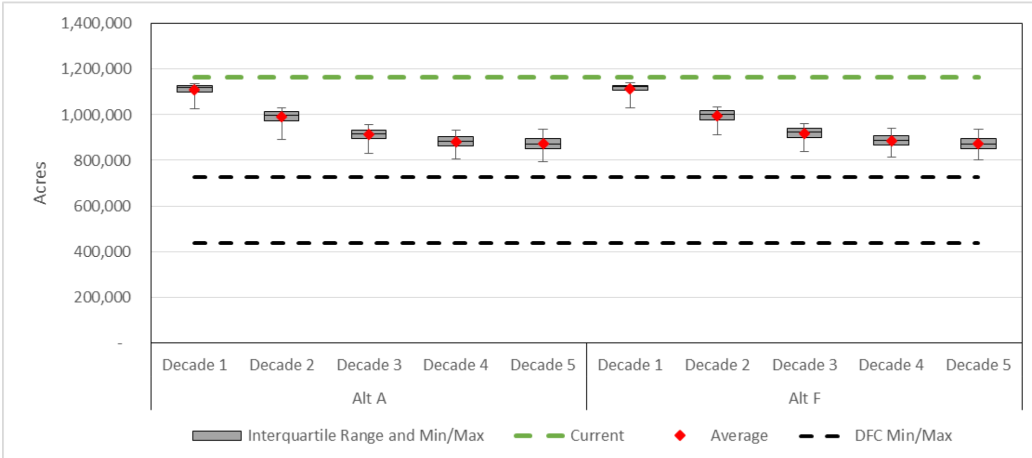


Figure 128. Douglas-fir cover type (total acres) over 5 decades, alternatives A and F

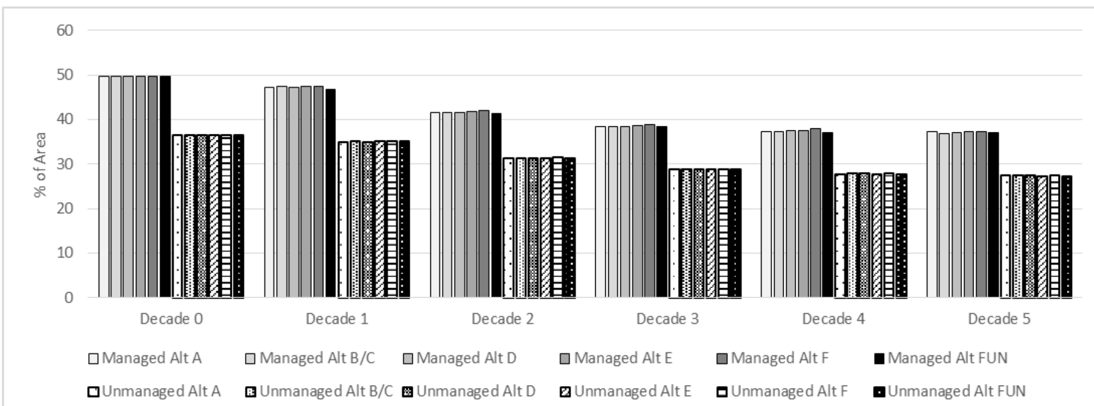


Figure 129. Douglas-fir cover type in managed versus unmanaged landscapes, forestwide

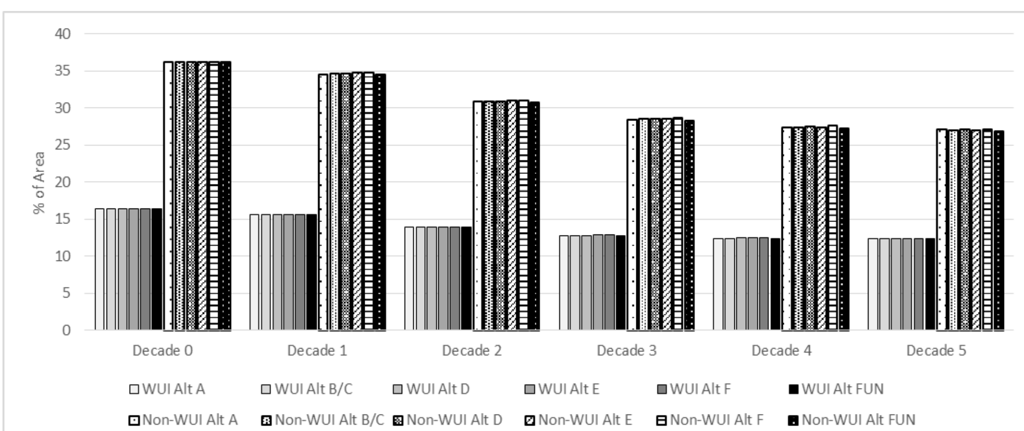


Figure 130. Douglas-fir cover type in WUI versus non-WUI areas, forestwide

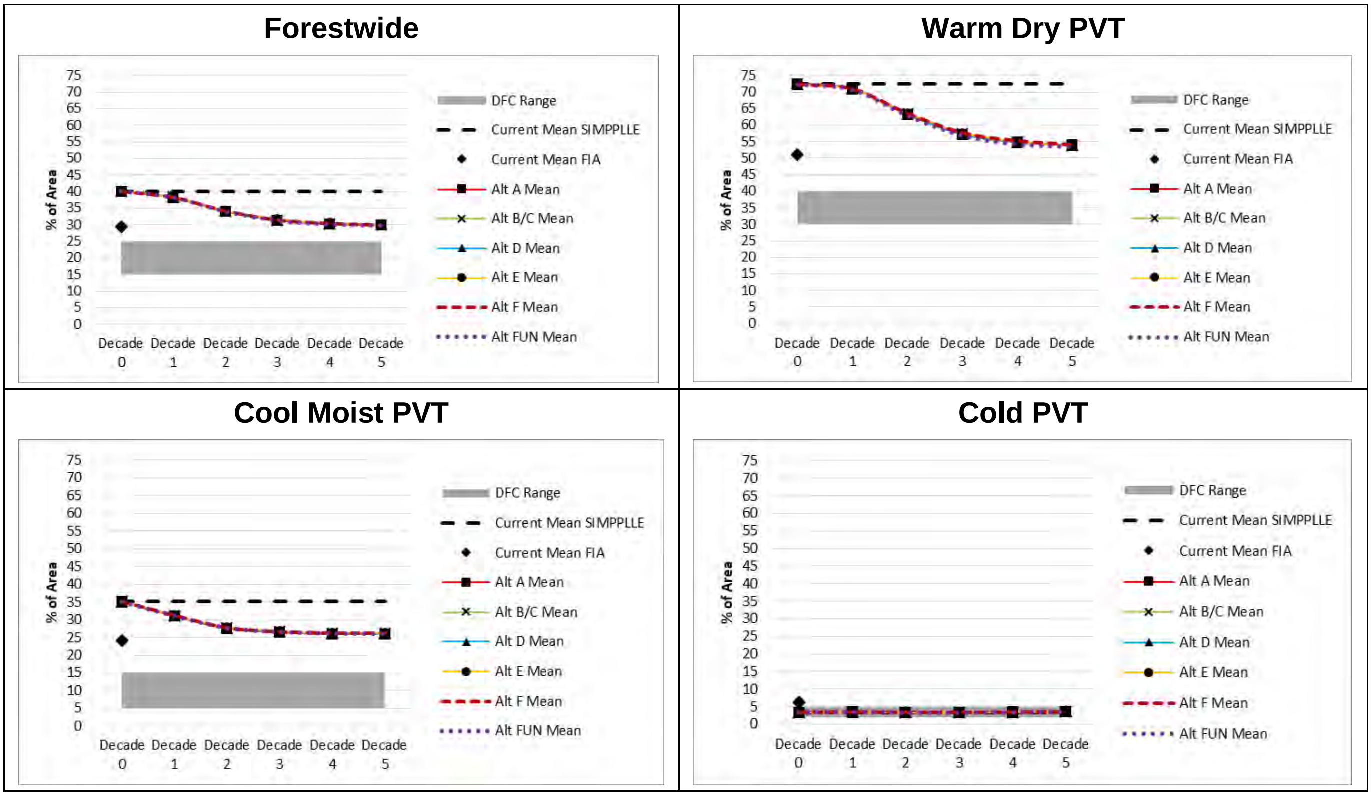
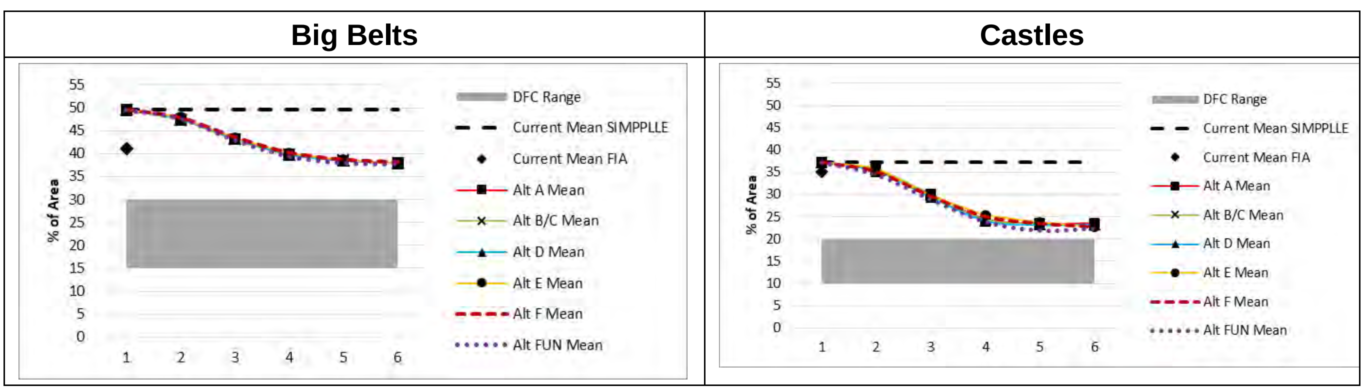


Figure 131. Douglas-fir cover type (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 132, displays Douglas-fir cover type (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



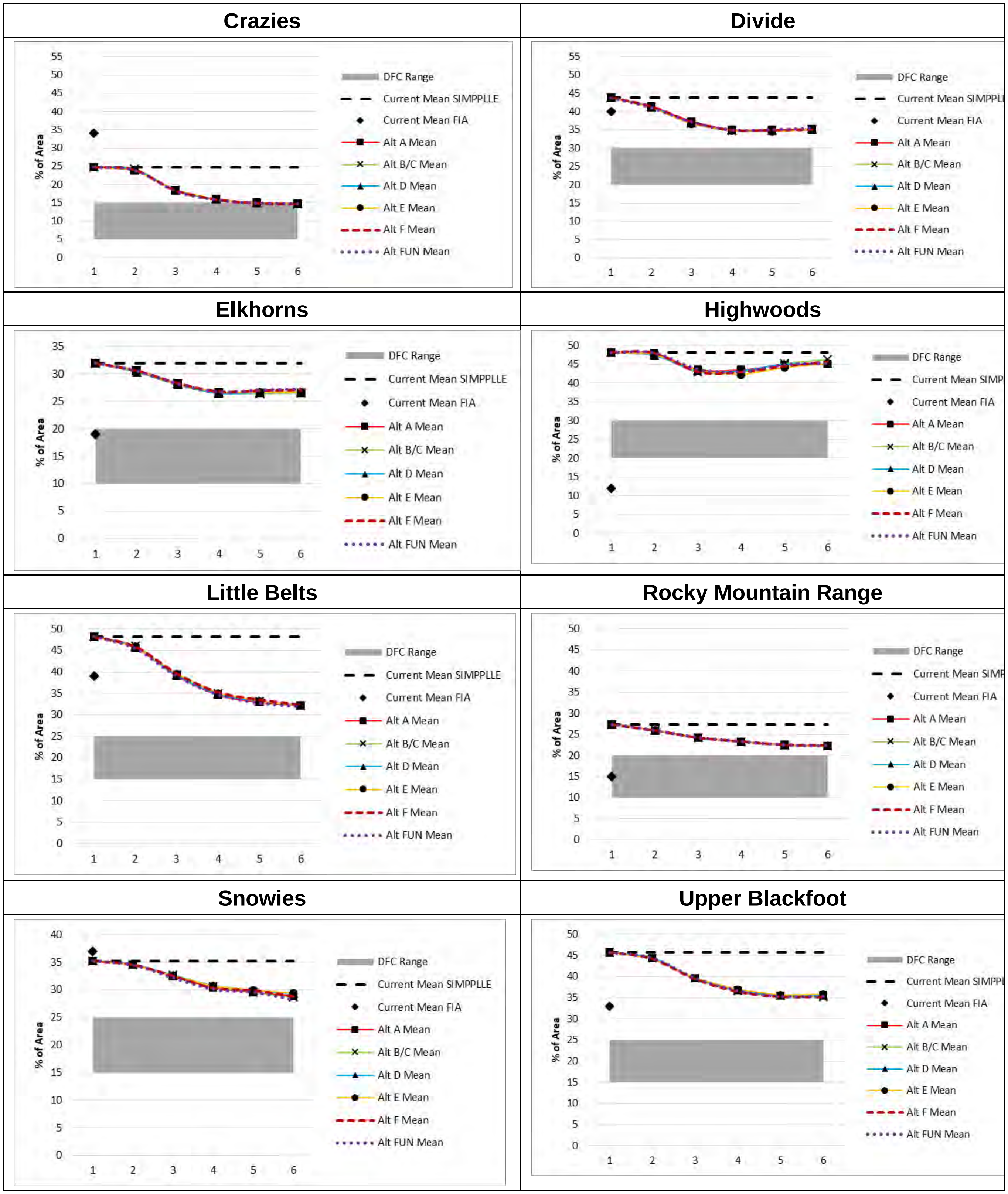


Figure 132. Douglas-fir cover type (% of total area) over 5 decades by alternative, by GA

Douglas-fir presence

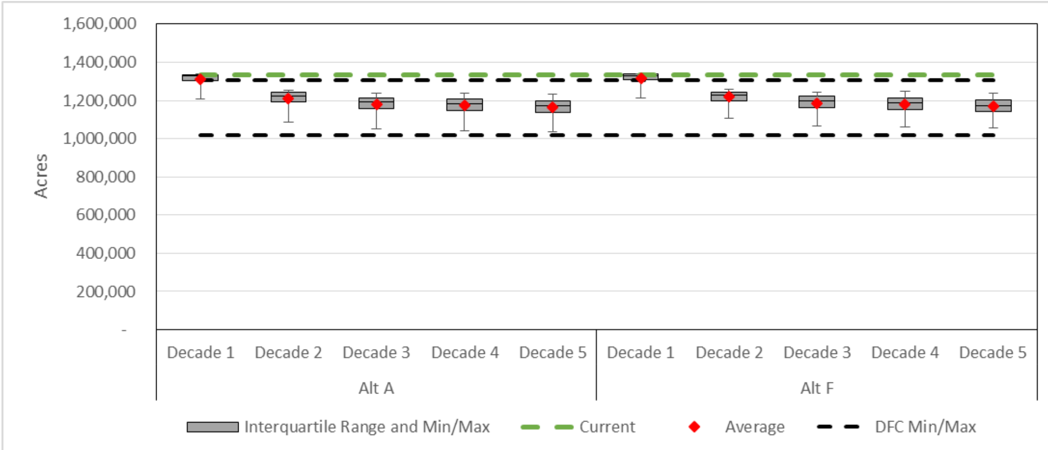


Figure 133. Douglas-fir presence (total acres) over 5 decades, alternatives A and F

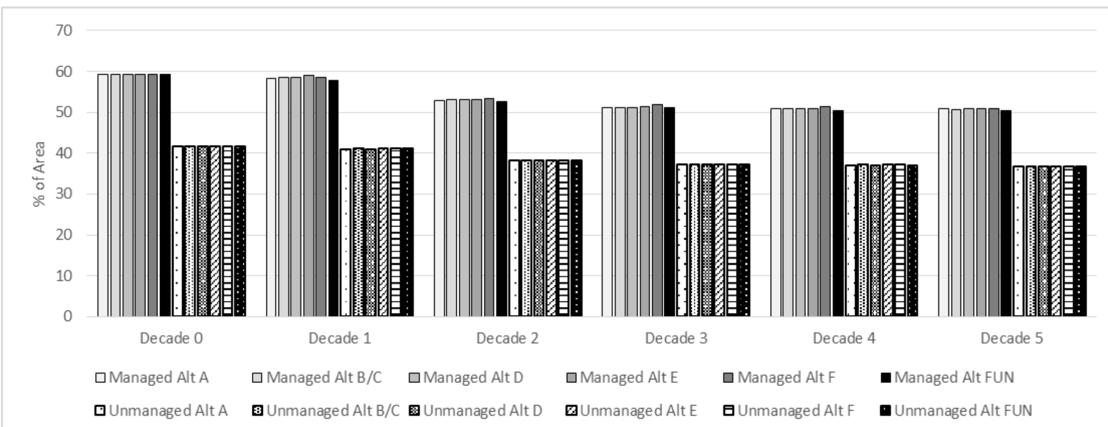


Figure 134. Douglas-fir presence in managed versus unmanaged landscapes, forestwide

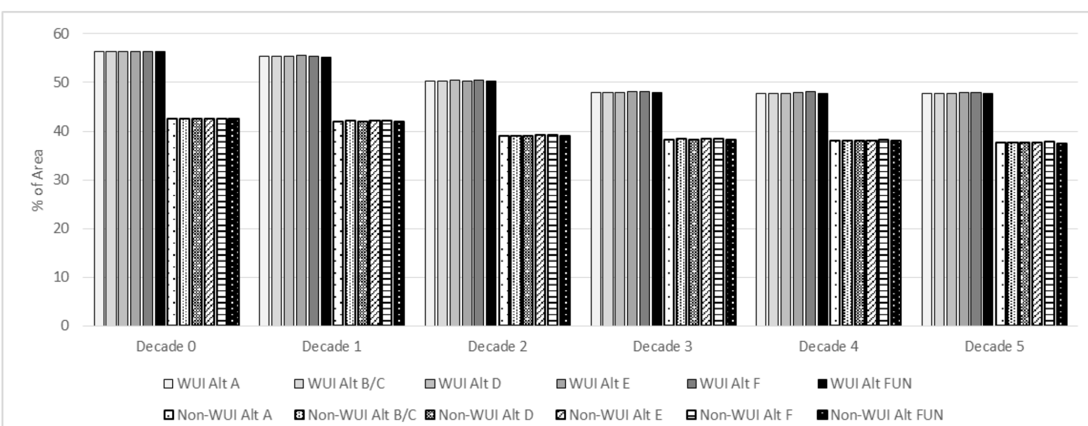


Figure 135. Douglas-fir presence in WUI versus Non-WUI areas, forestwide

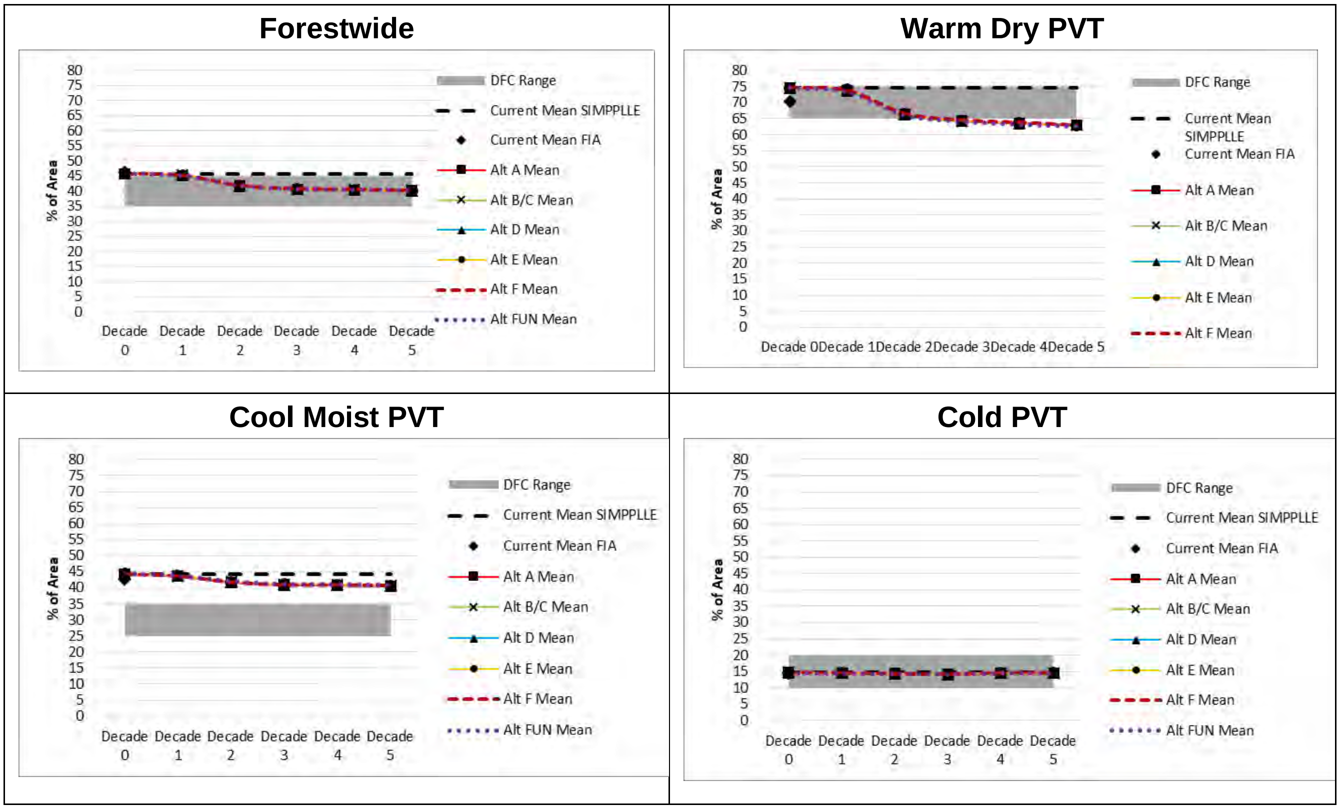
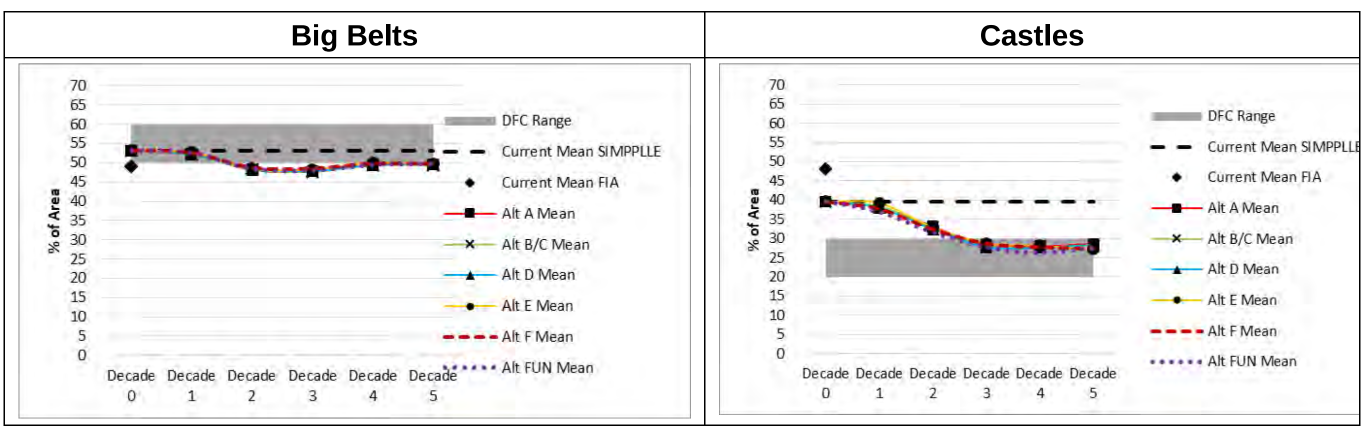


Figure 136. Douglas-fir presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 137, displays Douglas-fir presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



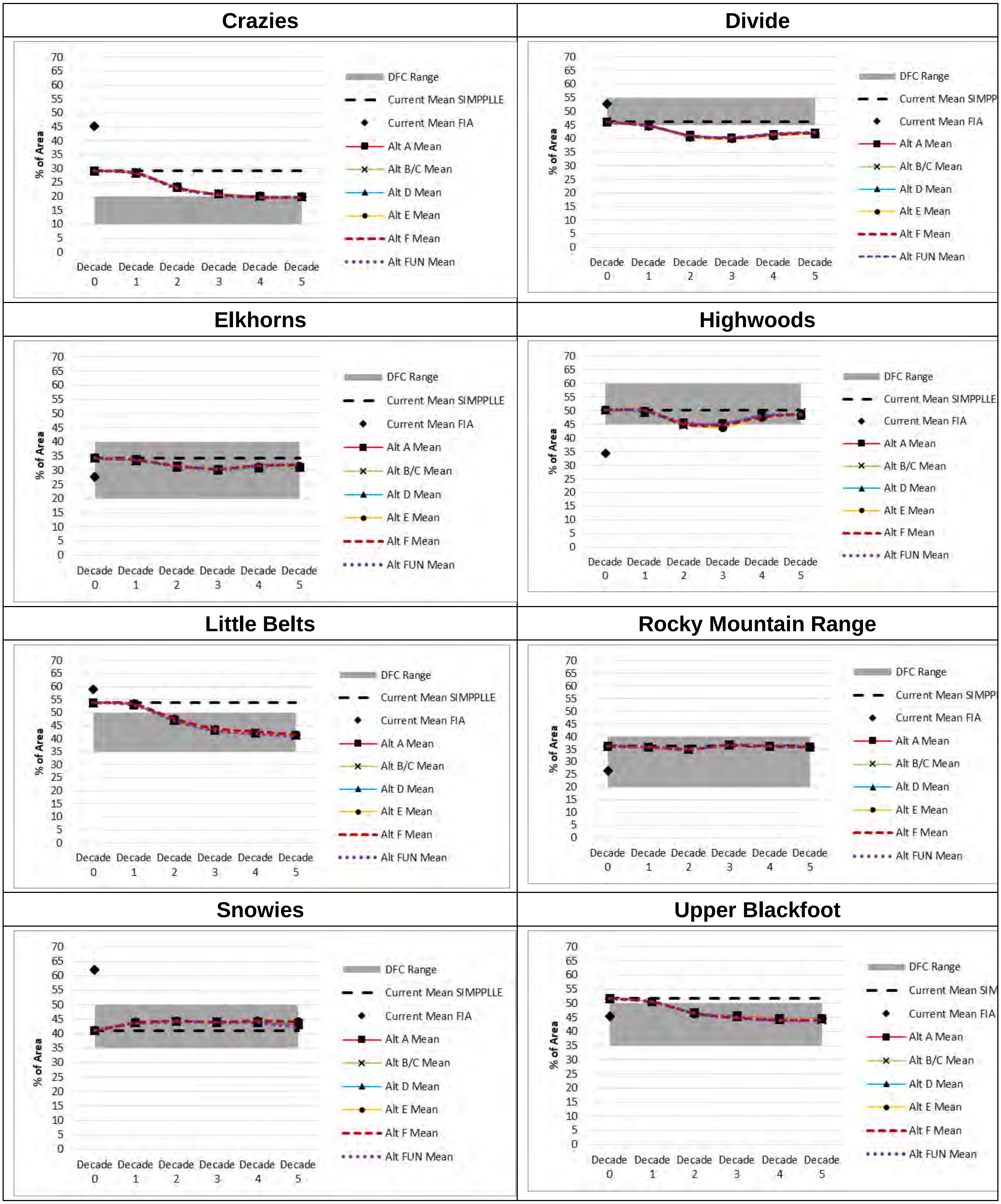


Figure 137. Douglas-fir presence (% of total area) over 5 decades by alternative, by GA

Lodgepole pine cover type and presence of lodgepole pine

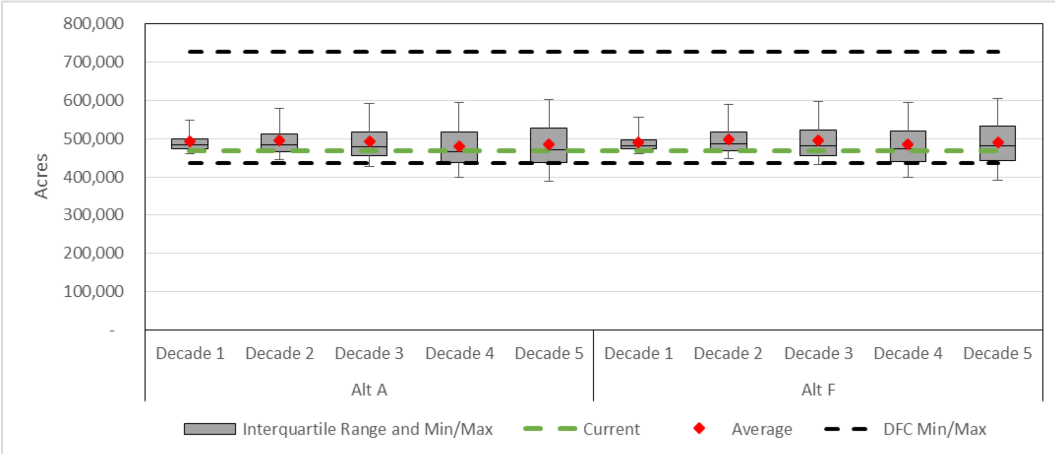


Figure 138. Lodgepole pine cover type (total acres) over 5 decades, alternatives A and F

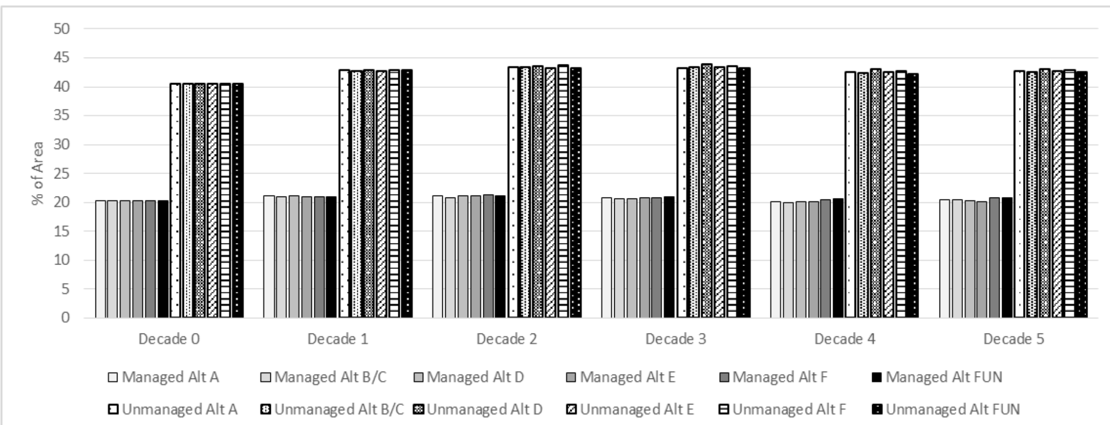


Figure 139. Lodgepole pine cover type in managed versus unmanaged landscapes, forestwide

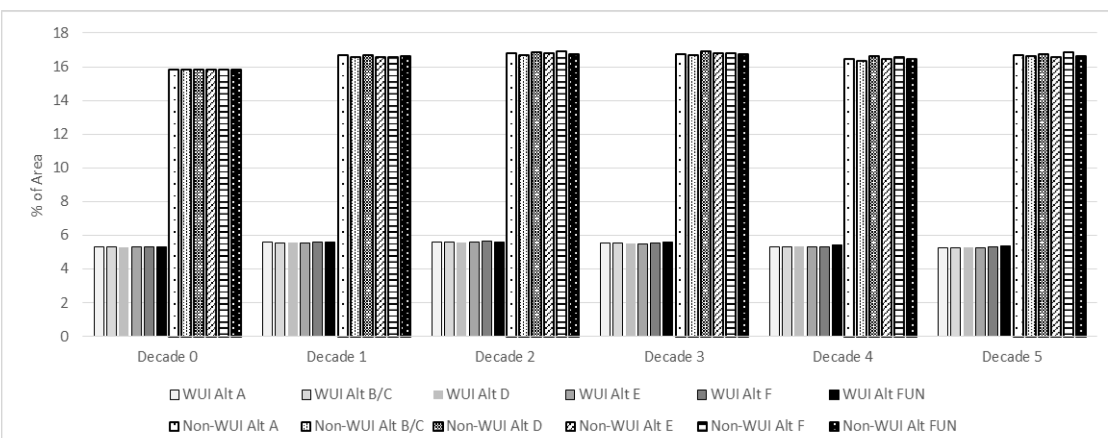


Figure 140. Lodgepole pine cover type in WUI versus non-WUI areas, forestwide

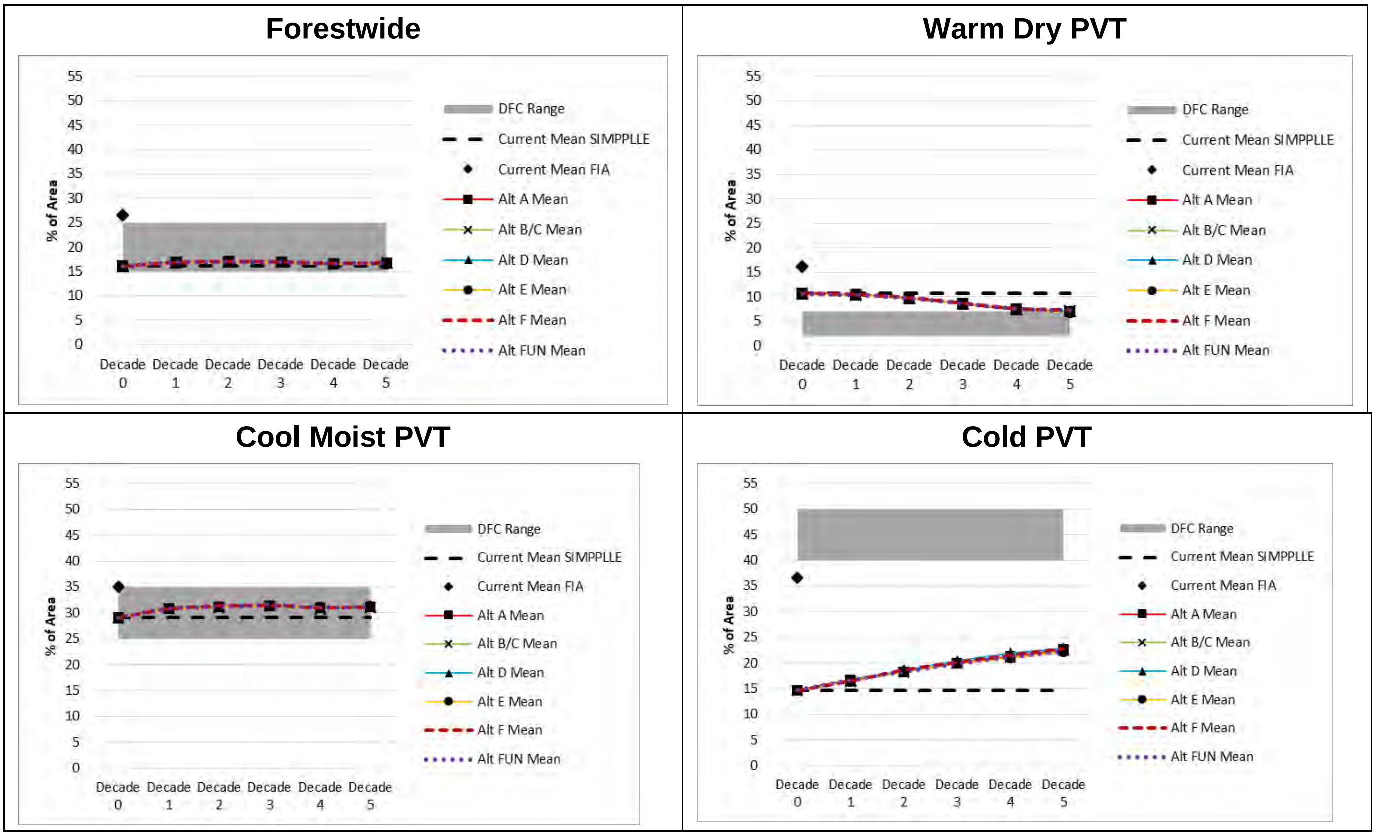
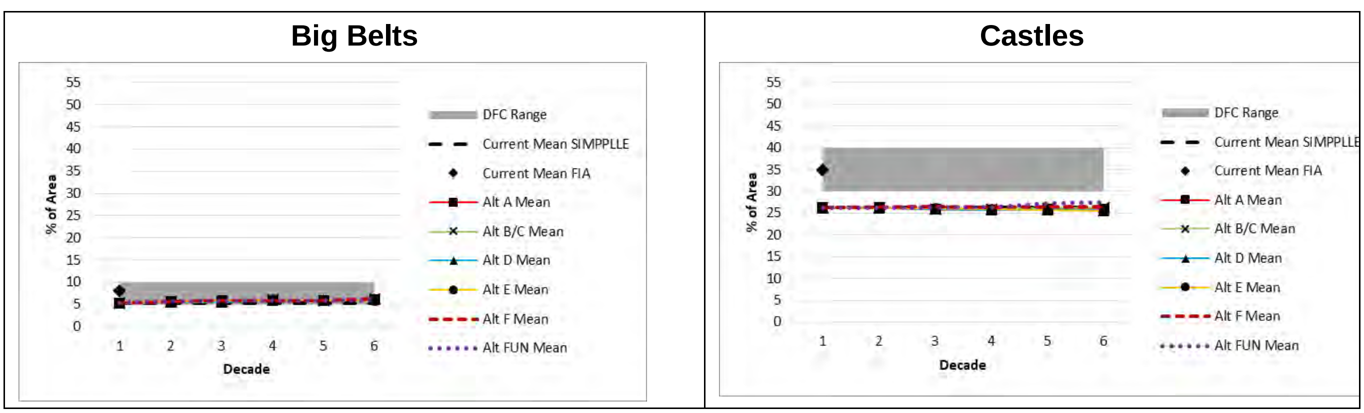


Figure 141. Lodgepole pine cover type (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 142, displays lodgepole pine cover type (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



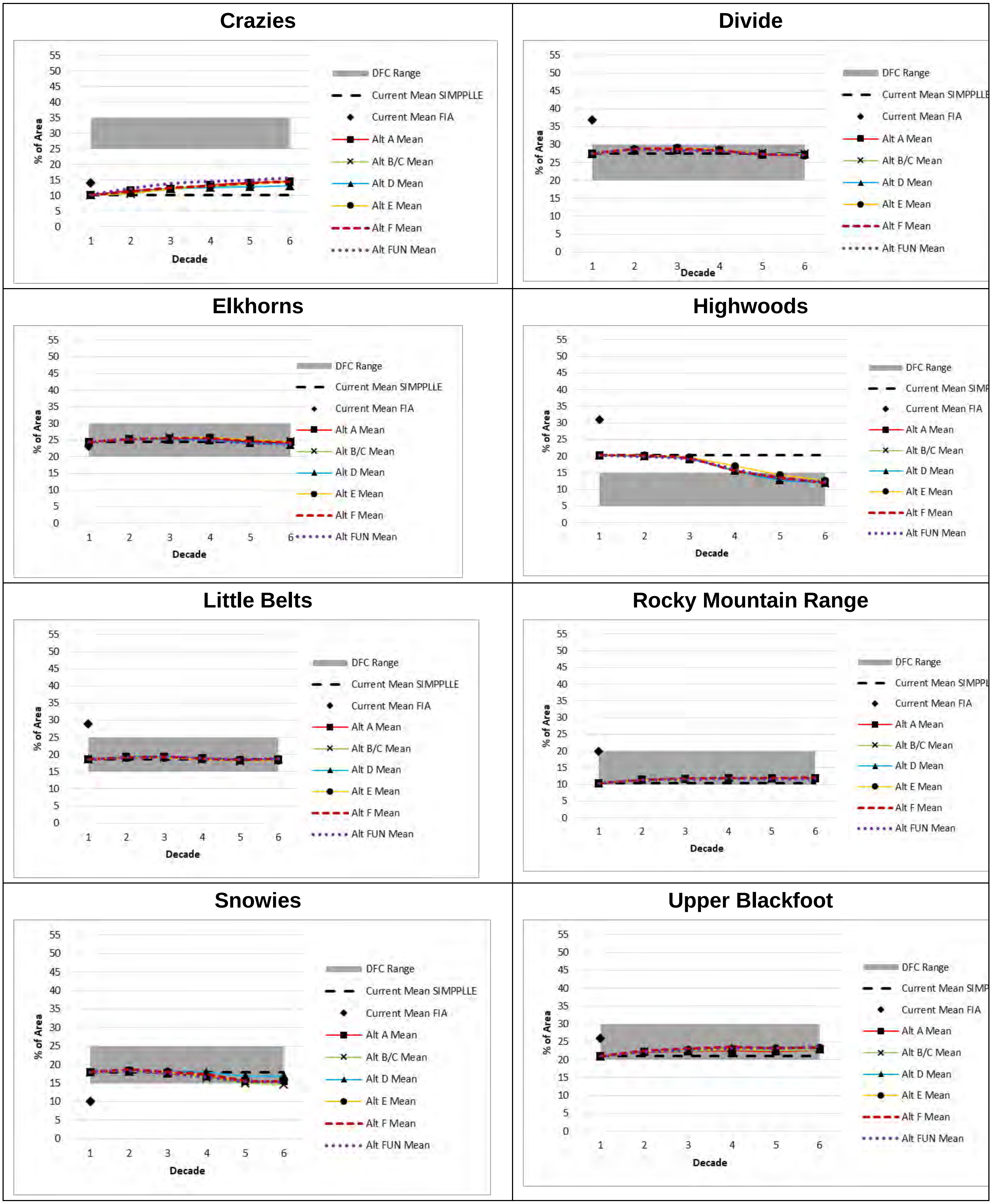


Figure 142. Lodgepole pine cover type (% of total area) over 5 decades by alternative, by GA

Lodgepole pine presence

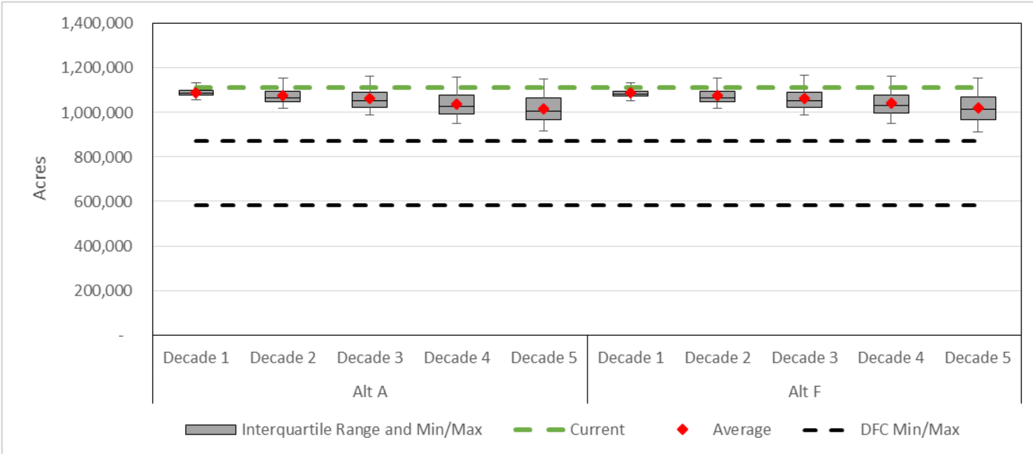


Figure 143. Lodgepole pine presence (total acres) over 5 decades, alternatives A and F

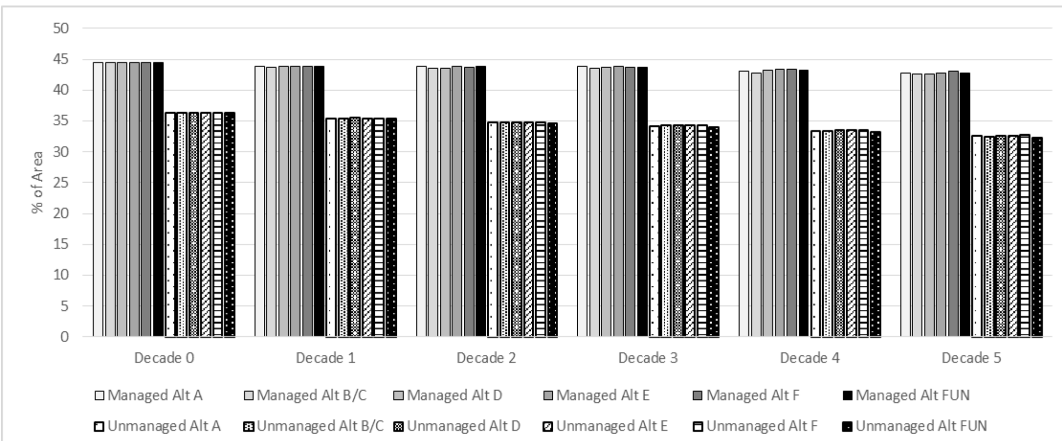


Figure 144. Lodgepole pine presence in managed versus unmanaged landscapes, forestwide

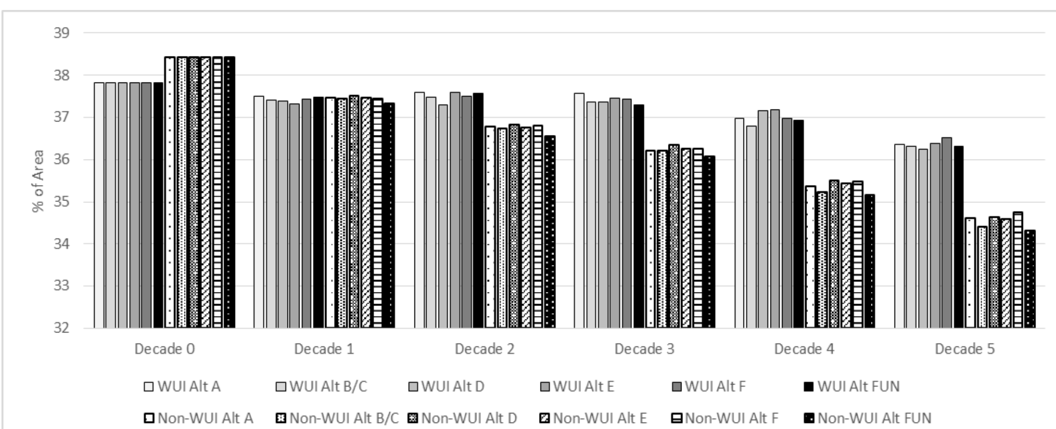


Figure 145. Lodgepole pine presence in WUI versus non-WUI areas, forestwide

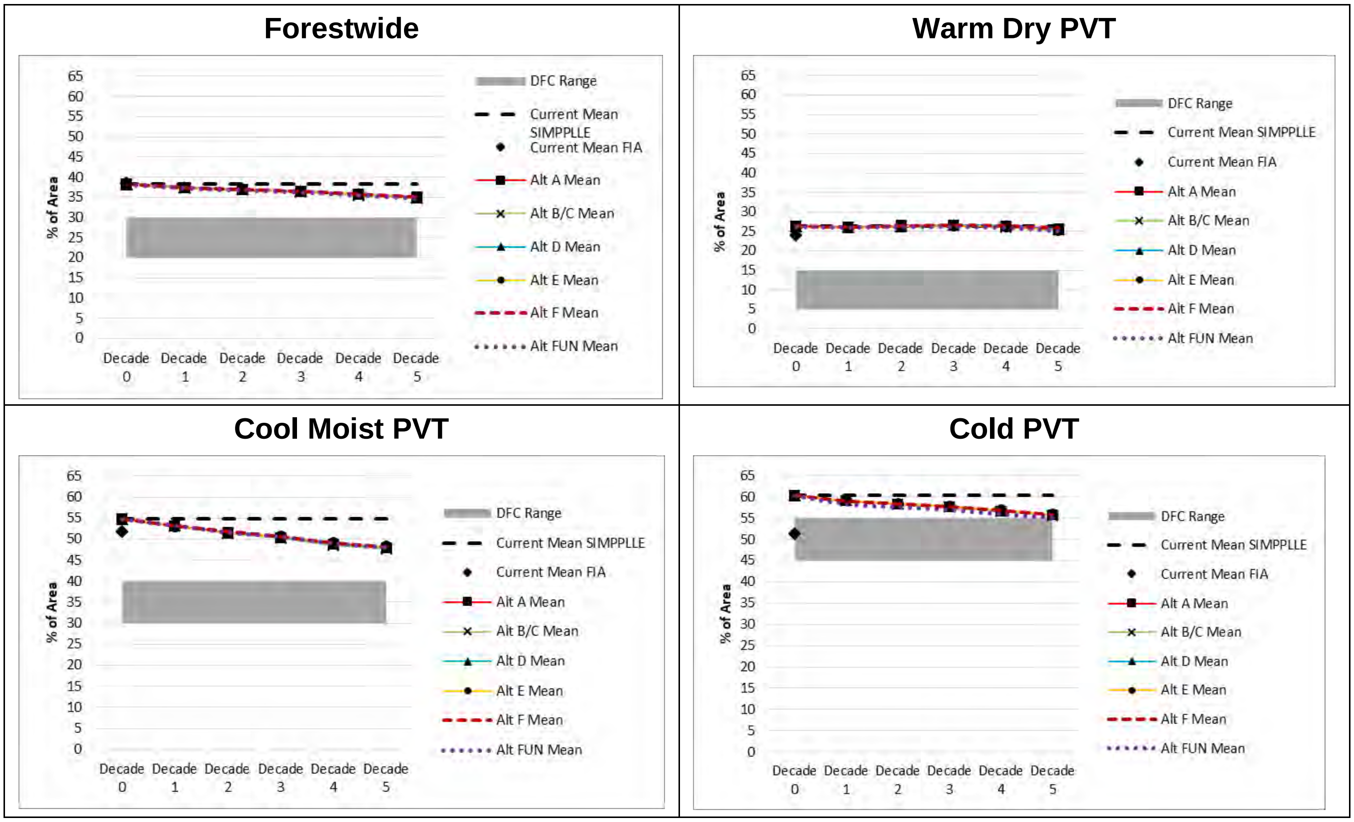
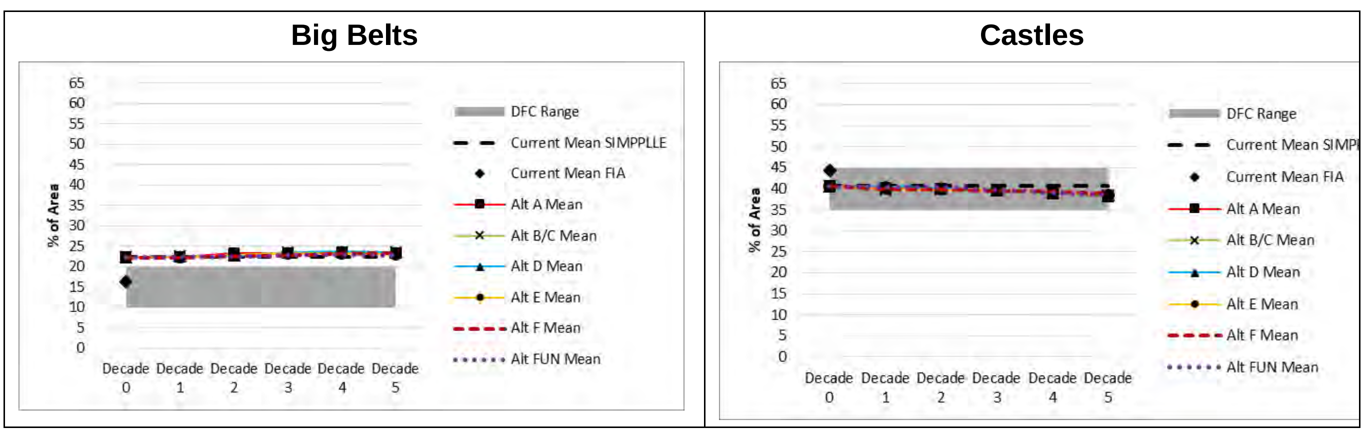


Figure 146. Lodgepole pine presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 147, displays lodgepole pine presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



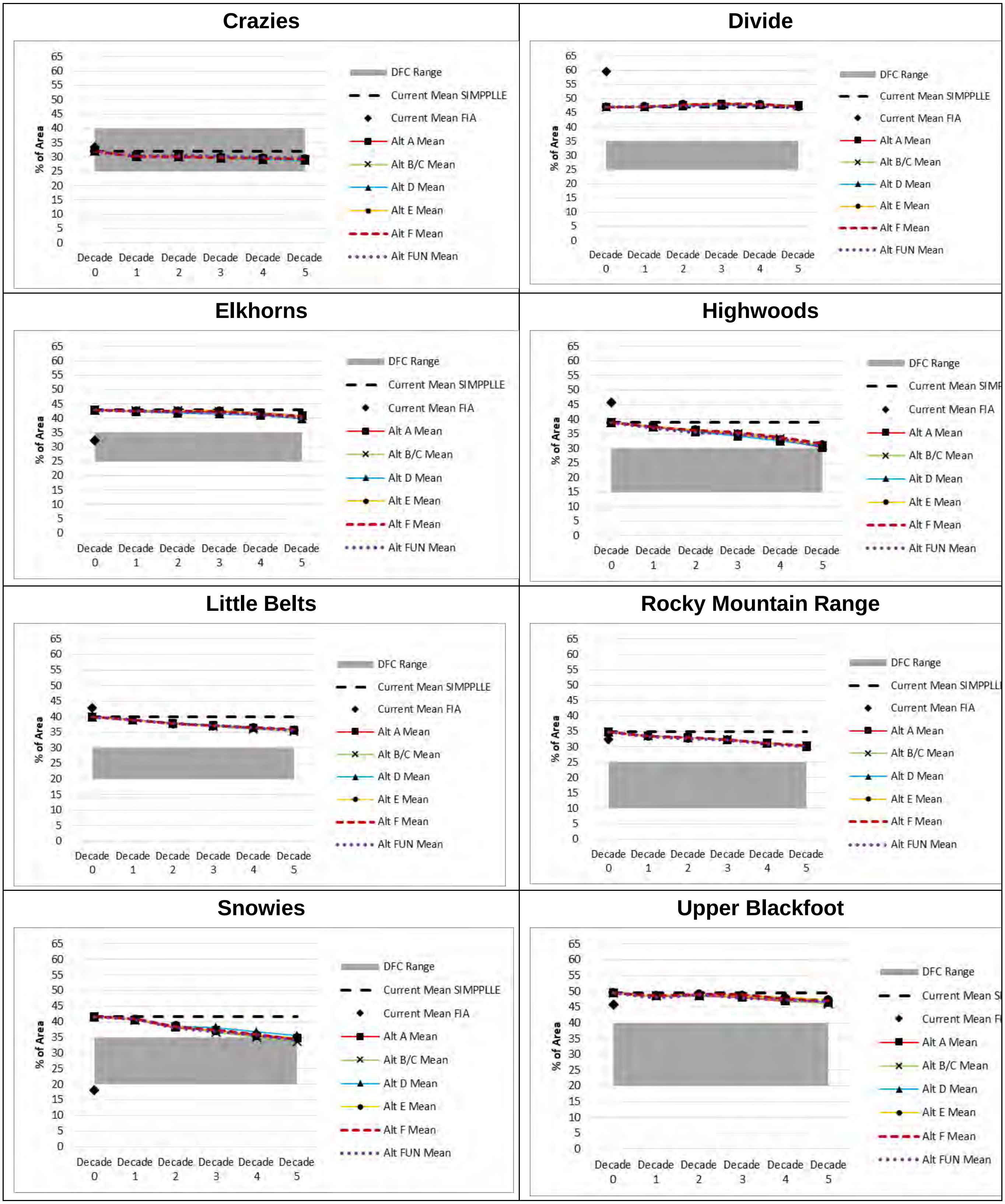


Figure 147. Lodgepole pine presence (% of total area) over 5 decades by alternative, by GA

Western larch cover type and presence of western larch

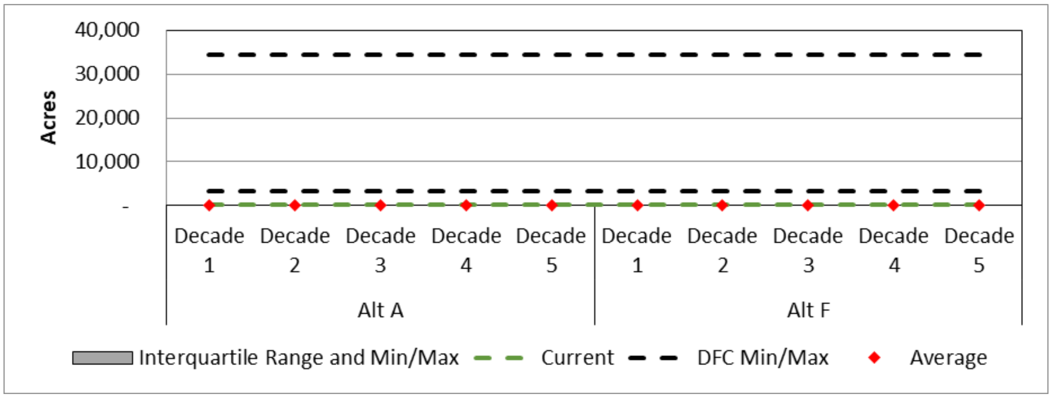


Figure 148. Western larch presence (total acres) over 5 decades, alternatives A and F

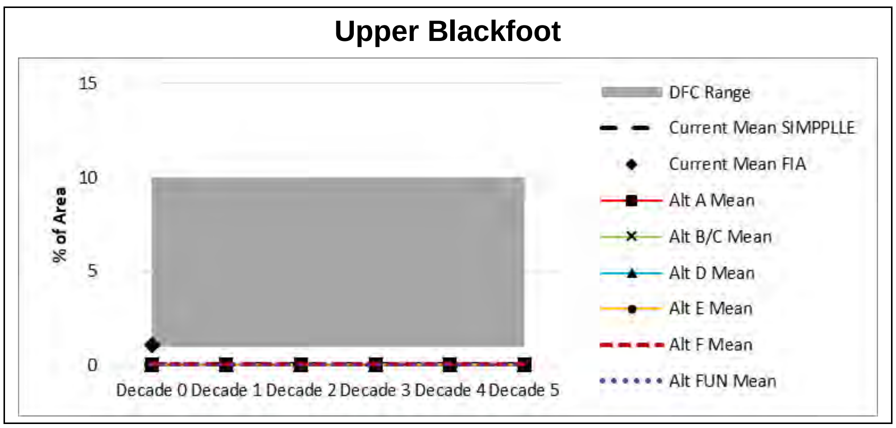


Figure 149. Western larch presence (% of total area) over 5 decades by alternative, in the Upper Blackfoot GA (not present in any other GA)

Spruce/fir cover type and presence of associated species (Engelmann spruce and subalpine fir)

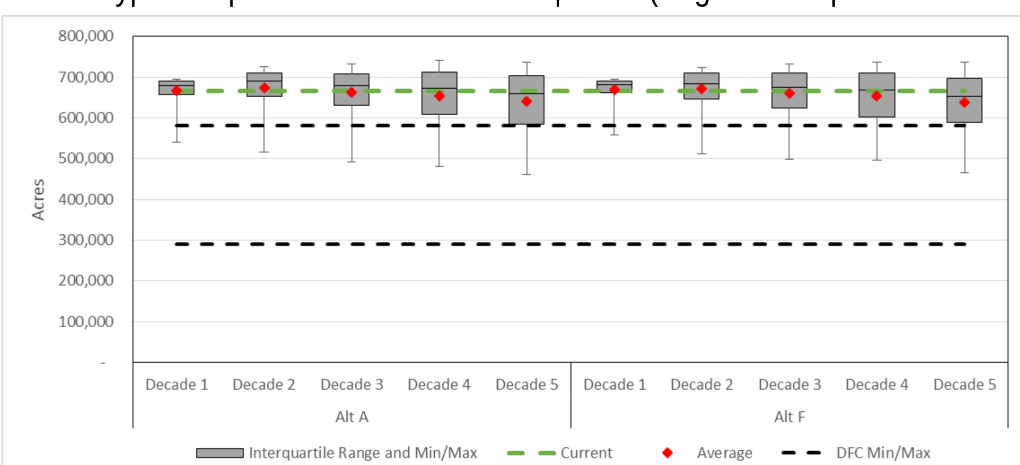


Figure 150. Spruce/fir cover type (total acres) over 5 decades, alternatives A and F

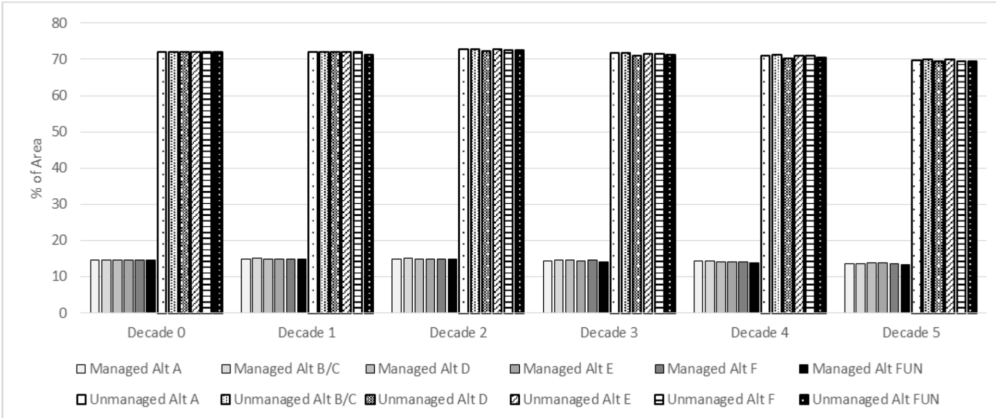


Figure 151. Spruce/fir cover type in managed versus unmanaged landscapes, forestwide

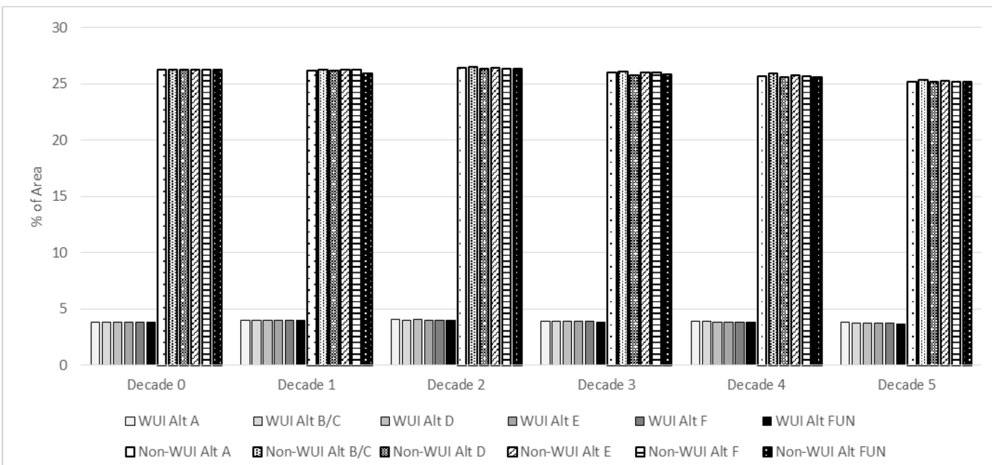
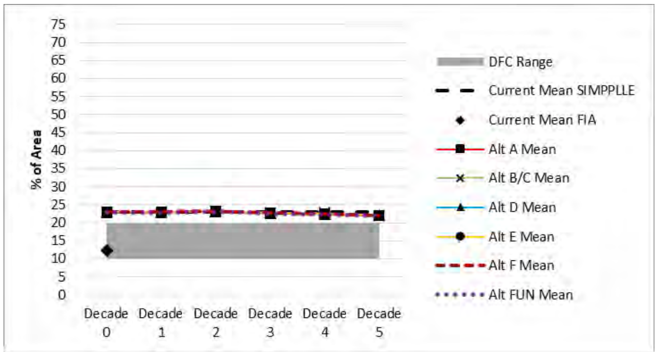


Figure 152. Spruce/fir cover type in WUI versus Non-WUI areas, forestwide

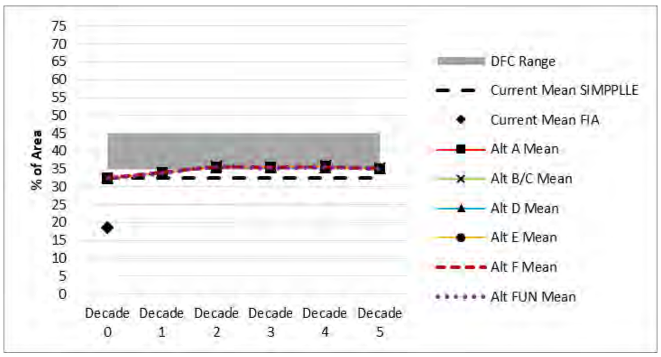
Forestwide



Warm Dry PVT

N/A

Cool Moist PVT



Cold PVT

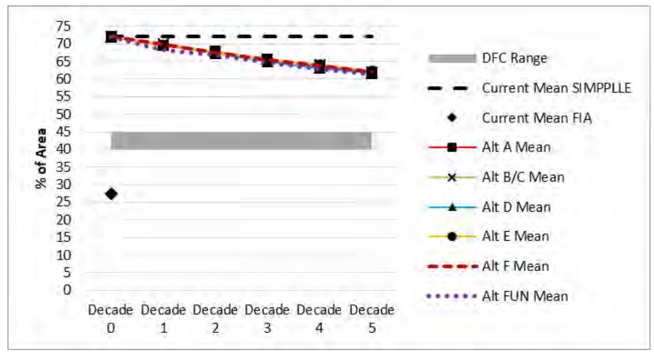
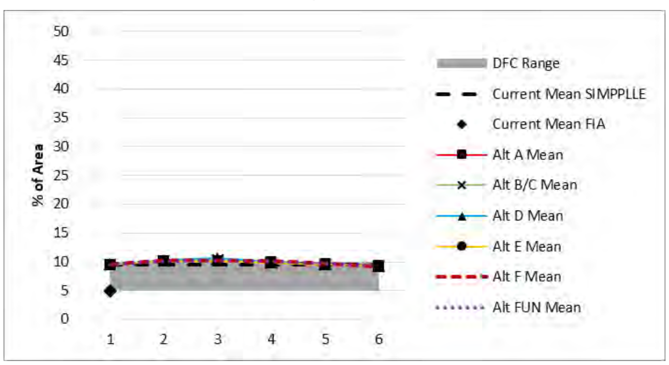


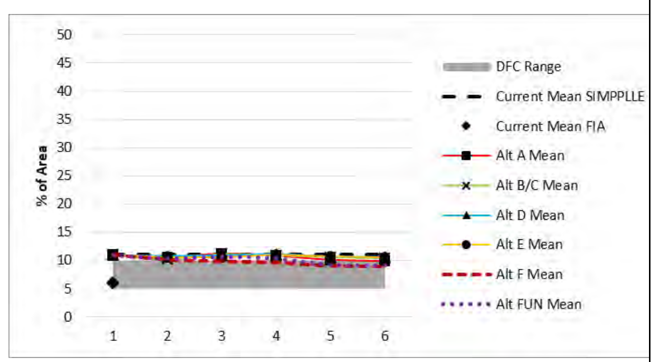
Figure 153. Spruce/fir cover type (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 154, displays spruce/fir pine cover type (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.

Big Belts



Castles



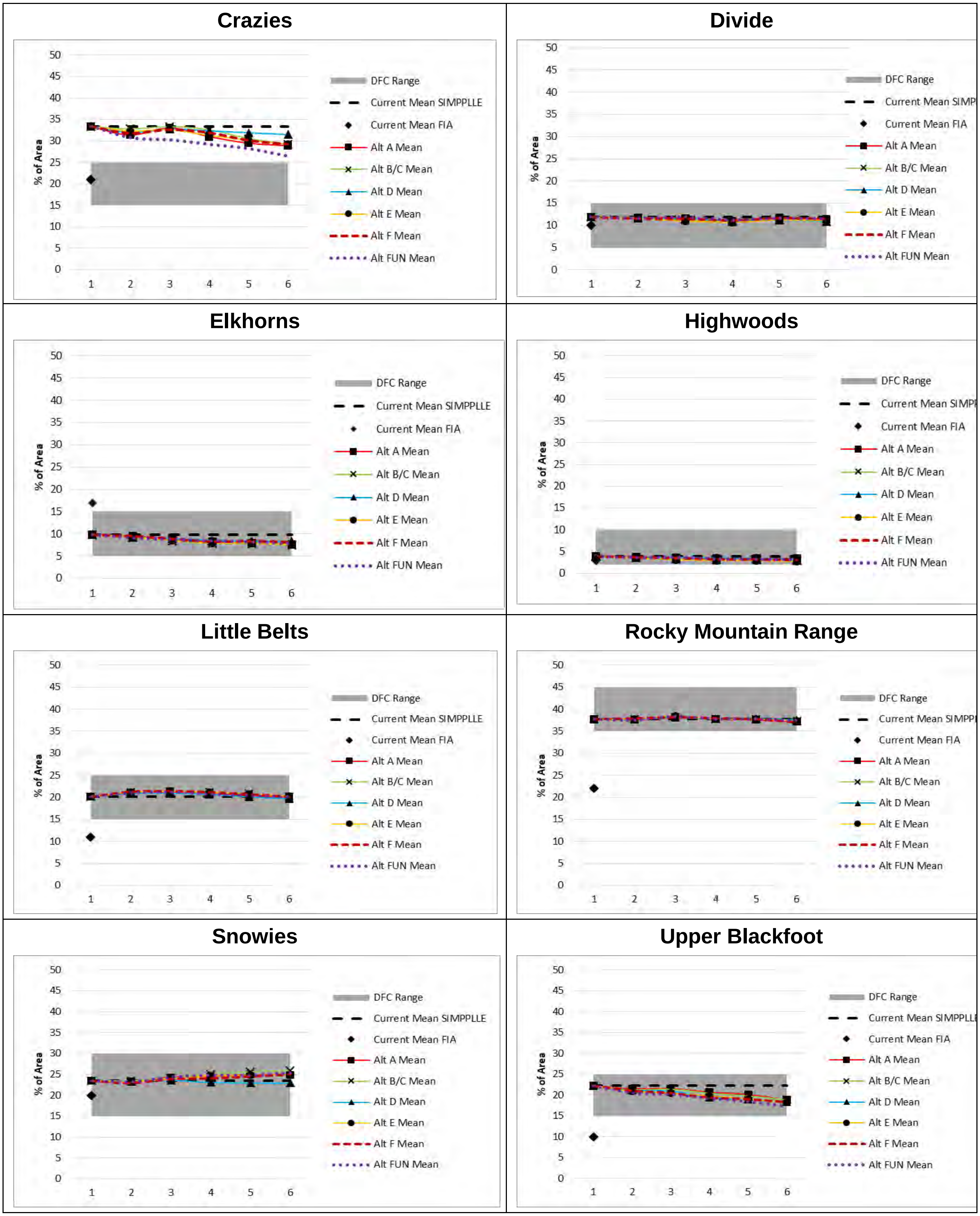


Figure 154. Spruce/fir cover type (% of total area) over 5 decades by alternative, by GA

Engelmann spruce presence

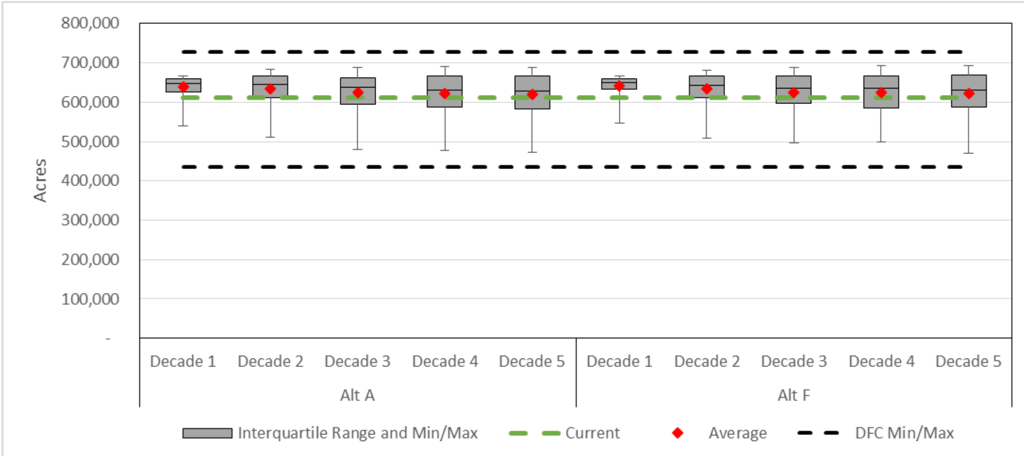


Figure 155. Engelmann spruce presence (total acres) over 5 decades, alternatives A and F

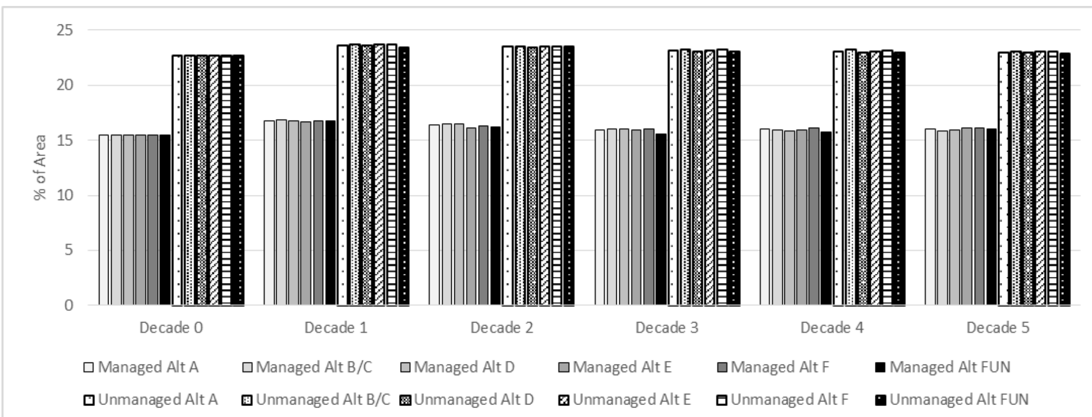


Figure 156. Engelmann spruce presence in managed versus unmanaged landscapes, forestwide

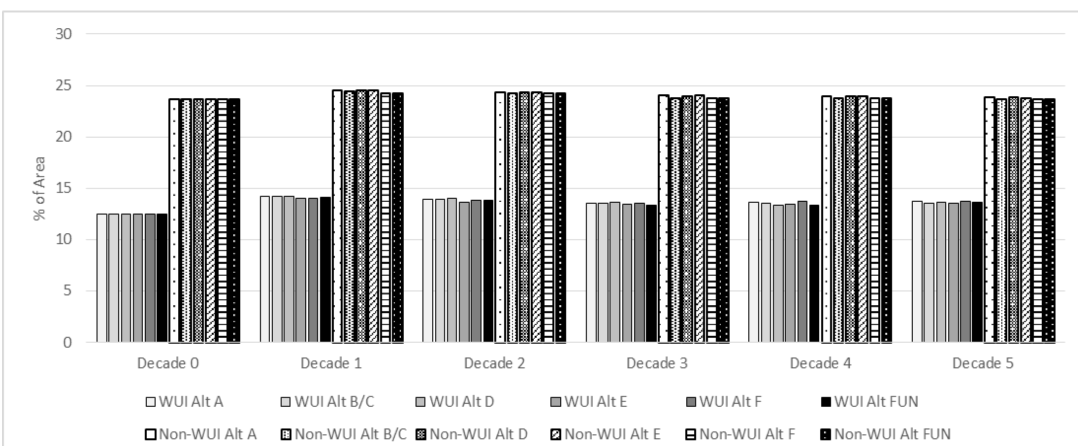


Figure 157. Engelmann spruce presence in WUI versus non-WUI areas, forestwide

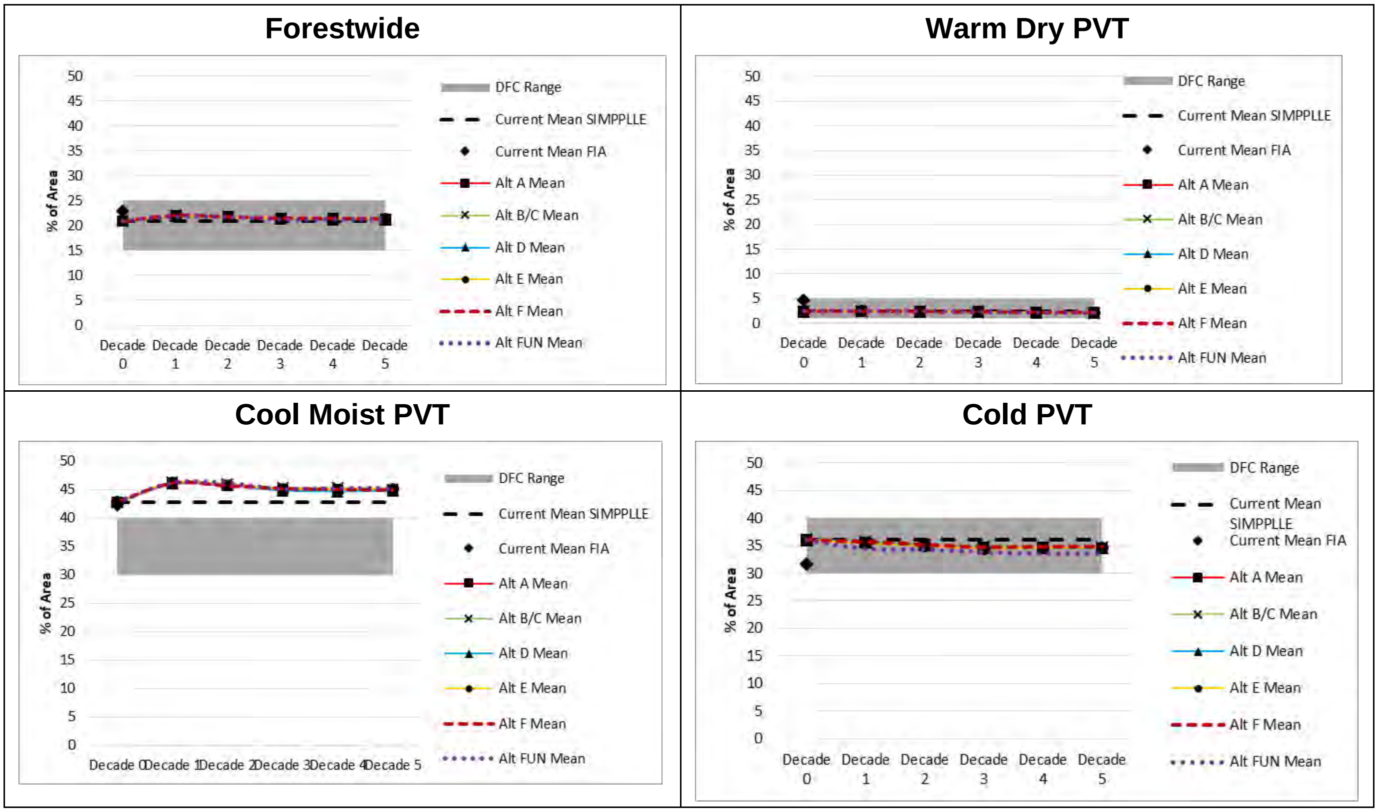
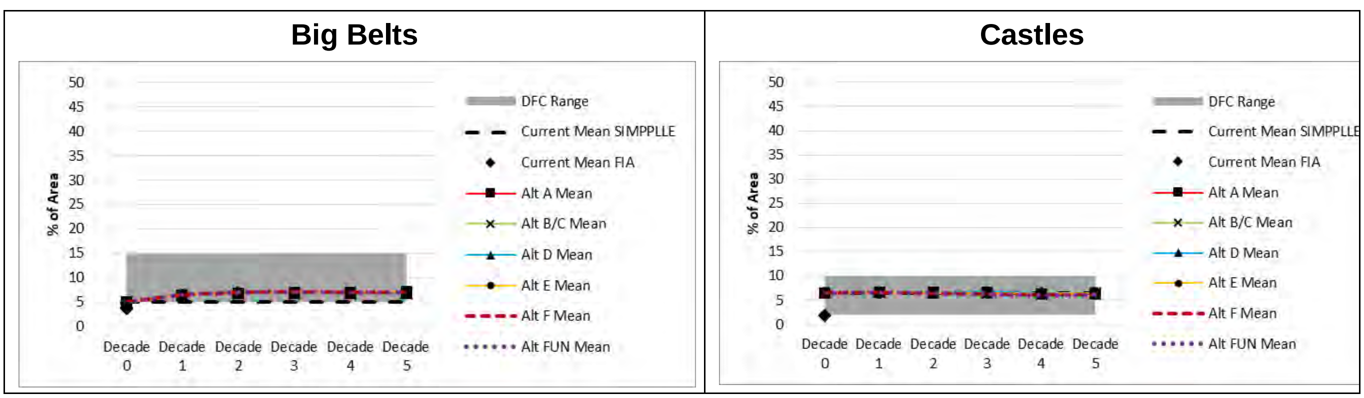


Figure 158. Engelmann spruce presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 159, displays Engelmann spruce presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



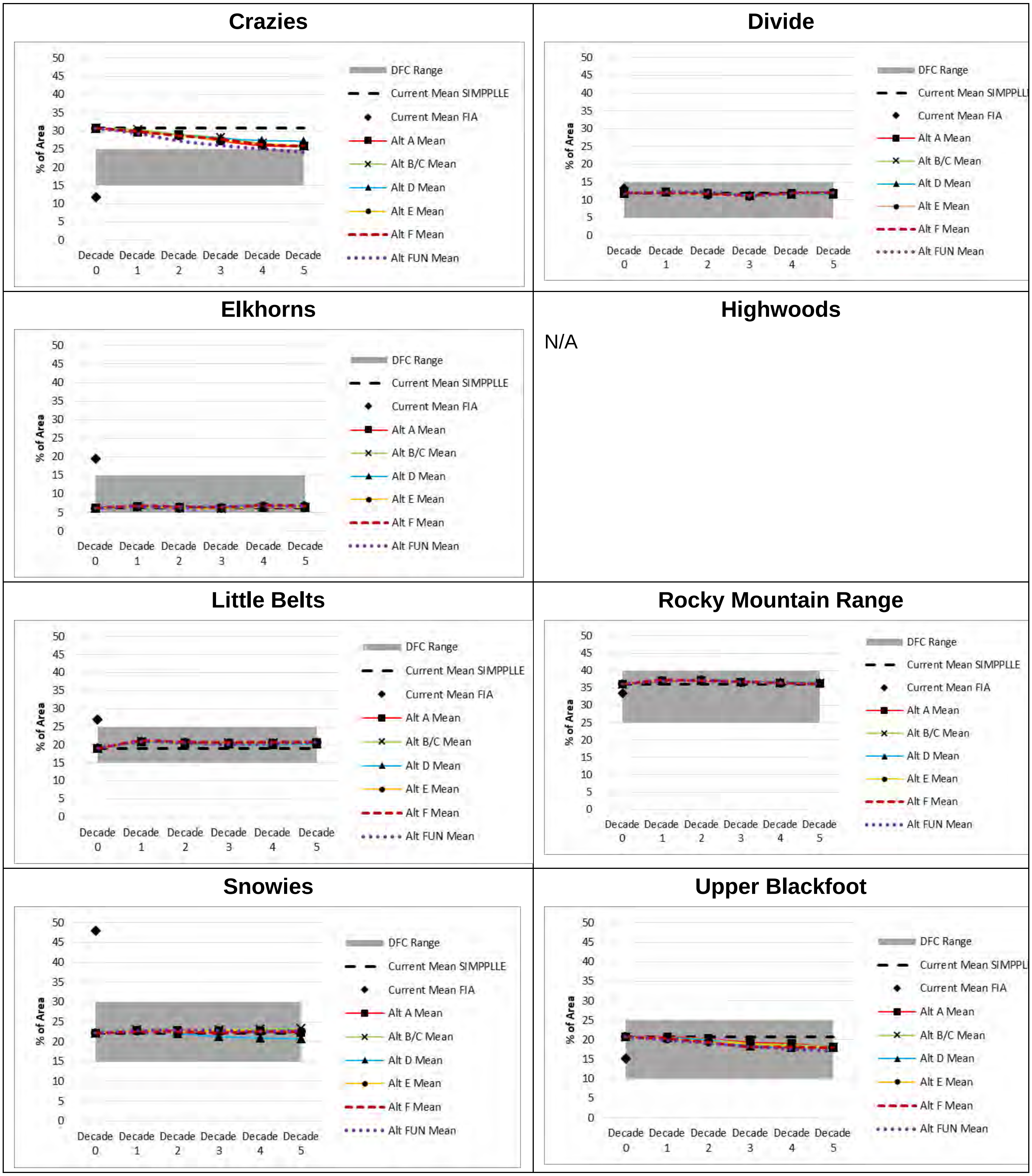


Figure 159. Engelmann spruce presence (% of total area) over 5 decades by alternative, by GA

Subalpine fir presence

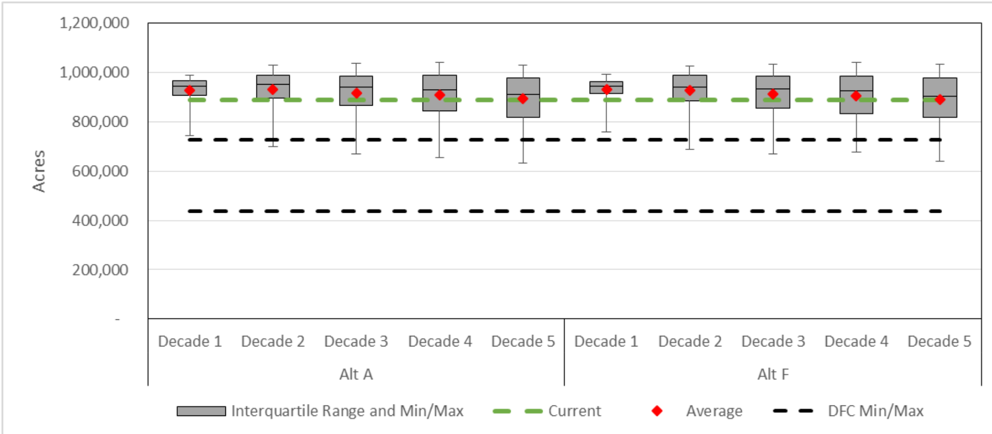


Figure 160. Subalpine fir presence (total acres) over 5 decades, alternatives A and F

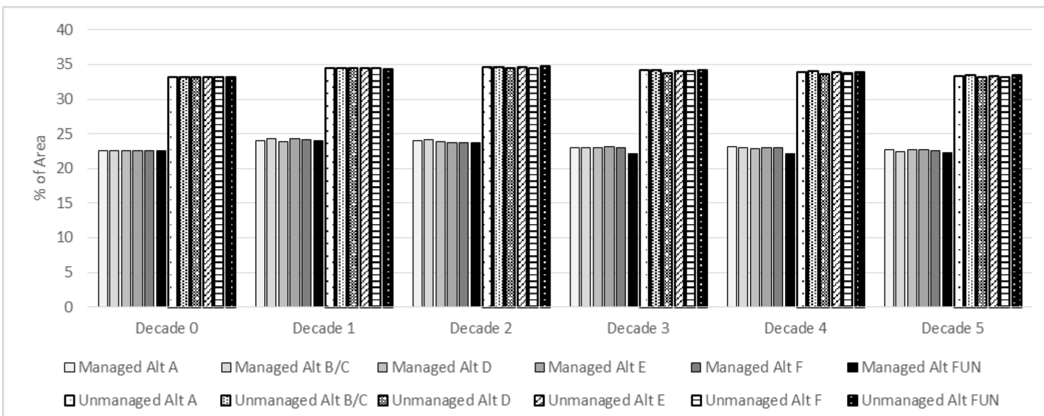


Figure 161. Subalpine fir presence in managed versus unmanaged landscapes, forestwide

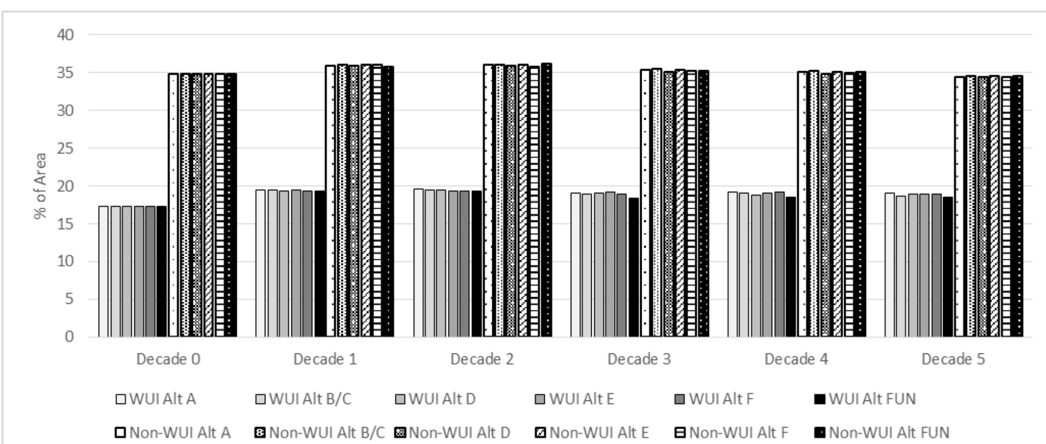
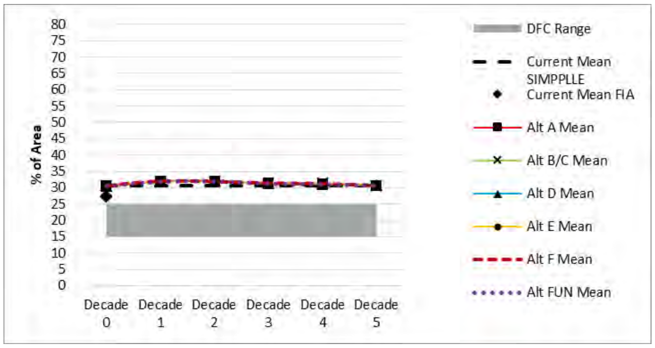


Figure 162. Subalpine fir presence in WUI versus non-WUI areas, forestwide

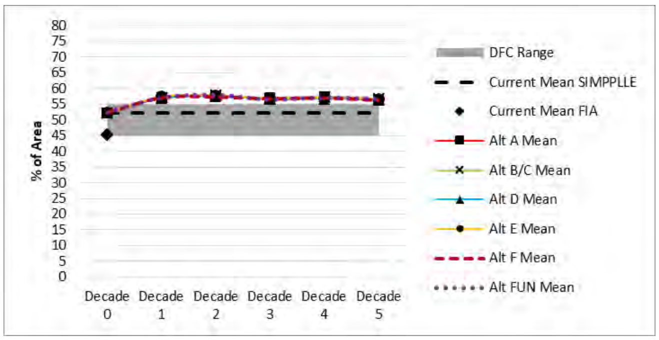
Forestwide



Warm Dry PVT

N/A

Cool Moist PVT



Cold PVT

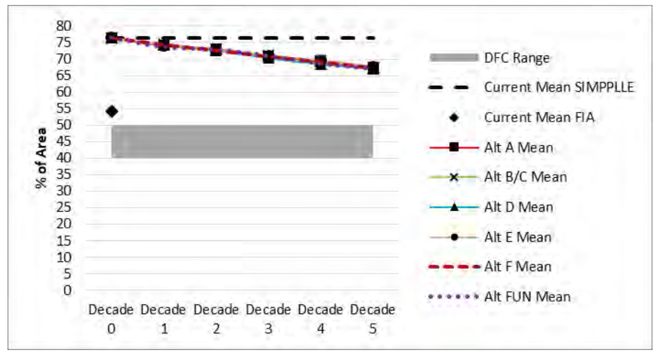
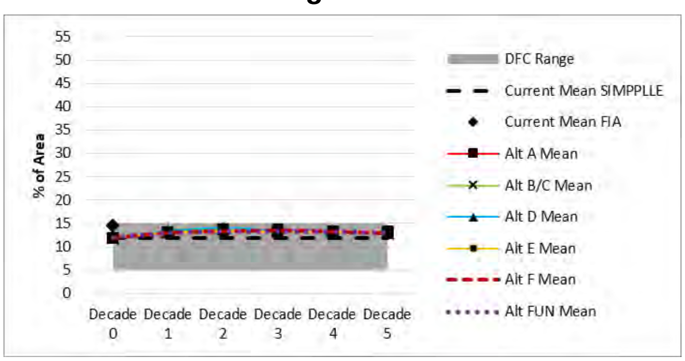


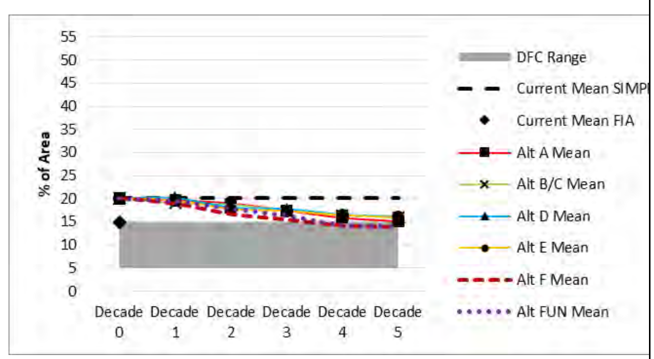
Figure 163. Subalpine fir presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 164, displays subalpine fir presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.

Big Belts



Castles



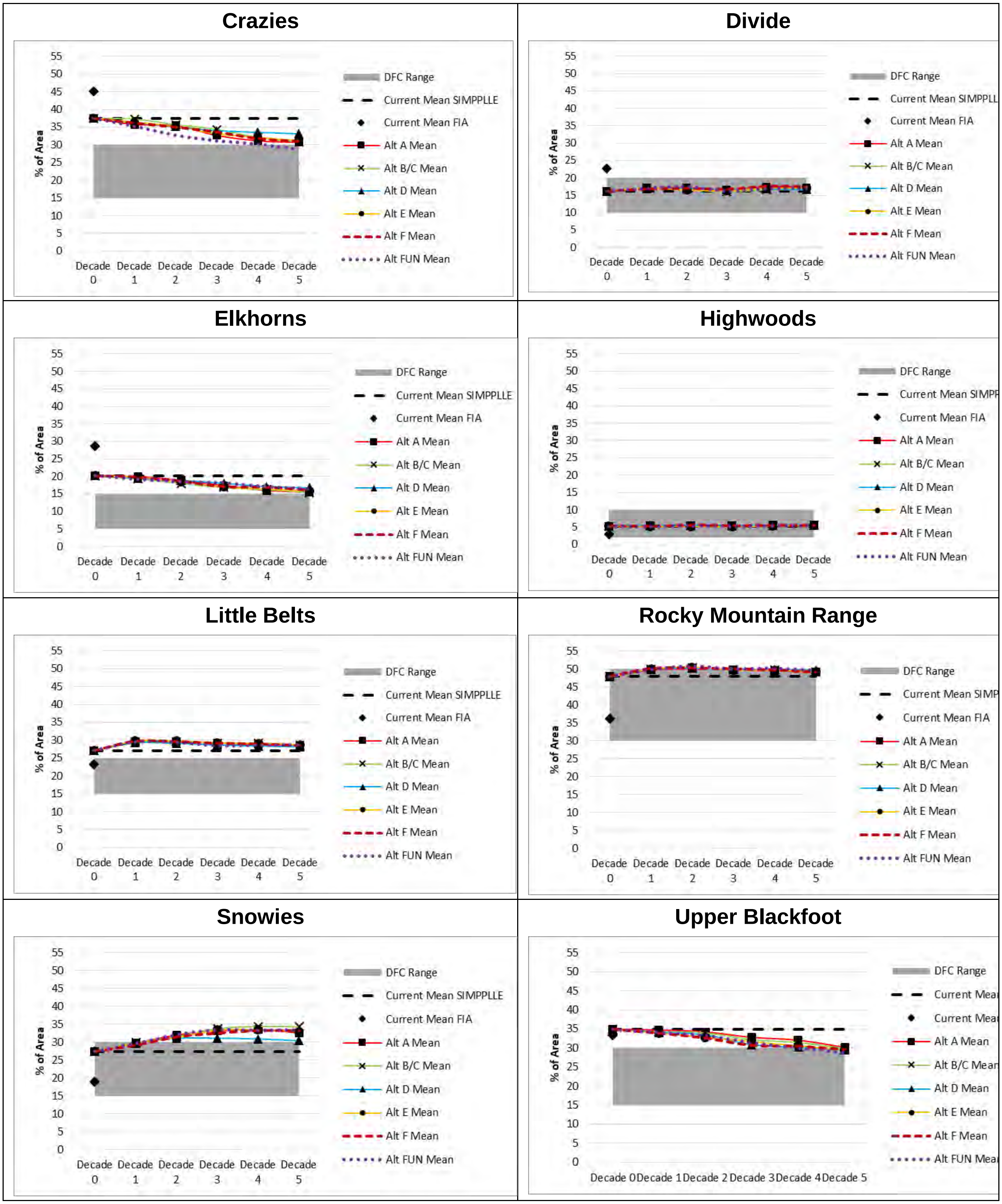


Figure 164. Subalpine fir presence (% of total area) over 5 decades by alternative, by GA

Whitebark pine cover type and presence of whitebark pine

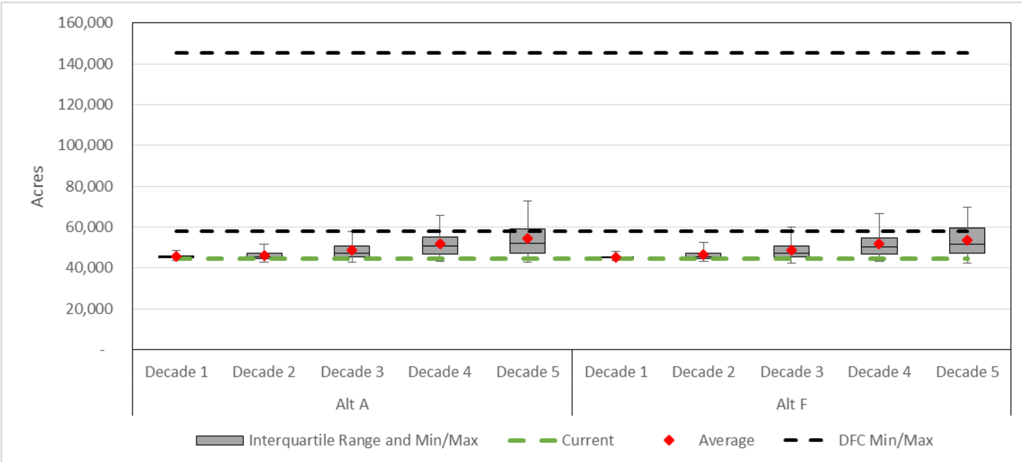


Figure 165. Whitebark pine cover type (total acres) over 5 decades, alternatives A and F

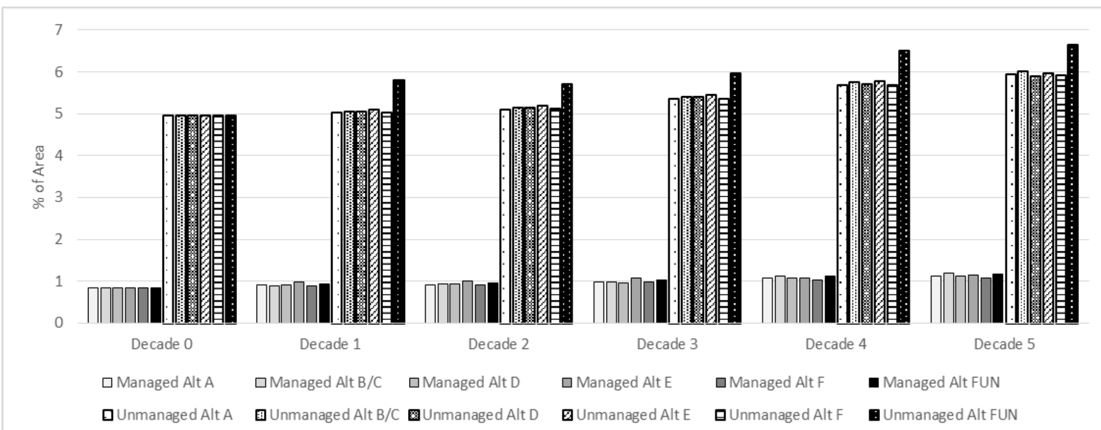


Figure 166. Whitebark pine cover type in managed versus unmanaged landscapes, forestwide

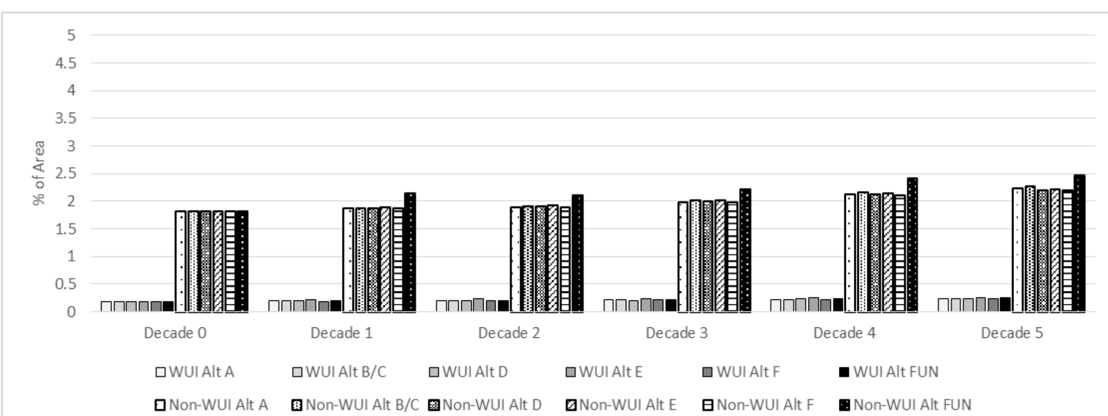


Figure 167. Whitebark pine cover type in WUI versus non-WUI areas, forestwide

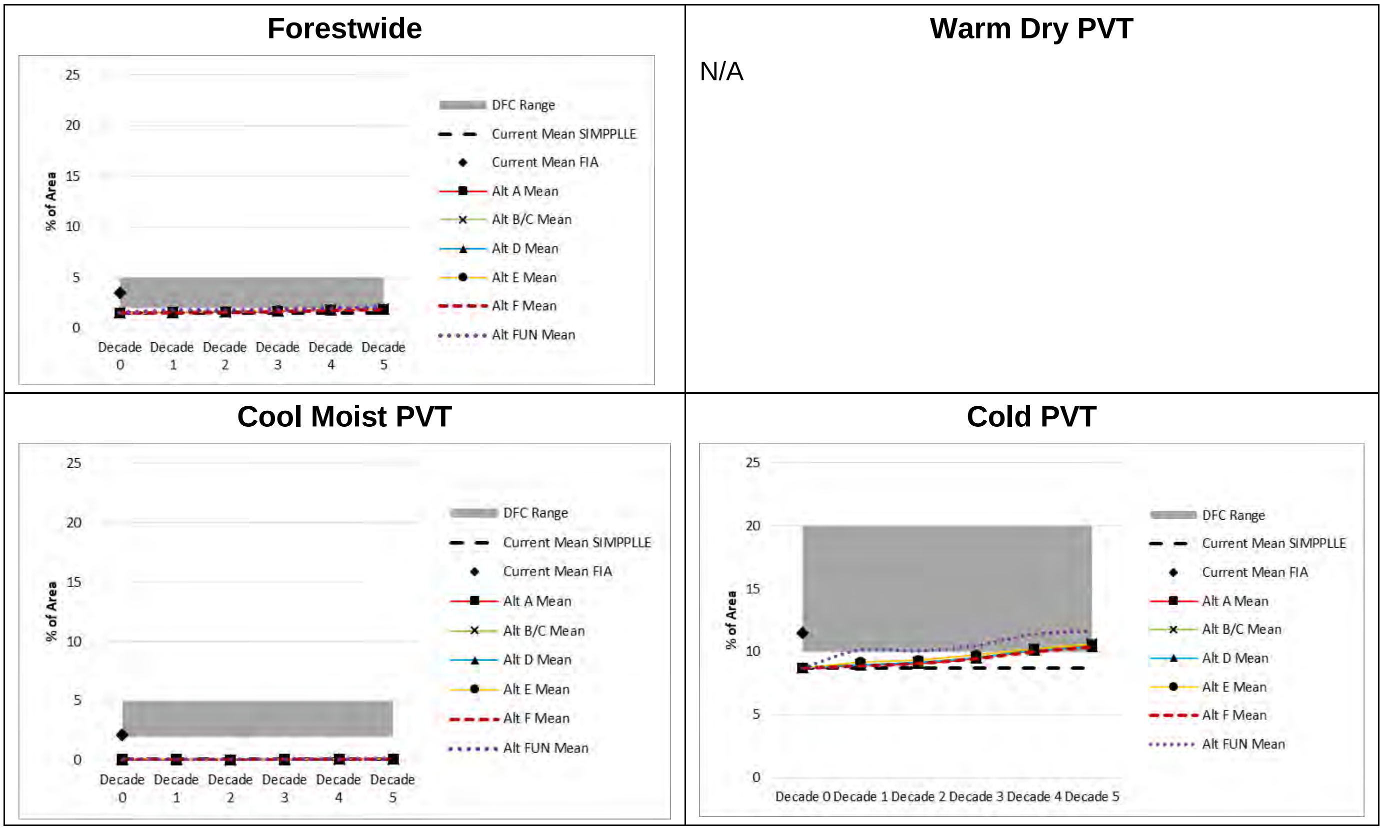
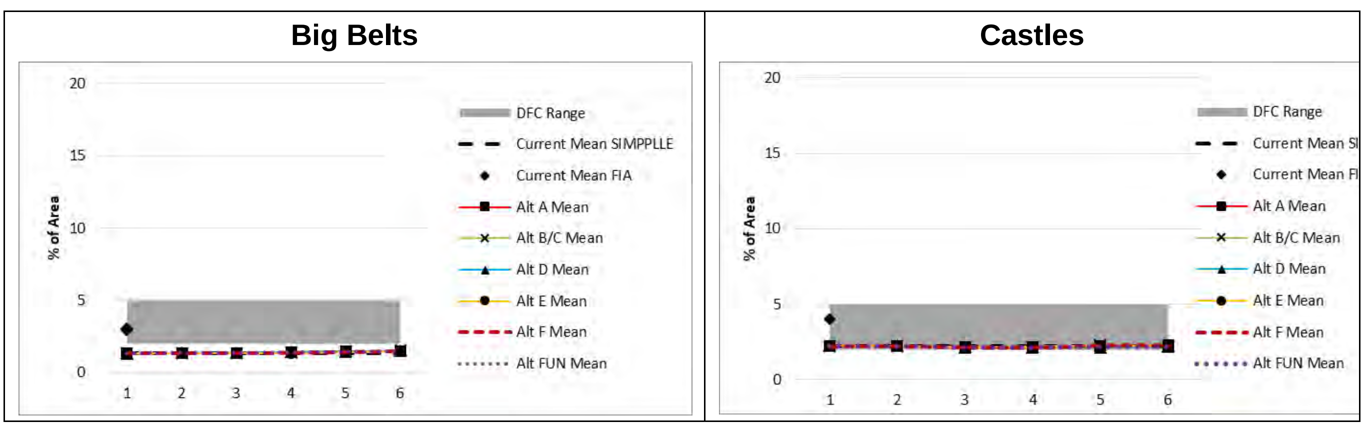
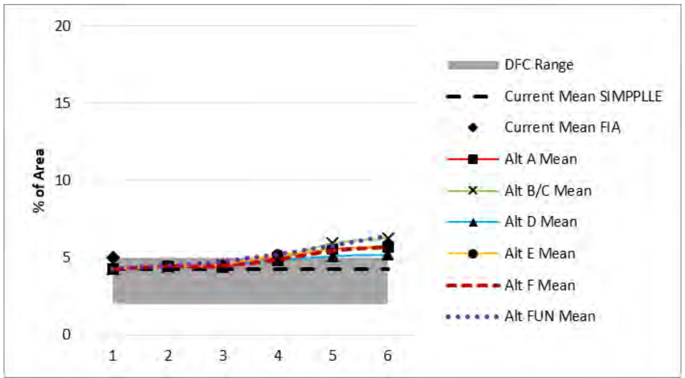


Figure 168. Whitebark pine cover type (% of total area) over 5 decades by alternative, forestwide and by PVT

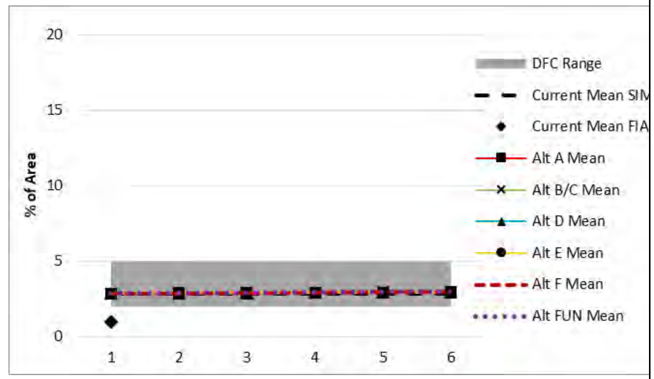
The following figure, Figure 169, displays whitebark pine cover type (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



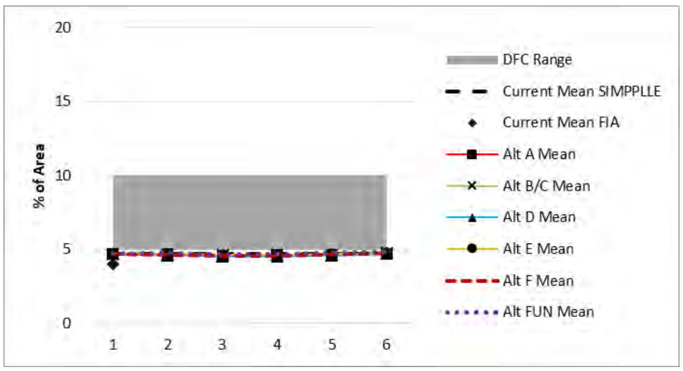
Crazies



Divide



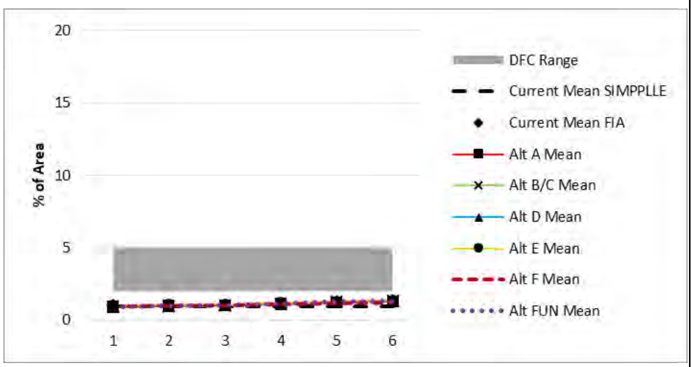
Elkhorns



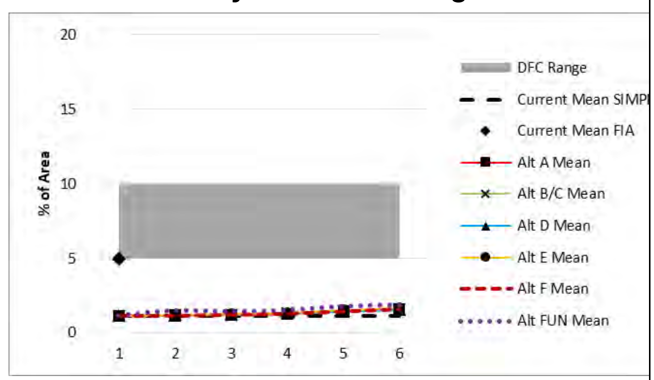
Highwoods

N/A

Little Belts



Rocky Mountain Range



Snowies

N/A

Upper Blackfoot

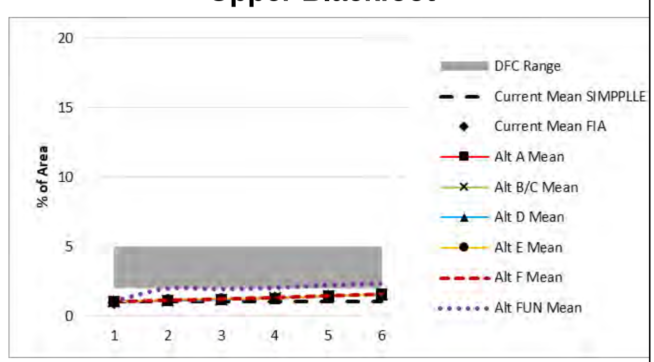


Figure 169. Whitebark pine cover type (% of total area) over 5 decades by alternative, by GA

Whitebark pine presence

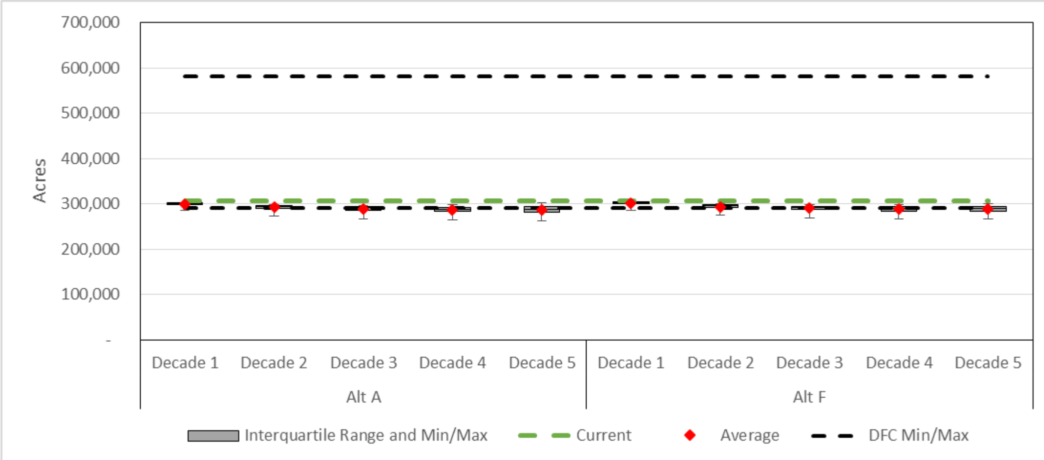


Figure 170. Whitebark pine presence (total acres) over 5 decades, alternatives A and F

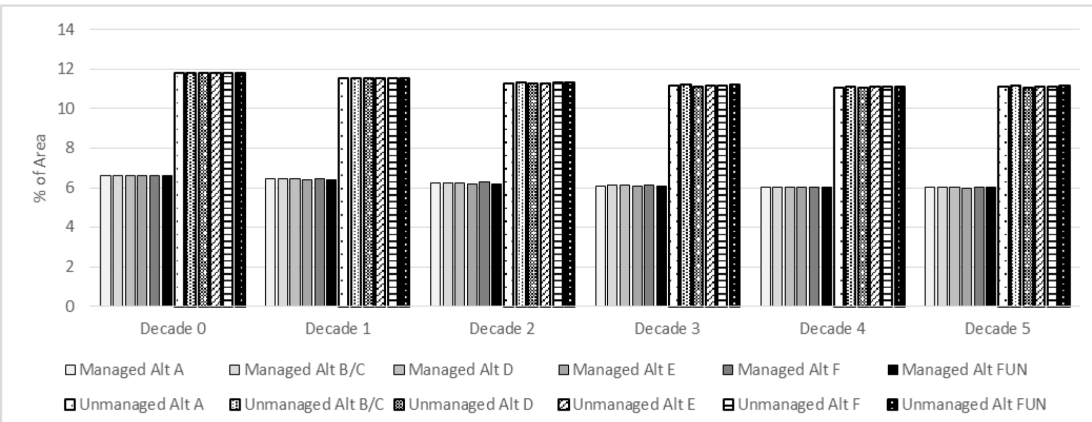


Figure 171. Whitebark pine presence in managed versus unmanaged landscapes, forestwide

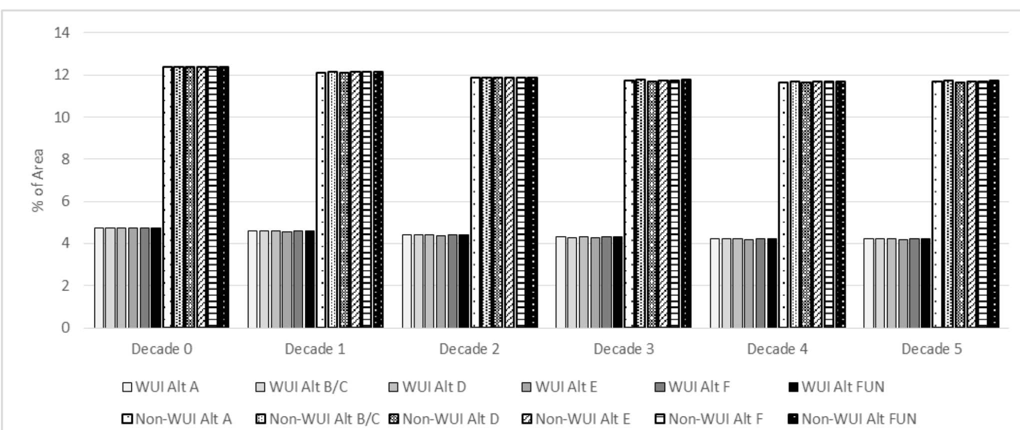
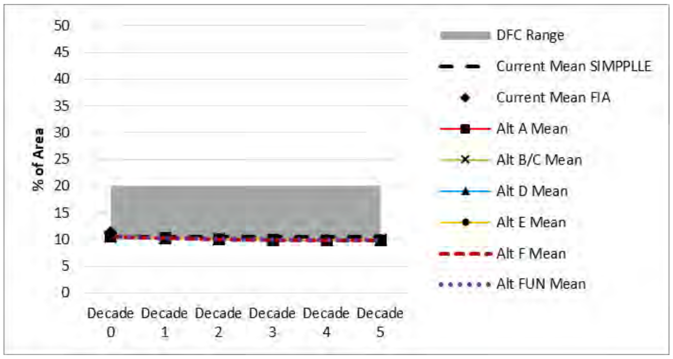


Figure 172. Whitebark pine presence in WUI versus non-WUI areas, forestwide

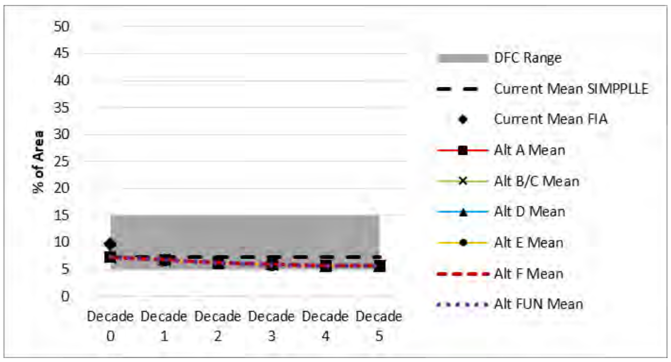
Forestwide



Warm Dry PVT

N/A

Cool Moist PVT



Cold PVT

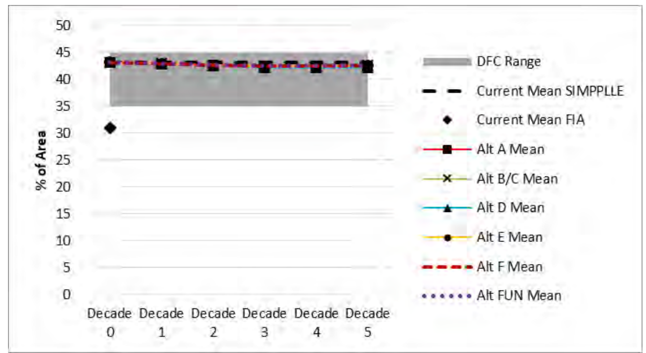
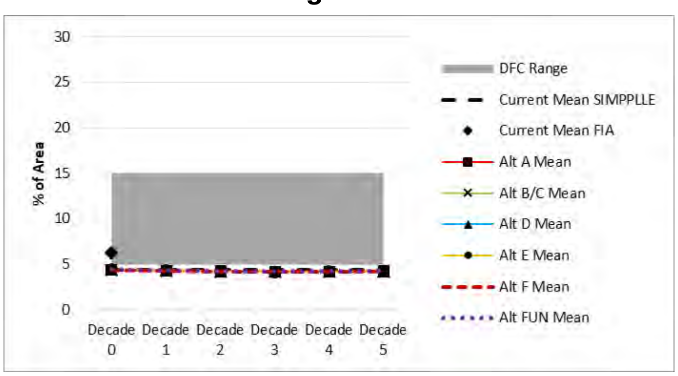


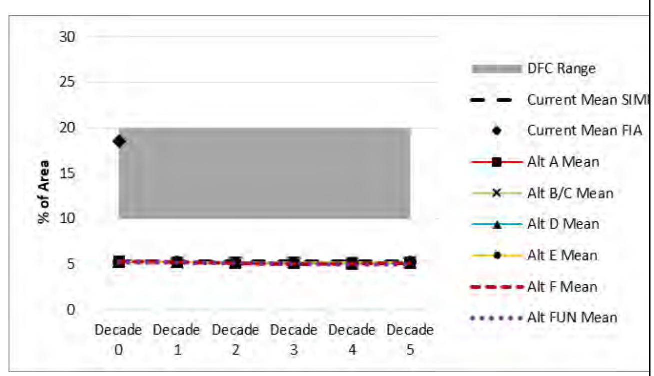
Figure 173. Whitebark pine presence (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 174, displays whitebark pine presence (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.

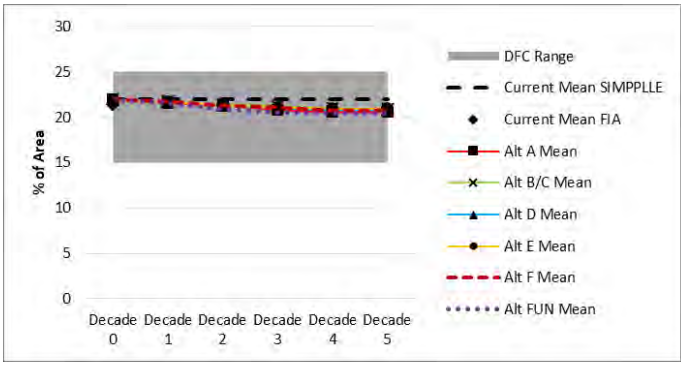
Big Belts



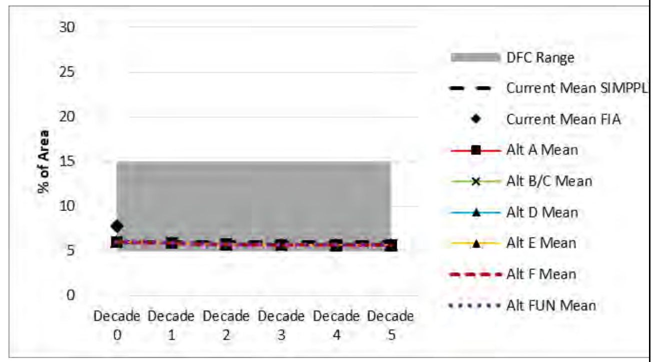
Castles



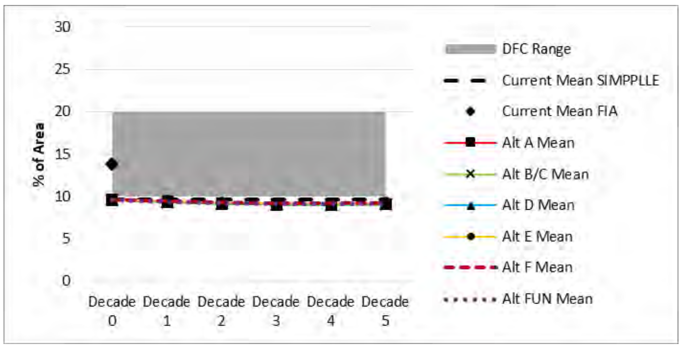
Crazies



Divide



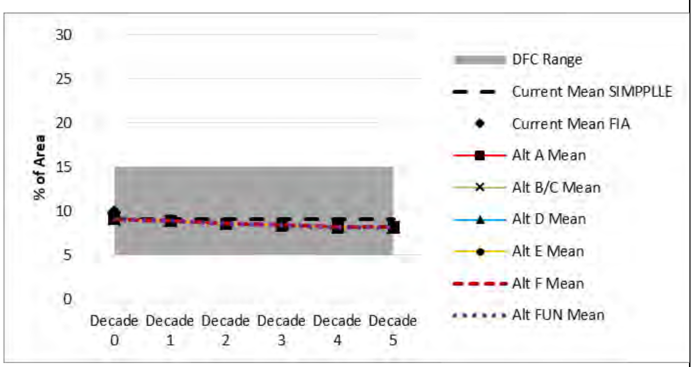
Elkhorns



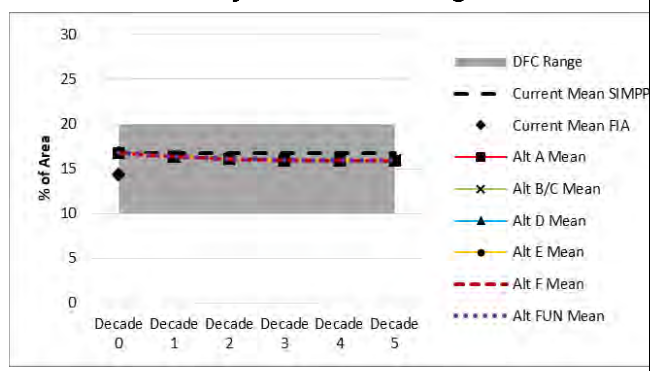
Highwoods

N/A

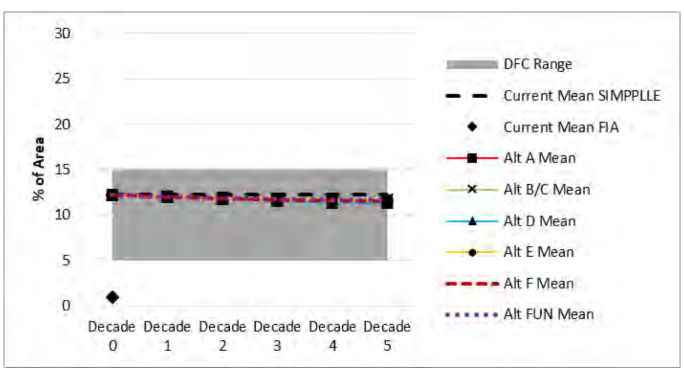
Little Belts



Rocky Mountain Range



Snowies



Upper Blackfoot

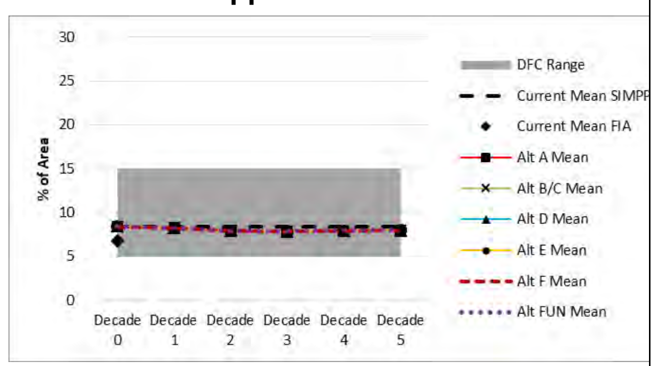


Figure 174. Whitebark pine presence (% of total area) over 5 decades by alternative, by GA

Forest structure

Forest size class

Seedling/sapling

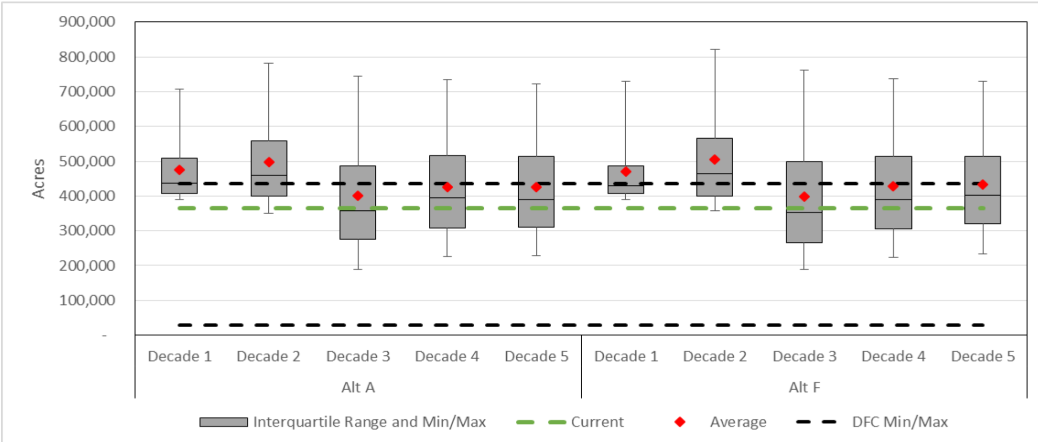


Figure 175. Seedling/sapling size class (total acres) over 5 decades, alternatives A and F

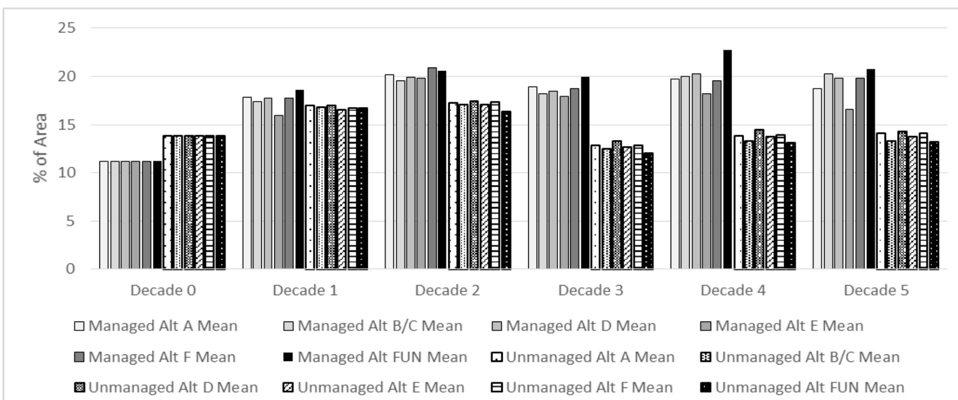


Figure 176. Seedling/sapling size class in managed versus unmanaged landscapes, forestwide

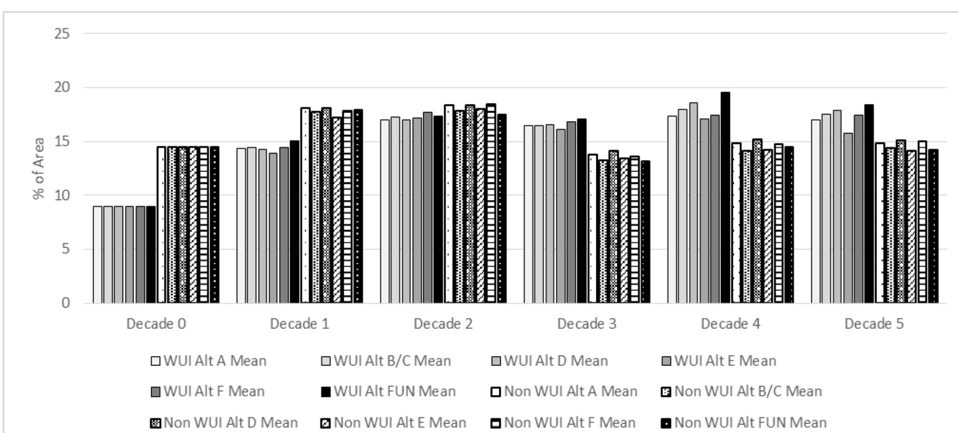


Figure 177. Seedling/sapling size class in WUI versus non-WUI areas, forestwide

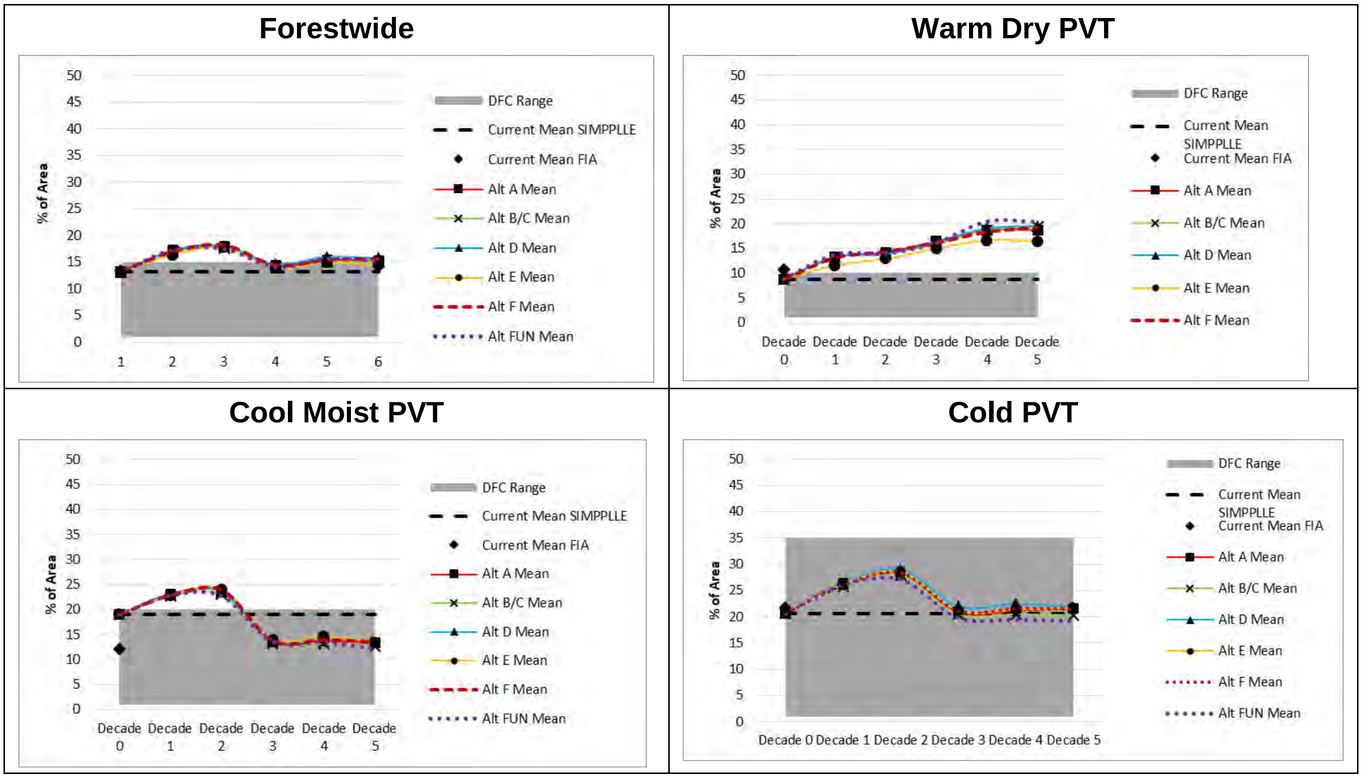
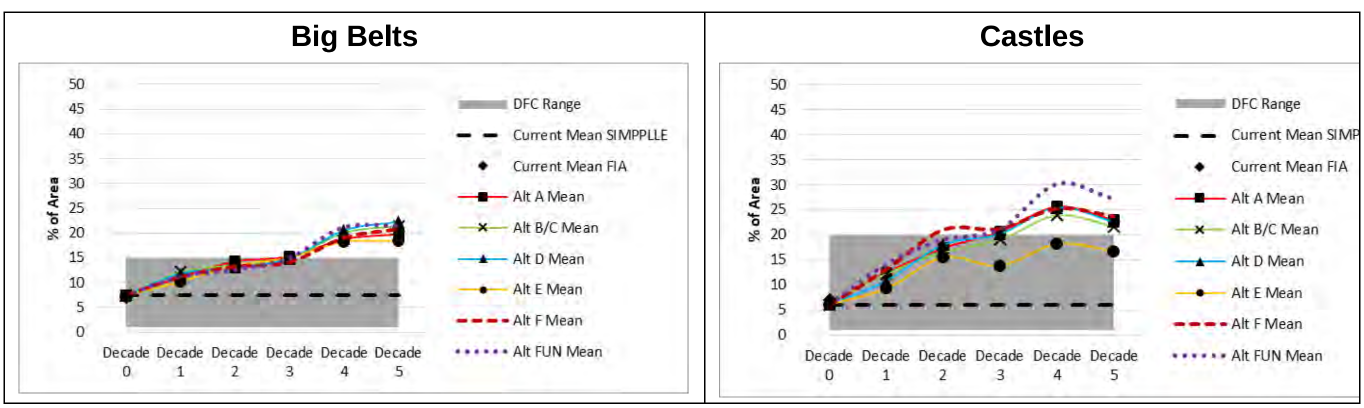


Figure 178. Seedling/sapling size class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 179, displays seedling/sapling size class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



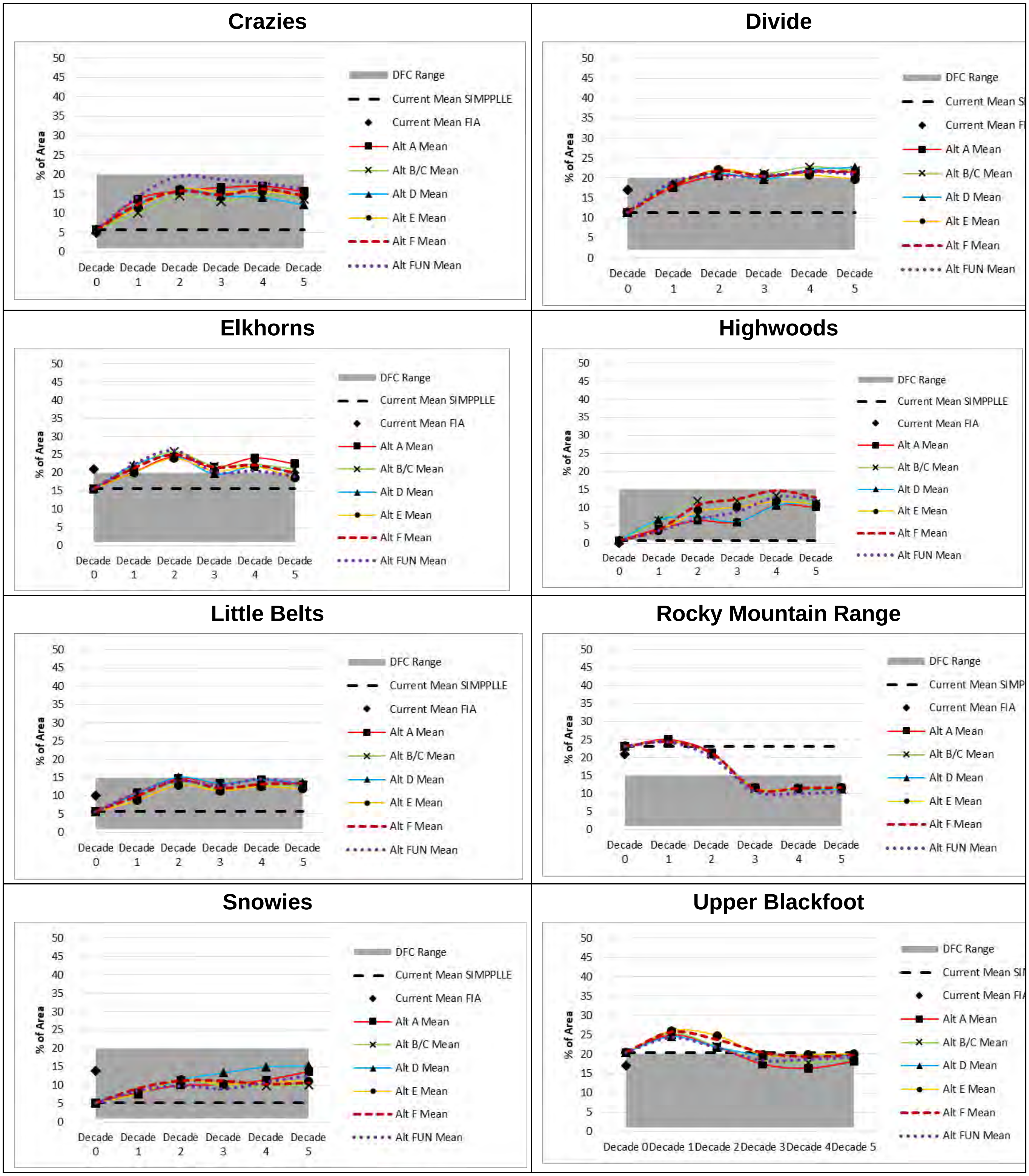


Figure 179. Seedling/sapling size class (% of total area) over 5 decades by alternative, by GA

Small tree

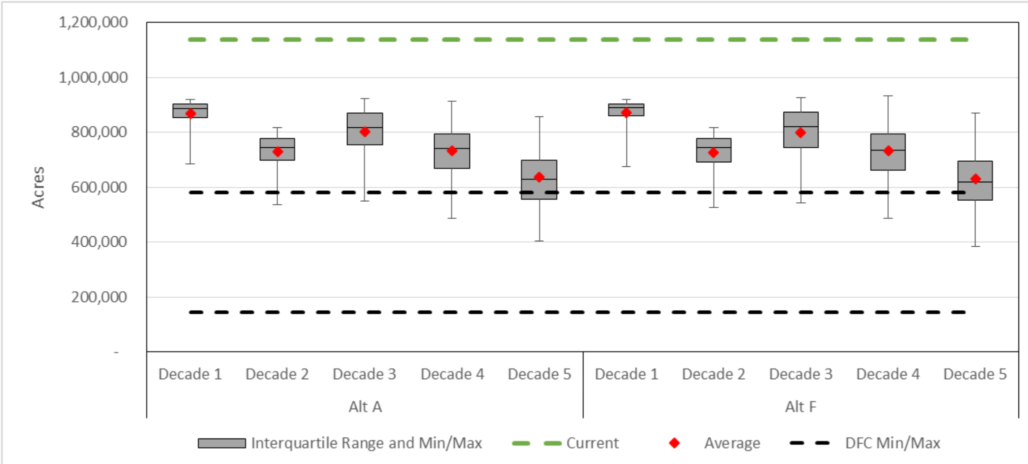


Figure 180. Small size class (total acres) over 5 decades, alternatives A and F

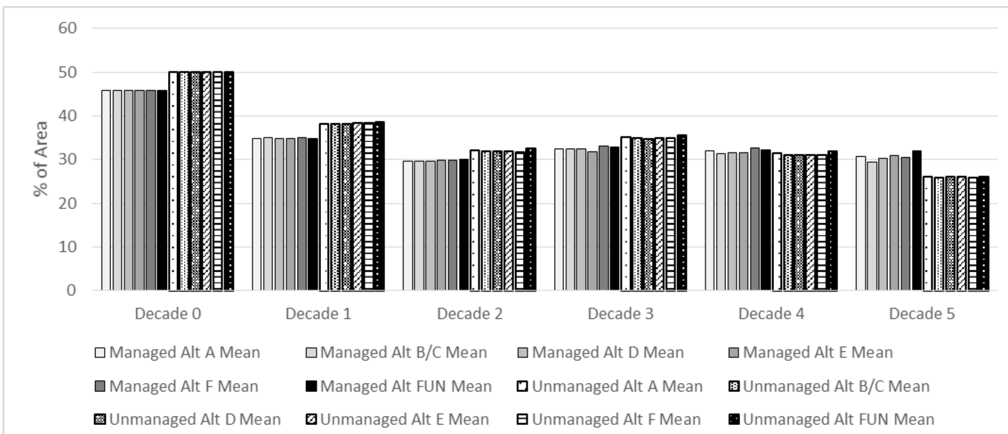


Figure 181. Small size class in managed versus unmanaged landscapes, forestwide

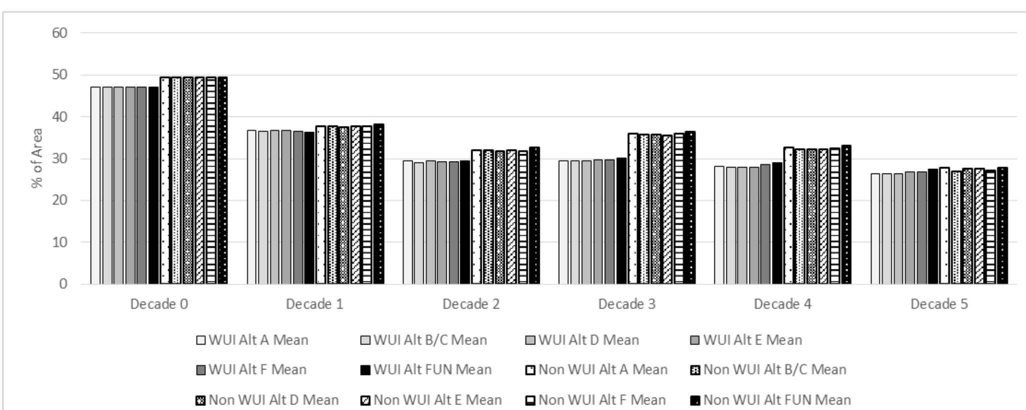


Figure 182. Small size class in WUI versus non-WUI areas, forestwide

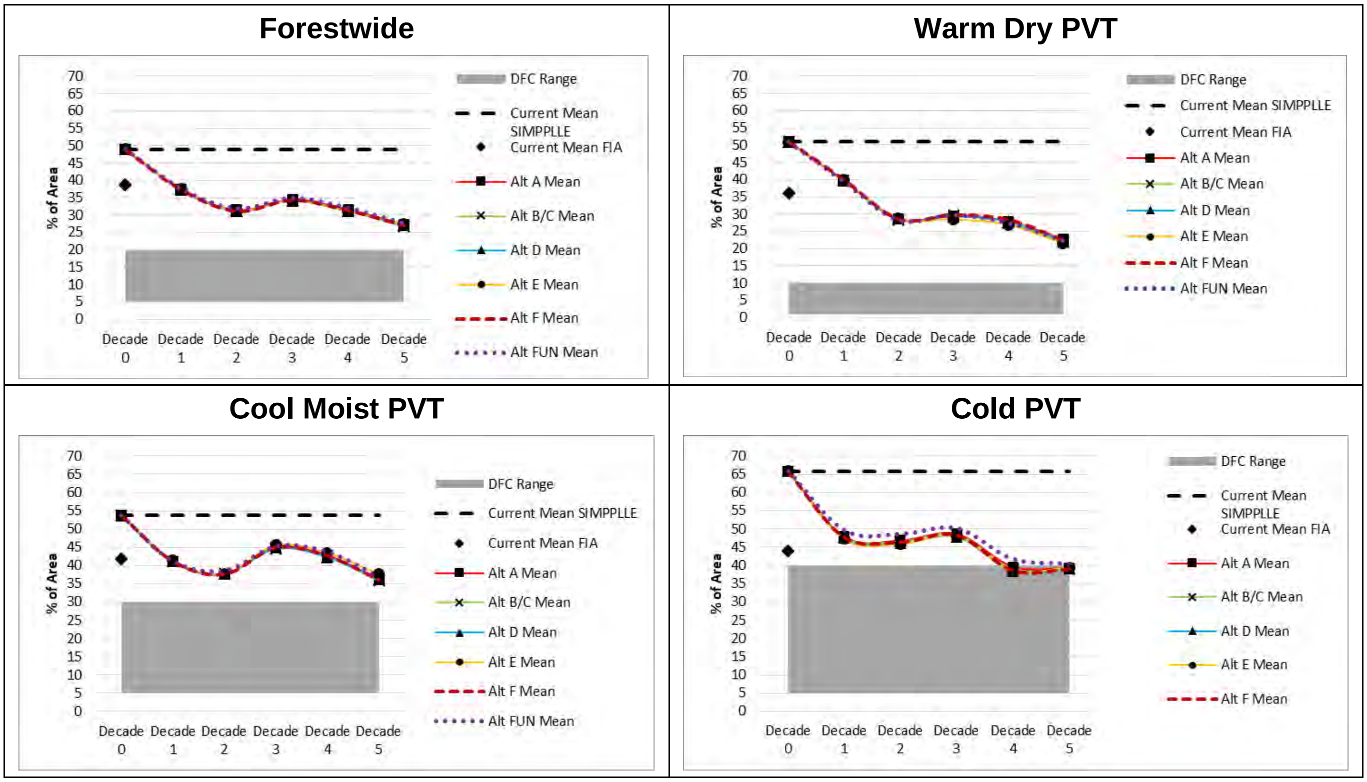
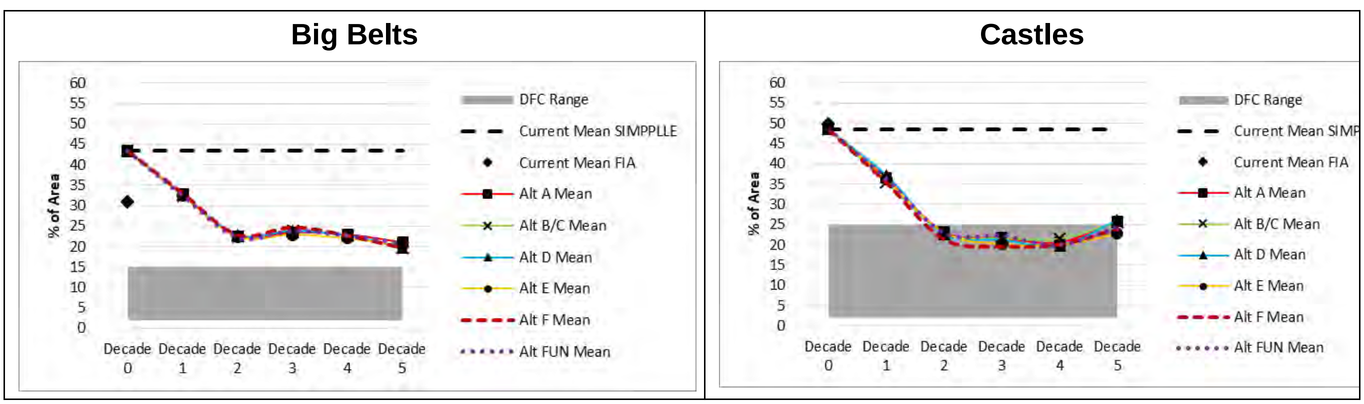


Figure 183. Small size class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 184, displays small size class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



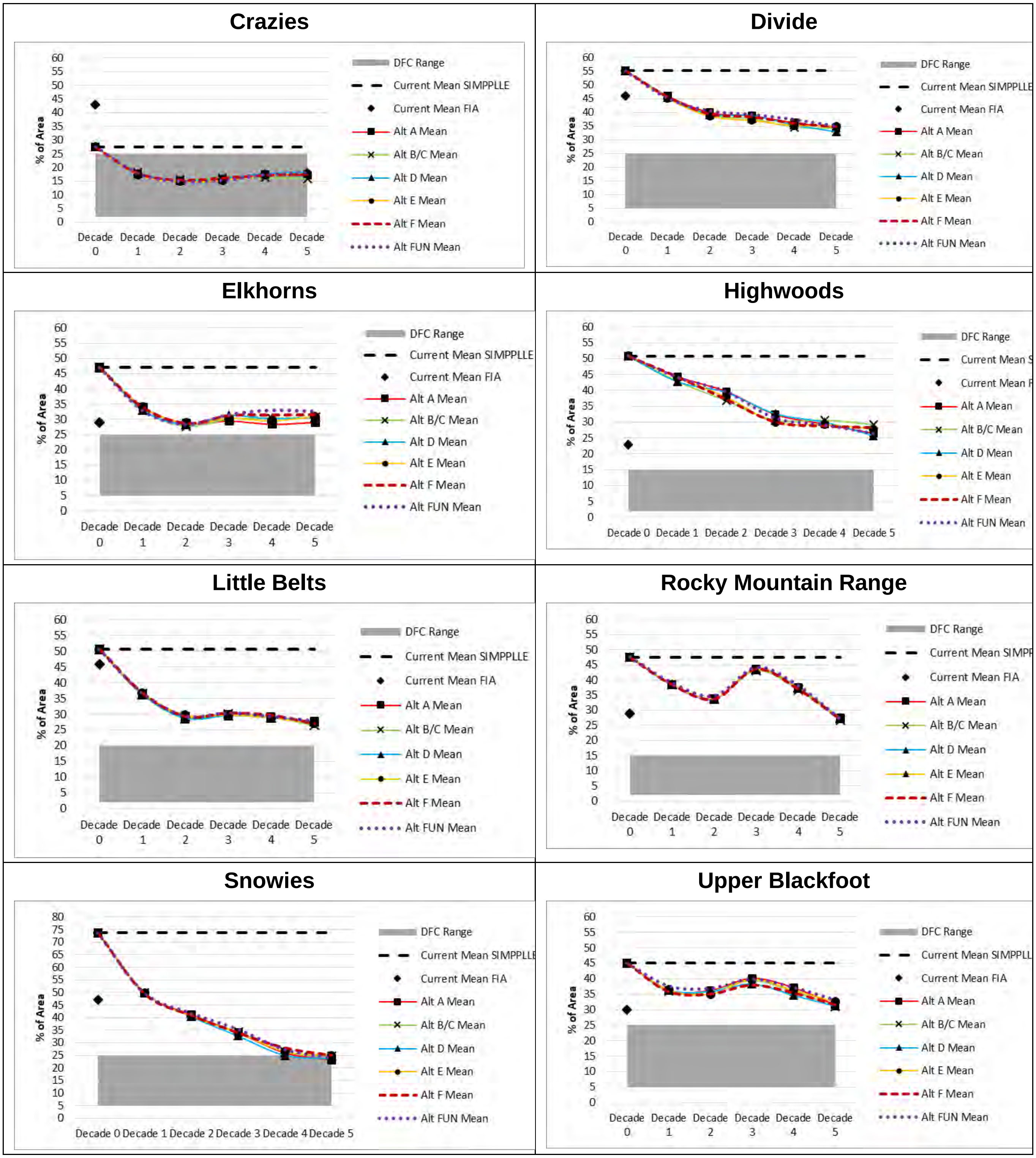


Figure 184. Small size class (% of total area) over 5 decades by alternative, by GA

Medium tree

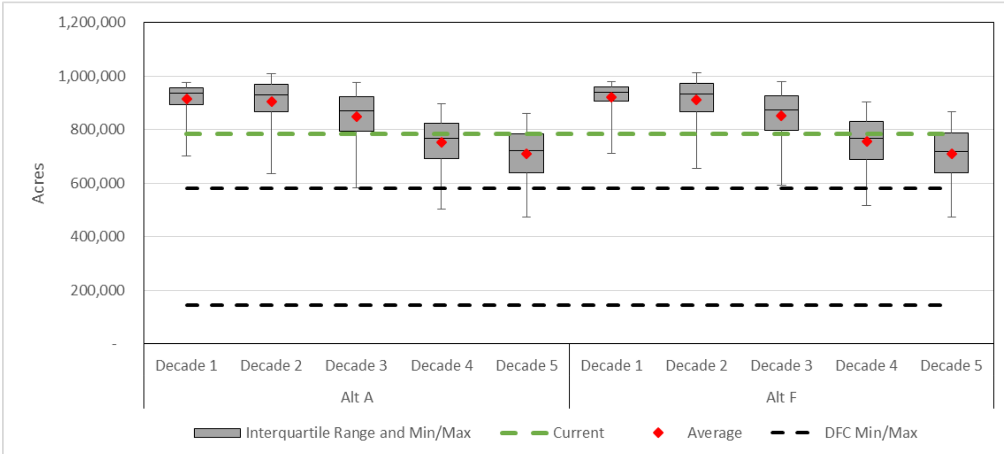


Figure 185. Medium size class (total acres) over 5 decades, alternatives A and F

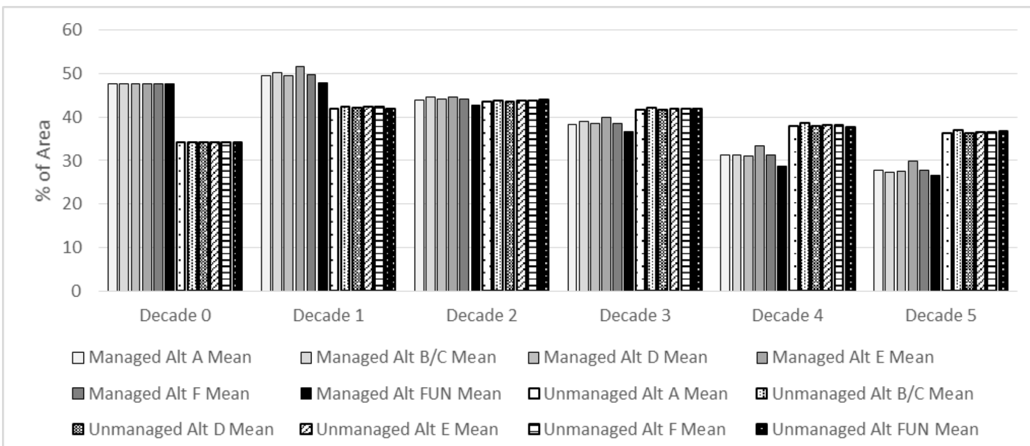


Figure 186. Medium size class in managed versus unmanaged landscapes, forestwide

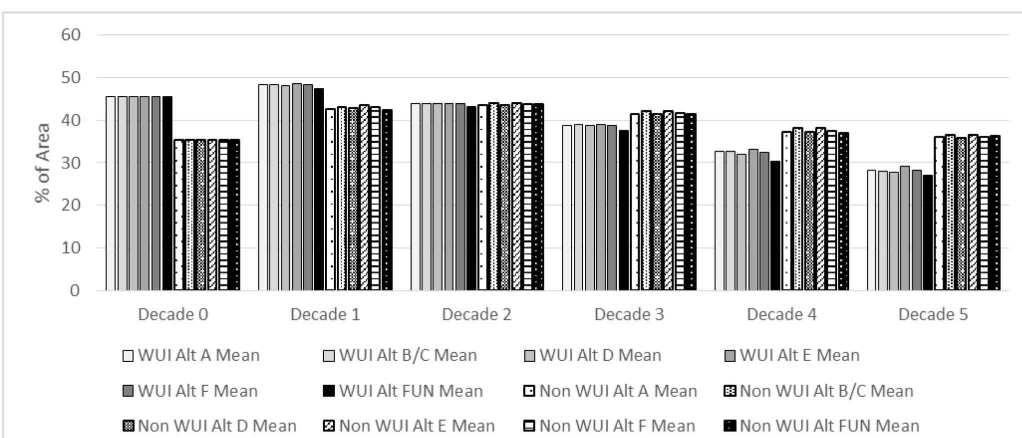


Figure 187. Medium size class in WUI versus non-WUI areas, forestwide

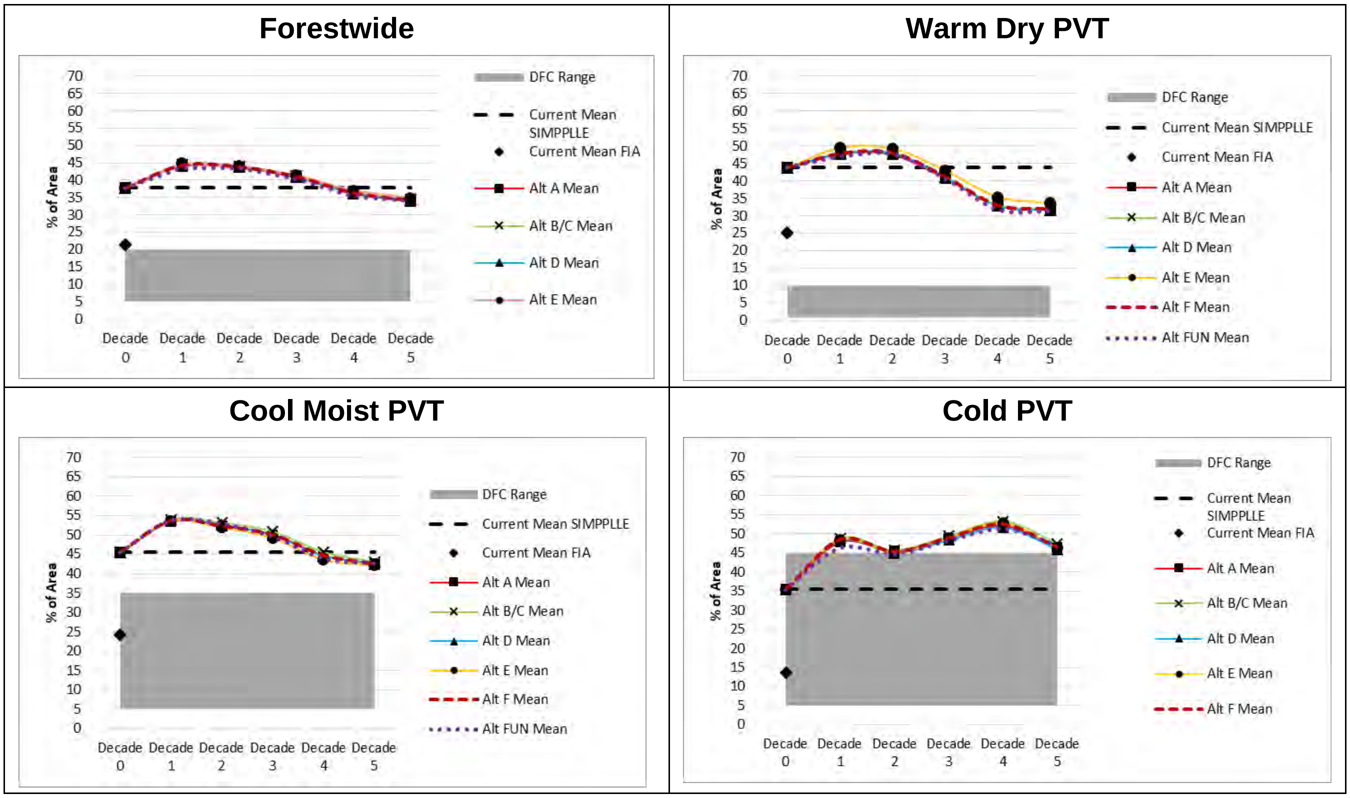
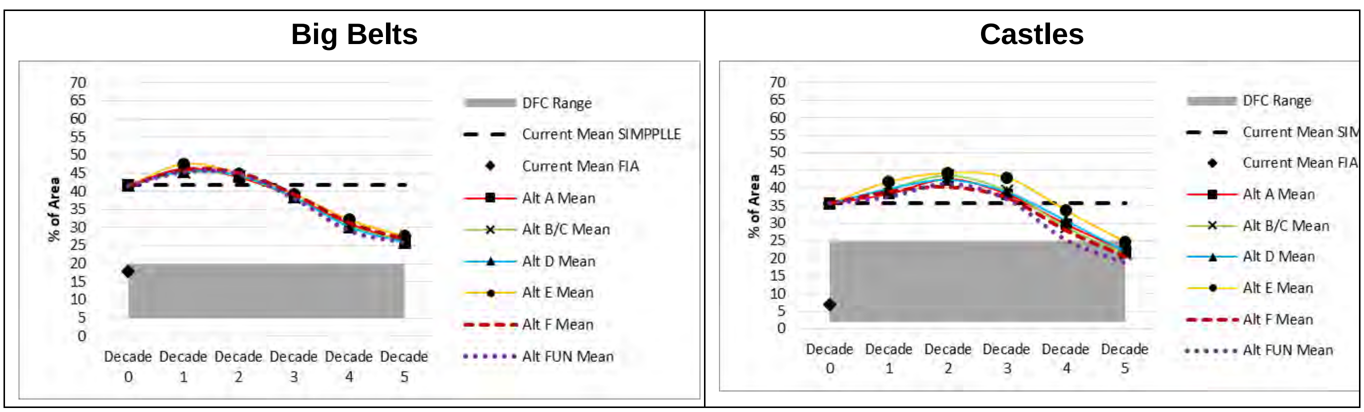


Figure 188. Medium size class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 189, displays medium size class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



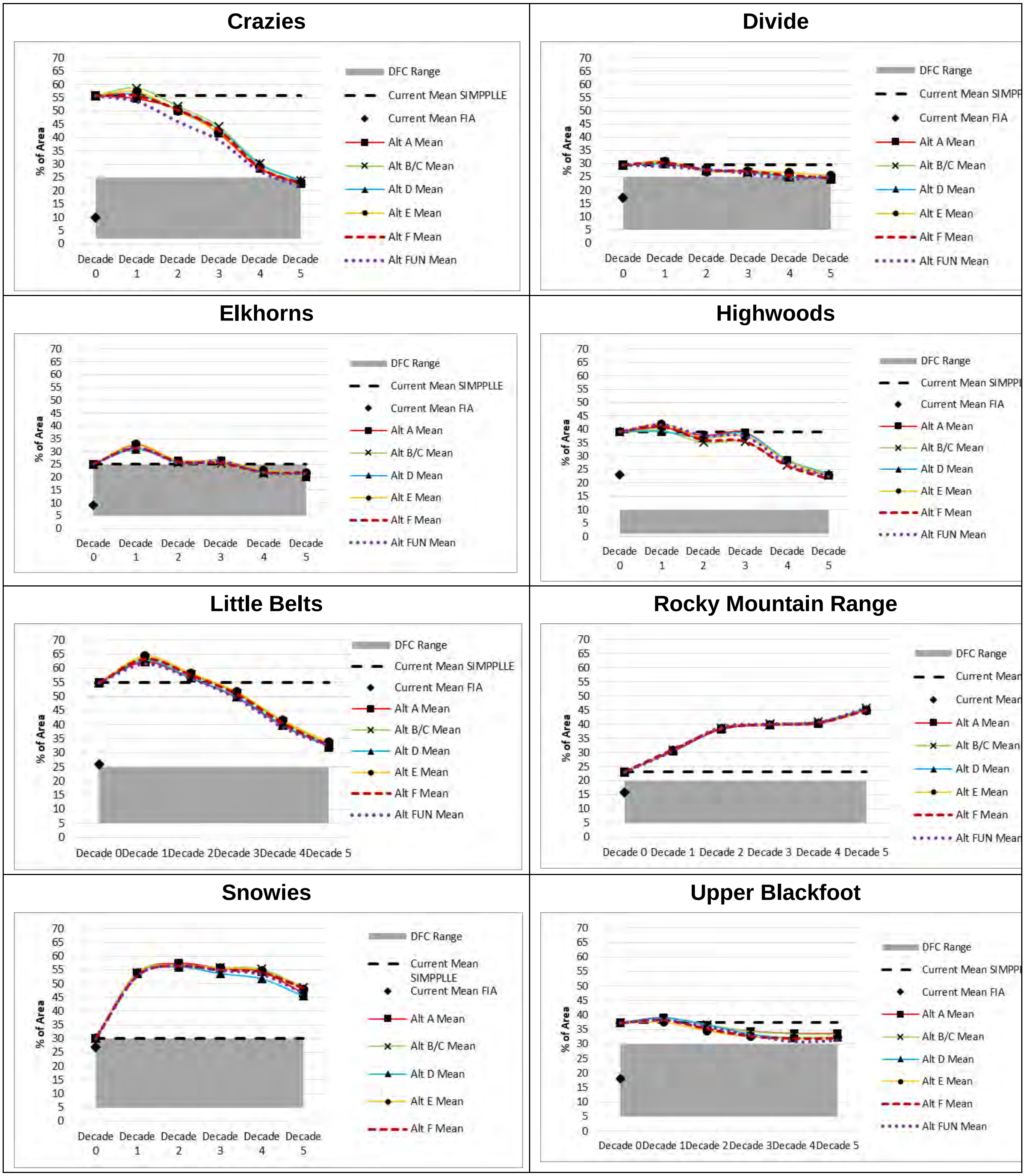


Figure 189. Medium size class (% of total area) over 5 decades by alternative, by GA

Large tree

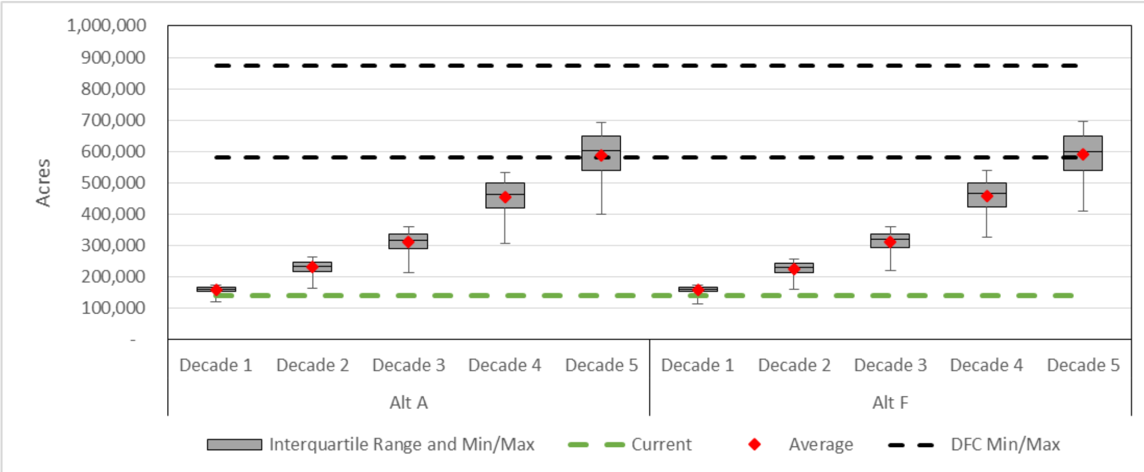


Figure 190. Large size class (total acres) over 5 decades, alternatives A and F

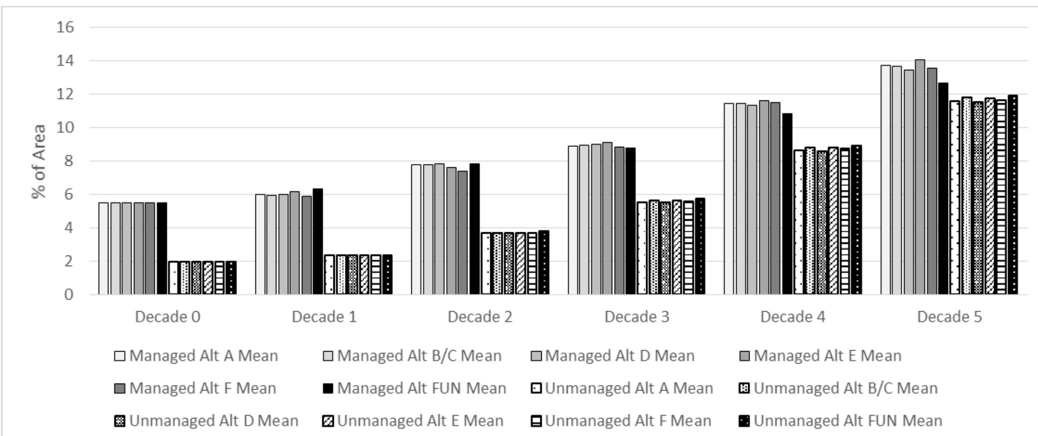


Figure 191. Large size class in managed versus unmanaged landscapes, forestwide

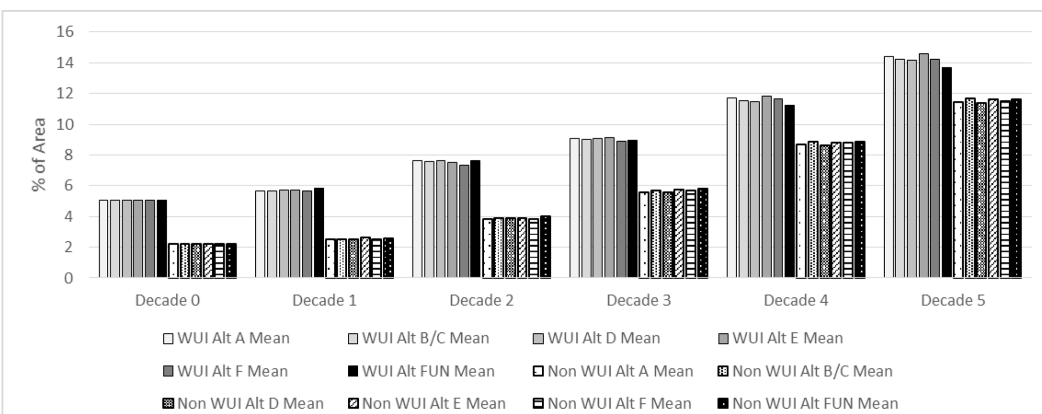


Figure 192. Large size class in WUI versus non-WUI areas, forestwide

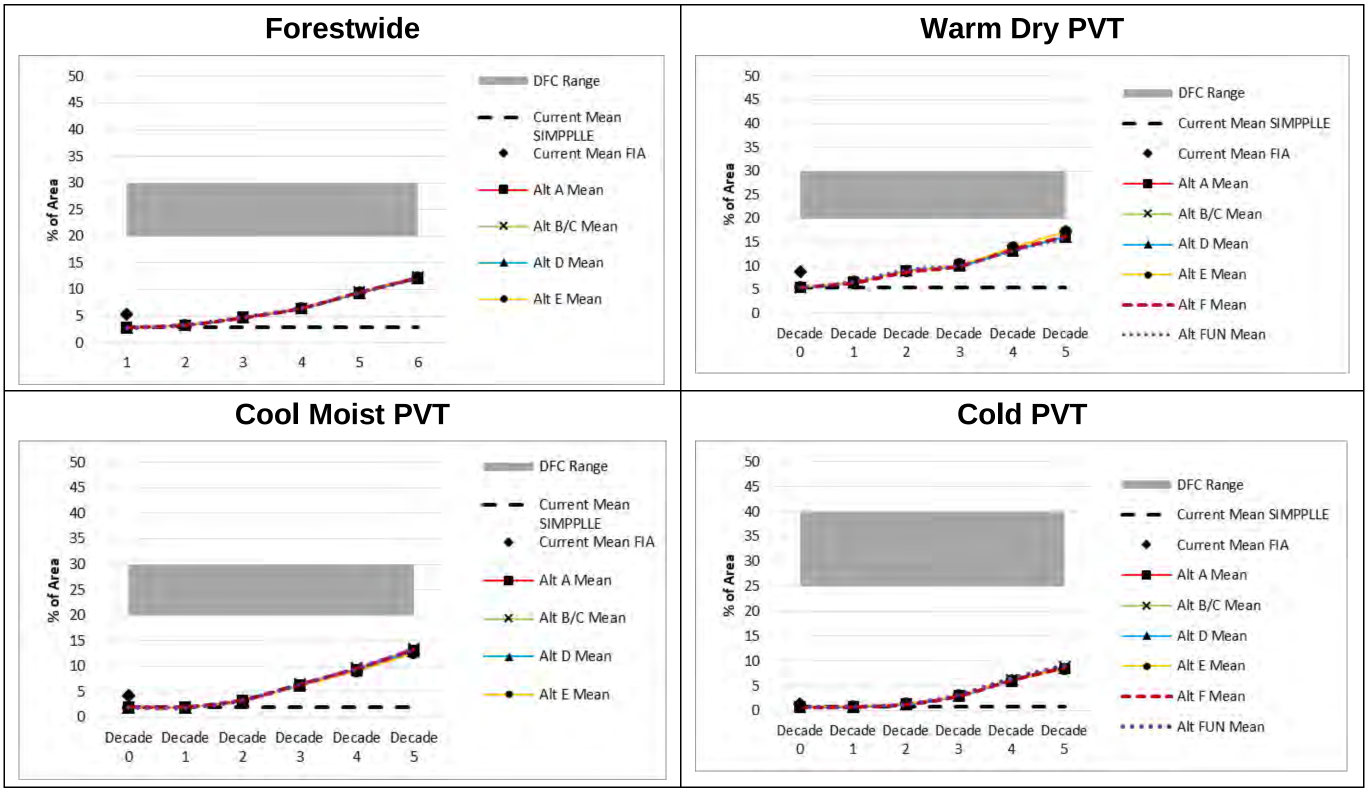
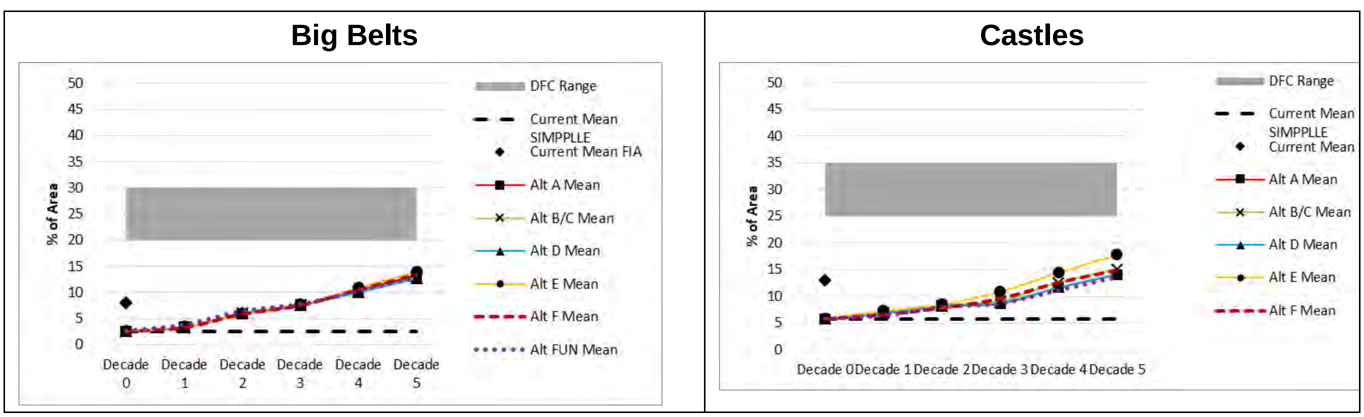


Figure 193. Large size class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 194, displays large size class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



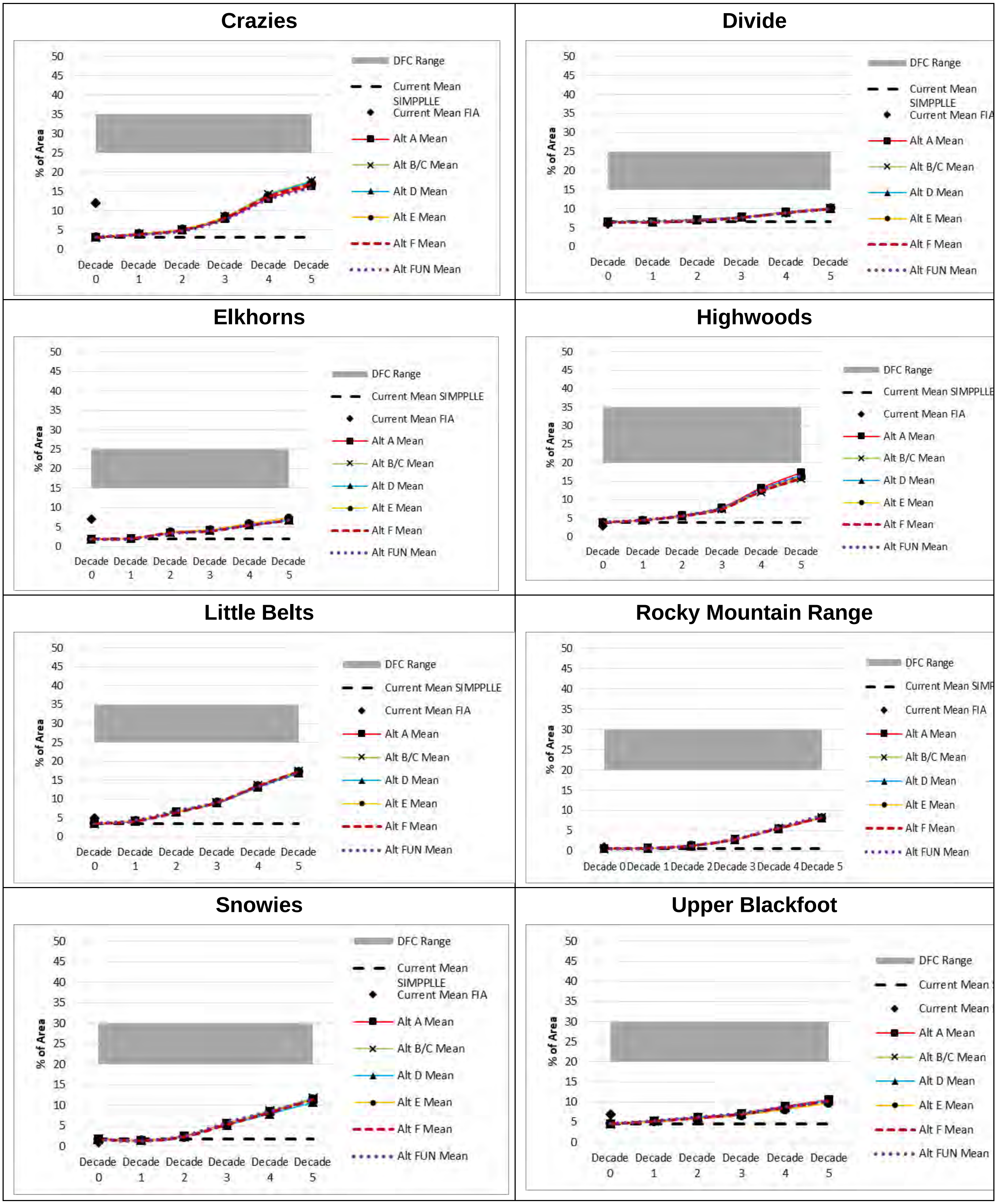


Figure 194. Large size class (% of total area) over 5 decades by alternative, by GA

Very large tree

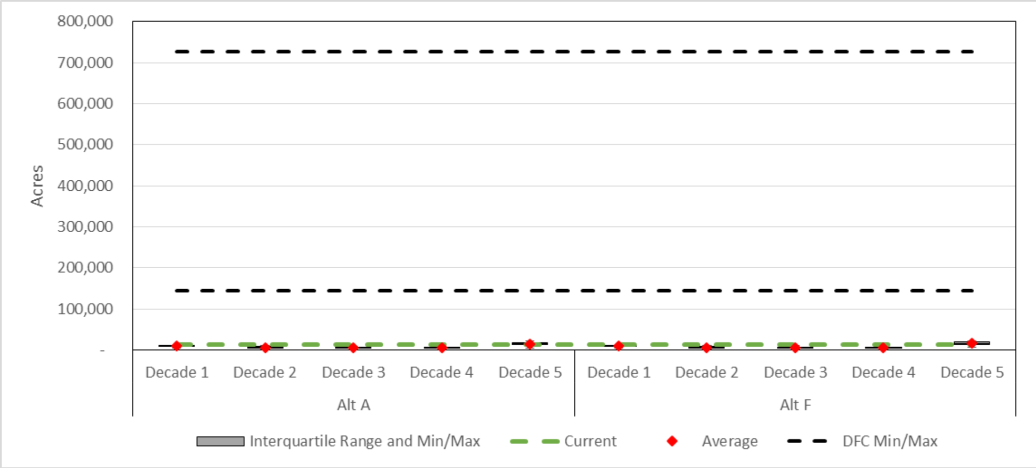


Figure 195. Very large size class (total acres) over 5 decades, alternatives A and F

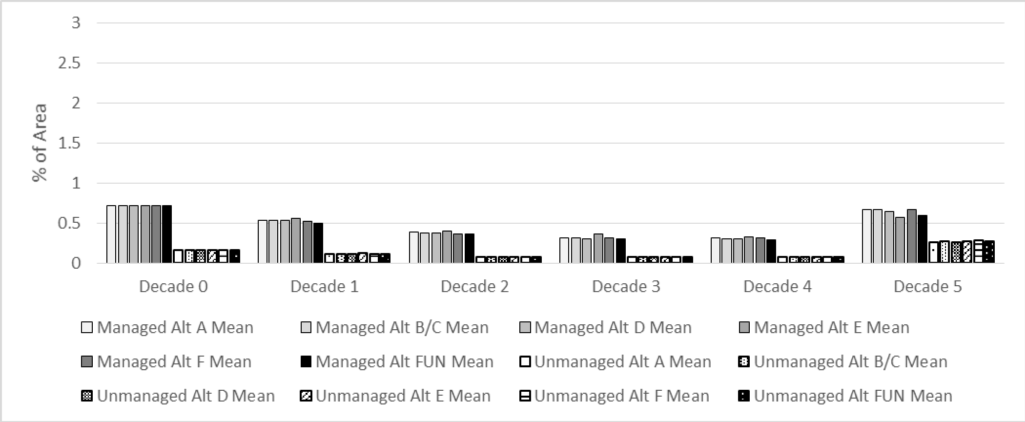


Figure 196. Very large size class in managed versus unmanaged landscapes, forestwide

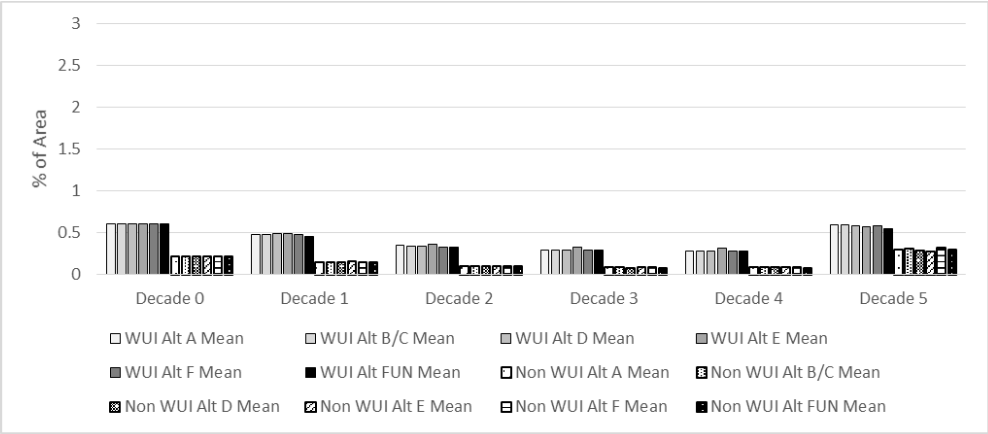


Figure 197. Very large size class in WUI versus non-WUI areas, forestwide

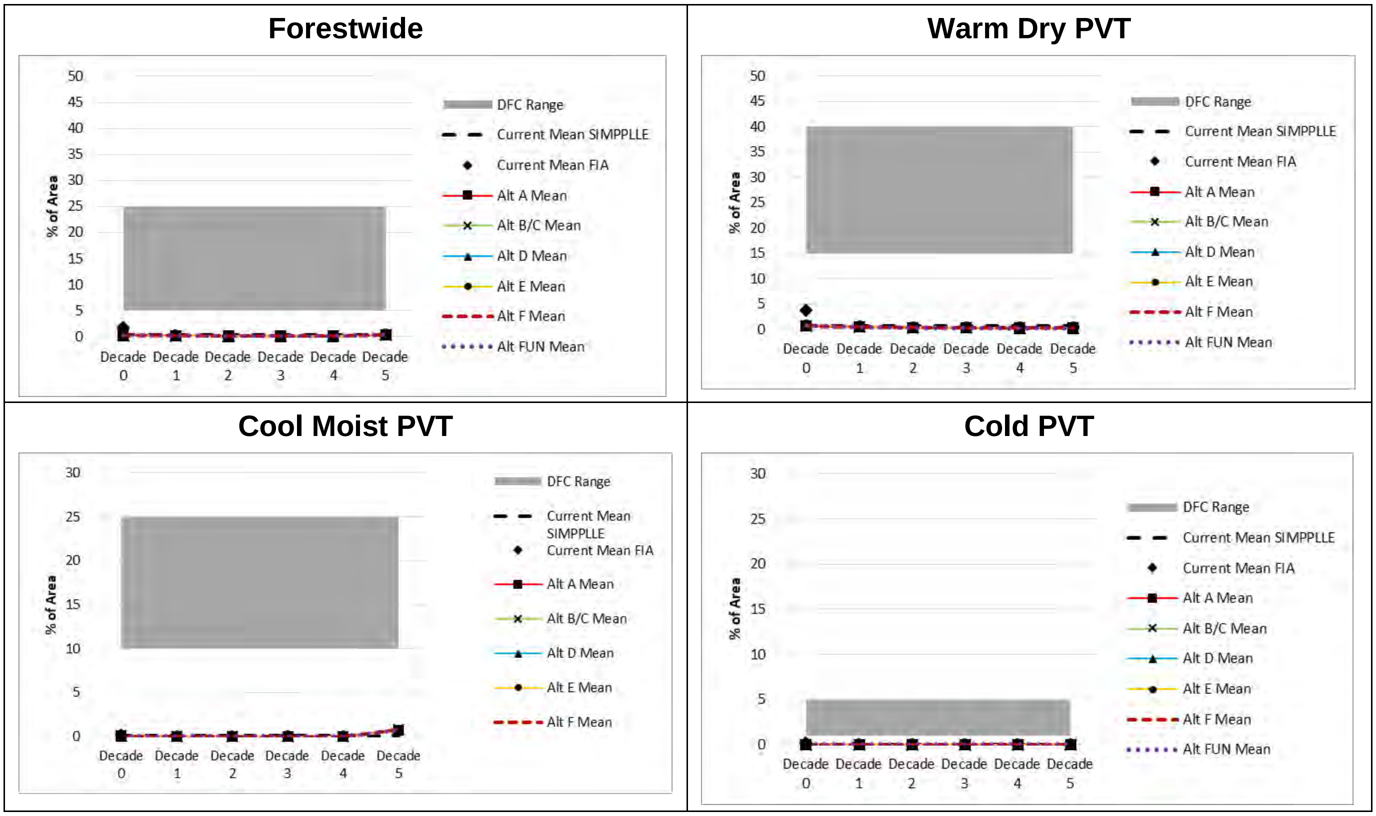
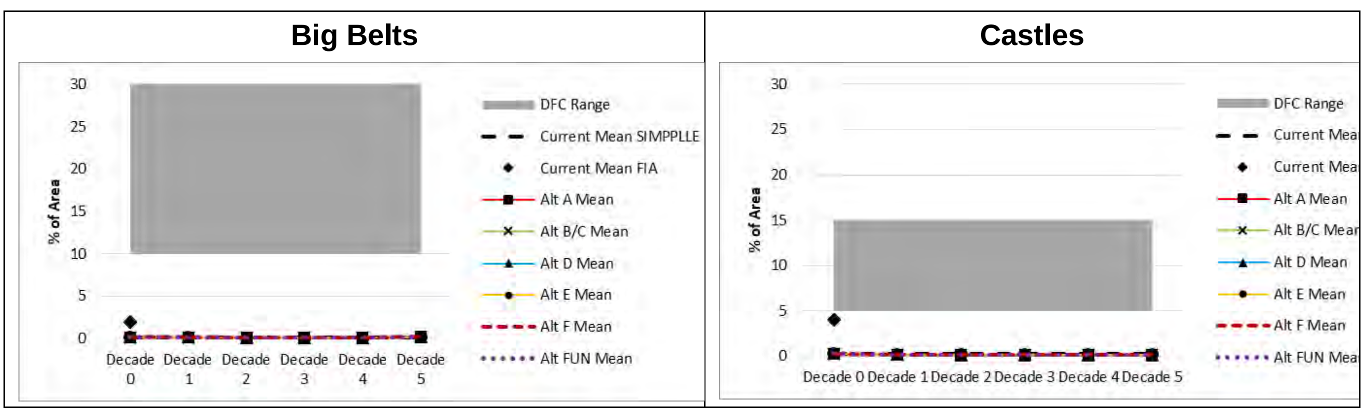


Figure 198. Very large size class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 199, displays very large size class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



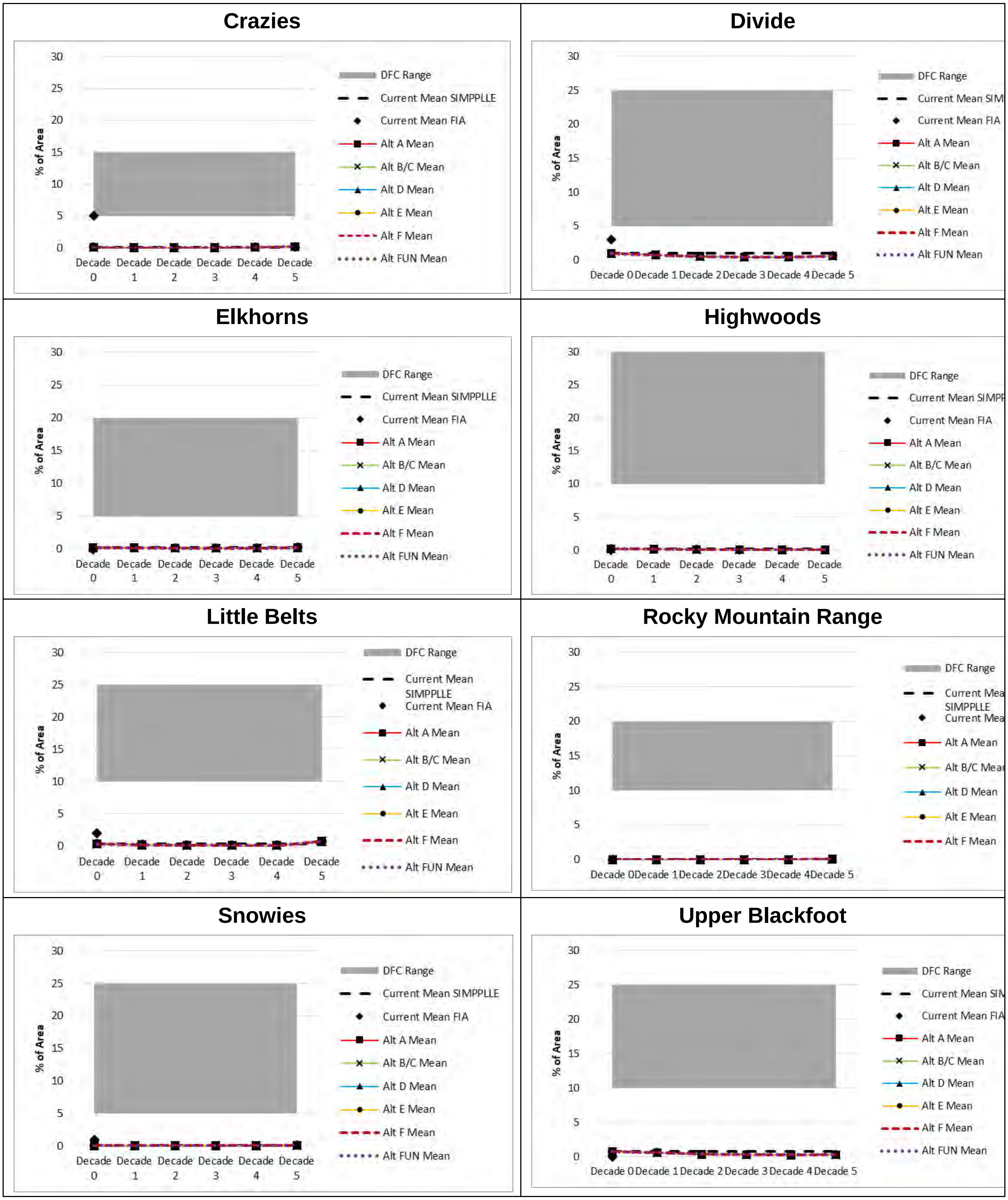


Figure 199. Very large size class (% of total area) over 5 decades by alternative, by GA

Large-tree structure

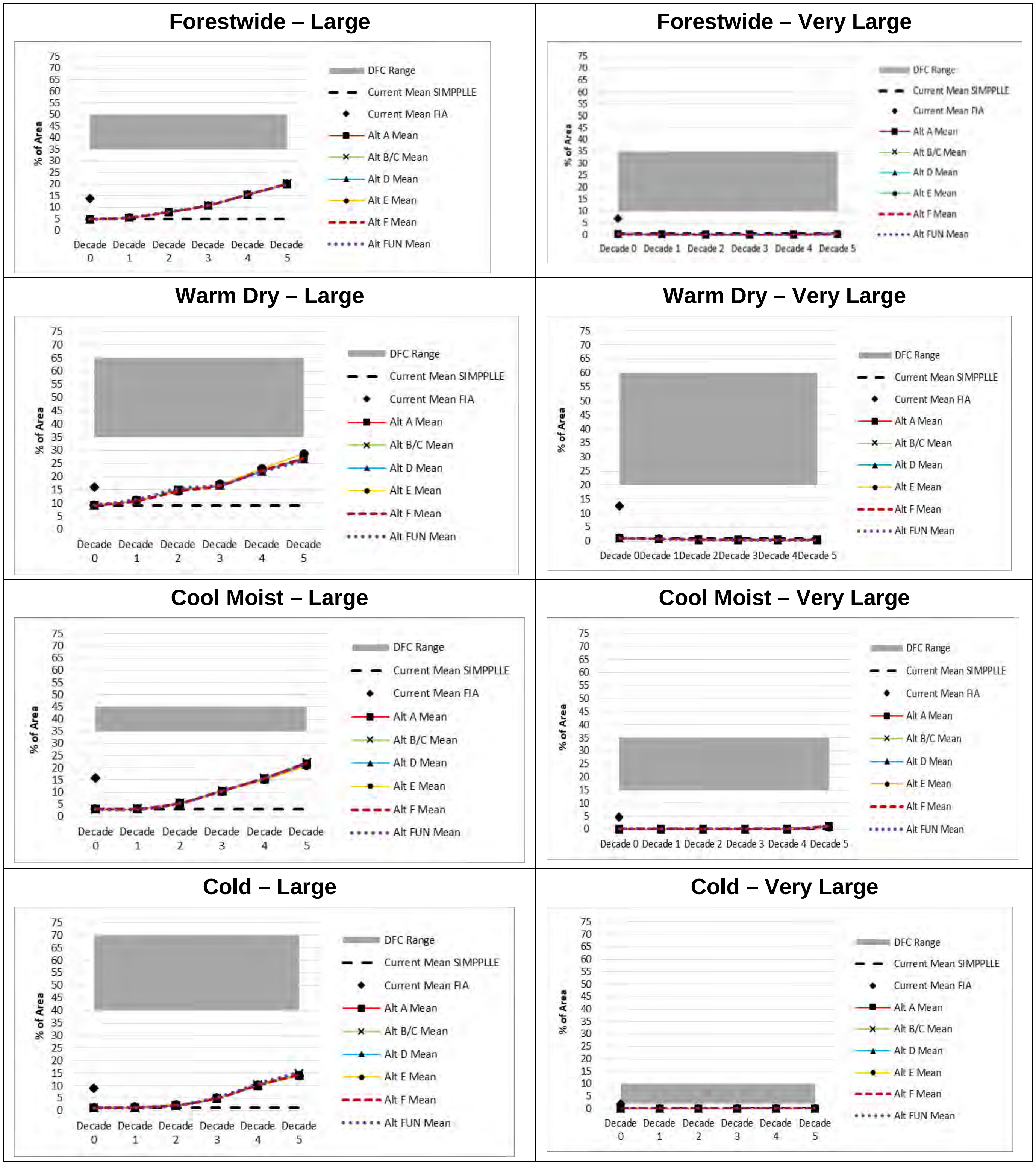


Figure 200. Large-tree structure (% of total area) over 5 decades by alternative, forestwide and by PVT

Forest density and vertical structure

Nonforested/low/medium density

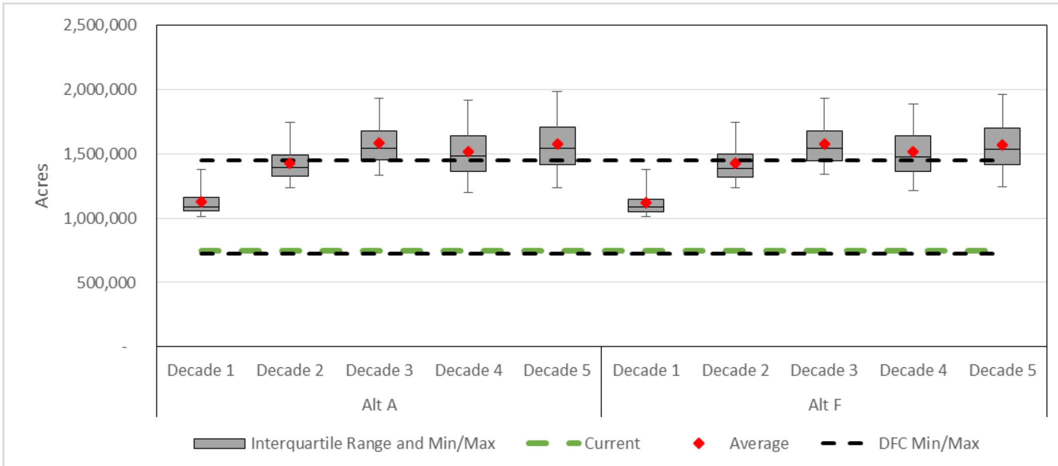


Figure 201. Nonforested/low/medium density class (total acres) over 5 decades, alternatives A and F

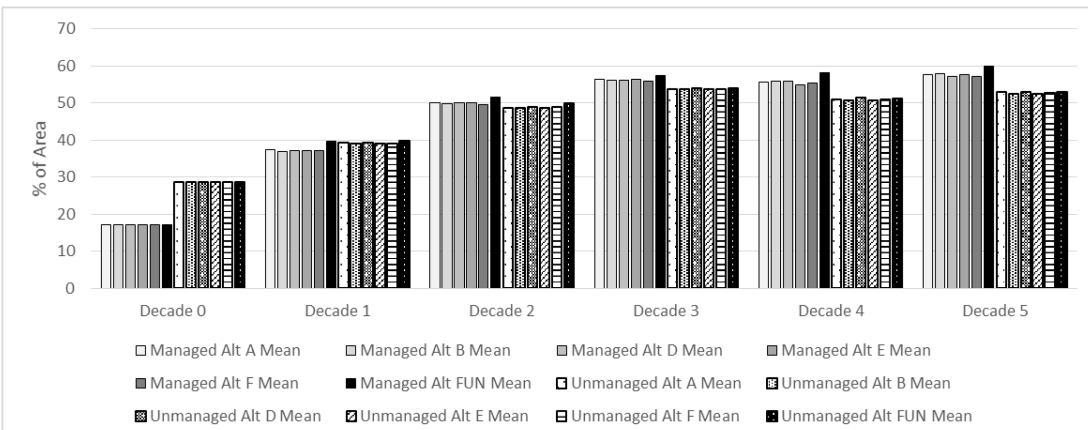


Figure 202. Nonforested/low/medium density class in managed versus unmanaged landscapes, forestwide

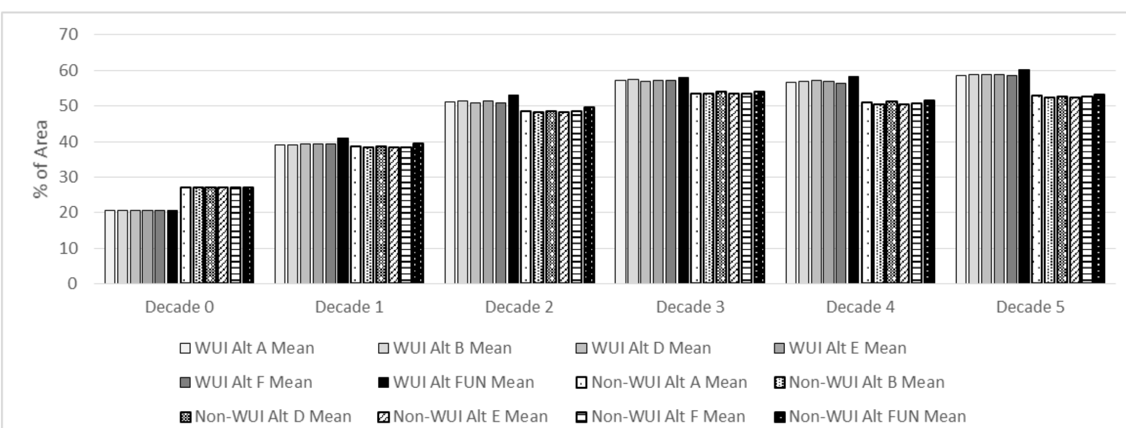


Figure 203. Nonforested/low/medium density class in WUI versus non-WUI areas, forestwide

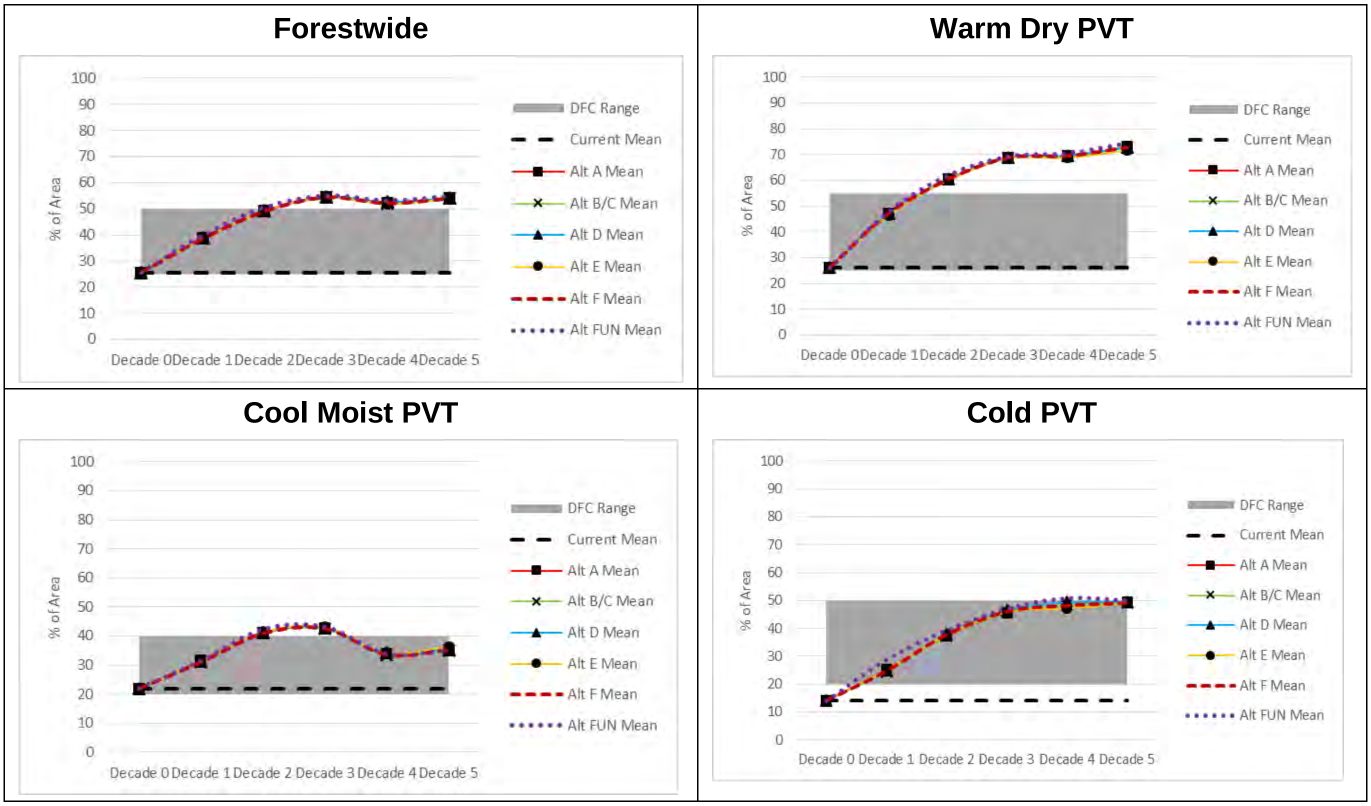
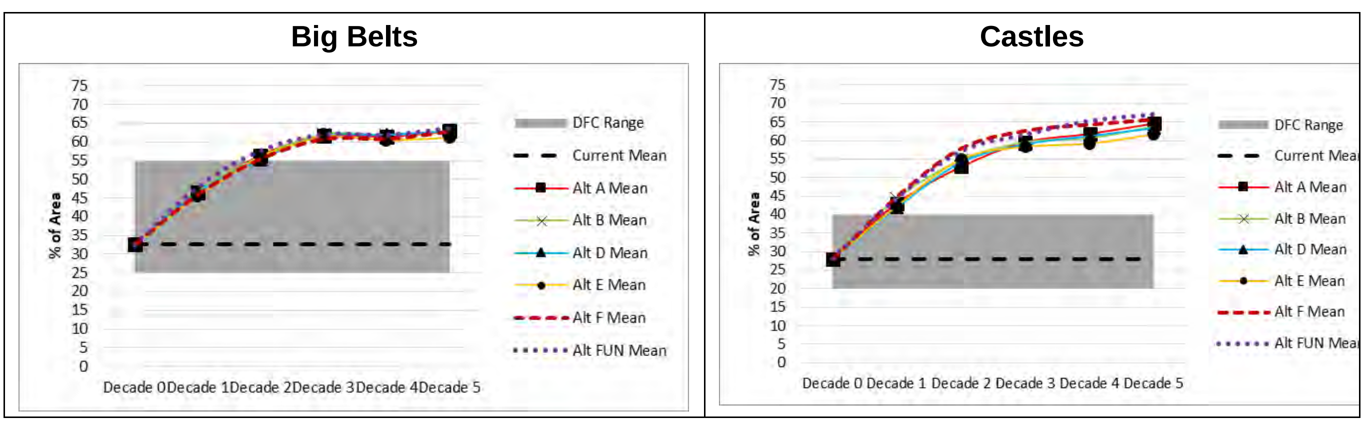


Figure 204. Nonforested/low/medium density class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 205, displays nonforested/low/medium density class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



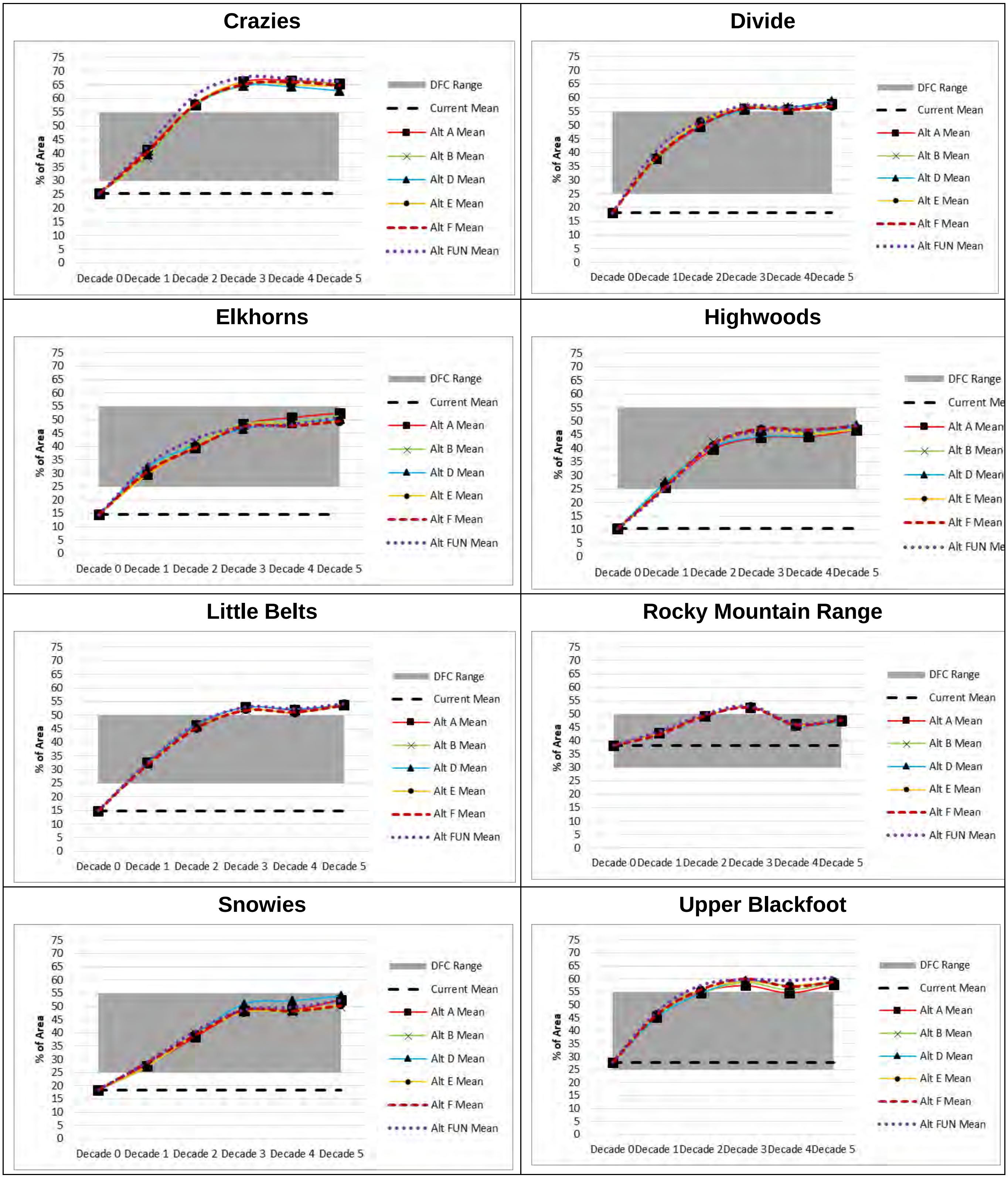


Figure 205. Nonforested/low/medium density class (% of total area) over 5 decades by alternative, by GA

Medium/high density

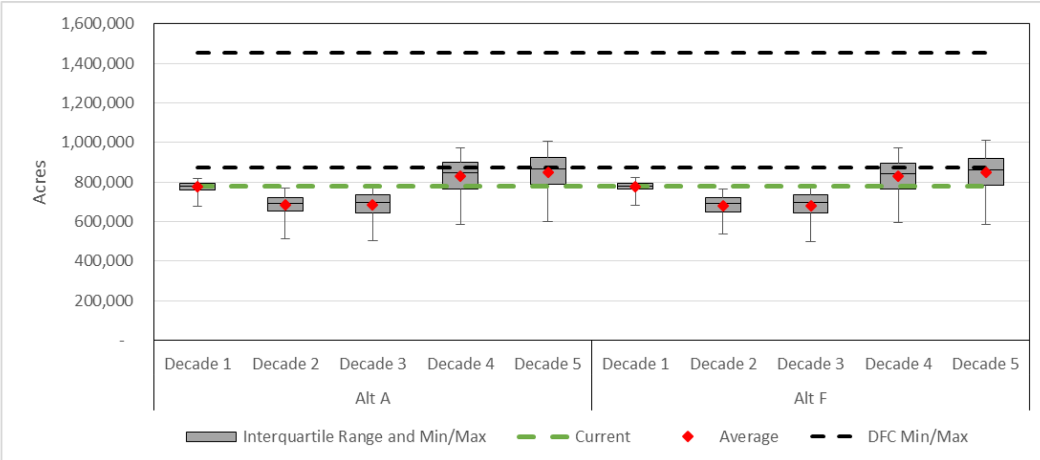


Figure 206. Medium/high density class (total acres) over 5 decades, alternatives A and F

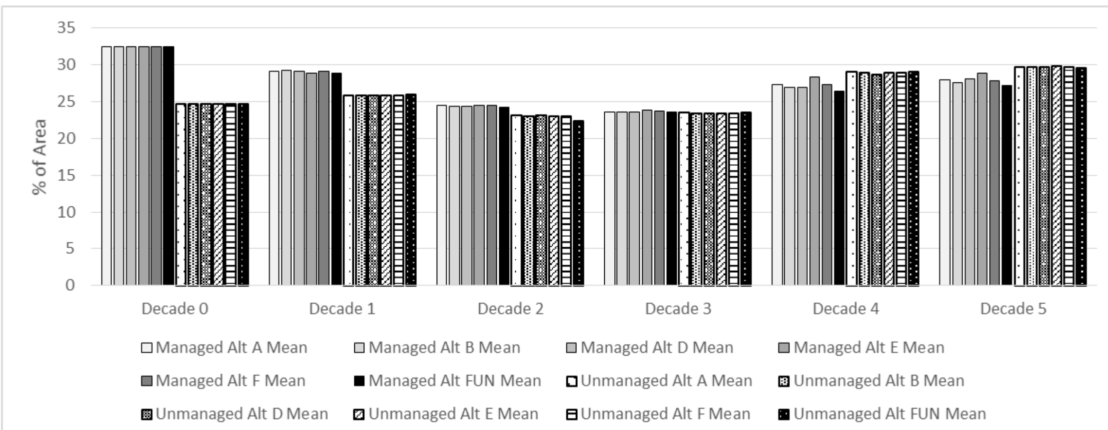


Figure 207. Medium/high density class in managed versus unmanaged landscapes, forestwide

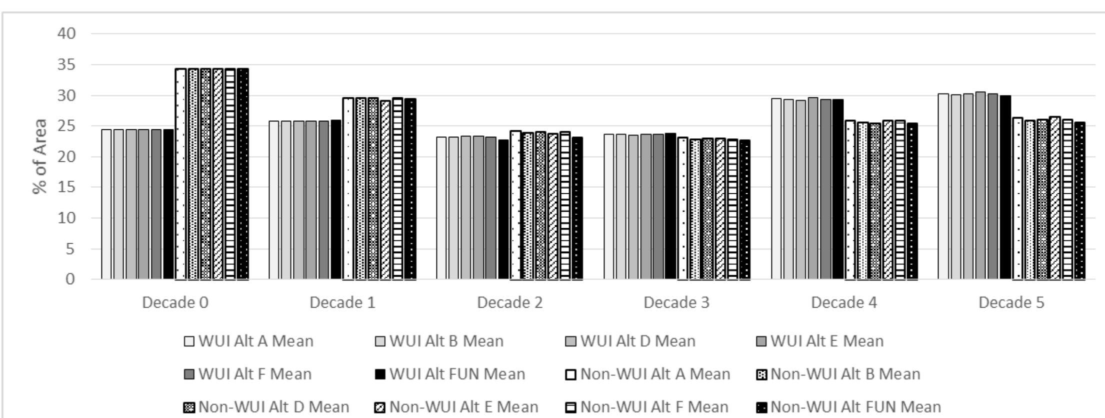


Figure 208. Medium/high density class in WUI versus non-WUI areas, forestwide

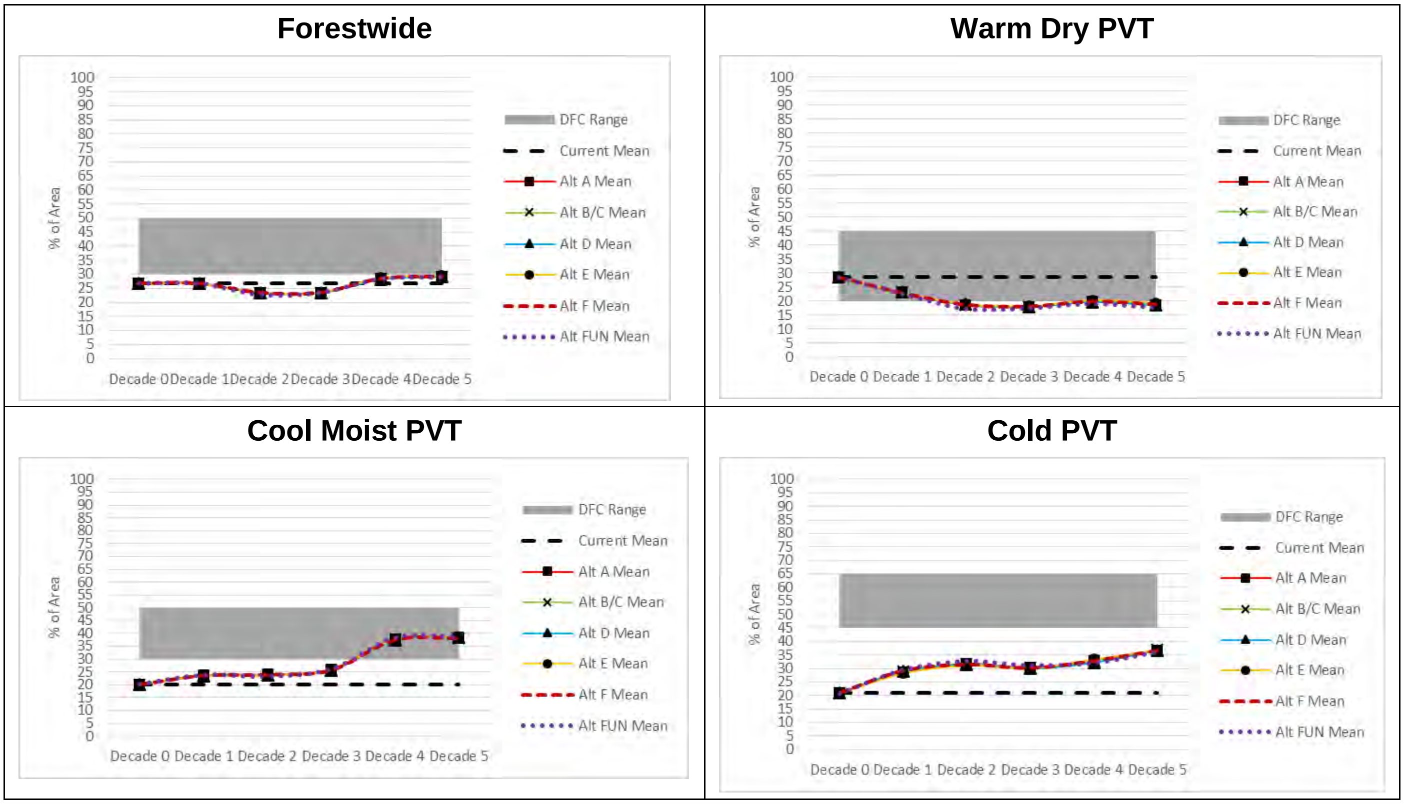
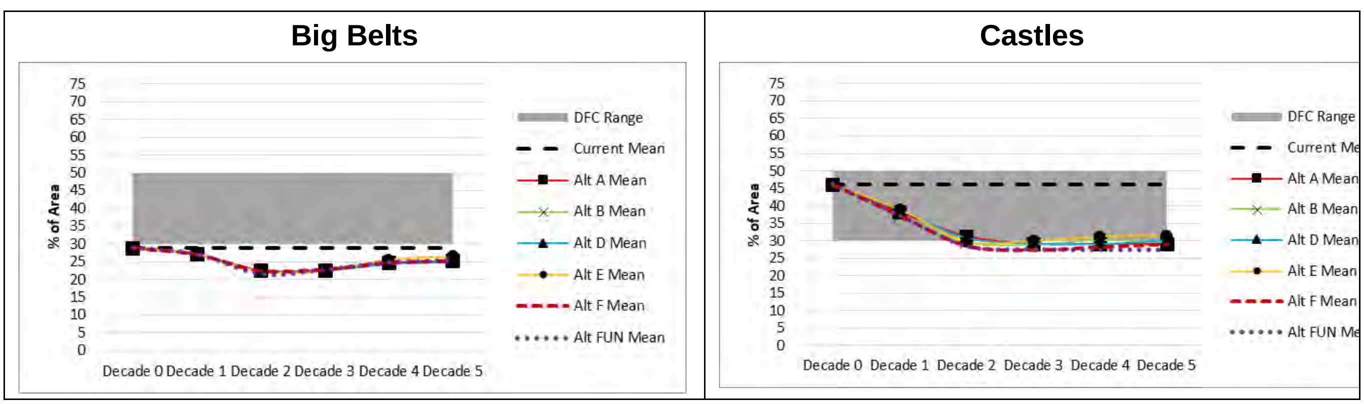


Figure 209. Medium/high density class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 210, displays medium/high density class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



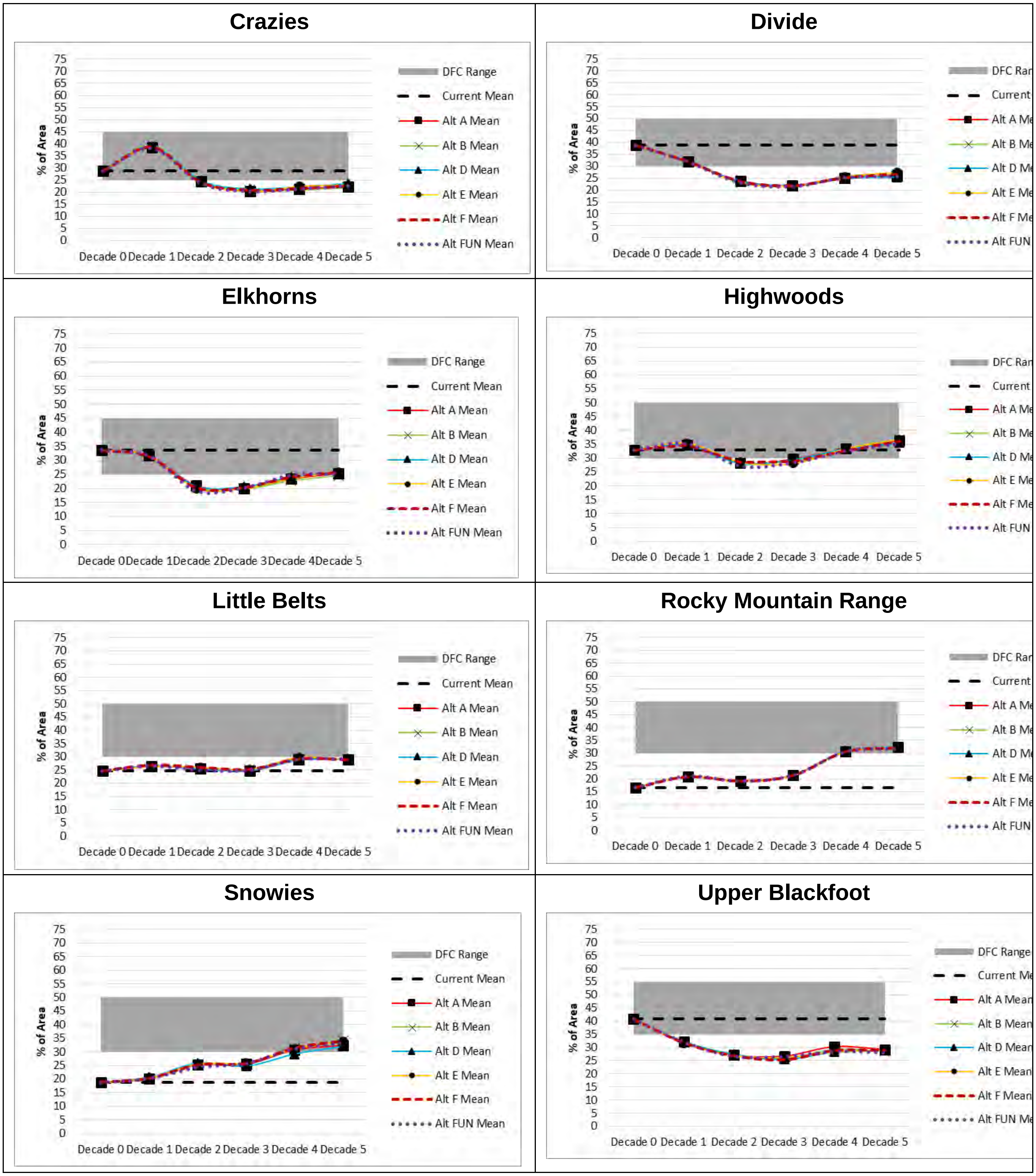


Figure 210. Medium/high density class (% of total area) over 5 decades by alternative, by GA

High density

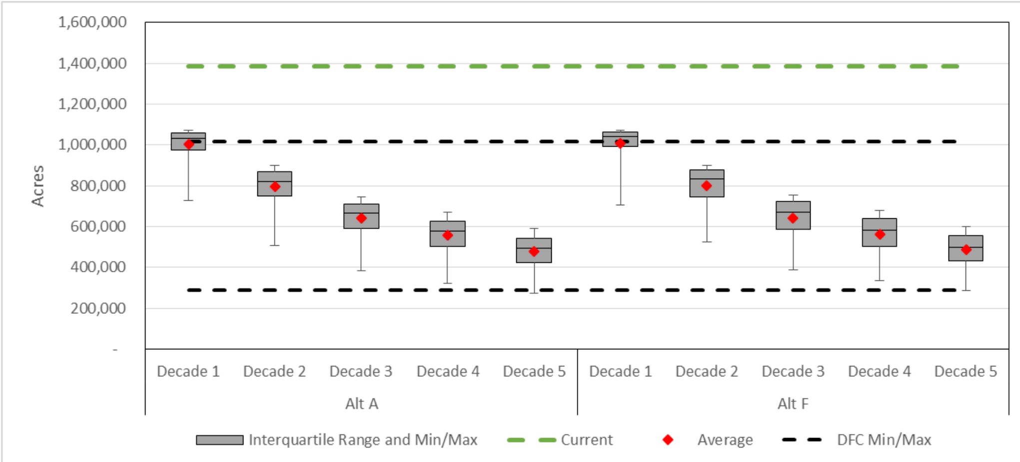


Figure 211. High density class (total acres) over 5 decades, alternatives A and F

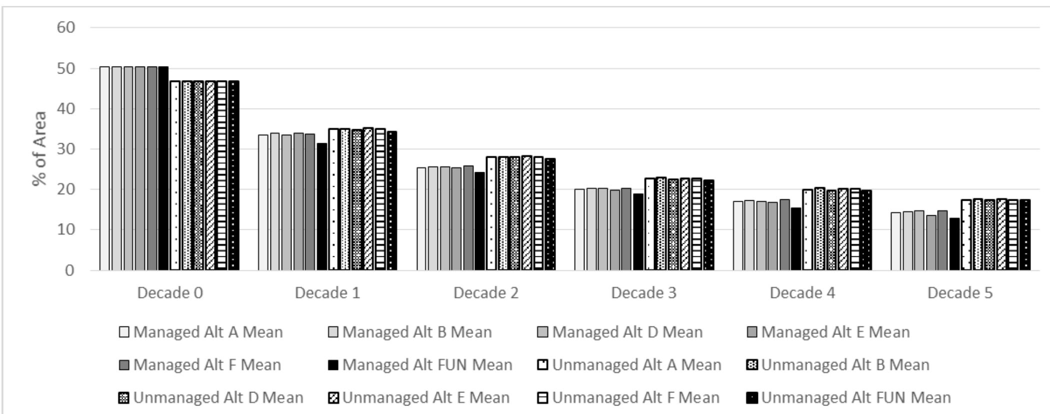


Figure 212. High density class in managed versus unmanaged landscapes, forestwide

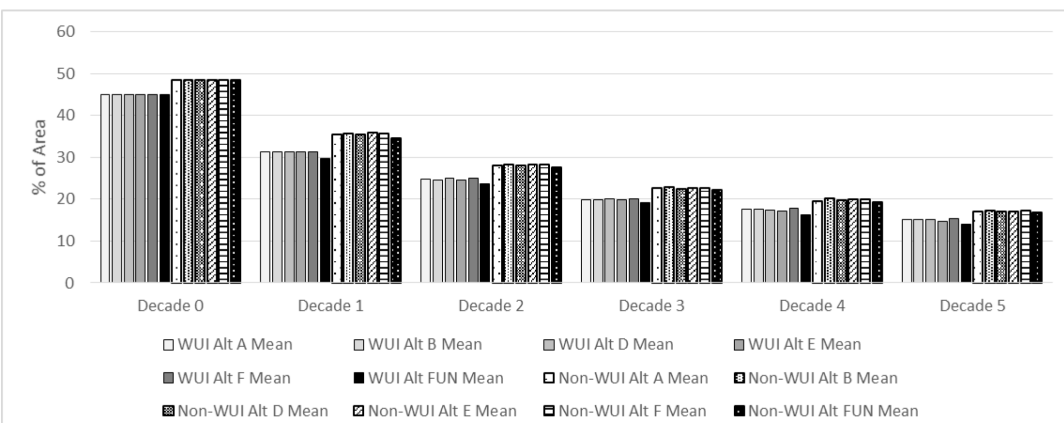


Figure 213. High density class in WUI versus non-WUI areas, forestwide

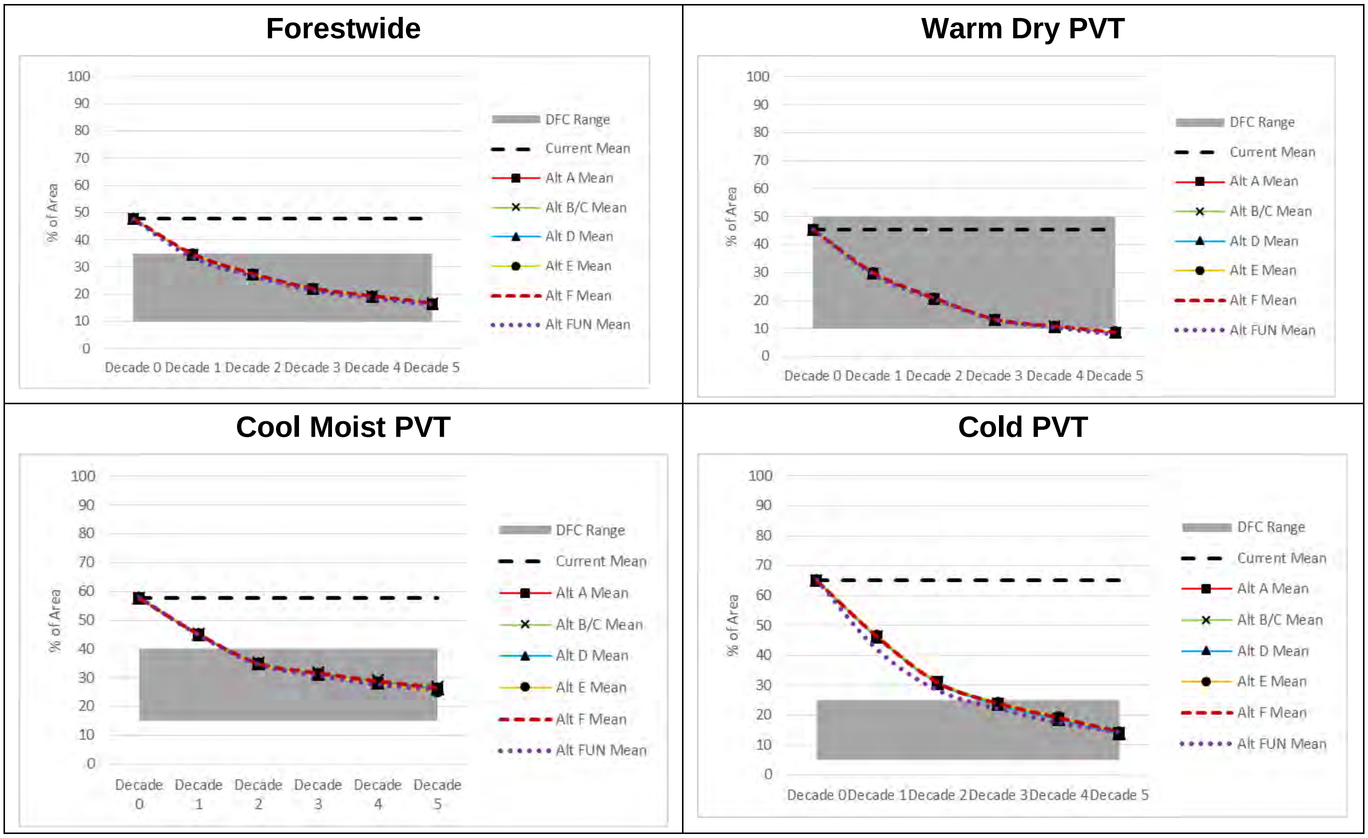
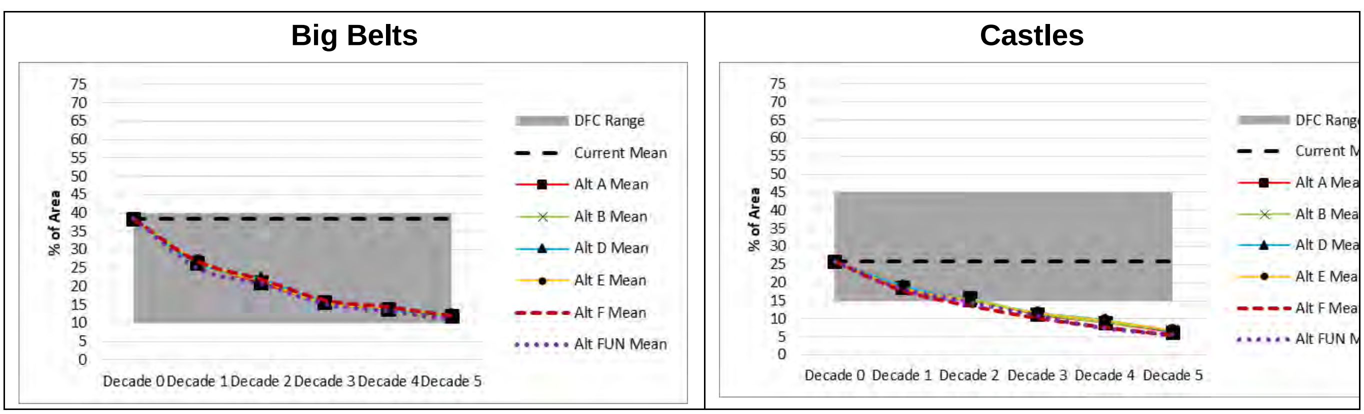


Figure 214. High density class (% of total area) over 5 decades by alternative, forestwide and by PVT

The following figure, Figure 215, displays high density class (% of total area) over five decades by alternative and by GA. The figure is large, so it is displayed over 2 pages.



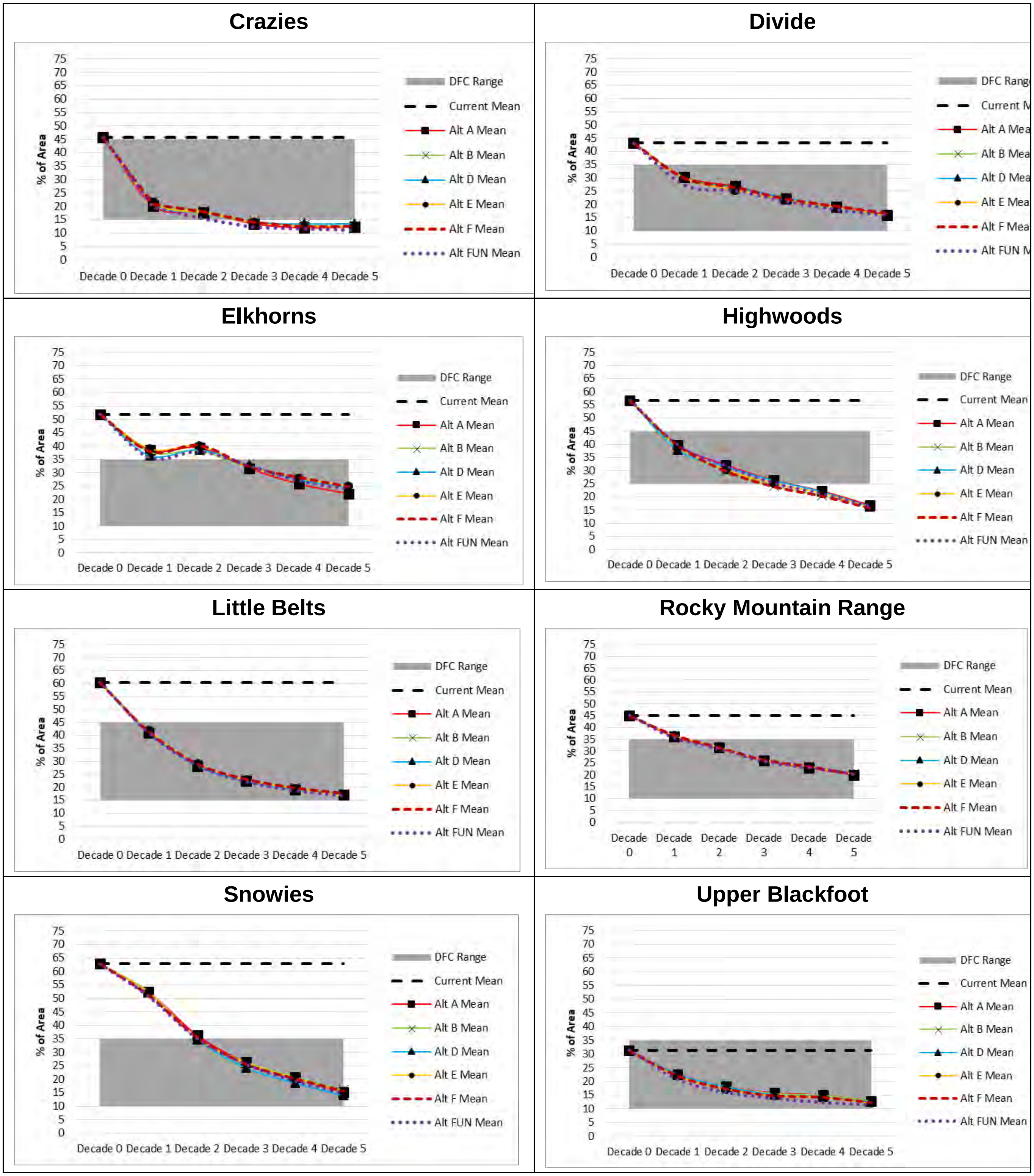


Figure 215. High density class (% of total area) over 5 decades by alternative, by GA

Vertical structure

Forestwide summaries are not shown because these structures vary strongly by PVT; and this attribute is not summarized by GA because there are no desired conditions. No Box/Whisker plots were produced.

Single-storied

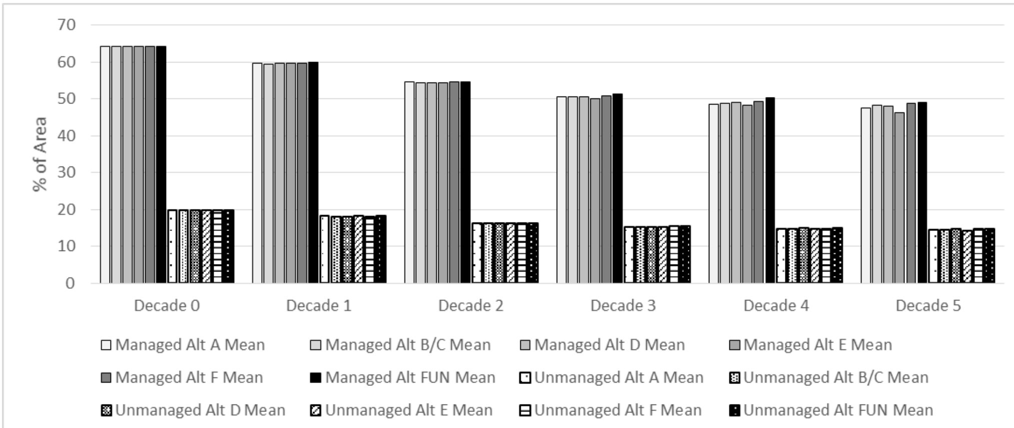


Figure 216. Single-storied vertical structure class in managed versus unmanaged landscapes, forestwide

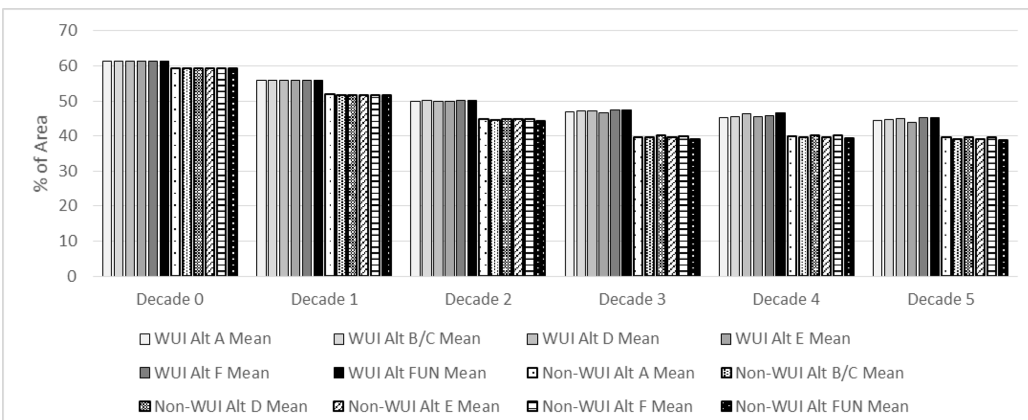


Figure 217. Single-storied vertical structure class in WUI versus non-WUI areas, forestwide

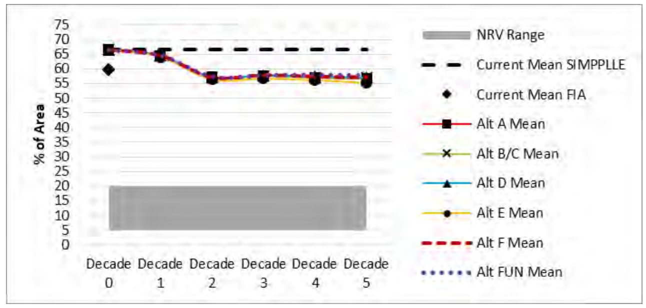
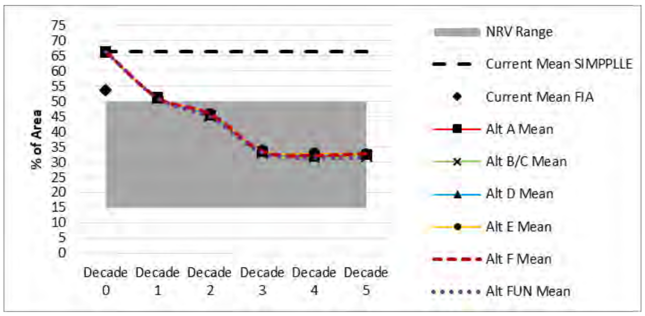
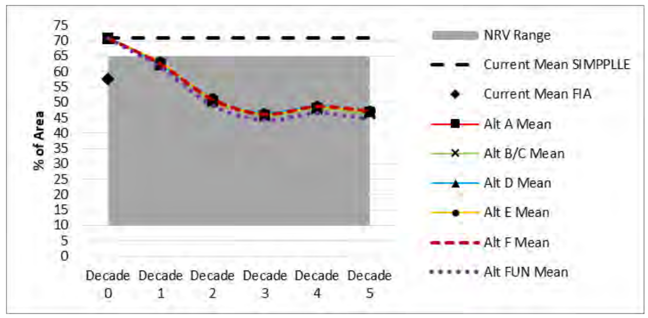
<table>
<tr><th>Forestwide</th><th>Warm Dry PVT</th></tr>
<tr><td>N/A</td><td></td></tr>
<tr><th>Cool Moist PVT</th><th>Cold PVT</th></tr>
<tr><td></td><td></td></tr>
</table>

Figure 218. Single-storied vertical structure class (% of total area) over 5 decades by alternative, forestwide and by PVT

Two-storied

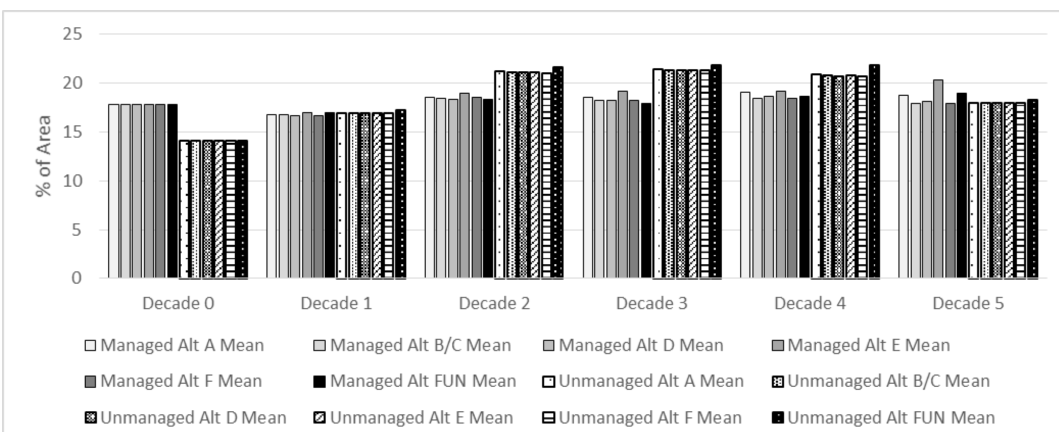


Figure 219. Two-storied vertical structure class in managed versus unmanaged landscapes, forestwide

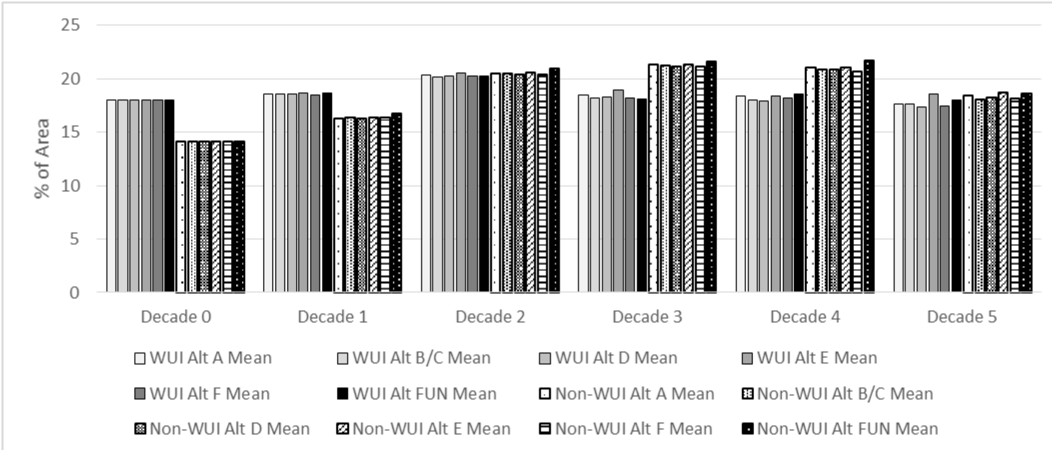
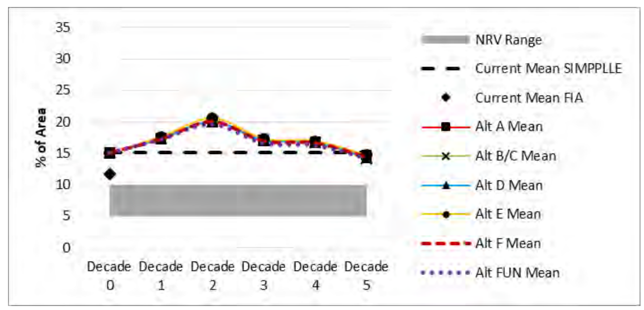


Figure 220. Two-storied vertical structure class in WUI versus non-WUI areas, forestwide

Forestwide	Warm Dry PVT
N/A	

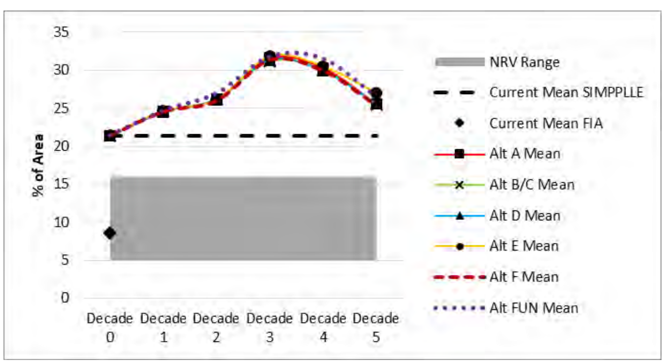
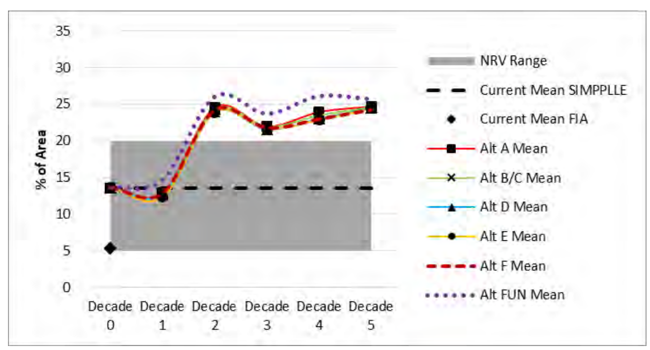
Cool Moist PVT	Cold PVT
	

Figure 221. Two-storied vertical structure class (% of total area) over 5 decades by alternative, forestwide and by PVT

Multistoried

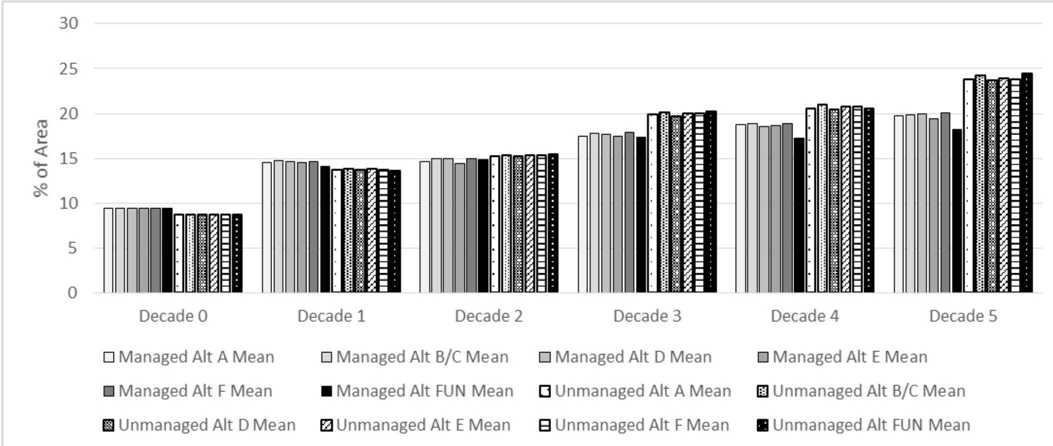


Figure 222. Multistoried vertical structure class in managed versus unmanaged landscapes, forestwide

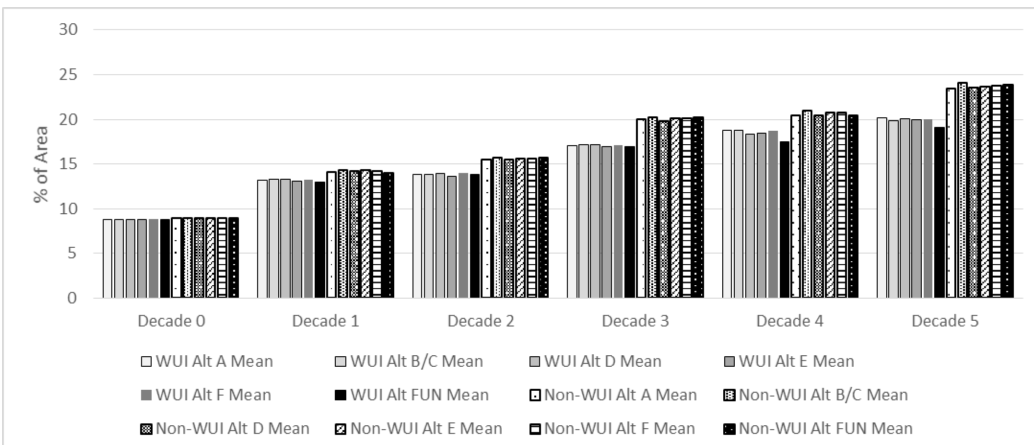


Figure 223. Multistoried vertical structure class in WUI versus non-WUI areas, forestwide

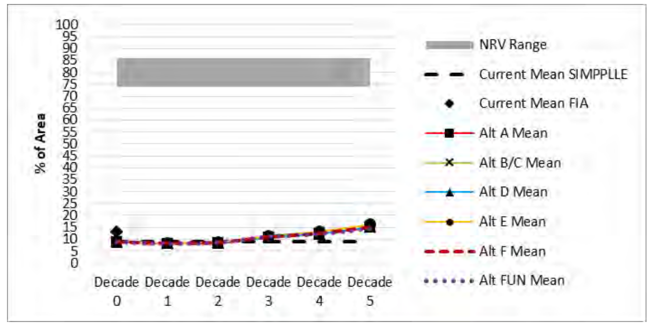
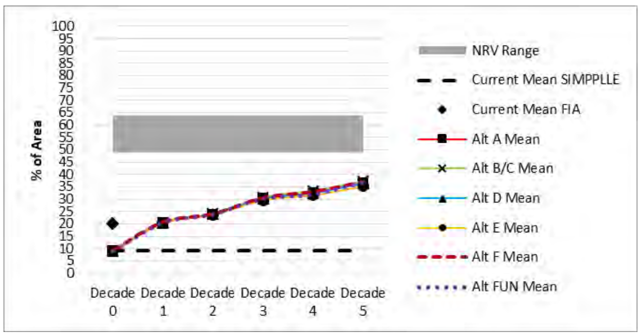
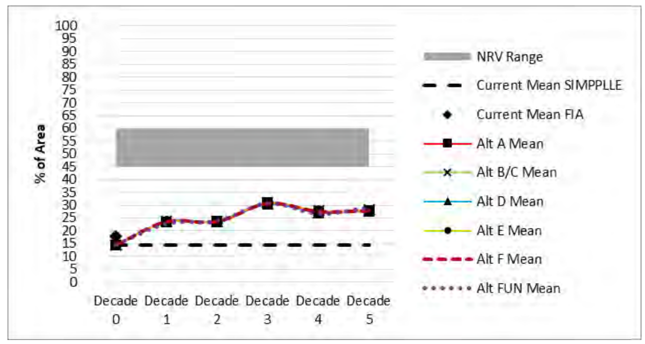
Forestwide	Warm Dry PVT
N/A	
Cool Moist PVT	**Cold PVT**
	

Figure 224. Multistoried vertical structure class (% of total area) over 5 decades by alternative, forestwide and by PVT

Landscape patch and pattern (early successional forest patches)

The average size (acres) of early successional forest patches is assessed. The first set of results below include seedling/sapling patches for as long as they remain in that size class.

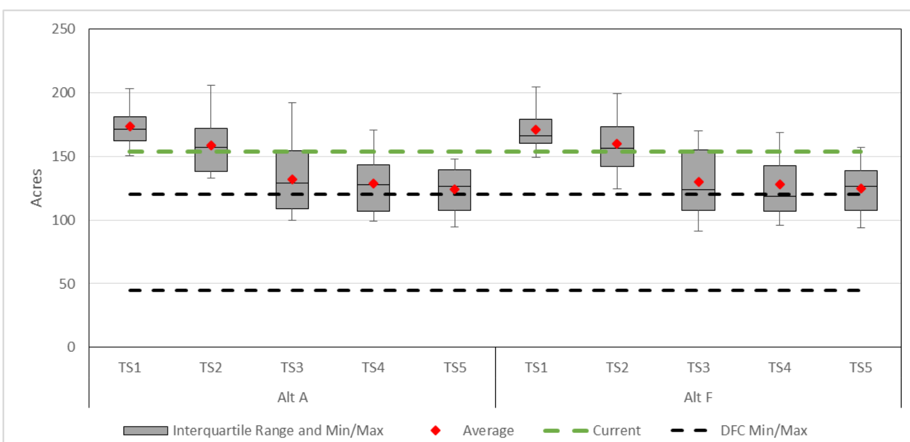


Figure 225. Early successional forest patches (average acres) over 5 decades, comparing alternatives A and F

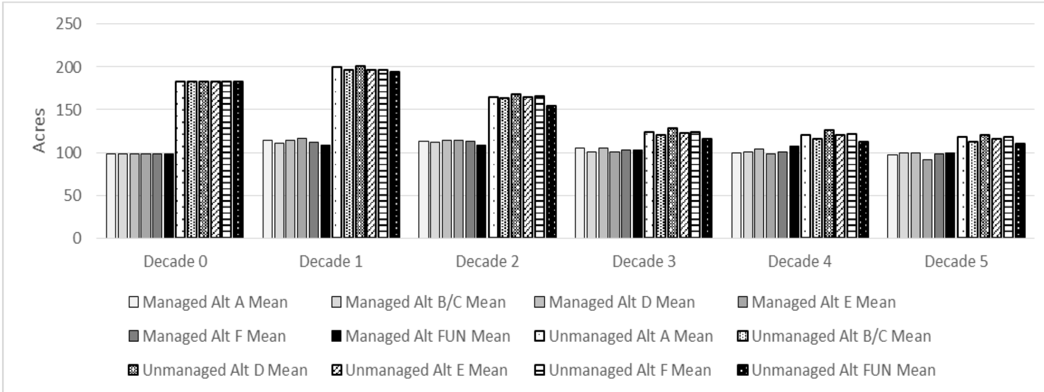


Figure 226. Early successional forest patches over 5 decades in managed versus unmanaged landscapes, forestwide

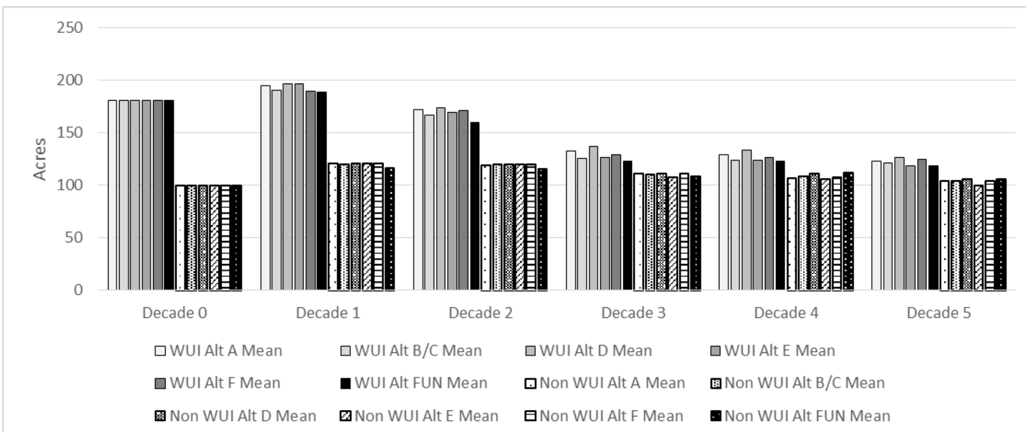


Figure 227. Early successional forest patches over 5 decades in WUI versus non-WUI landscapes, forestwide

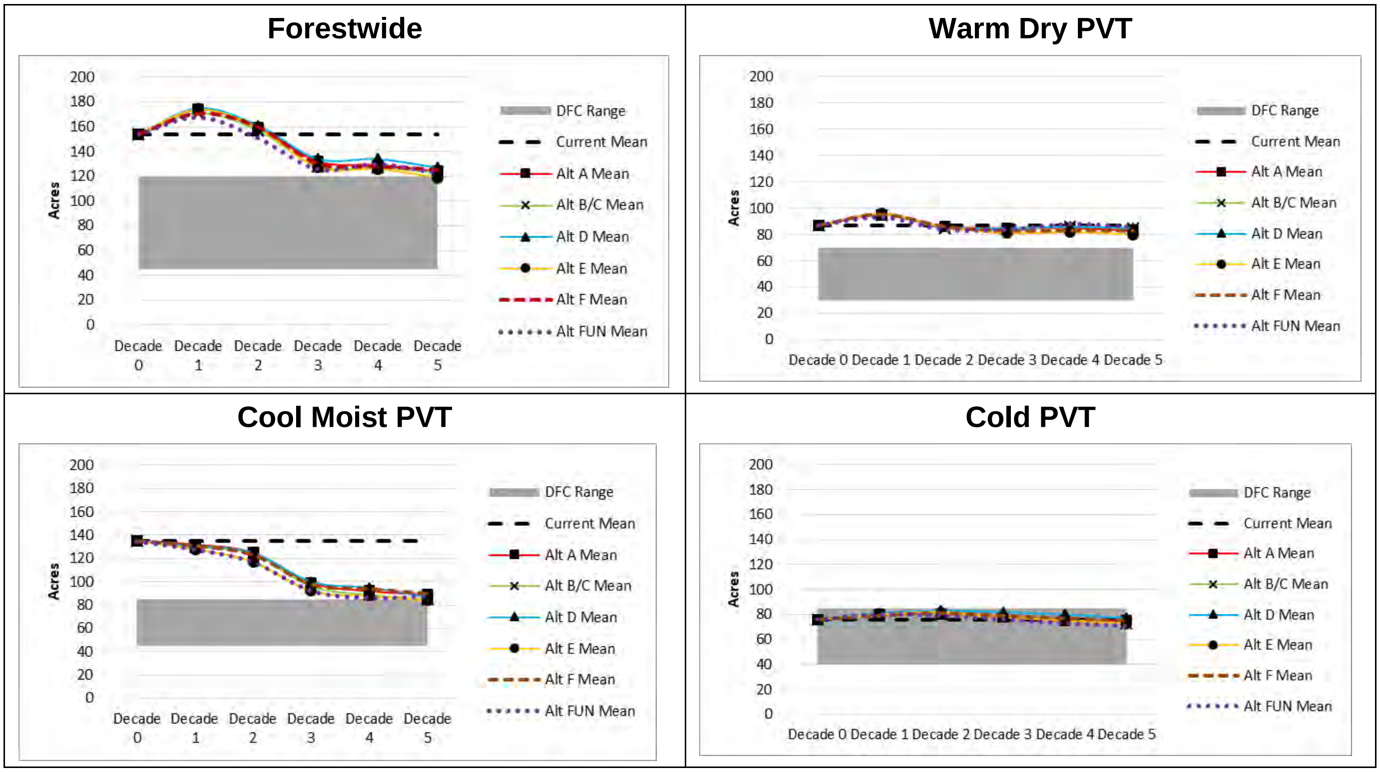


Figure 228. Early successional forest patches (average acres) over 5 decades by alternative, forestwide

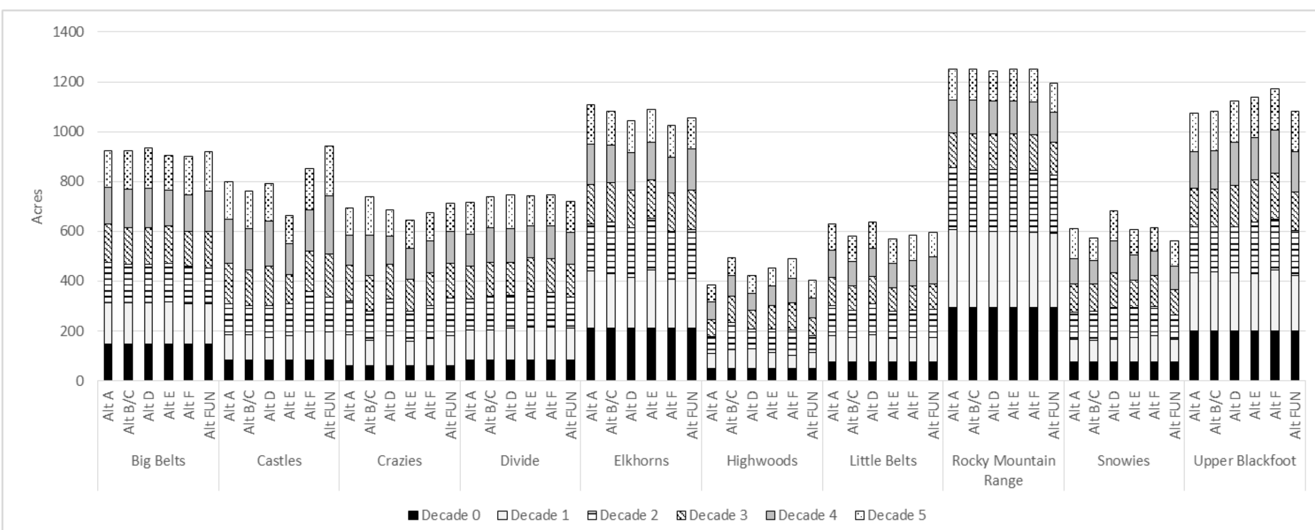
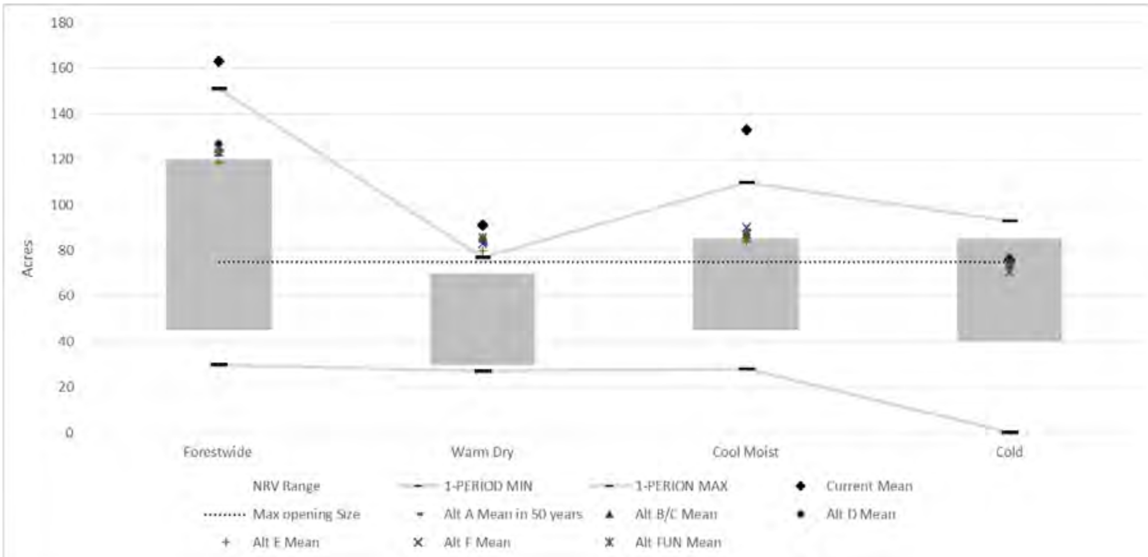


Figure 229. Early successional forest patches (average acres) over 5 decades by alternative and GA

The NRV analysis was also run with an assumption that forest openings would no longer be considered openings after 1 modeling period (10 years), once reforestation occurs, even though some of these patches would still be in the seedling/sapling size class. This analysis was used to inform FW-TIM-STD-08, the maximum opening size limit for even-aged regeneration harvest. The figure below displays the relationship between the two NRV ranges, along with the existing condition of early successional forest average patch sizes and predicted size in 50 years by alternative, and the maximum opening size limit.



This graphic displays the relationship between the NRV analysis for early successional forest patch sizes with the 75-acre limit (FW-TIM-STD-08), existing conditions, and projected conditions in 50 years by alternative. The gray columns indicate the NRV of patch sizes for as long as stands remain in a seedling/sapling condition. They gray lines with black bars indicate the NRV of patch sizes when openings are included for 1 decade (e.g., they are no longer considered openings after reforestation occurs); these ranges are slightly wider than the NRV of patches that are included until they progress out of the seedling/sapling stage. The black diamonds indicate the existing condition of patch sizes, and the other symbols depict the patch sizes in 50 years by alternative. The dashed line shows the opening size limit of 75 acres.

Figure 230. Early successional forest patches and maximum even-aged regeneration harvest openings

Special components: old growth, snags, and coarse woody debris

Old growth cannot be explicitly modeled. However, SIMPPLLE was used to estimate the abundance of large and very large forest size classes. As described in the methodology section, the proportions of large-tree structure show correlation to areas that are most likely to be old growth. The figures in the large-tree structure section show the anticipated trend of this condition as a proxy indicator for the potential expected trend of old growth. Snags and coarse woody debris cannot be modeled into the future with SIMPPLLE. The future effects to these attributes are addressed qualitatively in the EIS.

Wildlife habitat

Elk

The following series of figures display the SIMPPLLE modeling results for elk hiding cover for each alternative, over a 50-year analysis period, to supplement the information and conclusions presented in the body of the EIS. The figures include forestwide averages, and GA averages. Results and charts for each Elk Analysis Unit are available in the project record.

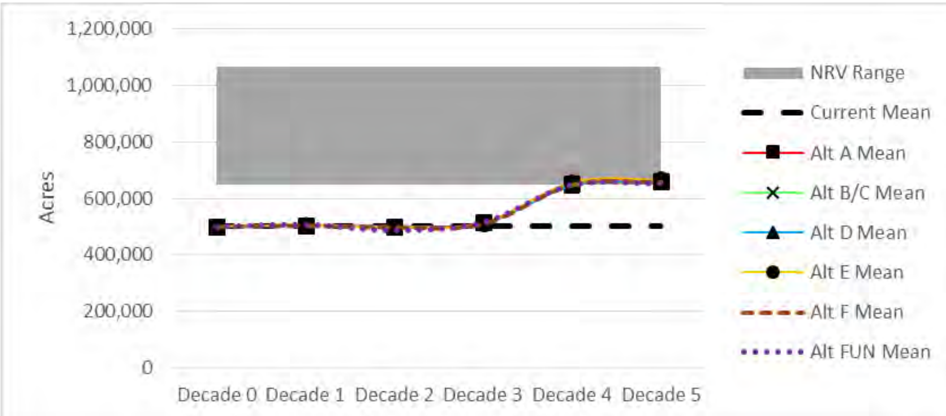
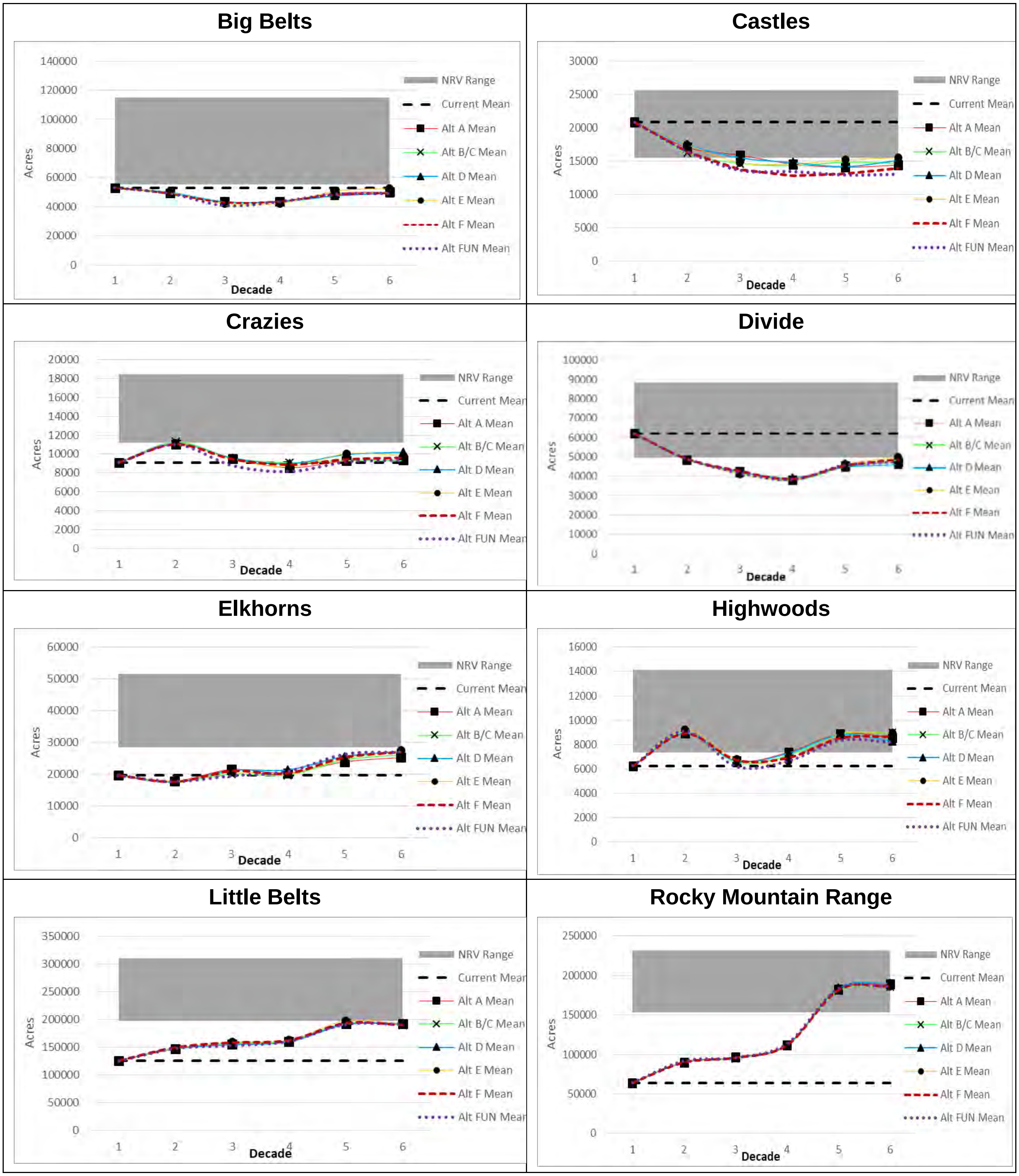


Figure 231. Elk spring/summer/fall hiding cover forestwide over time by alternative

The following figure, Figure 232, displays elk spring/summer/fall hiding cover over time by alternative and by GA. The figure is large, so it is displayed over 2 pages.



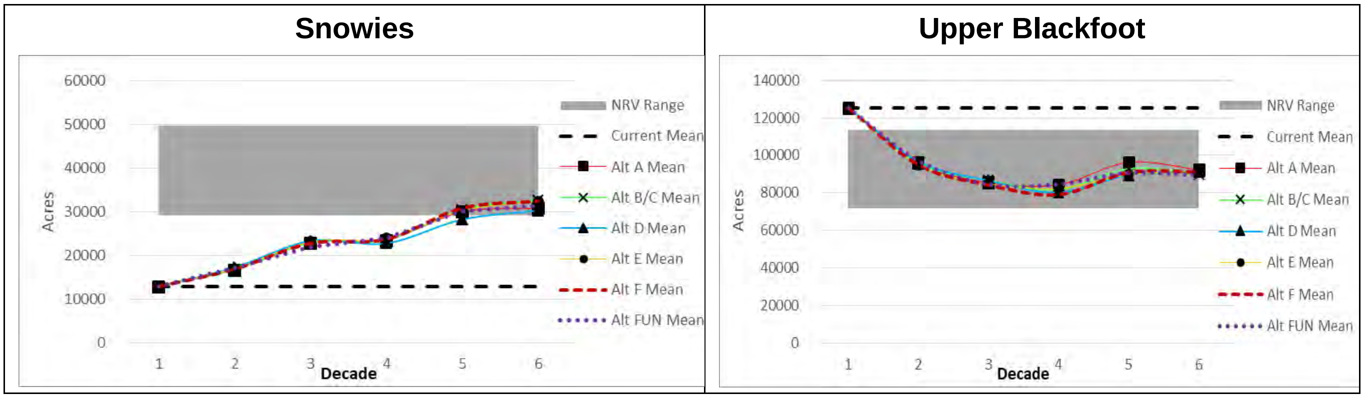


Figure 232. Elk spring/summer/fall hiding cover over time by alternative, by GA

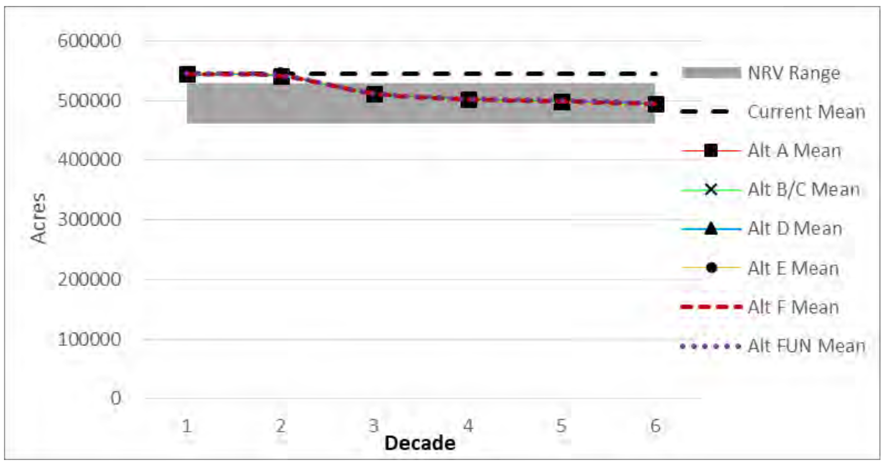
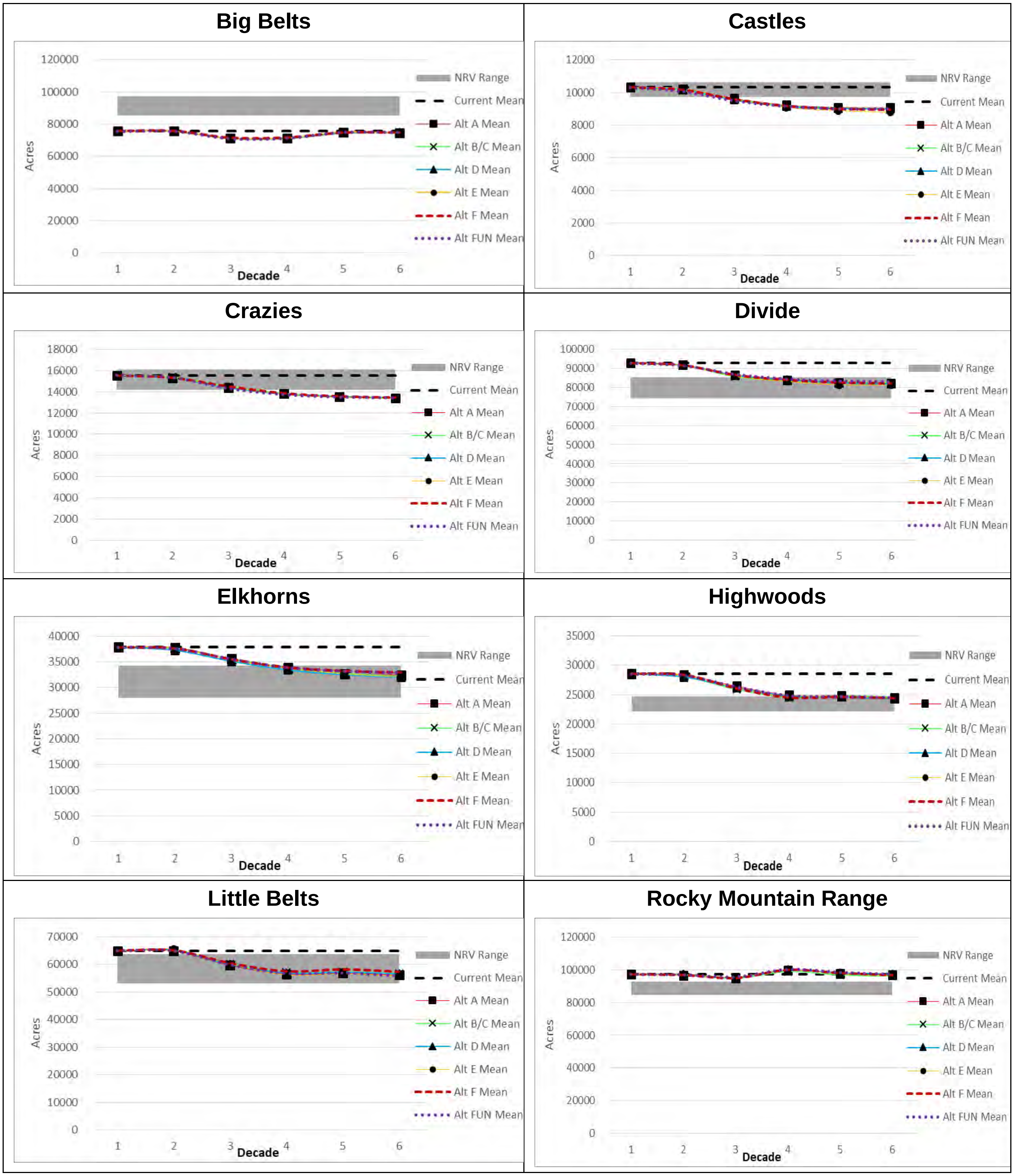


Figure 233. Elk winter hiding cover over time by alternative forestwide

The following figure, Figure 234, displays elk winter habitat by alternative and by GA. The figure is large, so it is displayed over 2 pages.



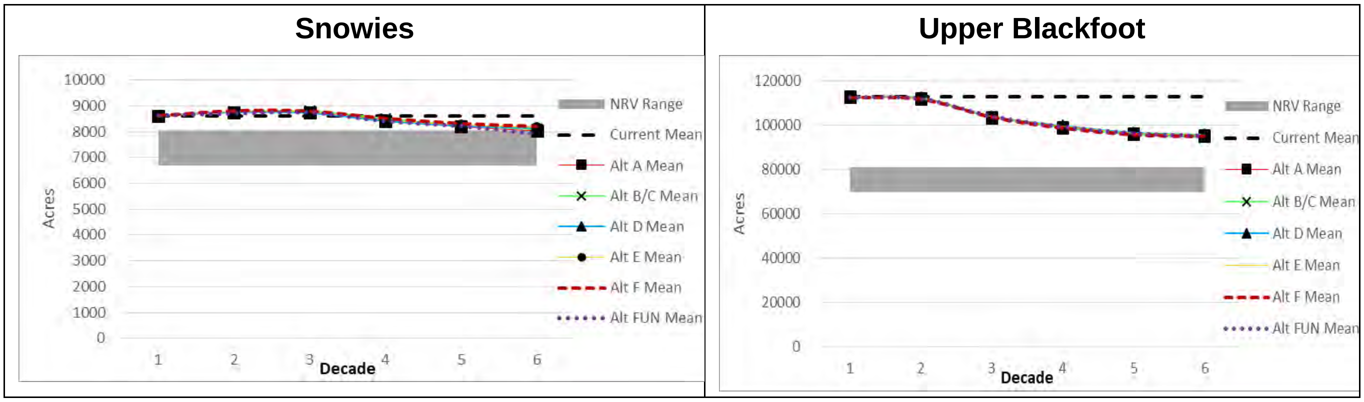


Figure 234. Elk winter habitat by GA over time by alternative

Flammulated owl

Flammulated owl nesting habitat remains generally below or at the low end of the NRV range at most scales of analysis, although the expected trends vary by GA.

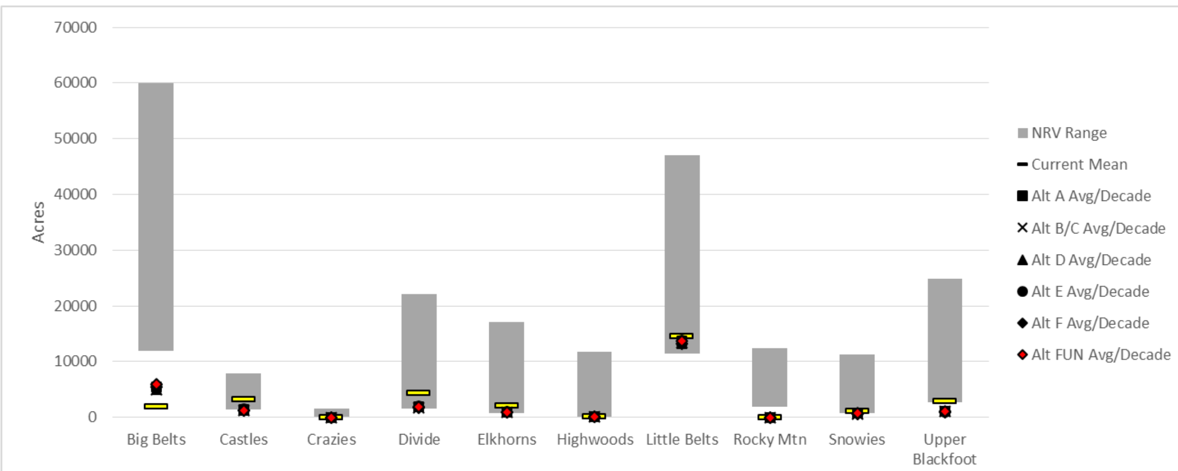


Figure 235. Flammulated owl nesting habitat, average acres/decade for 50 years by alternative

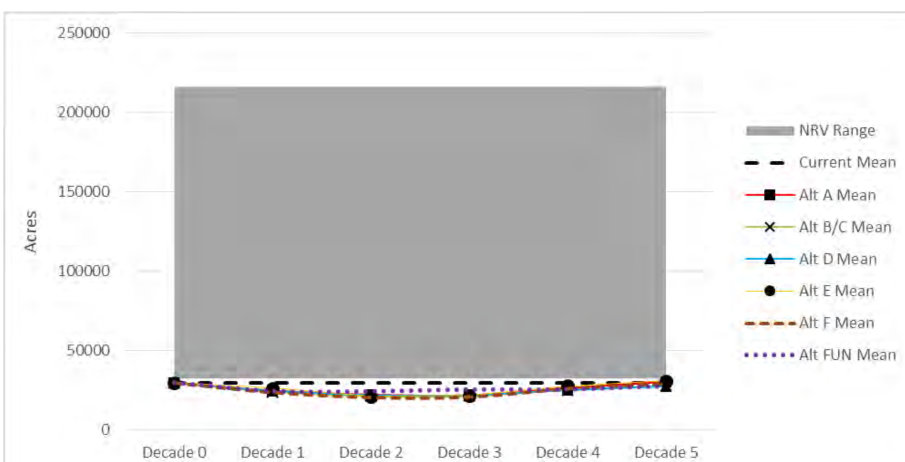
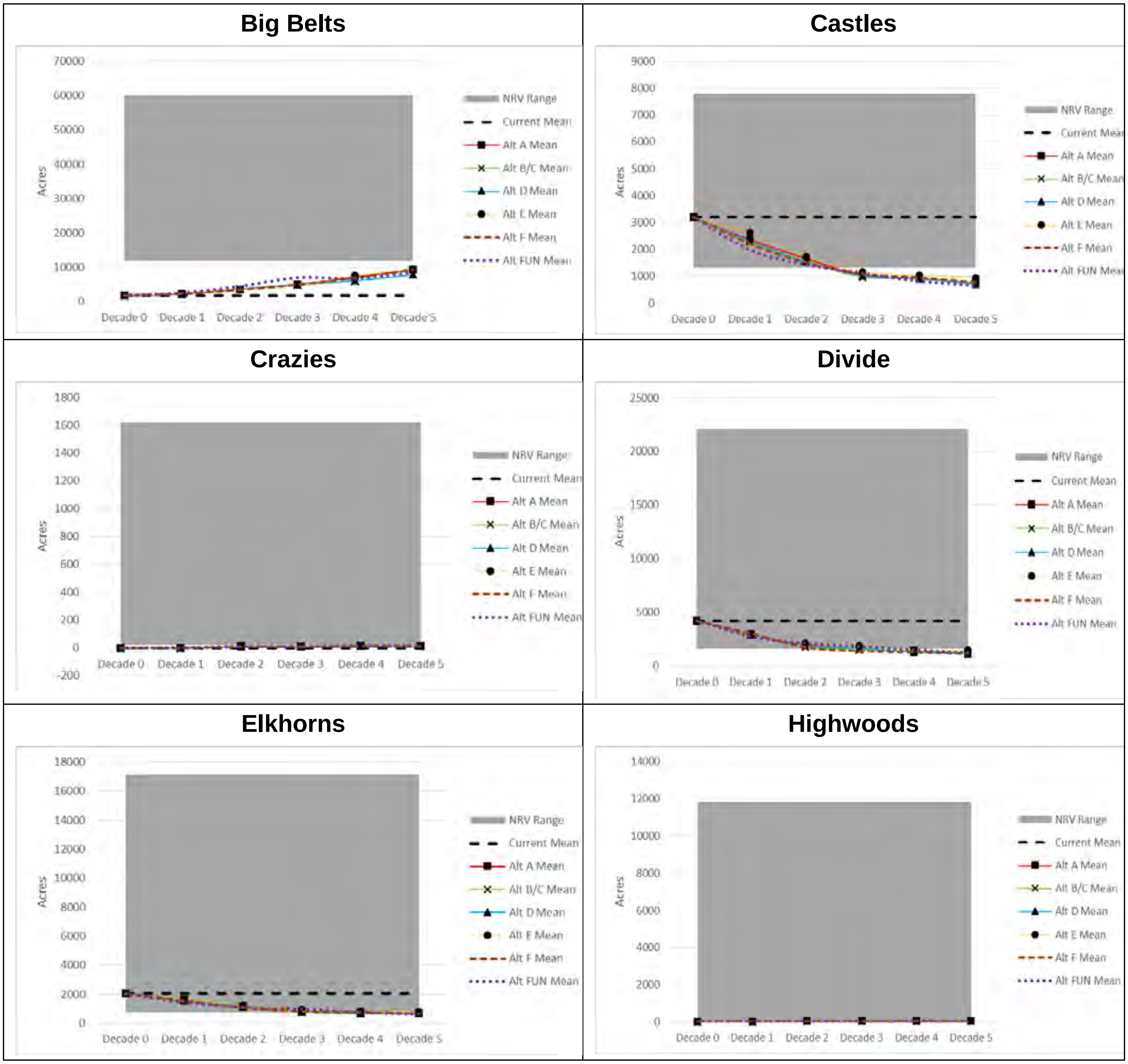


Figure 236. Flammulated owl nesting habitat over time by alternative forestwide

The following figure, Figure 237, displays flammulated owl nesting habitat over time by alternative and by GA. The figure is large, so it is displayed over 2 pages.



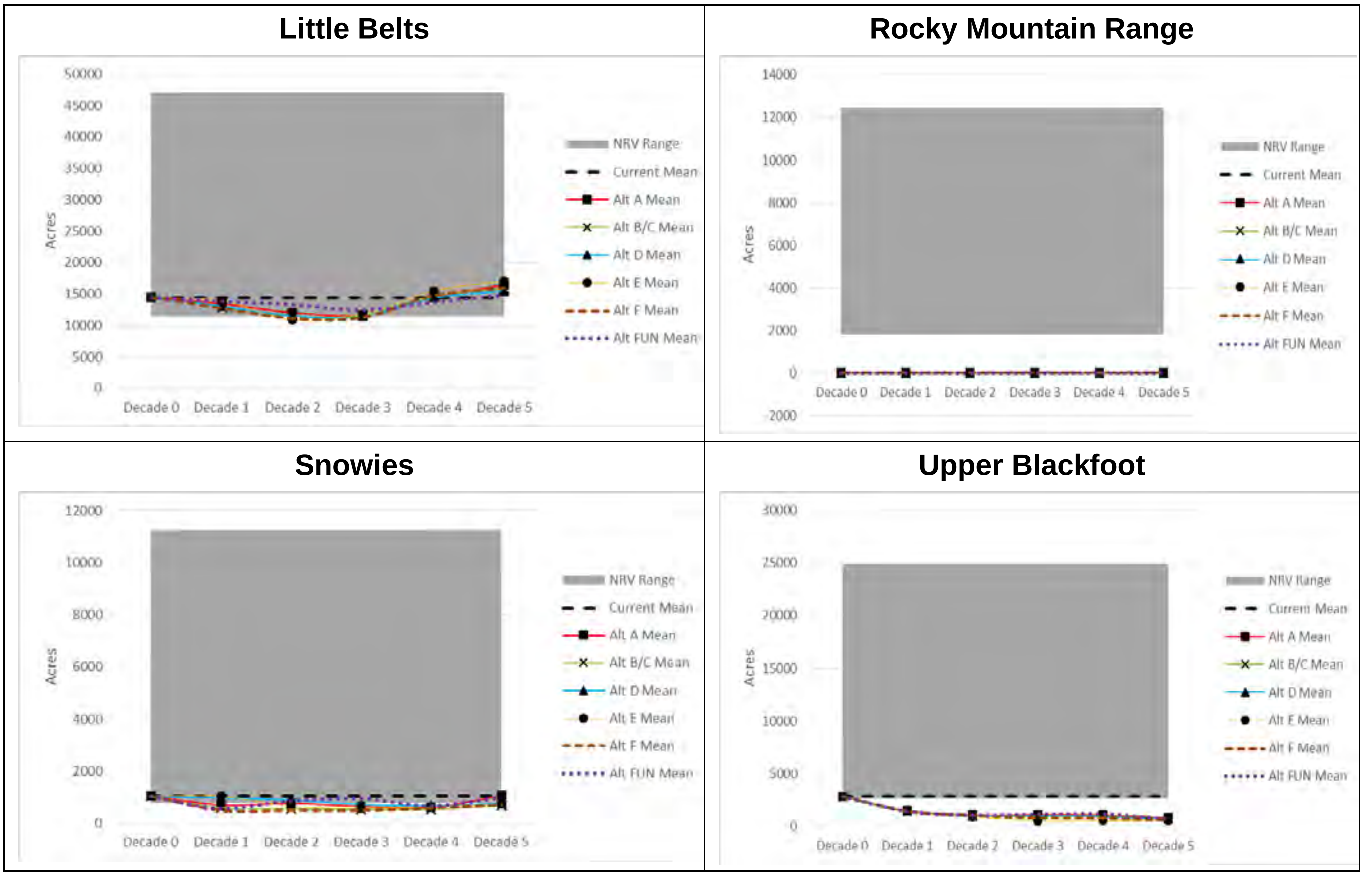


Figure 237. Flammulated owl nesting habitat over time by alternative, by GA

Lewis's woodpecker

Generally, this habitat condition increases and/or is maintained within the NRV range at all scales of interest. There is some variance by alternative at the GA scale, indicating that this habitat may be sensitive to influence by vegetation management.

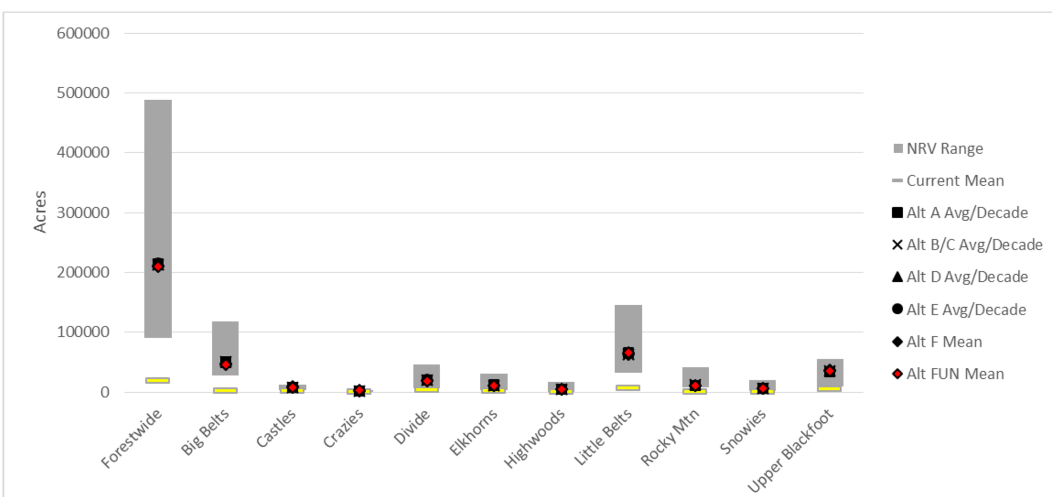


Figure 238. Lewis's woodpecker nesting habitat average acres/decade over 50 years by alternative

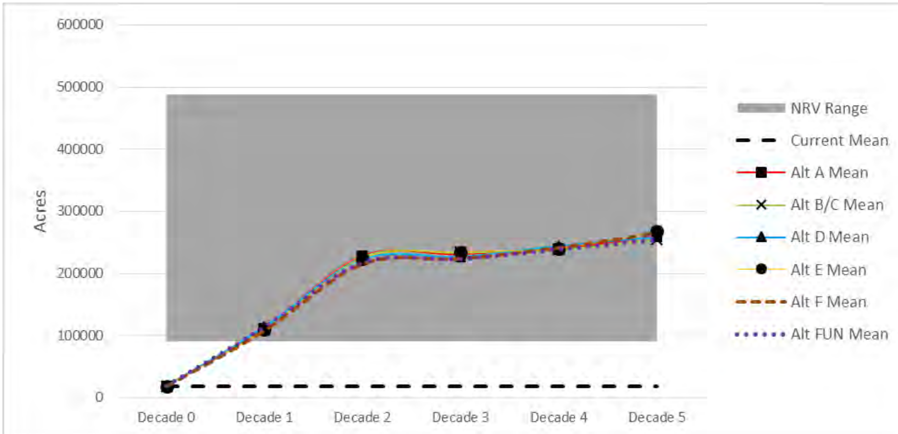
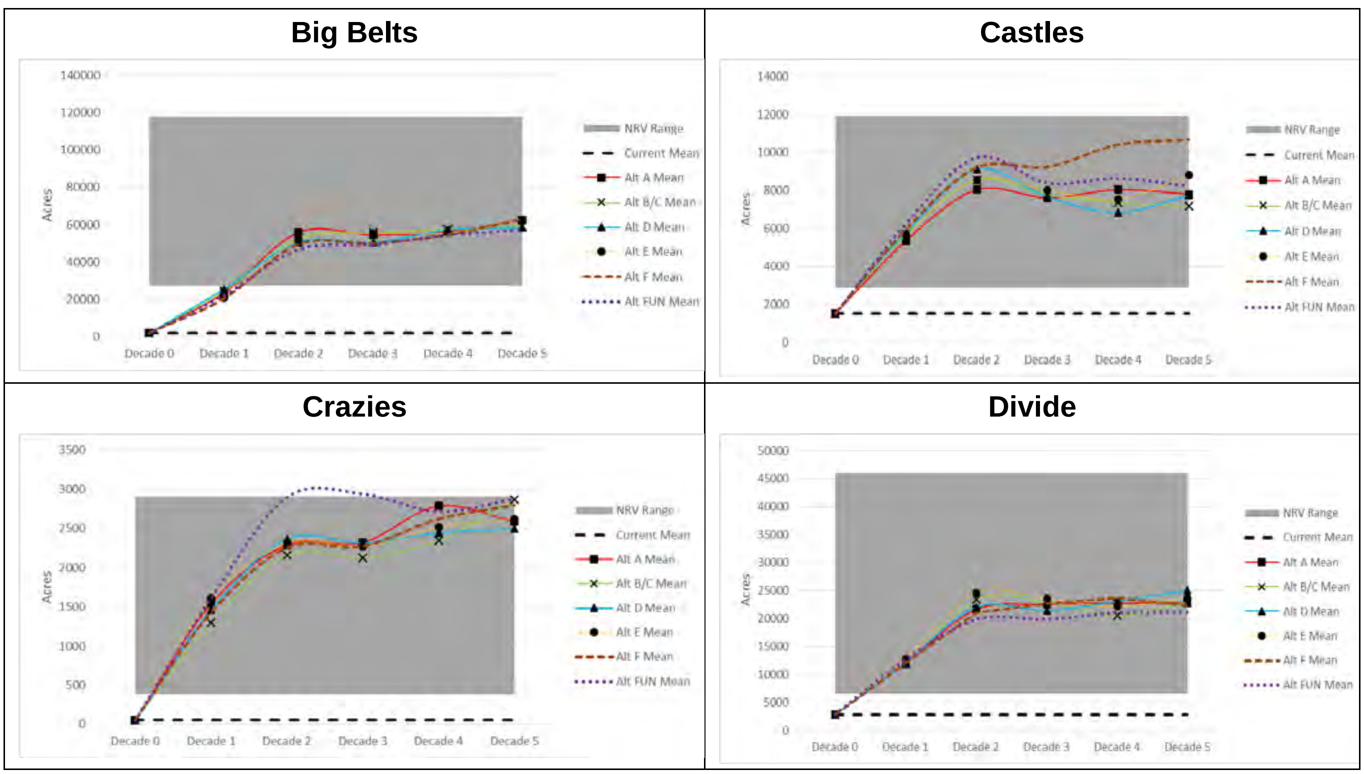


Figure 239. Lewis's woodpecker nesting habitat forestwide over time by alternative

The following figure, Figure 240, displays Lewis's woodpecker nesting habitat over time by alternative and by GA. The figure is large, so it is displayed over 2 pages.



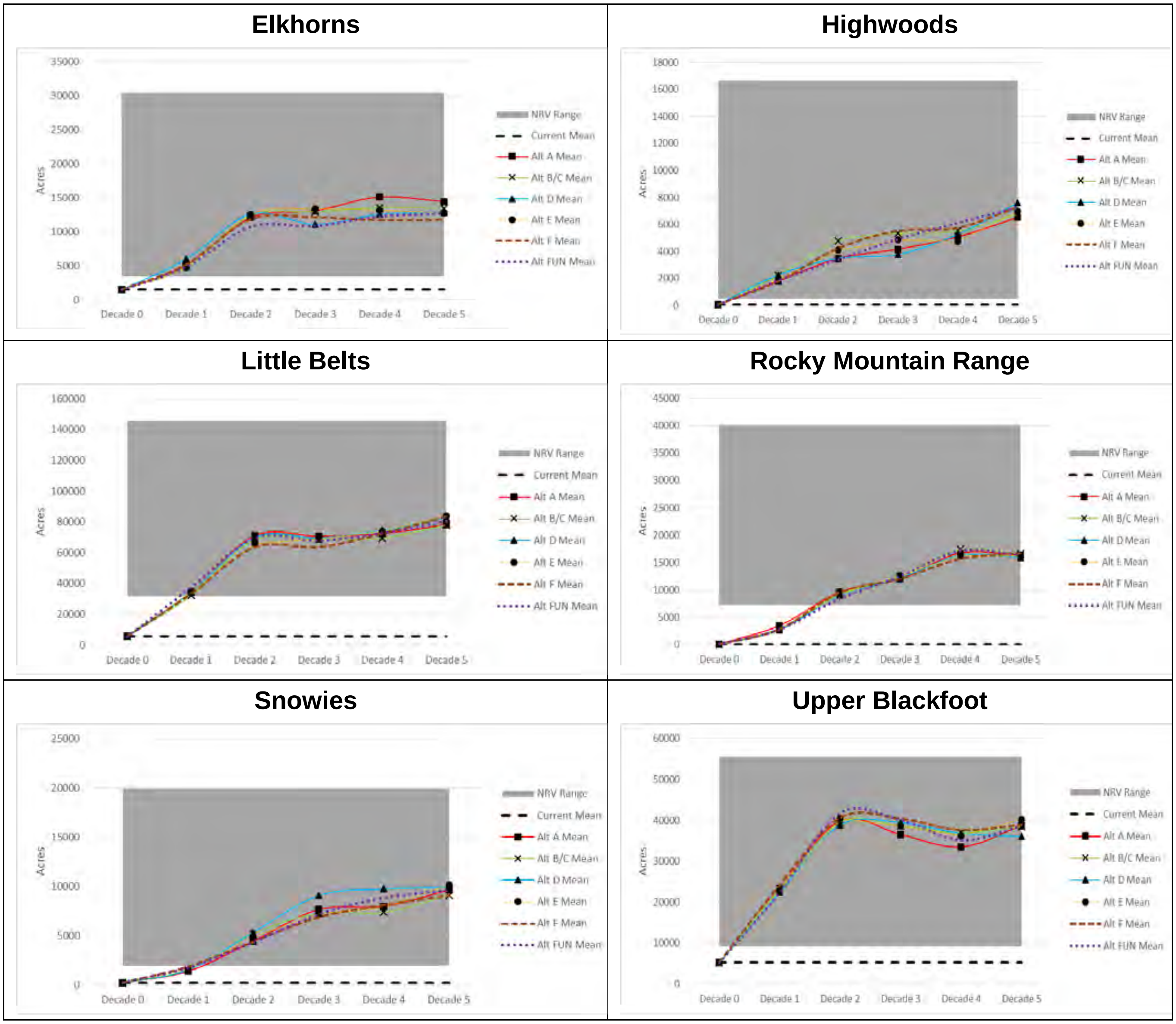


Figure 240. Lewis's woodpecker nesting habitat over time by alternative, by GA

Canada lynx

There is no potential lynx habitat within the Highwoods GA, and therefore no results are shown for that area. "Other" habitat is the remainder of potential habitat that does not meet one of the other habitat criteria; it is not explicitly shown in the figures below. The FEIS and updated NRV lynx modeling results vary from what was disclosed in the DEIS and NRV analysis for several reasons: the potential lynx habitat for the HLC NF was updated; the model input file was updated to reflect changes in vegetation conditions caused by recent fires and management; and several model query errors were corrected.

Stand Initiation

This habitat is limited under warm/dry climate because the model assumes that reforestation will tend to be more open and not gain the high densities needed to qualify as stand initiation habitat. In addition, western spruce budworm activity may be reducing or maintaining lower density classes. The chart below shows the level of this habitat condition, as a percentage of potential lynx habitat, averaged across the 50 year analysis period. These averages are generally within NRV, and generally above the existing condition (likely due to fire). There are negligible difference in alternatives.

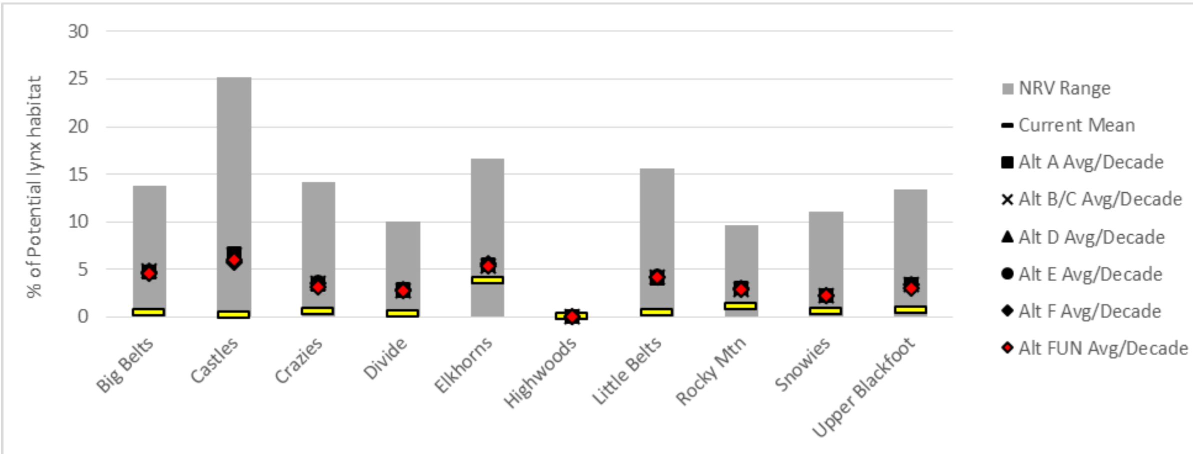
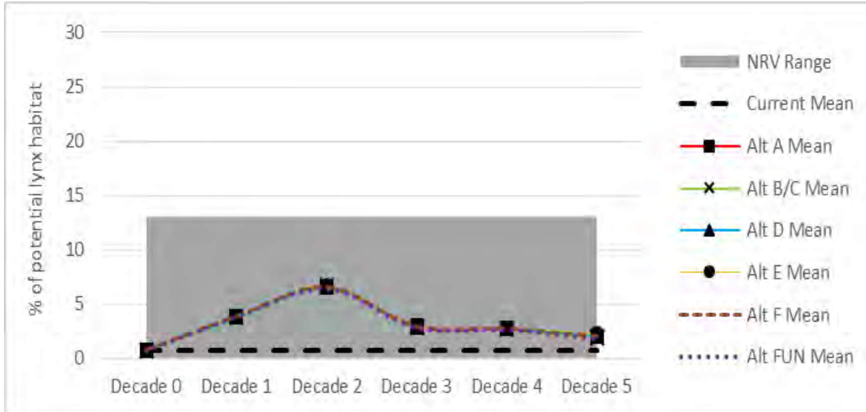
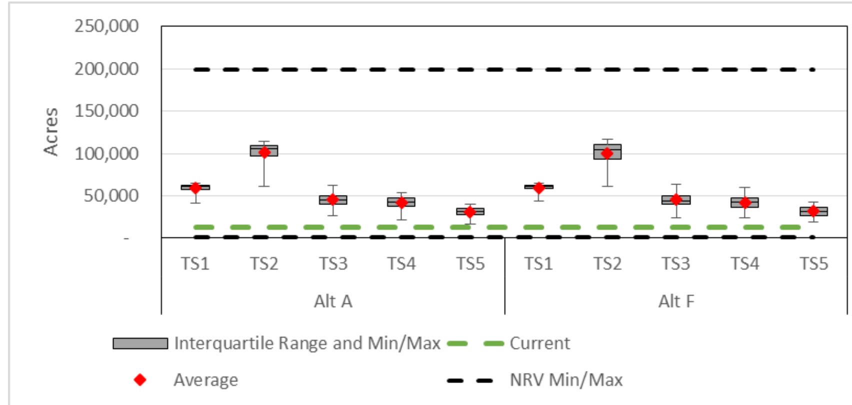


Figure 241. Average amount of stand Initiation Canada lynx habitat across 5 decades, by alternative and GA

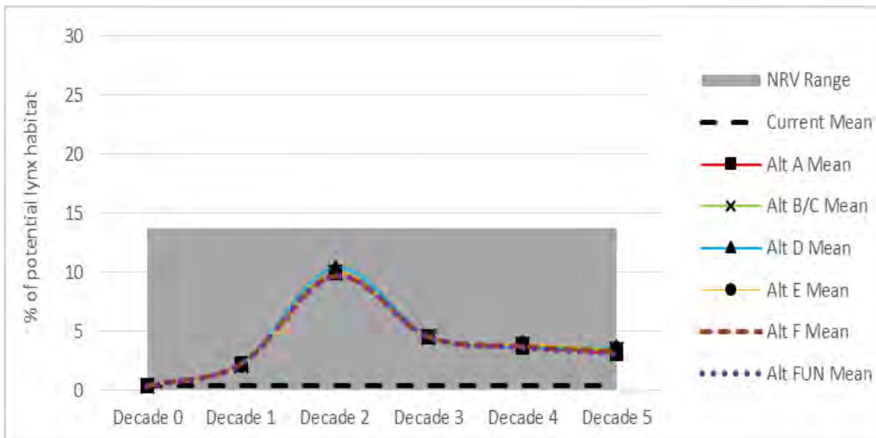
The following figure, Figure 242, displays stand initiation Canada lynx habitat over five decades by alternative and by analysis scale. The figure is large, so it is displayed over 5 pages.

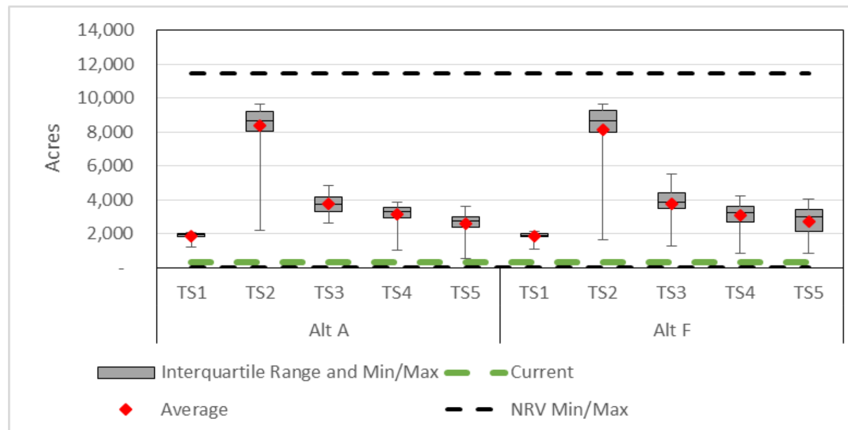
Forestwide



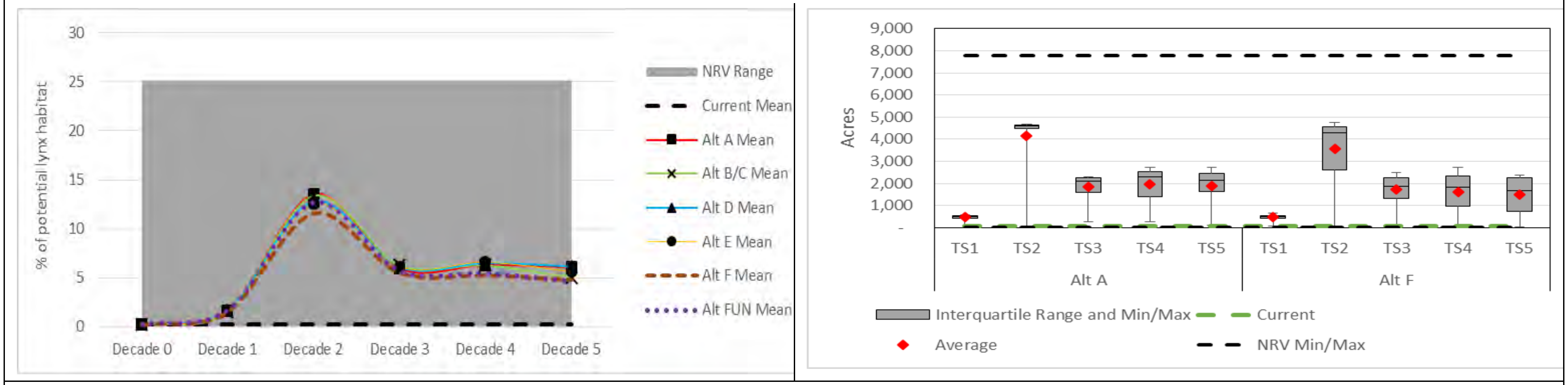


Big Belts

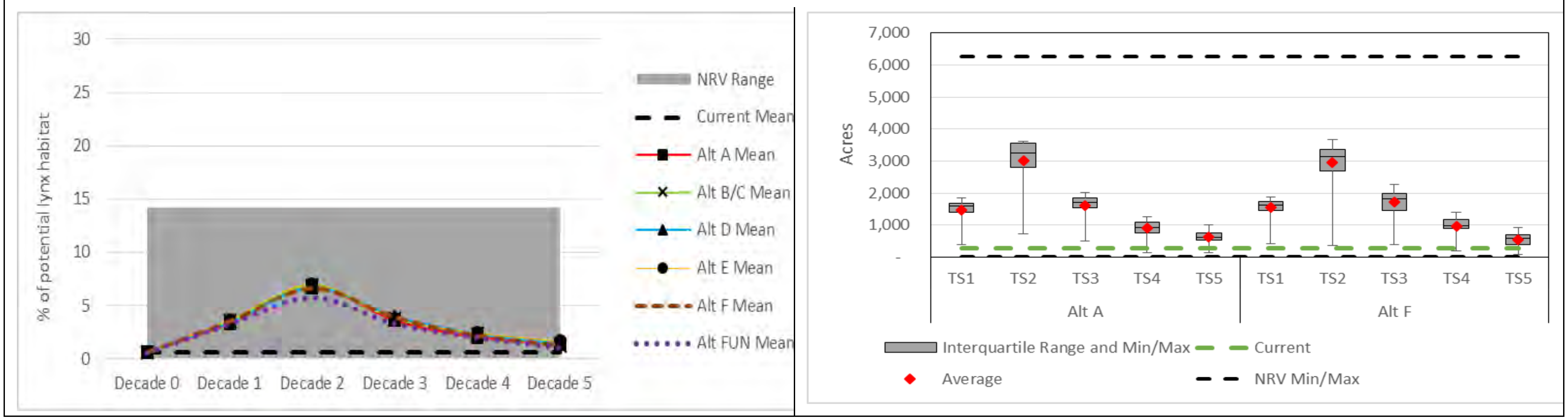




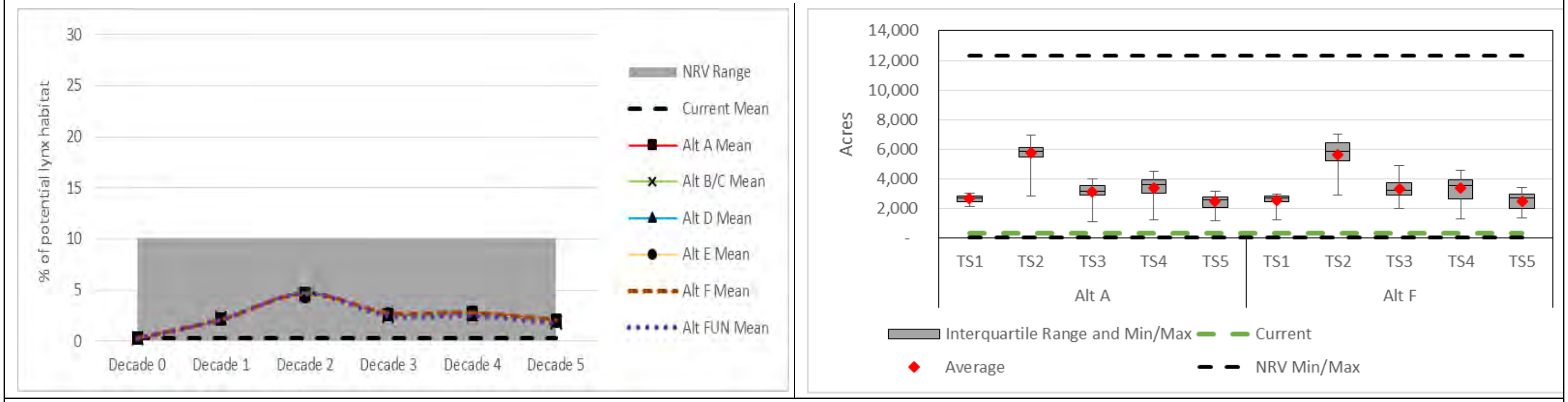
Castles



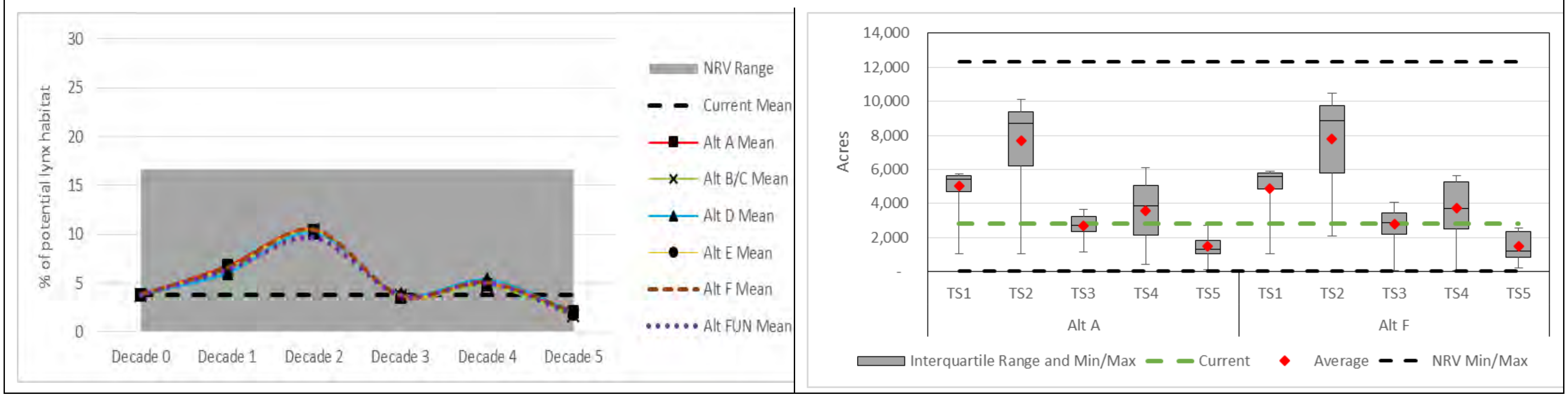
Crazies



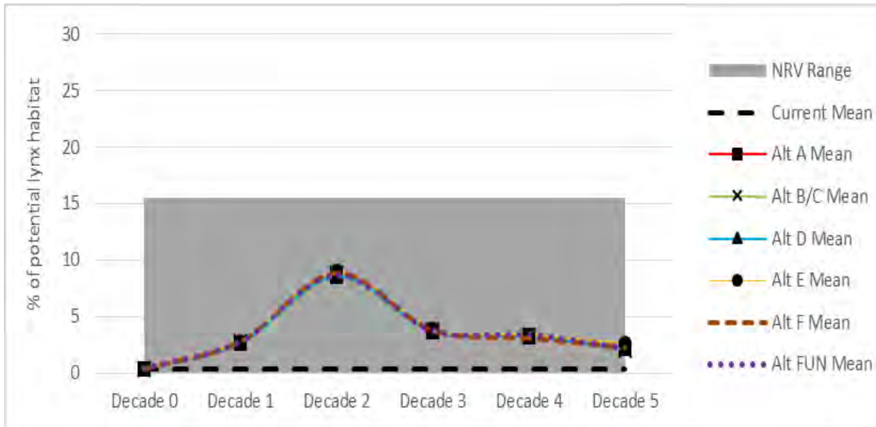
Divide

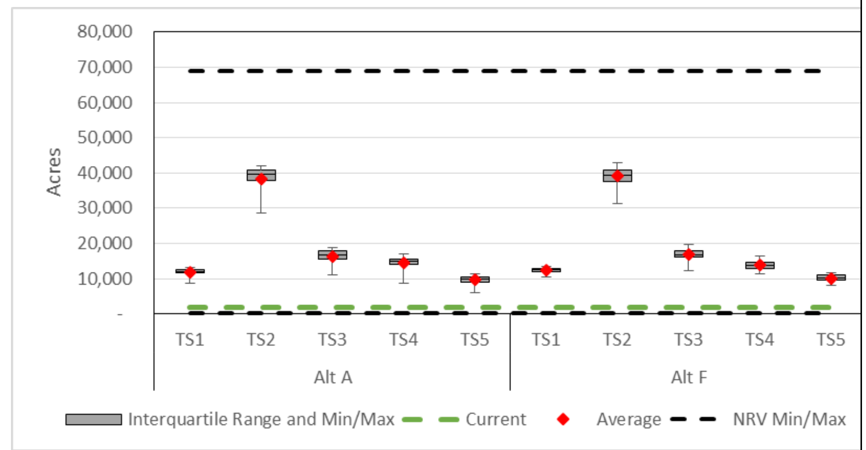


Elkhorns

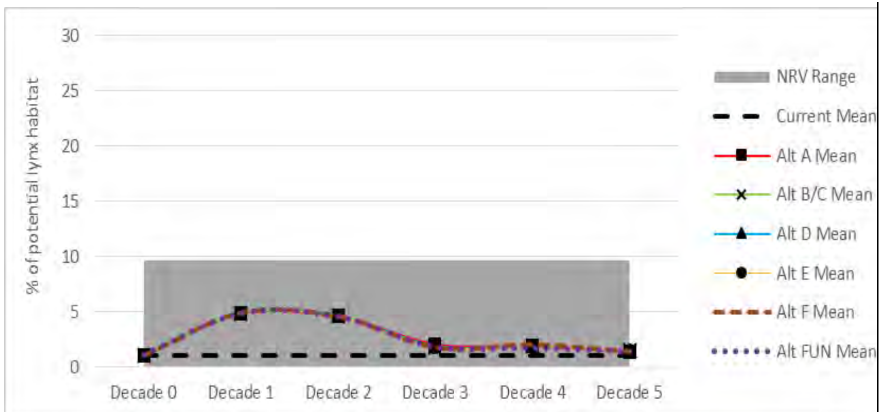


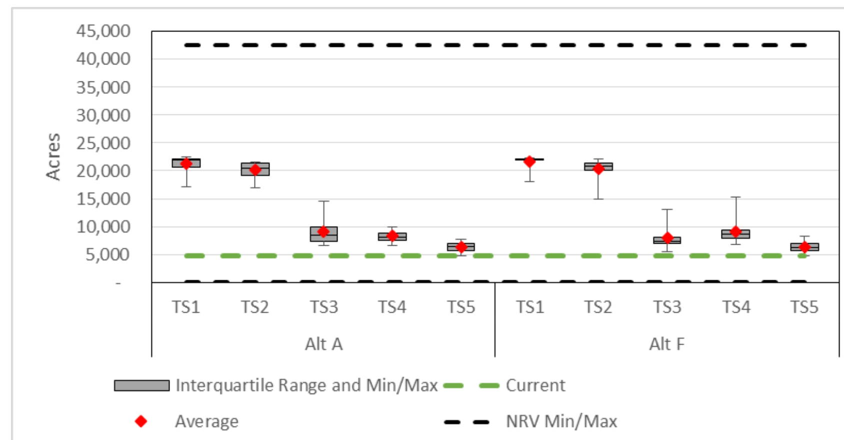
Little Belts





Rocky Mountain Range





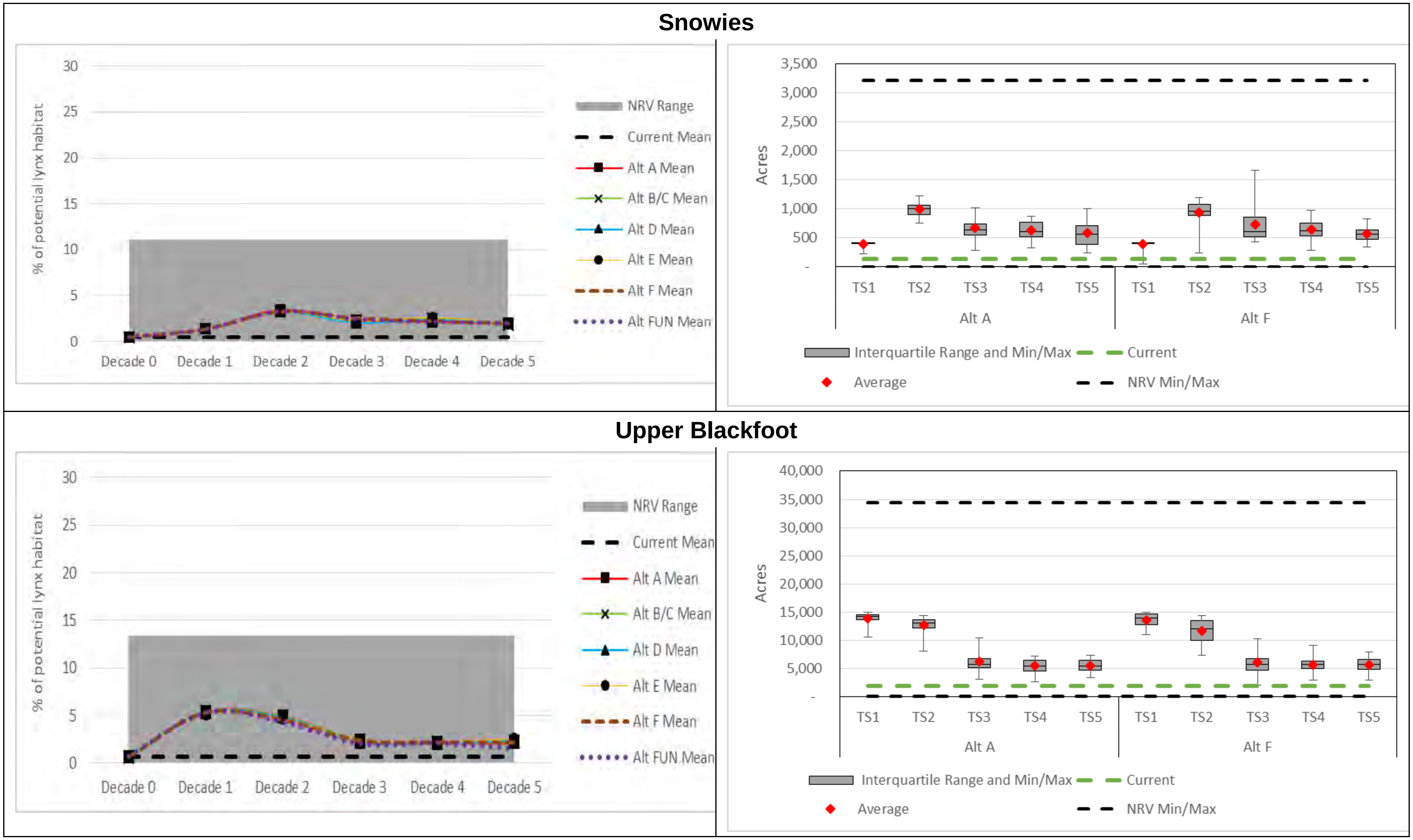


Figure 242. Stand initiation Canada lynx habitat over 5 decades, by alternative and analysis scale

Early stand initiation

In some GAs which are currently unoccupied, the extent of this habitat condition increases above the NRV. This trend is not evident in the forestwide average because of the large contribution in acres found in the large Rocky Mountain Range and Upper Blackfoot GAs, which are elevated now due to recent fire but decline over time toward the desired range. In some GAs, there is some variation across alternatives, although in most cases the magnitude is minor. The chart below shows the level of this habitat condition, as a percentage of potential lynx habitat, averaged across the 50 year analysis period. These averages are generally at the upper end or above the NRV, and there are some difference by alternative.

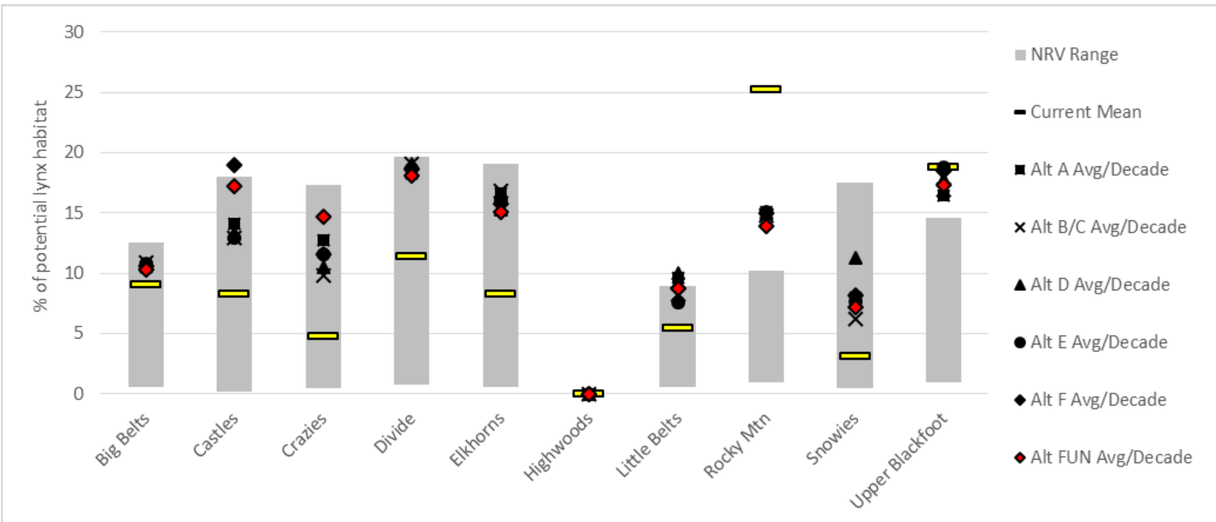
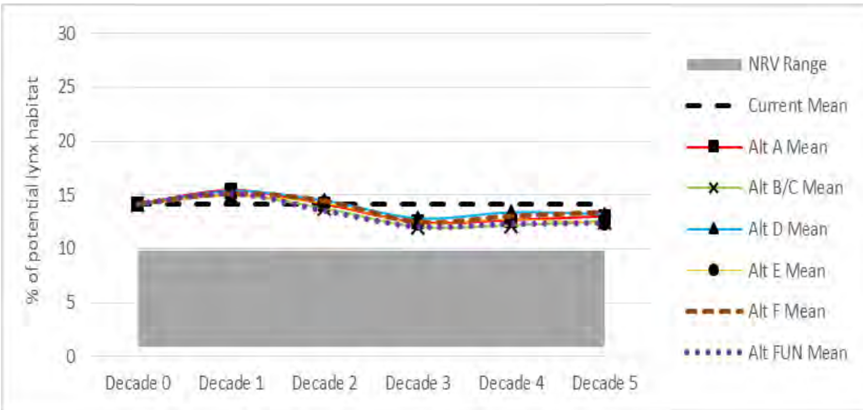
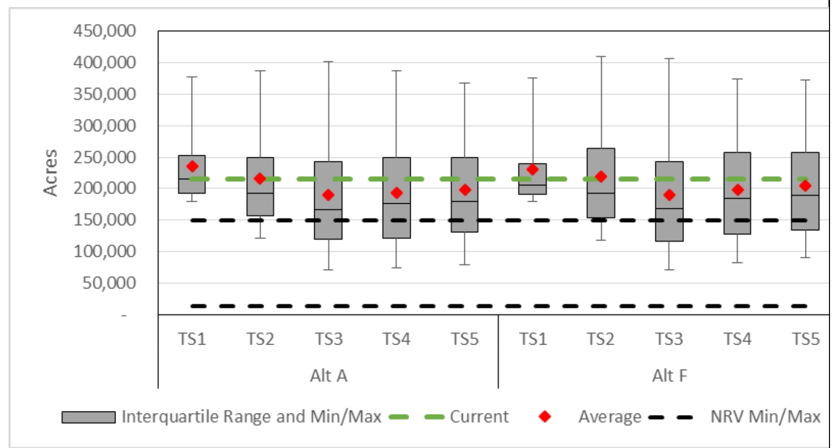


Figure 243. Early stand initiation Canada lynx habitat across 5 decades, by alternative and GA

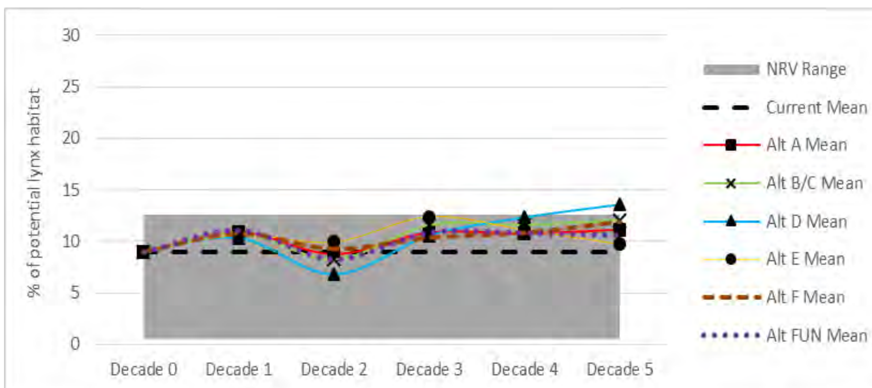
The following figure, Figure 244, displays early stand initiation Canada lynx habitat over five decades by alternative and analysis scale. The figure is large, so it is displayed over 5 pages.

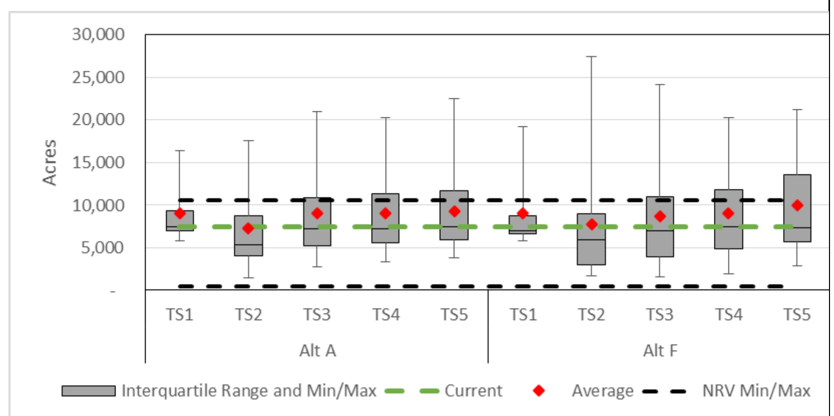
Forestwide



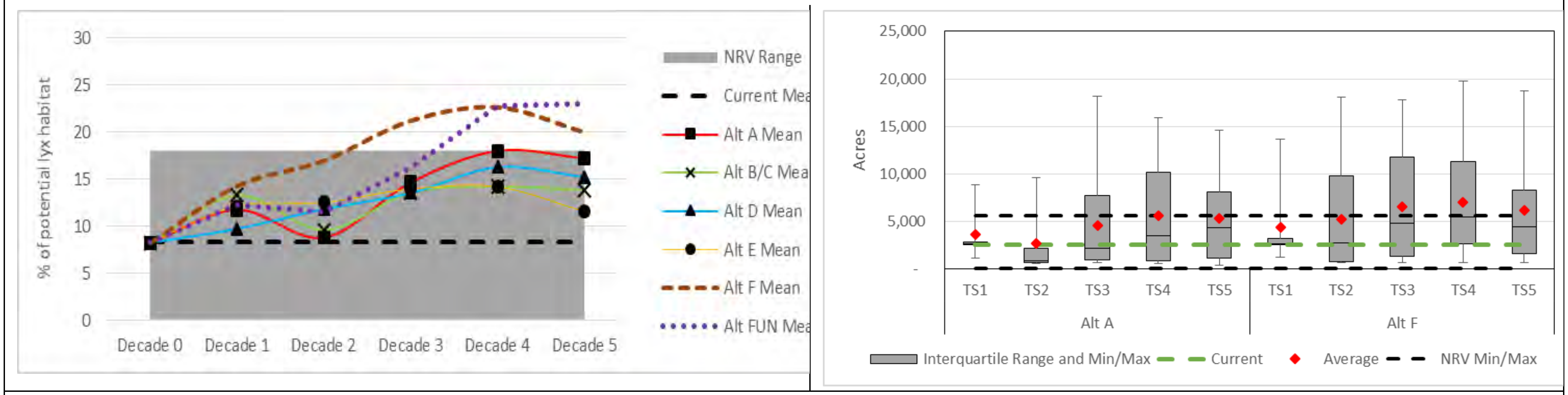


Big Belts

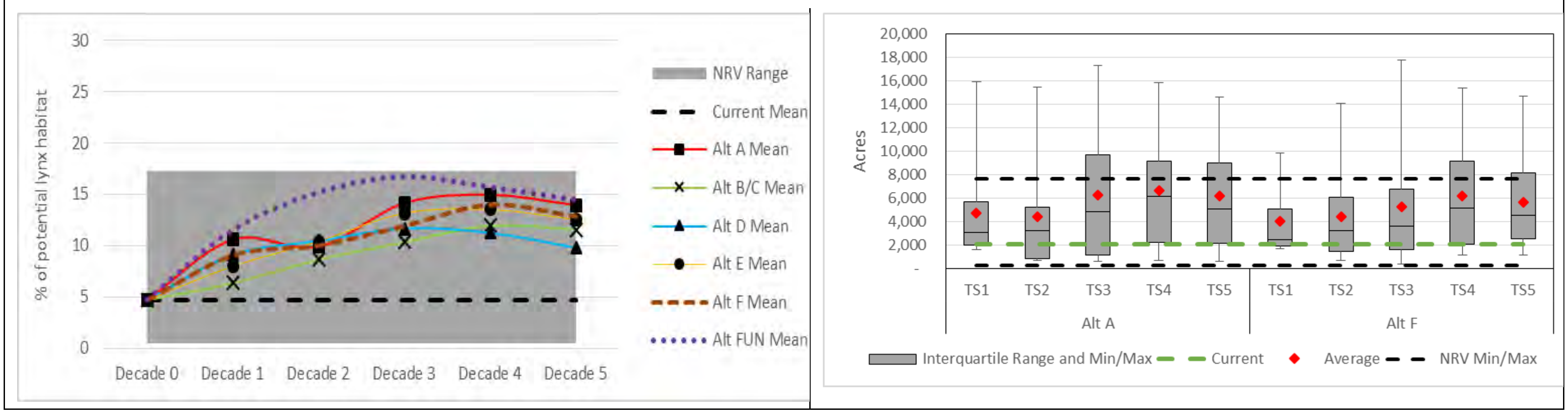




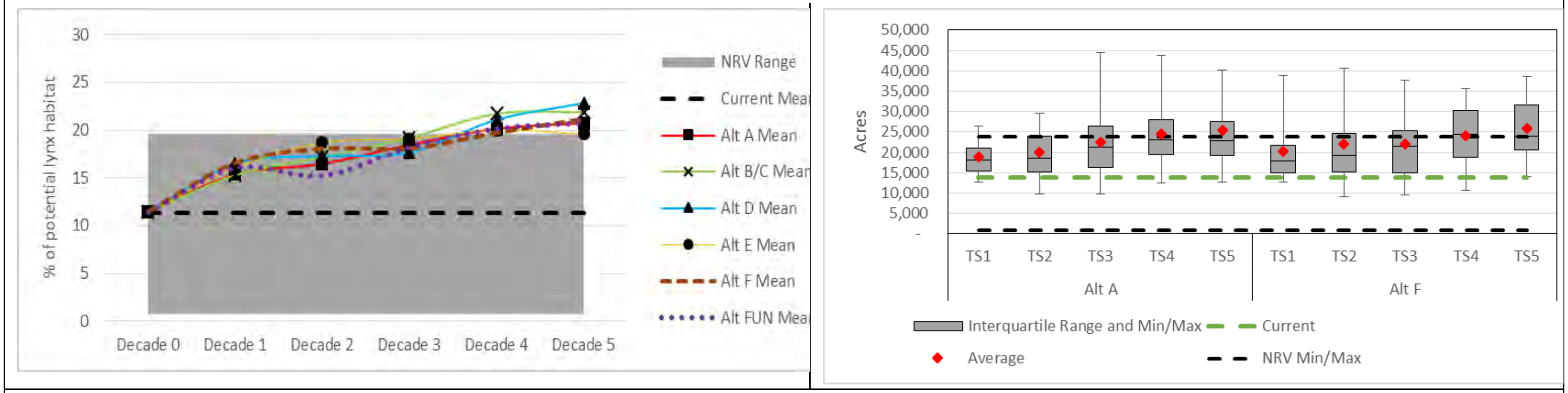
Castles



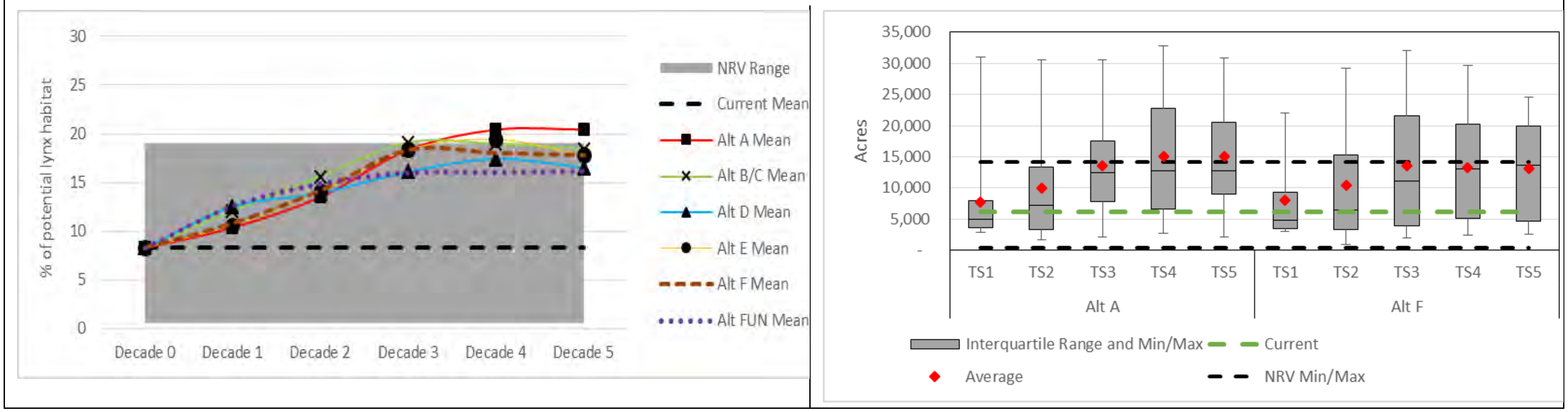
Crazies

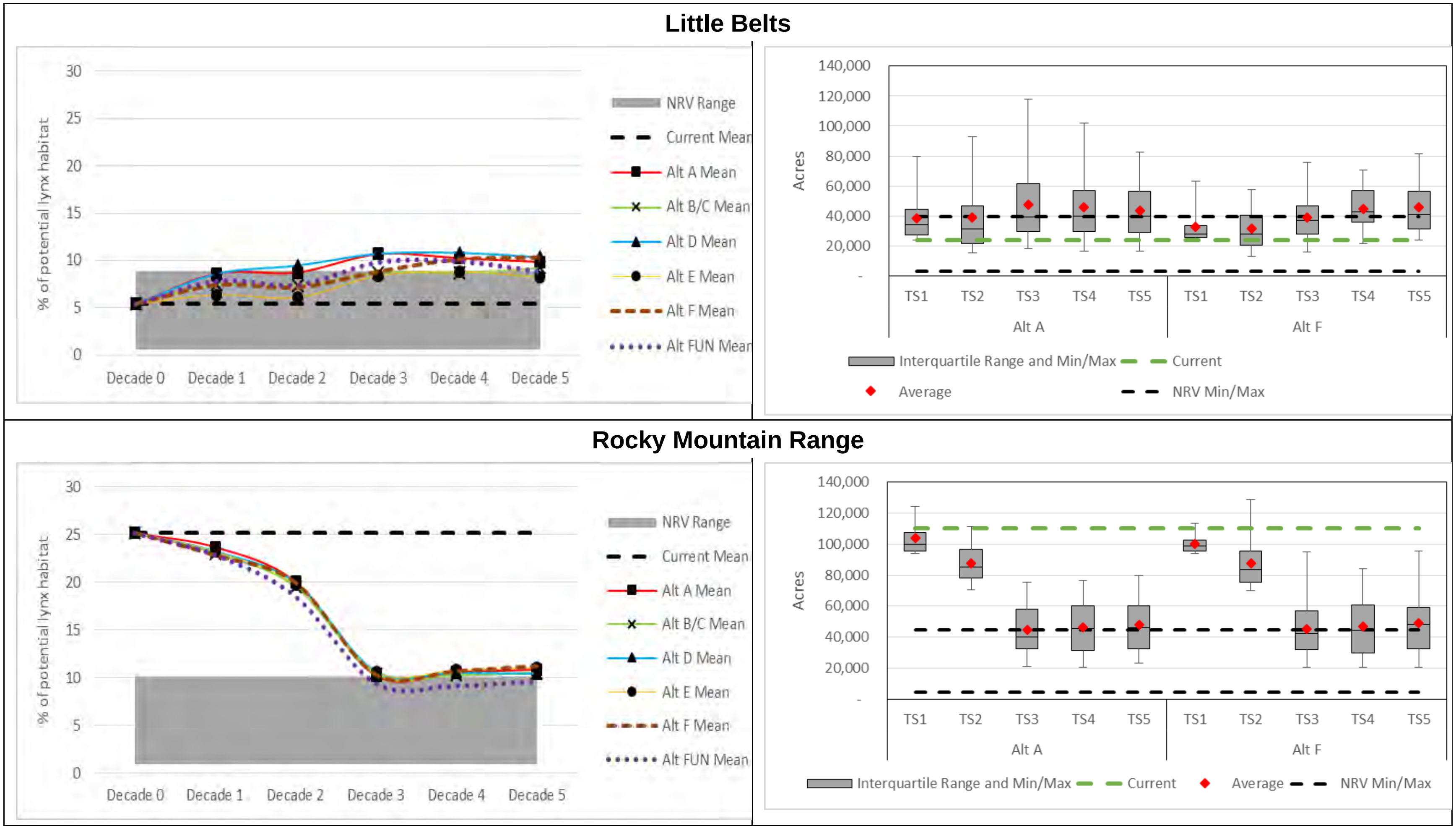


Divide



Elkhorns




Little Belts
% of potential lynx habitat
30
25
20
15
10
5
0
Decade 0
Decade 1
Decade 2
Decade 3
Decade 4
Decade 5
NRV Range
Current Mean
Alt A Mean
Alt B/C Mean
Alt D Mean
Alt E Mean
Alt F Mean
Alt FUN Mean
Acres
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
TS1
TS2
TS3
TS4
TS5
Alt A
Alt F
Interquartile Range and Min/Max
Current
Average
NRV Min/Max
Rocky Mountain Range

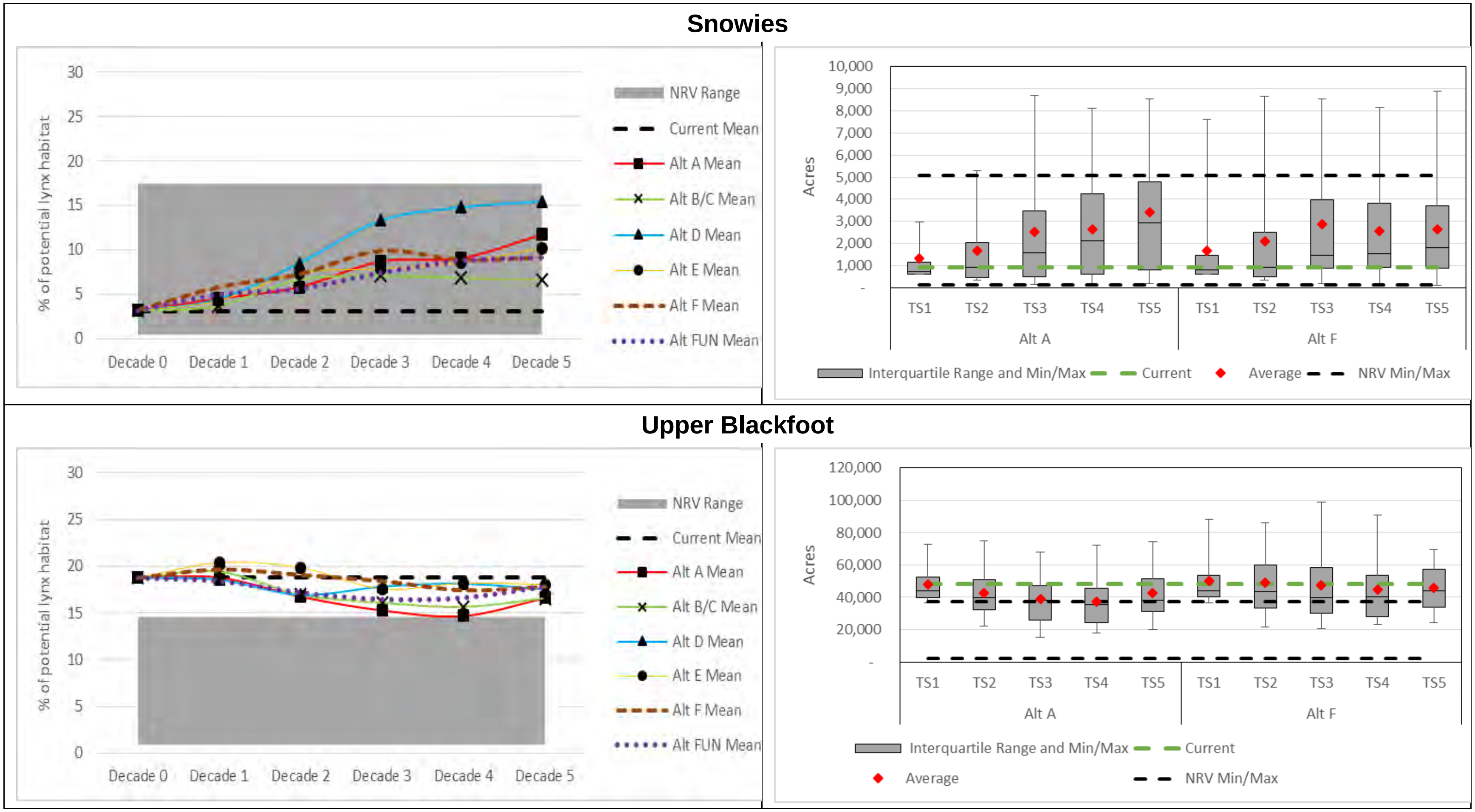


Figure 244. Early stand initiation Canada Lynx habitat over 5 decades, by alternative and analysis scale

Mature multistory

The model projects that Canada lynx mature multistory habitat will stay below the NRV. The chart below shows the level of this habitat condition, as a percentage of potential lynx habitat, averaged across the 50 year analysis period. It varies by GA as to whether the alternatives improve or worsen this trend. All alternatives appear to be similar.

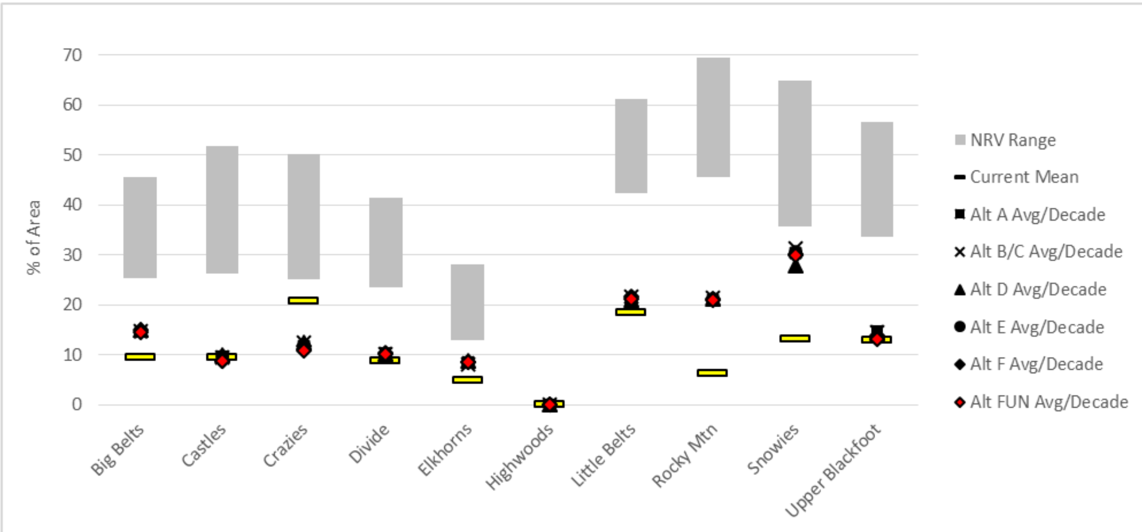
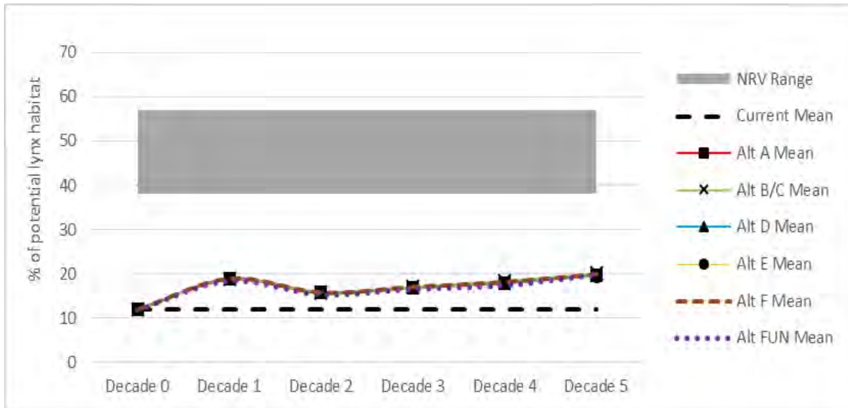
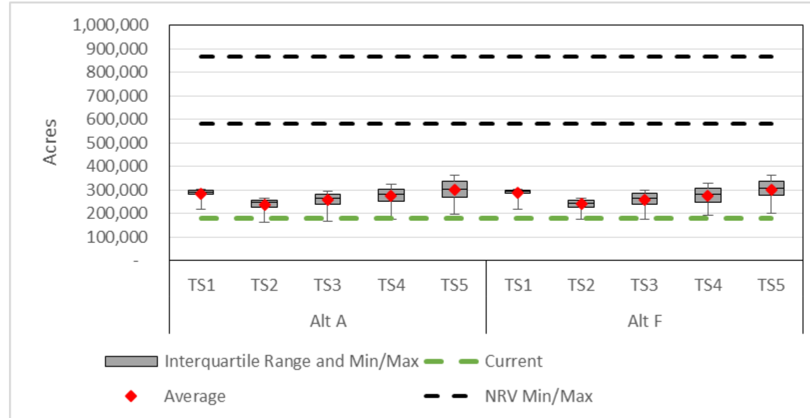


Figure 245. Mature multistory Canada Lynx habitat across all 5 decades, by alternative and GA

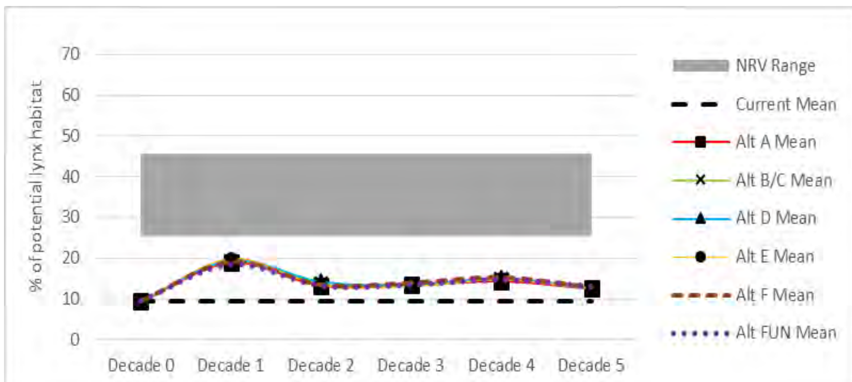
The following figure, Figure 246, displays mature multi-story Canada lynx habitat over five decades by alternative and analysis scale. The figure is large, so it is displayed over 5 pages.

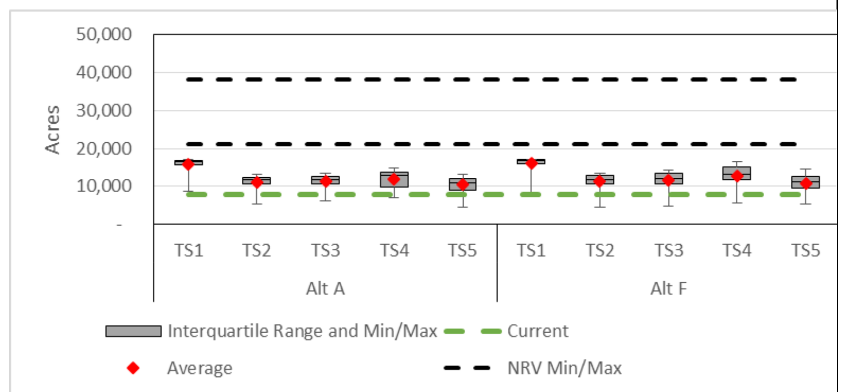
Forestwide



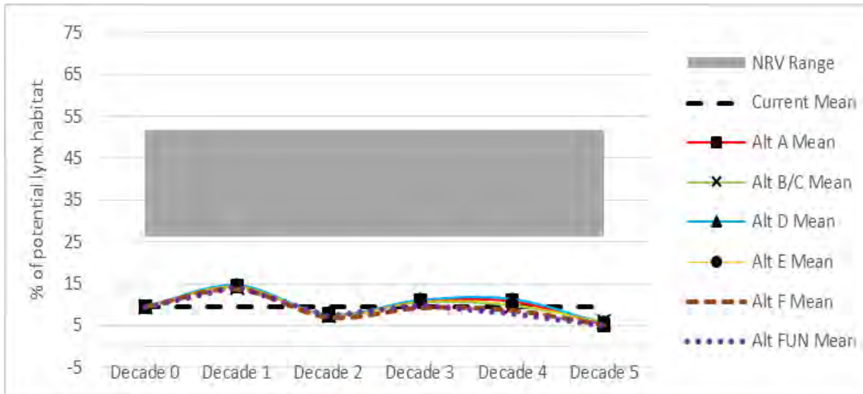


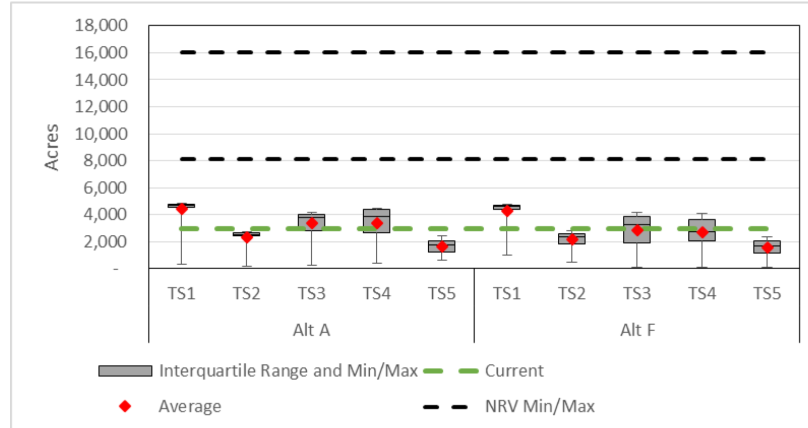
Big Belts



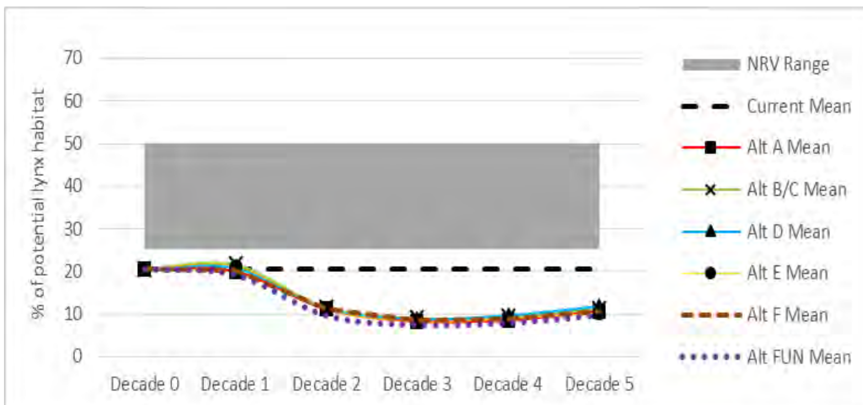


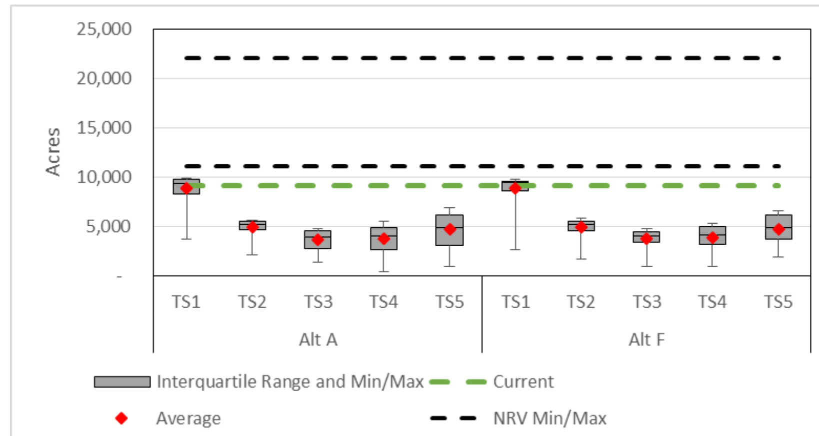
Castles



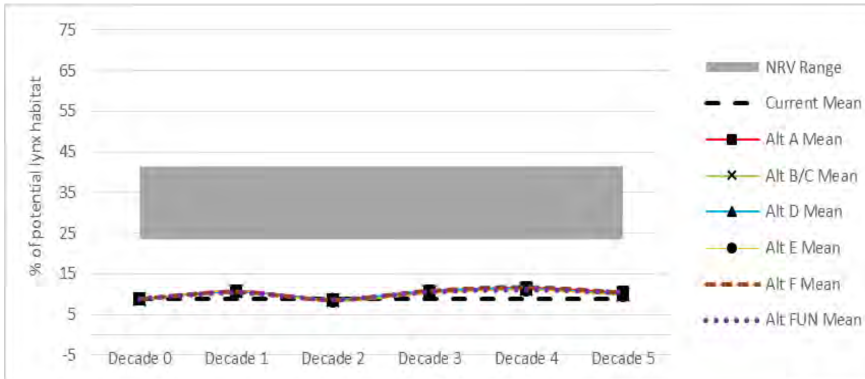


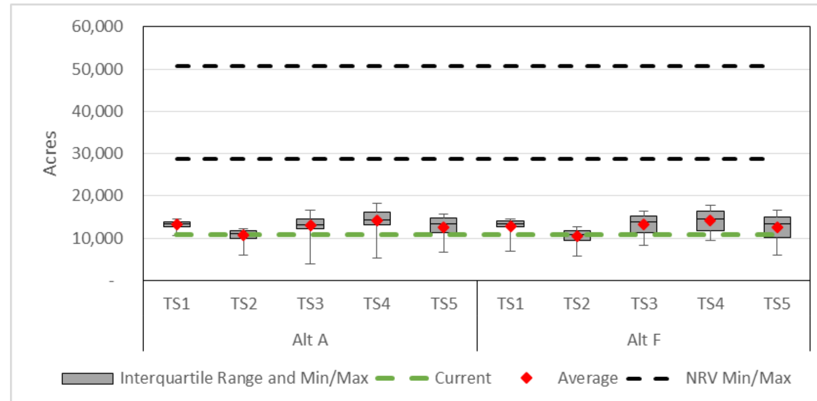
Crazies



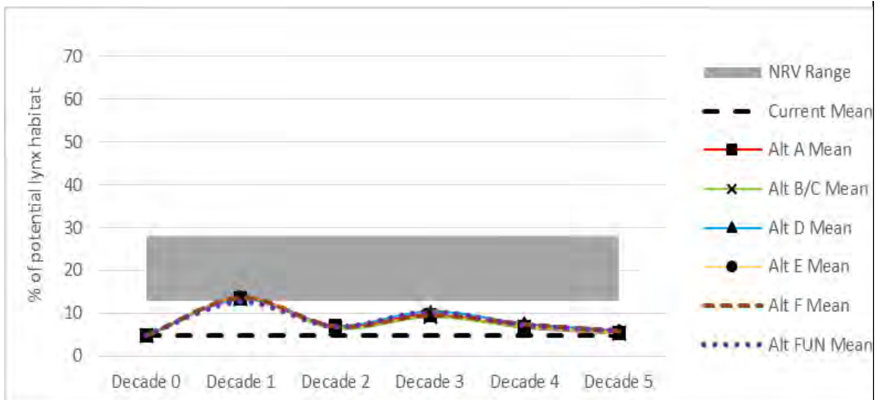


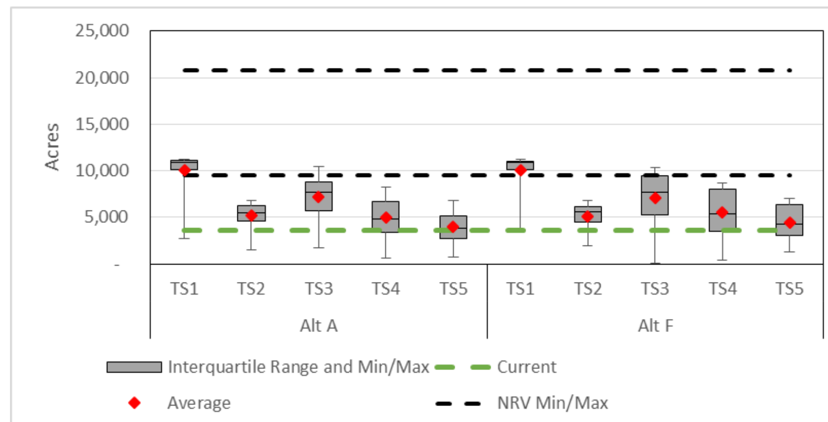
Divide



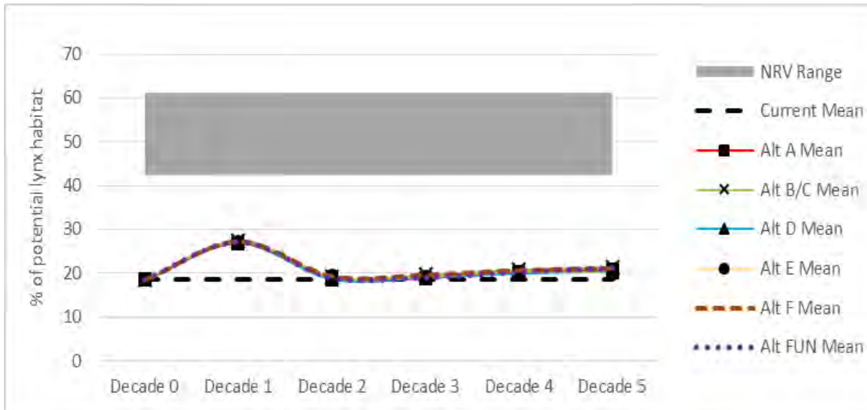


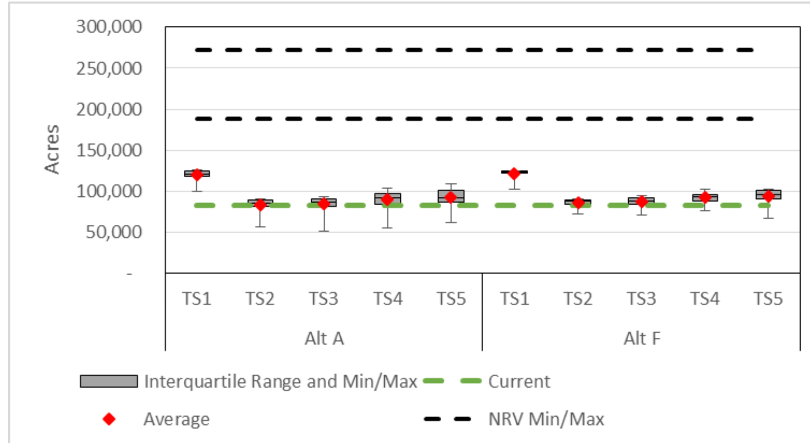
Elkhorns



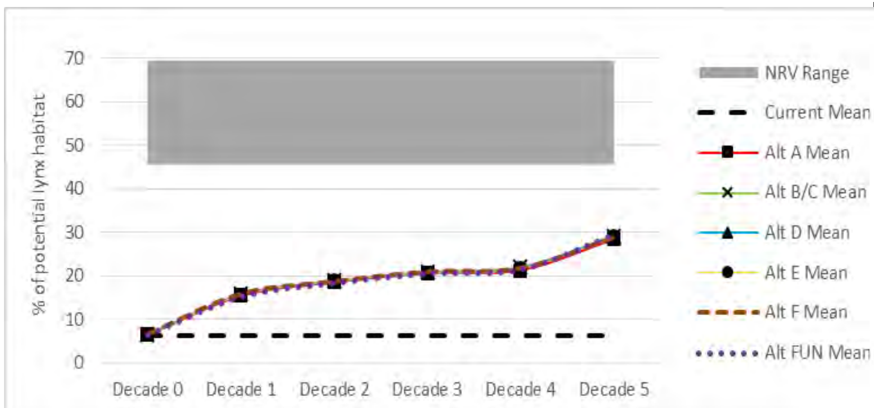


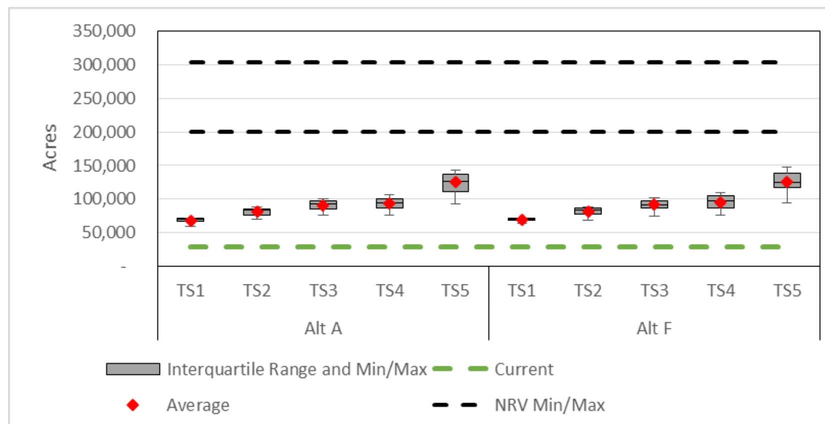
Little Belts





Rocky Mountain Range





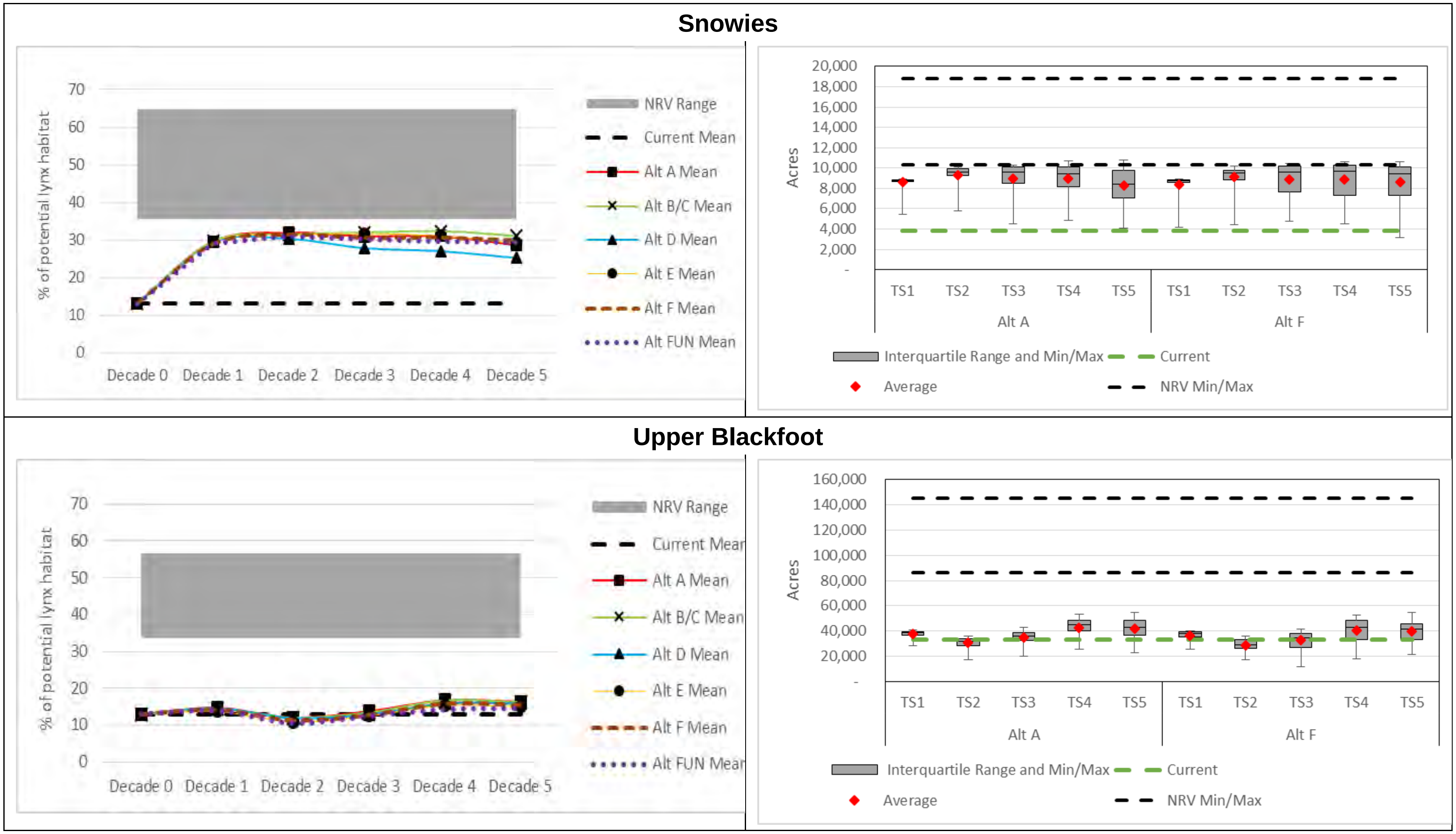


Figure 246. Mature multistory Canada lynx habitat over 5 decades, by alternative and analysis scale

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Appendix I. Natural Range of Variation Analysis and Results

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Tables

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Introduction

This document provides a summary and interpretation of the revised natural range of variation (NRV) analysis, which helps describe the ecological integrity of ecosystems. *Ecosystem integrity* is the quality or condition of an ecosystem when its dominant ecological characteristics occur within the NRV and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (CFR 219.19). Prior to revising forest plans, the interdisciplinary team must determine the extent to which ecosystems relevant to the plan area have integrity (FSH 1909.12.1). Ecosystems have integrity when their composition, structure, function, and connectivity are operating normally over multiple spatial and temporal scales (FSH 1901.12.14). Determining ecosystem integrity includes:

1. Using the NRV or alternative approach to determine conditions that sustain the integrity of the selected key ecosystem characteristics.
2. Assessing and documenting the current condition and status of ecosystems using key ecosystem characteristics and projecting their future conditions and trends.

This document summarizes of the NRV condition, along with some discussion of future trend. The assessment as well as FEIS provide more detailed analysis on future conditions.

The NRV concept can be further summarized as follows (FSH 1909.12.05):

"NRV is the variation of ecological characteristics and processes over scales of time and space that are appropriate for a management application. The pre-European influenced reference period considered should be sufficiently long, often several centuries, to include the full range of variation produced by dominant natural disturbance regimes and should also include short-term variation and cycles in climate. The NRV is a tool for assessing the ecological integrity and does not necessarily constitute a management target or desired condition. The NRV can help identify key structural, functional, compositional, and connectivity characteristics for which plan components may be important for either maintenance or restoration of such ecological conditions."

Direction also includes (FSH 1909.12.14a 2015):

- The Interdisciplinary Team should use the NRV as the ecological reference model, unless the past information regarding the key ecosystem characteristic is lacking or the system is no longer capable of sustaining key ecosystem characteristics based upon likely future environmental conditions.
- The NRV can be compared to existing conditions and recent disturbance processes, allowing the Interdisciplinary Team to identify important compositional, structural, and functional ecosystem elements for developing plan components.
- The NRV does not represent a management target or desired condition.
- The NRV should be described as a range of conditions and dominant processes occurring over the period selected for analysis.

Ecosystem integrity and the NRV is used to develop proposed plan components (FSH 1909.12.23.11a):

"An understanding of the NRV provides context and insights to the design of plan components. Agency intent is to promote ecosystem integrity in the plan area. However, it may not be possible or appropriate to strive for returning key characteristics to past conditions throughout the plan area. Understanding the NRV is fundamental in strategic thinking and planning, even if restoration to historical conditions is not the management goal or possible on parts of the plan area. The NRV is useful for understanding each specific ecosystem, its existing ecological conditions, and its likely future character based on projections of climate. The goal of understanding NRV is to help design plan components to maintain or restore the integrity of the diversity of ecosystems and

habitat types throughout the plan area [to] provide an ecosystem (coarse filter) approach to maintaining the persistence of native species."

Where appropriate, plan components should be designed to maintain or restore the NRV of key ecosystem characteristics needed to promote ecosystem integrity in the plan area, although for specific areas within an ecosystem, the Responsible Official may determine that it is not appropriate, practical, possible, or desirable to contribute to restoring conditions to the NRV (FSH 1909.12.23.11a).

Changes from the original natural range of variation analysis

The original NRV analysis was conducted in 2017, as summarized in the report titled "*Helena - Lewis and Clark National Forest Natural Range of Variation Analysis for Forest Plan Revision Summary Report March 2017*". This work was redone in May of 2018 to incorporate several key modeling improvements, described below. These improvements increase the accuracy of the analysis, which is crucial to the development and validation of desired future conditions. As a result, the desired conditions related to vegetation presented in the 2021 Forest Plan changed between the DEIS and the FEIS.

- *Updated western spruce budworm logic*. This logic better reflects the cyclic nature of this insect and more closely predicts likely acreages affected. The probability of forests experiencing damage if hazard to the pest was present in adjacent areas was increased, and pathways were added to include all species that can be affected. Pathways were also added to allow infestation in small size classes (pole and seedling/sapling forests), where the most damage can occur when in proximity to larger trees. The overall result is more areas being affected by this insect.
- *Updated fire spread logic calibrations*. The updated logic better reflects the size and shape of fires on the landscape. With the previous logic, fires modeled as square shapes; with the improved logic, they grow organically. In addition, an error was corrected that occurred when fires bumped up against the boundary. In the previous model version, fires had to meet a randomly-drawn predetermined size within the landscape. This means they were often modeled burning upwind and down hills/into drainages, and spread out at the boundaries of landscapes. The fire would hit the modeling boundary and "bounce" back into the landscape, rather than progressing onto adjacent lands. In the corrected model version, the size of the fire includes an inferred amount of burning outside the landscape, which means less burning within the landscape. The modeling extent also included lands on adjacent NFs to allow disturbances to progress naturally. Finally, rather than assigning fire distribution individually to each geographic area (GA), the fire distribution was assigned to the Forest as a whole. These updates to fire logic collectively resulted in a reduction in the estimated historic levels of fire on the landscape, which are more realistic based on expert review. Although the estimated acres of fire are reduced in the updated NRV, it remains a primary driving disturbance.
- *Improved potential vegetation type (PVT) classification*. Following the initial NRV modeling, issues with the crosswalk of habitat type groups in SIMPPLLE to the R1 broad PVTs were discovered. The amount of the cold type was underrepresented, and the amount of cool moist was overrepresented. This arose because there is not a direct crosswalk between the habitat type groups in SIMPPLLE and the R1 PVTs. Several habitat type groups are nested within two different broad groups: "abla3" (F2) and "pico" (F1). Because the specific habitat types are not mapped, assumptions must be made as to which group each pixel belongs in based on factors such as elevation, aspect, and dominant species. The logic to assign R1 broad PVTs was updated to better reflect the split between cold and cool moist, resulting in better alignment with the known abundance of these types according to plot data. This resulted in changes in the conditions summarized by PVT.
- *Updated spatial input file*. After the original NRV, but before the DEIS, the input file (map) for SIMPPLLE was updated to better reflect the species presence measured on FIA plots. In addition, the modeling extent was updated to exclude vast areas of private land between the GAs so that the entire

HLC NF can be modeled as one simulation. Non-NFS lands within the HLC NF boundary, as well as in a buffer outside the boundary, are included in the modeling to ensure results take into account the condition of all lands and allow disturbances to progress across the landscape. The results of fires and vegetation treatments that occurred after the map imagery was collected were incorporated. This updated input file was used as the starting condition for the new NRV analysis, so that it is consistent with the starting condition for future modeling.

- *Excluded private land inholdings from the results.* In the original NRV analysis, the acres reported included private land inholdings within GA boundaries. Although the model is still run across all ownerships, the revised NRV analysis reports outputs for NFS lands only, which allows for a straight comparison to the existing condition and the future condition modeling. This change was minor in most landscapes, but in a few GAs (e.g., the Big Belts) this change was measurable due to high amounts of private land inholdings.
- *Pathway adjustments*: Several pathway adjustments were made for the DEIS and incorporated into the revised NRV. This included ensuring that lodgepole pine had a mechanism for re-seeding after fires if it was present prior to the fire (serotinous seed) or living stands are present nearby; and ensuring that whitebark pine has the opportunity to re-seed after a fire if there is a whitebark pine seed source on the landscape (to reflect potential seed caching by birds). The result of these changes is relatively minor, but may cause a slight reduction in spruce/fir abundance and increase in lodgepole pine or whitebark pine abundance after fire in some cases.
- *Updated existing condition data:* The existing condition data has been updated to incorporate the latest available information. Base forest inventory analysis (FIA) data was updated from the Hybrid 2007 dataset to the Hybrid 2011 dataset. The intensified grid FIA data was updated from the 2013 dataset to a 2016 dataset. These datasets reflect the latest available re-measurements of plots. Finally, for the FEIS, it was determined that R1 VMap provides the best available depiction of density class based on canopy cover, because it is measured directly from imagery, rather than from FIA, where it is estimated. The existing condition values for the revised NRV are therefore derived from R1 VMap instead of FIA for the density class attribute.

The project file contains detailed spreadsheets and charts that compare the original NRV results and existing condition estimates, with the revised NRV results and updated existing condition estimates. For brevity, this report only includes the revised NRV results.

Methodology

To quantify the NRV, modeling was done to simulate vegetation conditions prior to European settlement. The best available model is SIMulating Patterns and Processes at Landscape scaLEs (SIMPPLLE) Version 2.5. This model was developed in Region 1 to answer landscape management questions. SIMPPLLE uses existing data and grows it through time with parameters that reflect historic climate and disturbance.

Thirty simulation runs were done for 1,000 years to provide a range of possible outcomes. This reference period allowed the HLC NF to simulate the conditions associated with much of the time period known as the Medieval Climate Anomaly (about 950 to 1250), as well as the other end of the climate spectrum known as the Little Ice Age (early 1300s to about 1870s). The inclusion of the Medieval Climate Anomaly is valuable in that it might indicate conditions and processes that could occur in the modern climate regime.

Any single simulation can present a possible scenario of what could happen, but cannot be taken as a precise prediction. SIMPPLLE provides for interaction between disturbances and vegetative patterns (Chew et al. 2012). The starting SIMPPLLE spatial dataset was built to reflect the condition measured with FIA data as closely as possible, but minor differences are inherent due to the process of associating grid data to polygons. The existing condition classifications used are consistent with the R1 Classification System (Barber, Bush and Berglund 2011). SIMPPLLE labels are cross-walked to this system.

Climate is the primary parameter used to depict the historic condition. The Rocky Mountain Research Station advised that the best indicator of past climate for this application is the Palmer Drought Severity Index (PDSI). PDSI has been used as an indicator for historic climate in other vegetation reconstructions (McGarigal and Romme 2012). Data for the PDSI is for a set of gridded points covering the continental United States (https://www.ncdc.noaa.gov/). Data point 83 from the 2008 North American reconstruction was used to evaluate the climate for the HLC NF. PDSI is presented as an annual value that has to be generalized to a decadal average for simulations in SIMPPLLE. The data was smoothed using a Savitzky–Golay filter with a 51 year window and a third order polynomial, as shown in Figure 1. Each filtered data point from year 970 to 2000 was classified such that data in the lowest quartile is dry, the middle two quartiles are normal and the upper quartile is wet. Each decade was classified as dry, normal or wet based on the annual value with the majority of occurrences.

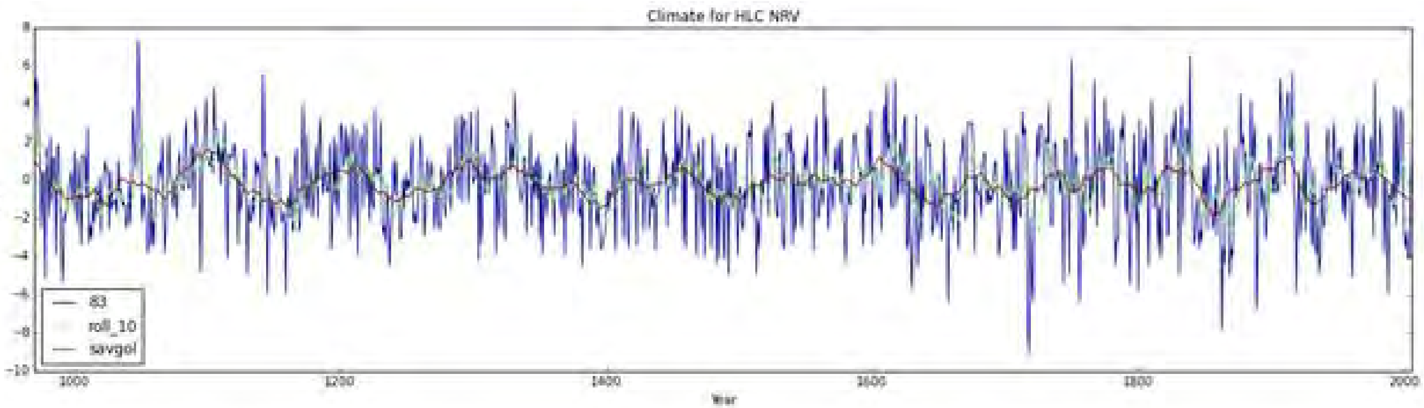


Figure 1. Smoothed Palmer drought severity index values to represent historic climate showing filtered data and rolling 10 year mean

Additional pathways and processes were calibrated to reflect the conditions on the HLC NF, including:

- *Successional Pathways*: Successional pathways are state and transitional models for each vegetation type that provide the foundation for the model. The existing data was reviewed, and pathways were added and/or modified based on expert judgement and successional theory.
- *Wildfire Processes*: Wildfire processes, including the probability of ignition, fire sizes, fire regimes (severities), weather ending events, and effects to successional pathways are key drivers in the model. Wildfire processes were calibrated using local fire history data, applicable fire history studies and publications, previous modeling efforts, and expert judgement.
- *Insect and Disease Processes*: The probability and effects of key insect and disease processes (bark beetles, defoliators, and root diseases) were also calibrated using the latest science regarding insect hazard and mortality trends, local data, and expert judgement.
- *Wildlife Habitat Definitions*: For the key wildlife habitats selected for modeling, the parameters used to define the habitat were developed based on the most recent inter-agency habitat modeling work available, other published literature, and expert judgement.

The NRV is compared to the existing condition throughout the analysis. Quantification of the existing condition is provided by queries directly from the most recent available FIA and FIA intensified plot data with 90%

confidence intervals. The NRV values shown in the charts reflect the averages across all time periods and SIMPPLLE model runs. Also see appendix H of the FEIS for more information regarding the data sources and SIMPPLLE model calibrations done for NRV modeling.

Potential vegetation types

Region 1 broad PVTs provide the foundation for stratification of the NRV. These broad groups are assemblages of habitat types (Milburn et al. 2015, Pfister et al. 1977, Mueggler and Stewart 1980). Generally, it is assumed that habitat type is fixed because it infers physical characteristics that influence site capability. To the extent that disturbances and climate alter growing conditions, it is possible that a habitat type could shift. However, it is not possible to predict or map this. The broad PVTs used for the HLC NF are shown in appendix D of the 2021 Forest Plan. Warm dry forest PVTs are generally the most abundant except in the Rocky Mountain Range GA, where cool moist types dominate. The Big Belts and Highwoods contain a particularly high proportion of warm dry types. Nonforested PVTs are extensive across the lands in between the island mountain ranges, and are important components within the GAs. Some PVTs that are rare or exist as small patches (such as alpine and riparian) are poorly captured with FIA data and PVT mapping.

Key ecosystem characteristics

Ecosystems are complex; it is only possible to quantify a subset of ecosystem characteristics. Table 1 lists the key ecosystem characteristics included in the revised NRV analysis. These characteristics include wildlife habitats of at-risk species or species of significant interest to the public that rely on vegetation characteristics that can be reasonably estimated using available modelling tools. These characteristics were analyzed at several scales as appropriate, including forest-wide, by GA, and/or by broad PVT.

Table 1. Key ecosystem characteristics of vegetation included in NRV analysis

Element	Characteristic
Composition	Cover type
	Tree species distribution
Structure	Forest size class
	Density class
	Vertical structure
	Large trees and large-tree structure
Pattern	Early successional forest openings
Wildlife Habitats	Canada lynx
	Flammulated owl
	Lewis’s woodpecker
	Elk

Analysis area

The HLC NF consists of 10 distinct geographic areas (GAs) spanning across a large portion of central Montana. The entire HLC NF was run as a single landbase, but results were summarized by GA when appropriate. Lands of all ownerships within the modeling extent were included. A map of the SIMPPLLE modeling extent is provided in appendix H.

Historic narrative

Vegetation on the HLC NF has changed through time. Along with physical site characteristics such as soils, the interactions of climate and disturbances determined the historic composition and structure of vegetation. Climate is a primary driver which exerts a strong influence on wildfire (Marlon et al. 2012, Littell et al. 2009) as well as insect and disease regimes. Vegetation varies with climate based on its direct influence on growing conditions as well as indirectly through its influence on disturbances. The last glacial period started roughly 40,000 years ago, reaching its peak 15,000 years ago; following this, a series of warming and cooling periods occurred (Losensky 2002). Following the Little Ice Age, some of the worst droughts and severe fires in the northwest occurred from the late 1800's to the mid-1930's (Barrett, Arno and Menakis 1997), a period which is correlated with a warm and dry climate phase.

In many areas of the HLC NF, limestone soils play a significant role in the location of plant communities (Losensky 1993b). Another unique feature of some landscapes are the woodland ecotones, which consisted of shrubby open-grown conifers which encroached into grasslands and periodically retreated with fire (ibid). Historic age class structures varied by cover type and GA; for example, in the Blackfoot most of the ponderosa pine forests were likely mature or old in 1900 due to the dry environment and prevalent underburning, while the Douglas-fir was dominated by mid-aged conditions and most lodgepole forests were less than 100 years old (ibid). In contrast, in the GAs with an island mountain range landform, a high proportion of young forest was present at that time as a result of frequent prairie fires (ibid). Early survey reports described in detail the forests and conditions that they observed in the GAs, including bull pine (ponderosa pine) at the lowest elevations, red fir (Douglas-fir), and lodgepole pine, along with less common species such as poplar (aspen and cottonwood), balsam fir (subalpine fir), spruce, and whitebark pine (Griffith 1904, Ayres 1900, U.S. Department of Agriculture 1926, Stickney 1907, Hatton 1904a, Hatton 1904b).

Wildfire is the most influential disturbance on the HLC NF, as lightning storms are common and provide a natural ignition source. Island mountain ranges, like many of the GAs on the HLC NF, support distinct fire regimes (Murray, Bunting and Morgan 1998). The protruding prominence of these ranges may attract a greater frequency of lighting-ignited fire; more fire can also result from the adjacency to steppe from which grass fires would spread (ibid). Island ranges may have a greater proportion burned in a given timespan than other landforms due to their limited extent; and have high landscape variability represented by a mosaic of distinguishable patches with distinct structures, compositions, and fuel loadings (ibid). Wind-speed during periods of drought may be more important than fuel or topographic parameters in facilitating large fire extent (ibid).

Coincident with a warm dry climate period, numerous reports indicate that large acreages on the HLC NF burned in the late 1800's in many of the GAs (Stickney 1907, Hatton 1904a, U.S. Department of Agriculture 1926, Hatton 1904b, Janssen 1949, Barrett 2005a, Losensky 1993a, Murray et al. 1998, Ayres 1900); (Leiberg 1904). For example, both Hatton (1904b) Janssen (1949) noted evidence of extensive fires in the late 1800's in the Big Belts which swept the range and gave rise to abundant pure, even-aged stands of Douglas-fir. Similarly, Aryes (1900) described evidence of extensive fire in the Rocky Mountain Range in 1889 which burned over 600 square miles with high severity during drought conditions, and gave rise to an increase in the abundance of lodgepole pine. During the period of settlement, human-caused fires associated with mining camps and settlements also increased in some areas, including the Elkhorns and Little Belts GAs (Griffith 1904, Leiberg 1904).

Early surveyors described the effects of the wildfires in the 1800's as undesirable relative to the ecosystem values at that time, using terms such as "destructive", "devastation", and "destroyed" (Stickney 1907, Hatton 1904b, Ayres 1900). Some early settlers and surveyors recognized the importance of forest cover not only for timber value, but to protect water resources needed for downstream uses such as irrigation (Griffith 1904, Hatton 1904a). When the forest reserves were established in the early 1900's fire suppression was considered to be necessary to protect resources. Fire suppression along with cooler, wetter climate conditions and grazing uses all contributed to an era of fire exclusion that was prominent from that time until roughly the 1980’s. At that point, warmer and drier conditions again began to prevail, and along with a build-up of fuels in some areas contributed to an increase in the acreages burned despite fire suppression efforts. In addition to climate, this trend has been influenced by an increased recognition of the natural role of fires that resulted in policy shifts that allow some natural fires to burn.

Insect and diseases also historically played an important role in shaping vegetation. These processes are influenced by climate and interact with wildfire. An early boundary report in the Upper Blackfoot GA found that “a considerable quantity of the lodgepole pine had been severely damaged by bark beetles”, which was “practically all mature”, 120-160 years old at that time (U.S. Department of Agriculture 1926). Janssen (Janssen 1949) and Hatton (1904a) both noted that root disease in Douglas-fir in the Big Belts was widespread. In 1949, western spruce budworm was also in a “severe epidemic stage”, in that GA which appeared to have started following red belt damage (Janssen 1949). Climate and weather play a major role in controlling insects, as does availability and quality of food and breeding habitat. Historically, insect populations would periodically build to high levels under favorable climatic and host conditions; cool climate conditions were not conducive to outbreaks.

A recent mountain pine beetle outbreak impacted the majority of pine forests across the HLC NF (Milburn 2015). Specifically, on the western part of the forest, roughly 2/3 of the lodgepole pine forests were impacted, with the most common change being a reduction in density. There has also been a reduction in ponderosa pine and lodgepole forest types, with a subsequent increase in subalpine fir and Douglas-fir; and the abundance of young forests increased as older trees were selectively killed. Other components of the forest were impacted, including an increase in small and medium snags, a decrease in old growth, and an increase in large woody debris. Similar vegetation changes undoubtedly occurred during historic outbreaks, although the severity and extent of the recent outbreak was influenced by anthropogenic factors such as fire exclusion that altered the condition and susceptibility of forests.

Human activities associated with settlement, such as urbanization, mining, logging, and grazing began in the mid to late 1800’s in most GAs, the influences of which are not considered part of the NRV. In the Elkhorns GA, accessible timber was cut over extensively around the 1880’s, and although regeneration was often “magnificent” it was also “menaced” by high amounts of woody debris left behind by fire and wasteful harvest practices (Griffith 1904, Stickney 1907). Other early surveys noted that in the Helena area “fire and the axe have made extensive invasions in the most accessible areas, and many of these show a present absence of forest conditions”; much of the accessible material was used for rail ties or cordwood (Hatton 1904b). Extensive mining indicated an ongoing demand for timber (Hatton 1904b, Griffith 1904).

Although Hatton (1904a) noted relatively little use of commercial timber within the Big Belts reserve due to a lack of roads, both he and Janssen (1949) noted that settlers established in the Big Belts in the 1870’s, and tree cutting was extensive to support the demand for timber from the rapidly growing communities of Great Falls and Helena. This included cutting of the ponderosa pine forests in the foothills; followed by lightning fires that occurred in the late 1880’s and early 1900’s this resulted in a decline of ponderosa pine forests (ibid). These “ponderosa pine bench” areas were also cut over during the building of the Canyon Ferry, Holter, and Hauser dams in the late 1890’s and early 1990’s (ibid). Further, miners burned off whole drainages to expose ore leads; as a result many of these areas were deforested (ibid). Similarly, in the Little Belts 25% of the forest area on the landscape was “logged to exhaustion”, and mining camps caused extensive fires since 1860 (Leiberg 1904).

In contrast, in the Upper Blackfoot GA reports indicate that due to inaccessibility there was not much demand for timber cutting during the early phases of settlement, and in 1926 the area was extensively forested with mature and over-mature forest (U.S. Department of Agriculture 1926). Similarly, early tree cutting was limited to “village use” in the Rocky Mountain Range, as “often the material can only be taken out with great difficulty” (Ayres 1900).

To a lesser extent than early harvest practices, modern vegetation management (since roughly 1940) has influenced composition and structure on a relatively small proportion of the HLC NF (8%).

NRV results and discussion

Introduction

This section summarizes the NRV results from SIMPPLLE that describe the envelope of vegetation conditions that were likely present in the plan area prior to European settlement. An understanding of the NRV provides insight into the dynamic nature of ecosystems, the components that have sustained the current complement of wildlife and plants, and the structural and functional properties of a resilient ecosystem. The NRV analysis includes inherent uncertainty and modeling limitations, and it is therefore necessary to use additional information to ensure that the desired conditions described in the plan meet future ecological and social needs.

Some NRV attributes are analyzed for individual GAs in addition to forestwide because each GA is unique. Attributes are also characterized by PVT to display conditions on the sites which have the capacity to support them. Due to limitations in available data and lack of statistical confidence, estimates are not broken down by PVT at the GA level. The extent to which existing conditions are similar or dissimilar to the NRV is discussed for each ecosystem characteristic. For most attributes, the 5^{th} and 95^{th} percentile ranges of the NRV outputs are reported, because this range eliminates rare outliers. However, the absolute minimum and maximum may be discussed where it provides additional context.

This report primarily focuses on disclosing the NRV condition and does not interpret future conditions and the effects of forest plan actions or alternatives. Further discussion of results of the NRV analysis as compared to the estimated effect of the 2021 Forest Plan and alternatives can be found in the FEIS.

Disturbances

Wildfires

Fire regimes exert a high level of influence on all key ecosystem characteristics. Historic wildfire regimes are analyzed in terms of the average acres burned per decade and fire severity. *Fire severity* describes immediate fire effects, as opposed to burn severity that depicts longer-term effects on vegetation and soils (Lentile et al. 2006). Fire severity is classified as low, mixed, or stand replacing based on effects to above-ground vegetation. To capture the differences in fire regimes and probability of fire in each GA, calibrations were done in the model by PVT, cover type, species fire resistance, and fire type under certain weather parameters. Historic fire occurrence and size data were used for calibrating fire probabilities.

Figure 2 displays the NRV for the average range acres burned by decade, by fire type, by broad PVT. The warm dry broad PVT tended to burn with mixed severity, while cool moist and cold sites tended to burn with stand replacing severity. Fires in nonforested PVTs are typically classified as stand replacing in the model, because they often kill the existing grasses, forbs, and shrubs. With all PVTs and fire types considered, the NRV estimates a 5th to 95^{th} percentile range of 20,000 to 235,000 acres burned per decade across the HLC NF.

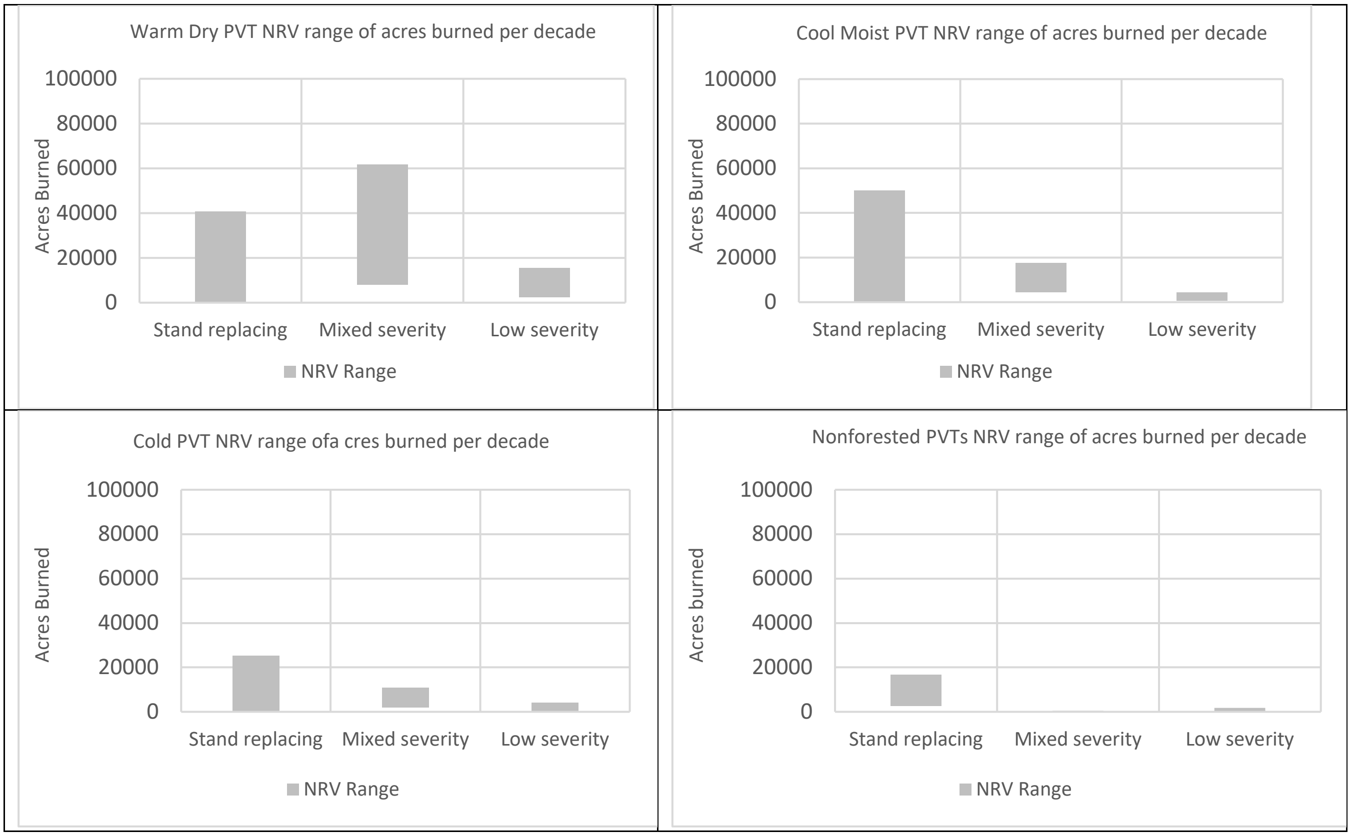


Figure 2. NRV .05-.95 range of acres burned per decade forestwide by PVT

The average acres burned per decade in the NRV (103,000 acres) is less than the average acres burned per decade since 1985 according to the Monitoring Burn Severity Trends (MTBS) database; this appears to contradict the well-researched trend that the role of fire has diminished from the NRV due to anthropogenic influences such as fire suppression. Therefore, further exploration of the data is warranted. It is critical to clarify that the overall NRV range (5-95 percentile of 20,000-235,000 acres/decade on NFS lands) is more appropriate to consider than the average acres/decade, because the historical "envelope" is more important than the single mean value.

First, the period of 1985-2015 is examined, because this represents when climate shifted to warm and dry, with associated increases in fire activity, and is often considered to represent a new/current fire regime. Decades are summarized as 1985-1994; 1995-2004; and 2005-2015. As shown in Table 2 and Figure 3, in most GAs the acres burned are below or at the low end of the NRV. In some GAs, the recent levels of burning have moved within the NRV range, but all except the Rocky Mountain Range remain within the NRV range. Although the forestwide totals are within the NRV range, it is important to note the spatial distribution of burning. Recent burning has been concentrated in some GAs but nearly absent from others, and represents different proportions of the forest total than what occurred in the NRV.

Table 2. Current burning (MTBS, 1985-2015) Compared to the NRV analysis (NFS lands only)

GA	Current Burning (30 years, 1985-2015, MTBS)			NRV (rounded to nearest 100)		
	Acres/decade	% of GA	% HLC NF acres burned	Acres/decade burned 5-95 percentile	% of GA	% HLC NF acres burned
Big Belts	15,743 (70-29,347)	5%	11%	2,700-51,400	6%	17%
Castles	2 (0-5)	0%	0%	150-11,000	4%	3%
Crazies	174 (0-511)	0%	0%	110-9,300	4%	2%
Divide	98 (0-193)	0%	0%	1900-35,500	6%	12%
Elkhorns	8,016 (0-23,745)	5%	6%	730-24,100	5%	7%
Highwoods	12 (0-35)	0%	0%	90-6,300	4%	2%
Little Belts	9,370 (3,584-14,909)	1%	7%	3,000-65,700	3%	20%
Rocky Mountain	80,018 (8,162-161,779)	10%	57%	2,200-55,600	2%	17%
Snowies	434 (0-1,249)	0%	0%	250-14,500	3%	4%
Upper Blackfoot	27,476 (6,850-43,847)	7%	19%	2700-47,200	5%	16%
Forestwide	**141,000 (79,262-190,221)**			**20,000-235,000**		

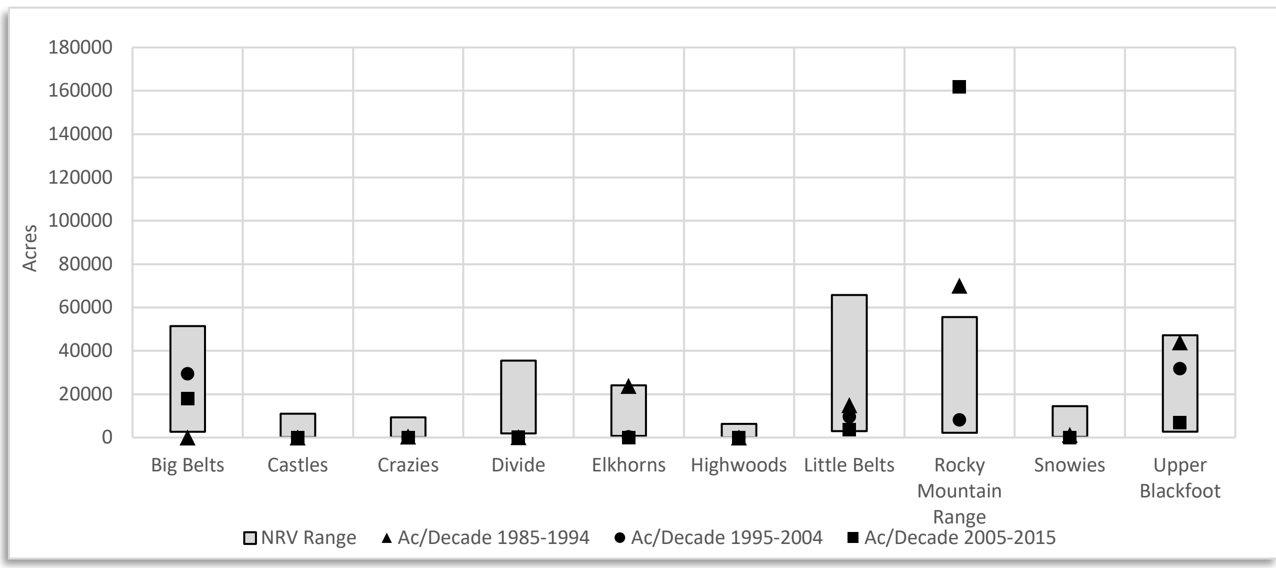


Figure 3. Acres burned/decade 1985-2015 (MTBS) compared to NRV 5-95 percentile ranges

A longer time scale of recent fire can be evaluated against the NRV, as shown in Table 3, to better understand the influences of the cool/moist climate period and fire exclusion era. The HLC NF fire history database was queried to show all fires since consistent records have been kept (1940-2016, 76 years). Decades are summarized as 1940-1949; 1950-1959; 1960-1969; 1970-1979; 1980-1989; 1990-1999; 2000-2009; and 2010-2016. Table 3 shows not only the 5-95 percentile range of the NRV, but also the absolute minimum and maximum acres burned in a decade. In most GAs, the average acres/decade burned since 1940 is at the lower end of the 5-95th percentile NRV range, with some below even the absolute minimum acres burned/decade (Castles, Divide, Highwoods). The maximum or upper bound of the range for actual acres burned is within the 95th percentile of the NRV for all GAs with the exception of the Rocky Mountain Range GA; however, the acres burned are within the absolute maximum of the NRV.

Table 3. Comparison of NRV range and acres burned 1940-2016 (NFS lands)

GA	Acres burned 1940-2016	Acres per decade 1940-2016	NRV 5-95 percentile acres burned per decade	NRV absolute min/max acres burned per decade
Big Belts	91,242	12,006 (0-65,657)	2,700-51,400	920-223,000
Castles	60	8 (0-43)	150-11,000	30-110,200
Crazies	1,952	257 (0-1,144)	110-9,300	30-62,000
Divide	589	77 (0-267)	1,900-35,500	400-164,000
Elkhorns	37,597	4,947 (0-37,311)	730-24,100	90-168,000
Highwoods	45	6 (0-35)	90-6,300	30-65,000
Little Belts	42,813	5,633 (498-12,353)	3,000-65,700	1,300-264,000
Rocky Mountain	362,603	47,711 (168-143,837)	2,200-55,600	680-220,000
Snowies	5,811	765 (0-2,780)	250-14,500	30-145,000
Upper Blackfoot	81,922	10,779 (0-36,886)	2,700-47,200	670-184,000
Forestwide	624,635	82,189 (2,155-257,194)	20,000-235,000	10,000-521,000

The Rocky Mountain Range GA is unique in its relationship to the NRV. This GA only accounted for 17% of the HLC acres burned in the NRV but accounts for 57% of the burning that has occurred since 1985; in other words, much of the recent fire on the HLC has been concentrated there. The total acres burned in recent decades exceeds the 95th percentile acres burned in a given decade in the NRV. However, the recent acres do not exceed the absolute maximum acres of burning/decade. Therefore, the recent levels of fire would have been uncommon but not unprecedented in the 1,000 years prior to European settlement. The Rocky Mountain Range contains large expanses of backcountry where natural fire has been allowed to occur. The burning that resulted in the average fire acres exceeding the NRV occurred during the last 30 years, following decades of very little fire. The large fire years in this GA occurred in notable dry fire seasons (1988, 2007, and 2015); refer to the figures in the following section. This landscape has made disproportionate strides in recent decades to make up for the earlier fire deficit.

The Upper Blackfoot also exceeded the average NRV acres burned per decade in recent years; however, the acres burned are well within NRV 5-95th percentile range per decade. The area burned from 1985-2015 in the Big Belts and Elkhorns is similar to NRV average and well within the 5-95th percentile range. Burning in the other landscapes has contributed little to the forestwide total, and have been at the low end or below the NRV range (Castles, Crazies, Divide, Highwoods, Little Belts, and Snowies).

Over time, as shown in Figure 4, the acres burned per decade forestwide were below the 5-95th NRV range except for 1980-1989; 2000-2009; and from 2010 to present day. This indicates that under recent climate and policy regimes, burning in recent decades has moved into the NRV range at the forestwide scale, and this trend is likely to continue given expected climate. The levels of recent burning are well within the absolute NRV maximum, indicating that such burning was uncommon but not unprecedented during the historic period. The following section includes graphs of the trend over this time period for each GA.

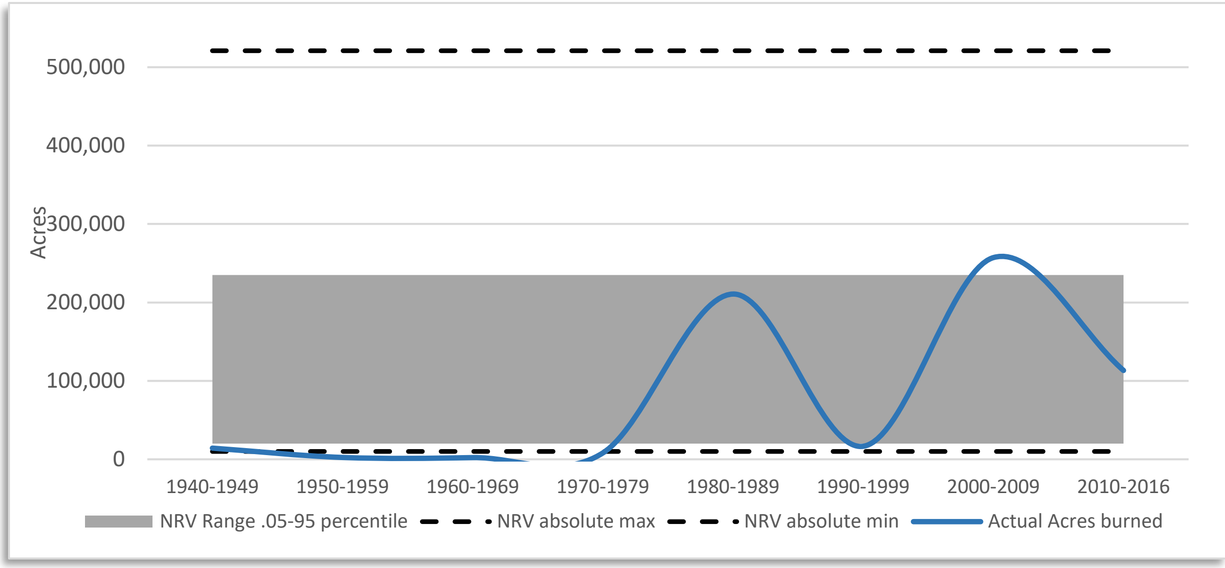


Figure 4. Forestwide acres burned/decade from 1940-2016 compared to NRV range

These data comparisons indicate that several GAs (Rocky Mountain Range, Upper Blackfoot, Elkhorns, and Big Belts) have moved within the NRV 5-95 percentile range for average fire acres burned/decade in the last 30 years. This does not mean that more burning should not or will not occur in those areas, but rather that continued burning may maintain the trend of being within the NRV. It also does not mean that the recent levels of burning have “made up” for the acres that would have burned since fire suppression began; all GAs except the Rocky Mountain Range are within the NRV ranges for area burned and likely remain “deficit” for acres that would have burned over the longer time period of fire exclusion. The NRV included cool/moist climate periods when less burning would occur, and the current condition reflects a warm/dry period (as well as other influences such as fuel buildup), and therefore it is reasonable to expect that future burning will be at the upper end of the NRV range; and it is not implausible that future burning could exceed the NRV.

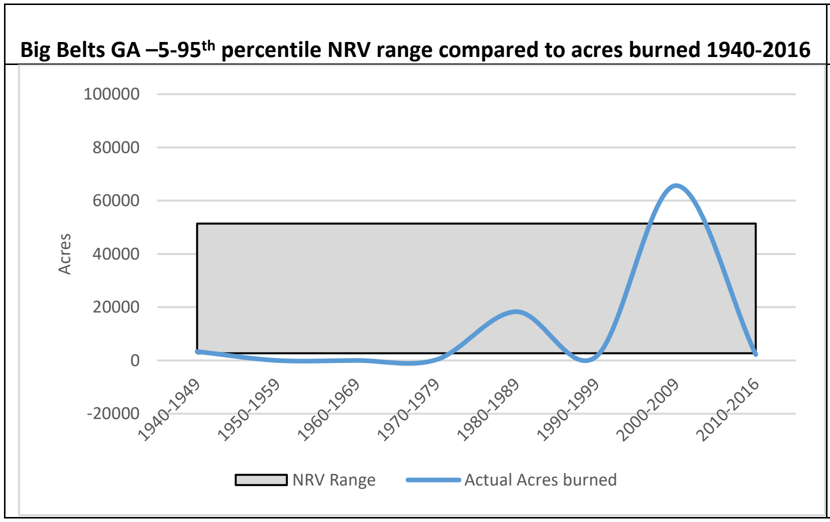
These trends are consistent with the widely documented trend of a fire deficit in the West (Keane et al. 2002, Hessburg and Agee 2003, Westerling et al. 2006), as well as with studies that indicate wildfire acres burned are increasing after the long period of fire exclusion due to climate and other feedbacks such as fuel buildup and fire policies (Marlon et al. 2012, Westerling et al. 2006). The trends also agree with Hollingsworth (2004) which concluded that fire exclusion and cool moist climate conditions resulted in acreage burned well below historic levels prior to 1970; but that recent decades are approaching historic levels. Acres burned and the number of large fires have increased since 1980 in part due to 1) fuel buildup caused by fire exclusion (especially in low severity regimes); 2) the influence of a warm/dry climate on vegetation, fire behavior, and effectiveness of suppression; 3) recent fire policies that have allowed natural fires to burn; and 4) more complete record-keeping.

Still, in many areas, today’s fire intervals are longer than they were pre-settlement (Barrett et al. 1997, Barrett 2005b, Heyerdahl, Miller and Parsons 2006). Studies indicate that low or mixed severity, high frequency fire regimes that maintained low tree densities and favored fire-tolerant trees have shifted to stand-replacing regimes at less frequency; this influences succession and can reduce biodiversity when extensive areas are regenerated by fire that historically would have been mosaics (Barrett et al. 1997, Hessburg, Agee and Franklin 2005, Lehmkuhl et al. 2007). Changes may include higher tree density, more multi-storied stands and ladder fuels, and a greater homogeneity of structures across the landscape which results in a greater probability for disturbances to affect large areas (Hessburg et al. 2005).

Even in forest types where stand-replacing regimes are natural, such as lodgepole pine, at the landscape scale fire suppression may have induced mosaic homogeneity in forests that previously contained a heterogeneous mix of fire-initiated age classes (Barrett 1993). In these areas suppression (particularly of small fires) has decreased the acreage burned in normal fire seasons and reducing the natural variability in landscape patterns (ibid). As a result, the larger, contiguous blocks of uniform stands are subject to beetle outbreaks and catastrophic fires when fire weather is extreme (Hughes et al. 1990, Barrett 1993). Although fire intervals are generally long, patchy re-burns in regenerating lodgepole can occur at fairly short intervals; lodgepole has adapted to this by producing open cones at a very young age to fill in such gaps. Once these trees reach a mid-successional age, they then shift to producing serotinous cones in preparation for regenerating after the next stand replacing event.

In short, the lack of fire has disrupted successional processes, altered fire regimes, and altered landscape diversity in composition and structure. Given expected future climate conditions, fire will likely shape the landscape to a greater degree than management actions. The NRV modeling showed that stand replacing and mixed severity fires were at the higher end of their range in terms of the percent area burned during warm and dry climate periods. Multiple studies have predicted an increase in fire areas burned in the Rocky Mountains in part due to anthropogenic climate change (Abatzoglou, Rupp and Mote 2014, McKenzie et al. 2004, Yue et al. 2013, Riley and Loehman 2016, Clark, Loehman and Keane 2017). Therefore, while the NRV provides an important depiction of our past, the future of fire may exceed historic levels. The exact level is difficult to predict due to the uncertainty in many factors, such as fire suppression, policy, changes in anthropogenic emissions, as well as ecosystem conditions and other disturbances.

GA NRV ranges of acres burned compared to recent burning levels



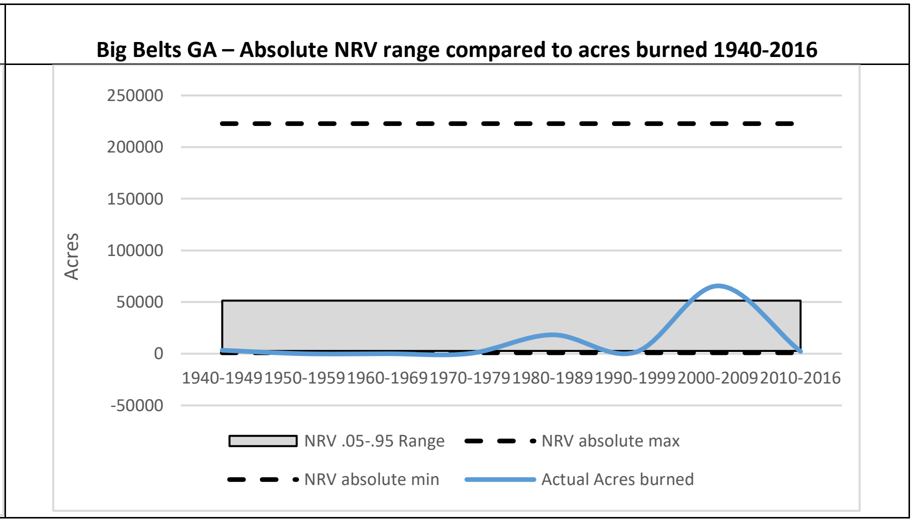
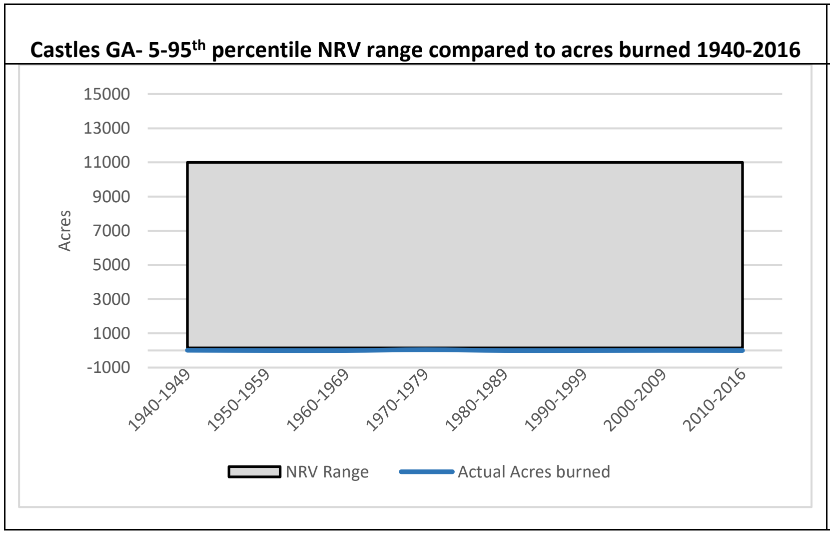


Figure 5. Big Belts NRV ranges of acres burned compared to recent burning levels



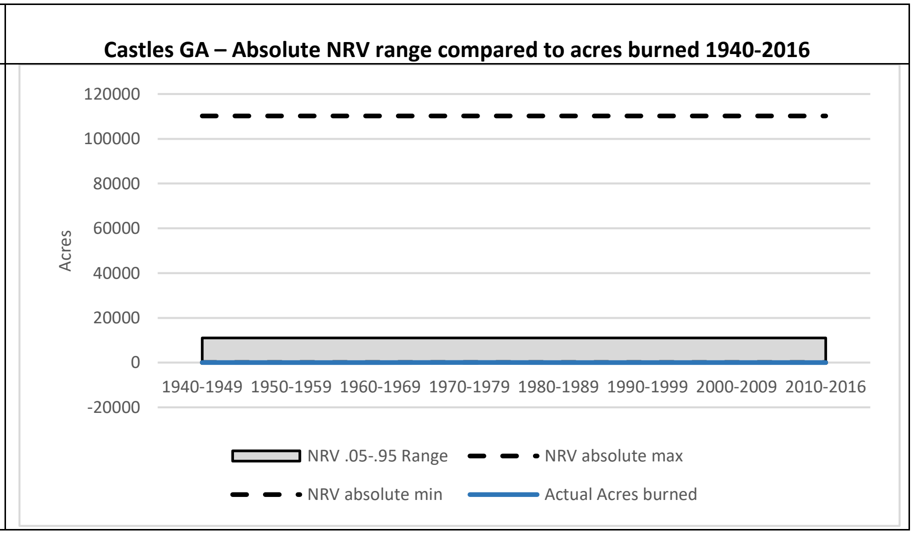


Figure 6. Castles NRV ranges of acres burned compared to recent burning levels

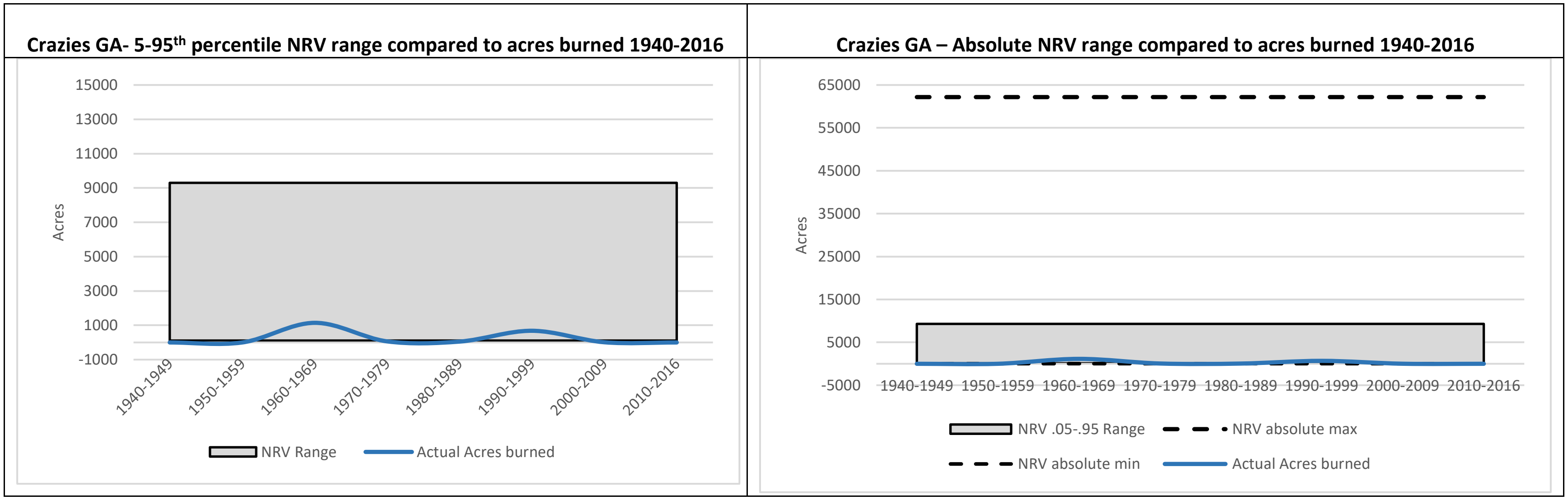


Figure 7. Crazies NRV ranges of acres burned compared to recent burning levels

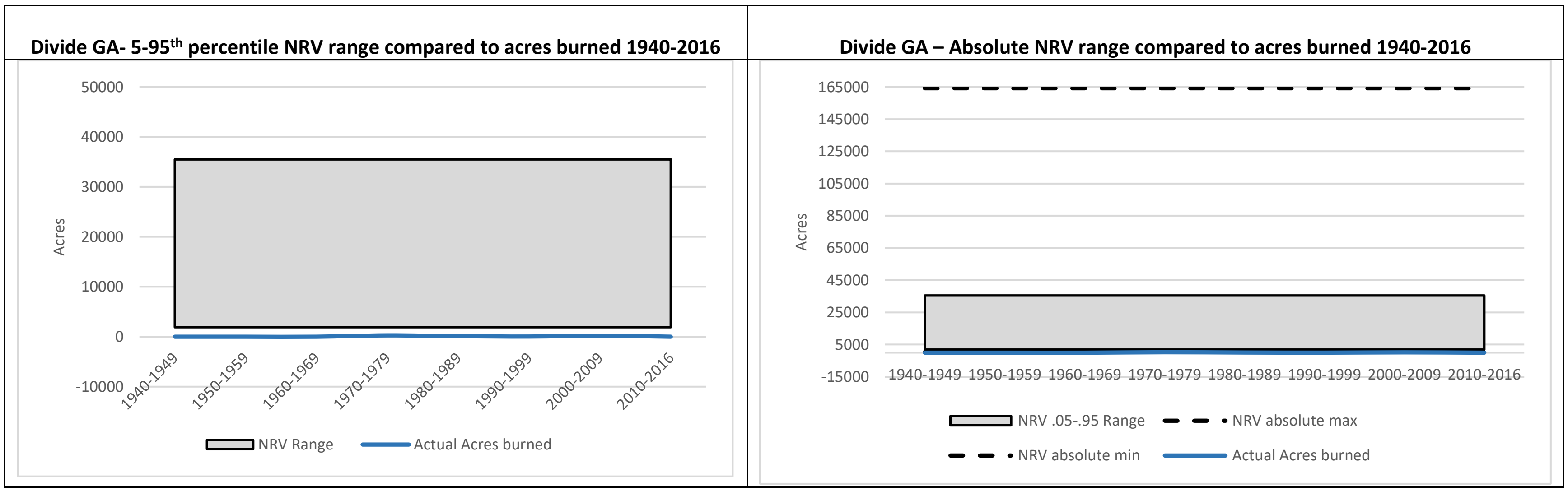


Figure 8. Divide NRV ranges of acres burned compared to recent burning levels

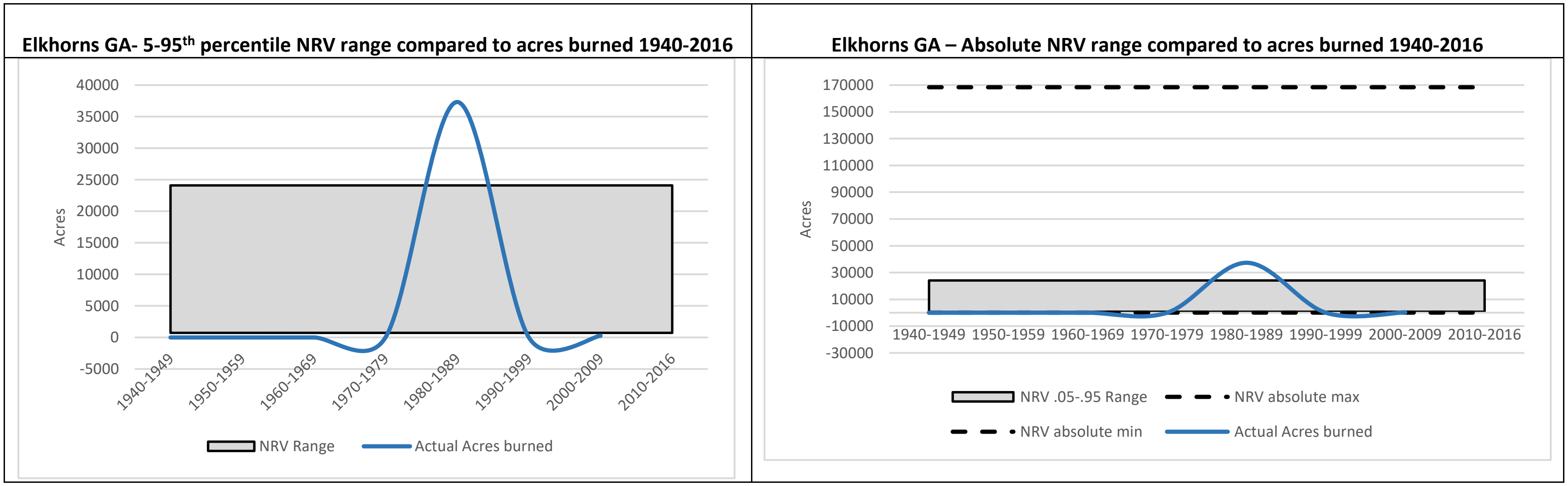


Figure 9. Elkhorns NRV ranges of acres burned compared to recent burning levels

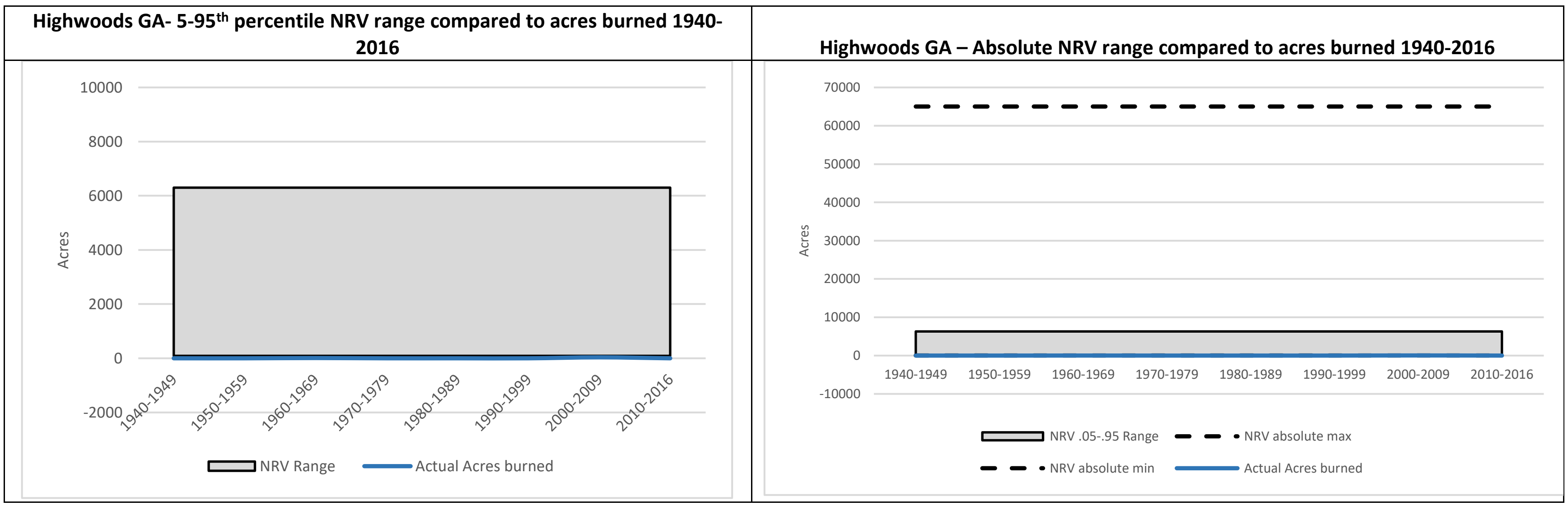
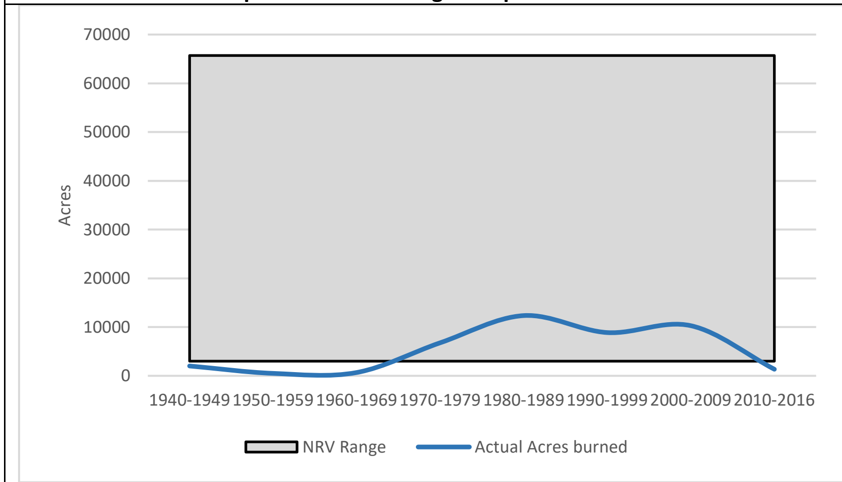


Figure 10. Highwoods NRV ranges of acres burned compared to recent burning levels

Little Belts GA- 5-95th percentile NRV range compared to acres burned 1940-2016	Little Belts GA – Absolute NRV range compared to acres burned 1940-2016



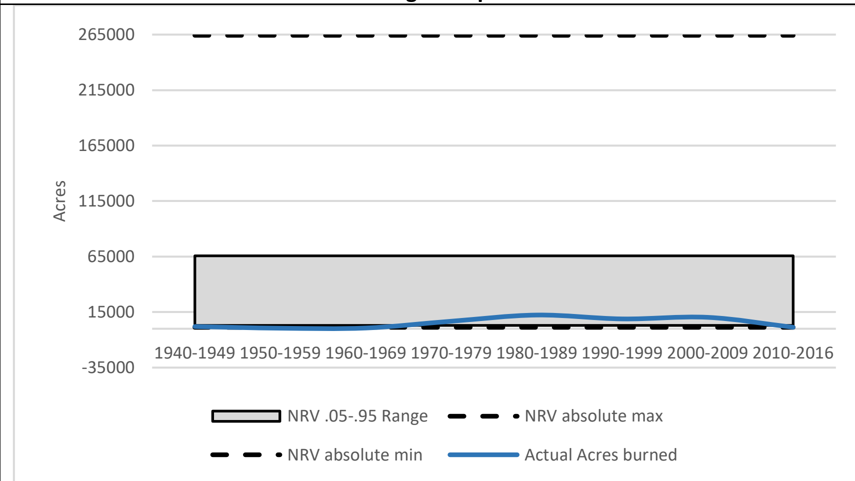
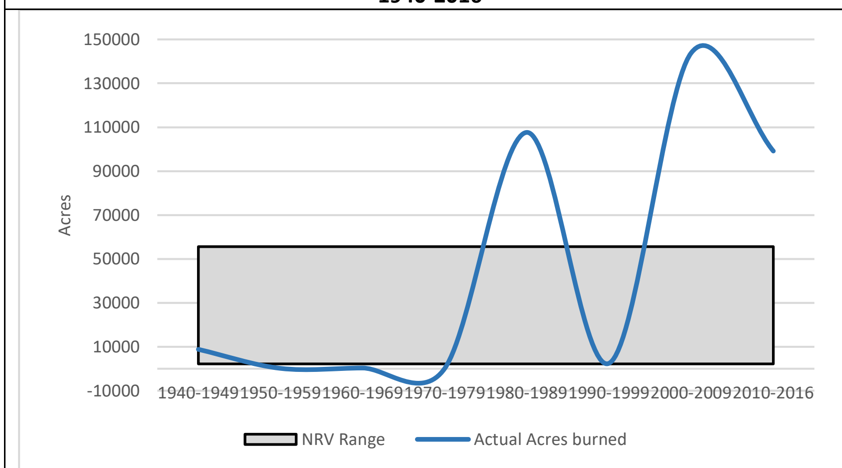


Figure 11. Little Belts NRV ranges of acres burned compared to recent burning levels

Rocky Mountain Range GA- 5-95th percentile NRV range compared to acres burned 1940-2016	Rocky Mountain Range GA – Absolute NRV range compared to acres burned 1940-2016



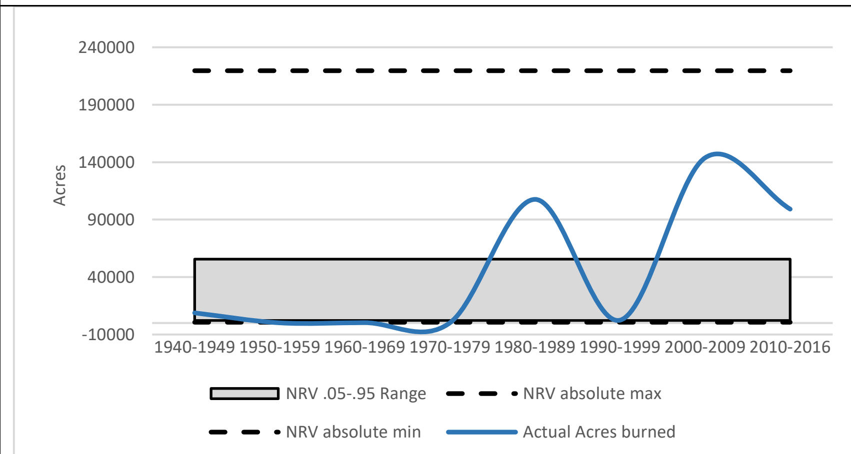
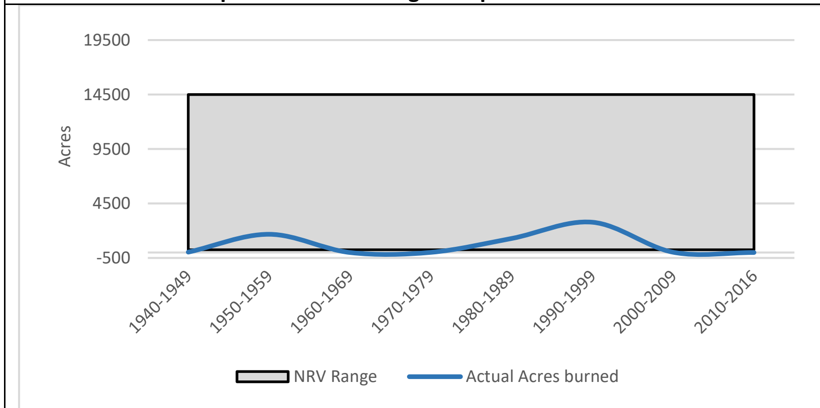


Figure 12. Rocky Mountain Range NRV ranges of acres burned compared to recent burning levels

Snowies GA- 5-95th percentile NRV range compared to acres burned 1940-2016



Snowies GA – Absolute NRV range compared to acres burned 1940-2016

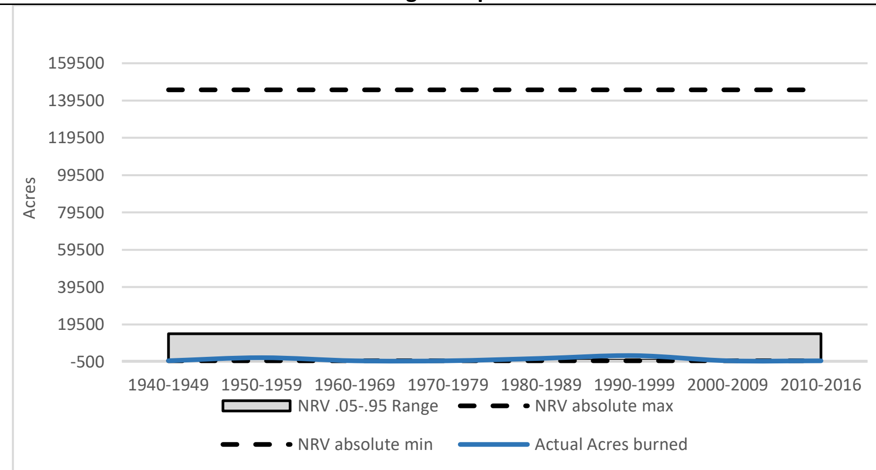
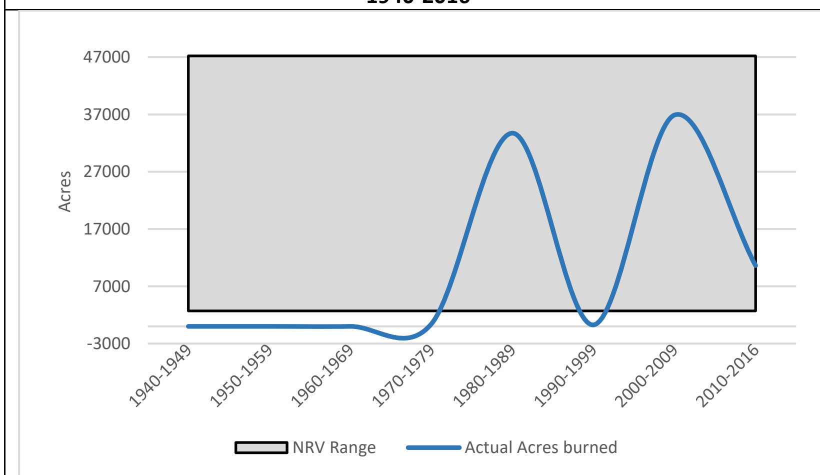


Figure 13. Snowies NRV ranges of acres burned compared to recent burning levels

Upper Blackfoot GA- 5-95th percentile NRV range compared to acres burned 1940-2016



Upper Blackfoot GA – Absolute NRV range compared to acres burned 1940-2016

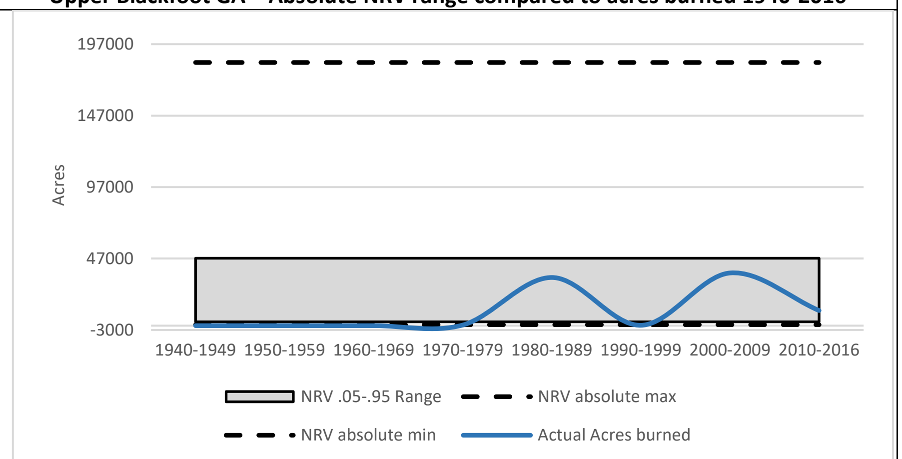


Figure 14. Upper Blackfoot NRV ranges of acres burned compared to recent burning levels

Insects and disease

Insect regimes are analyzed in terms of the average acres affected by decade for the major forest insect pests: mountain pine beetle, Douglas-fir beetle, and western spruce budworm. Root disease is the primary disease impacting the HLC NF, but not to a great degree due to the relatively dry climate east of the continental divide. Insect outbreaks are influenced by climate, disturbances, and the condition of vegetation. The current warm/dry climate cycle correlates with the increased extent of outbreaks that have occurred since the 1980's. The susceptibility of vegetation has supported recent outbreaks; for example in many landscapes there was a widespread homogeneity of mature lodgepole pine available to support mountain pine beetle. Human actions such as fire suppression, logging practices, and land development in conjunction with succession influence vegetation which in turn impacts insects and diseases.

Figure 15 displays the NRV condition of average acres infested per decade compared to the most recent decade for which data is readily available: 2005-2015, using Aerial Detection Survey (ADS) data. Previous decades are not shown because electronic data prior to 2000 is not readily available. This shows that mountain pine beetle and western spruce budworm were well above the NRV for that period, while Douglas-fir beetle was at the lower end of its NRV. Root disease is not well captured by the available data sources, but it appears that the presence of root disease is likely within the NRV range. Insect events are expected to be cyclic in nature, and the wide NRV indicates periods with little to no activity as well as active periods.

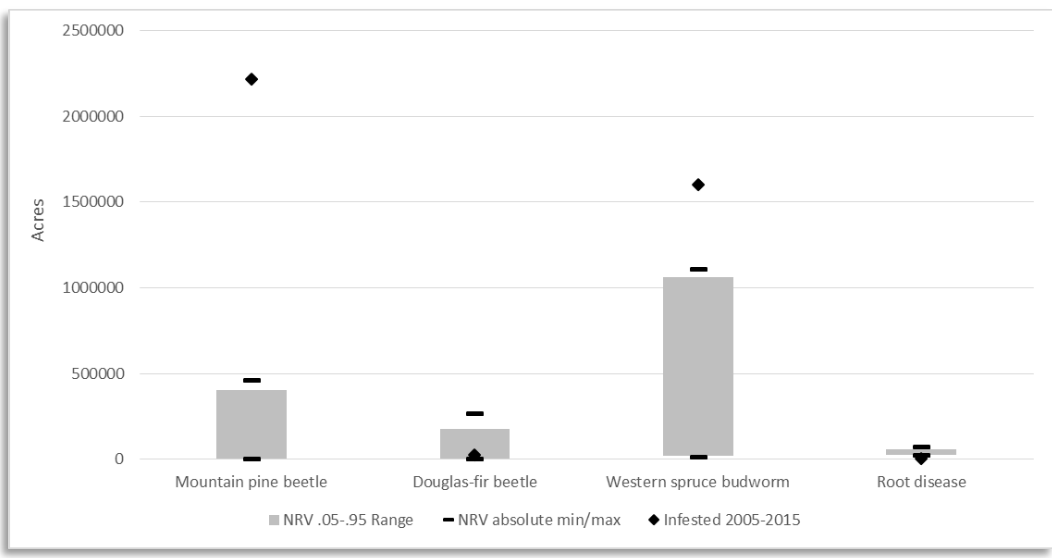


Figure 15. NRV acres impacted by insects and disease per decade compared to 2005-2015 forestwide

The large mountain pine beetle outbreak that occurred recently followed a period of little insect activity for many decades. Conversely, western spruce budworm events have been chronic episodes often correlated with warm and dry conditions. The span of recent available electronic data is limited to 2000-2015. As shown in the figures below, over this timespan mountain pine beetle activity exceeded the absolute maximum of the NRV range, indicating that this outbreak was unprecedented in the historical condition. Douglas-fir beetle has been at the low end of the NRV range since 2000. Western spruce budworm has shown a cyclic pattern within its NRV range.

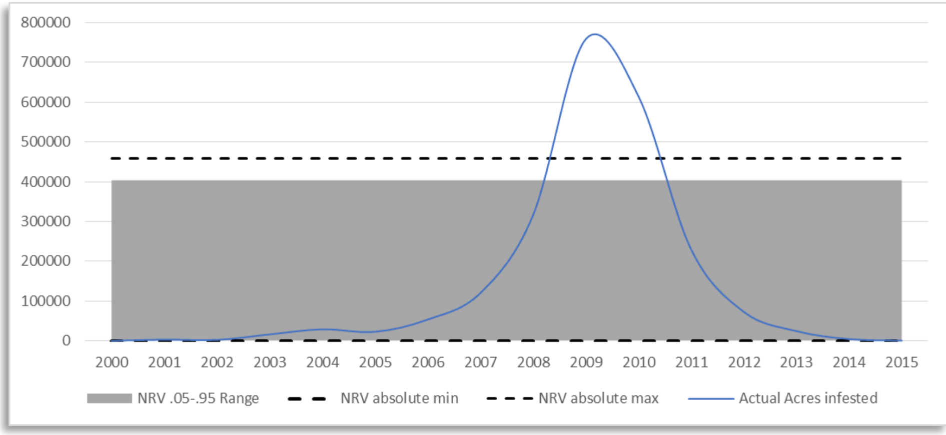


Figure 16. NRV acres infested/decade by mountain pine beetle compared to acres 2000-2015 forestwide

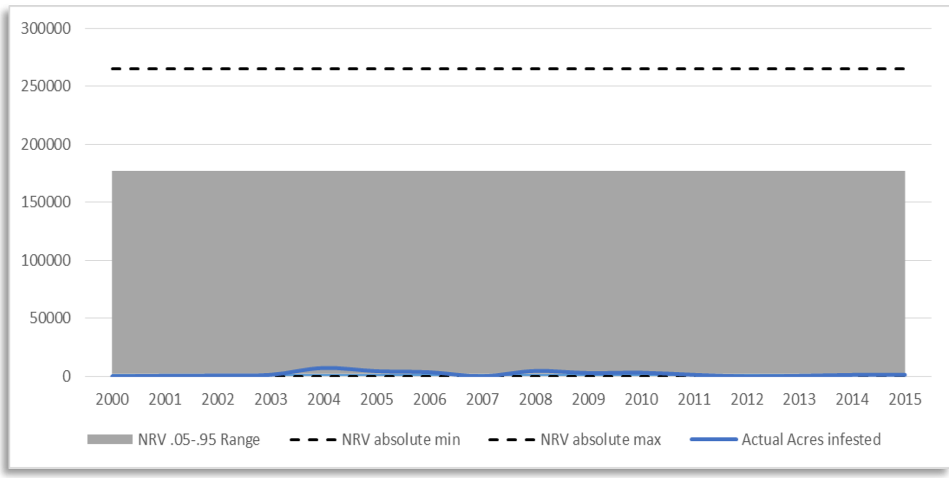


Figure 17. NRV acres infested/decade by Douglas-fir beetle compared to acres 2000-2015 forestwide

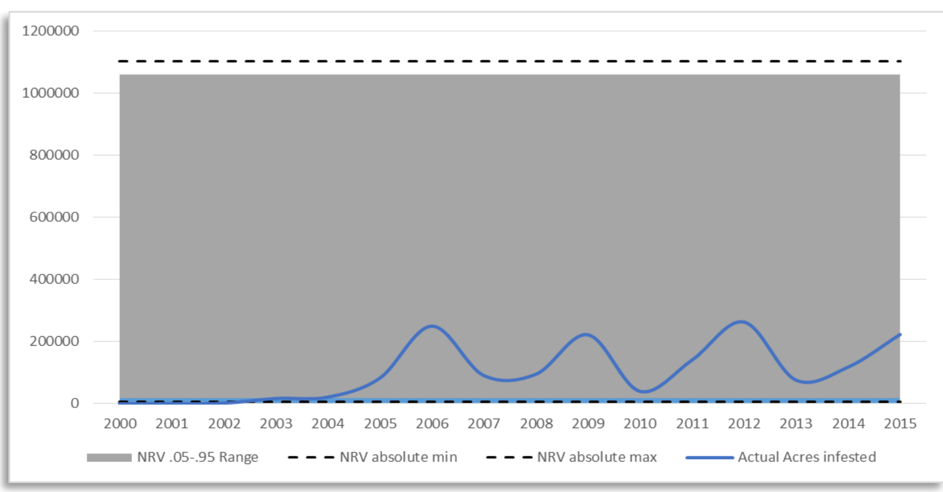


Figure 18. NRV acres infested/decade by spruce budworm compared to acres 2000-2015 forestwide

Severe bark beetle activity was at the high end of the NRV range during warm and dry periods. Many studies have found that increased warm and dry conditions in the future may promote or exacerbate native pest infestations; however, specifically in the case of mountain pine beetle, there are both positive and negative effects of a warming climate on population growth through phenological synchrony and generation timing (Halofsky et al. 2018a). It is likely that the future will bring insect activity at the upper end or above the NRV.

Composition

To represent vegetation composition on the HLC NF, two key ecosystem characteristics have been identified: 1) cover type (forested and non-forested types); and 2) the distribution of individual tree species on the landscape.

Cover Type

Cover types are groups of existing dominant vegetation (Milburn et al. 2015). Unlike PVT, cover type shifts through time on a site based on successional processes and disturbances. Without disturbance, forested cover types generally transition from early successional, shade intolerant species to late successional, shade tolerant species. Disturbances may intervene at any point in the successional trajectory to alter composition and structure. Appendix D of the 2021 Forest Plan describes the cover types found on the HLC NF. Nonforested cover types are not currently classified for Region 1; therefore, all nonforested cover types are grouped together for the model outputs. While the available FIA data includes estimates for sparsely vegetated areas, the SIMPPLLE model considers these to be non-vegetated, so they are excluded from the comparisons.

The way that cover types are classified in SIMPPLLE differs from the R1 Classification System. In the R1 Classification System, cover types are depicted by groupings of dominance types, which are based on the plurality of the most common species (Milburn et al. 2015, Barber et al. 2011). Conversely, SIMPPLLE tracks species based on a label that lists the common species, but does not indicate relative abundance. For example, a label of “DF-LP” does not indicate whether Douglas-fir or lodgepole pine is dominant. To build a crosswalk for cover type, logic was developed based on the relationships between SIMPPLLE species labels and the dominance types in VMap. For example, if “DF-LP” SIMPPLLE pixels were most commonly correlated with a Douglas-fir dominance type in VMap, then this label was cross-walked to a Douglas-fir cover type.

A critical limitation of this method occurs for species that were more prevalent in the NRV than the existing condition. For example, a label of “WB-AF” most commonly correlates to a spruce/fir type in today’s VMap. However, historically the abundance could have been heavier to whitebark pine, and perhaps would have been a whitebark pine cover type. There is no way in SIMPPLLE to know which species in the mix was more dominant. For this reason, results must be placed into context with the knowledge that the NRV may depict many whitebark pine cover types as spruce fir; and similarly aspen may be masked in many other cover types.

Cover type forestwide and by broad potential vegetation type

As shown in Figure 19, the NRV analysis at the forestwide scale indicates that the ponderosa pine and spruce/fir cover types are below the NRV range of abundance on the landscape, while the mixed mesic conifer type (Douglas-fir) and lodgepole pine types are higher. Ponderosa pine may be less abundant due to fire exclusion and type conversion to Douglas-fir, a well-established trend in the West over the last century. Conversely, the spruce fir type may be less abundant due to recent large-scale fires that have not yet recovered, or regenerated to a more fire-adapted early seral species such as lodgepole pine. In other areas, fire exclusion may have promoted spruce/fir, but warming and drying conditions along with increased fire activity are ameliorating this trend when summarized at the forestwide scale.

While aspen and whitebark pine appear to be similar or even slightly above their NRV, most likely these types are actually at or below the NRV given the limitations in the modeling, and literature sources that indicate these types are less abundant than they were historically ((Tomback 2007, Shepperd, Bartos and Mata 2001). The analysis also indicates that nonforested types are more abundant than they were historically; however, this is most likely reflecting areas that have recently burned and have not yet reforested, as opposed to natural meadows and parks. Many studies applicable to the HLC NF indicate that tree encroachment has reduced the extent and health of true nonforested cover types as compared to the historic condition (Means 2011, Heyerdahl et al. 2006).

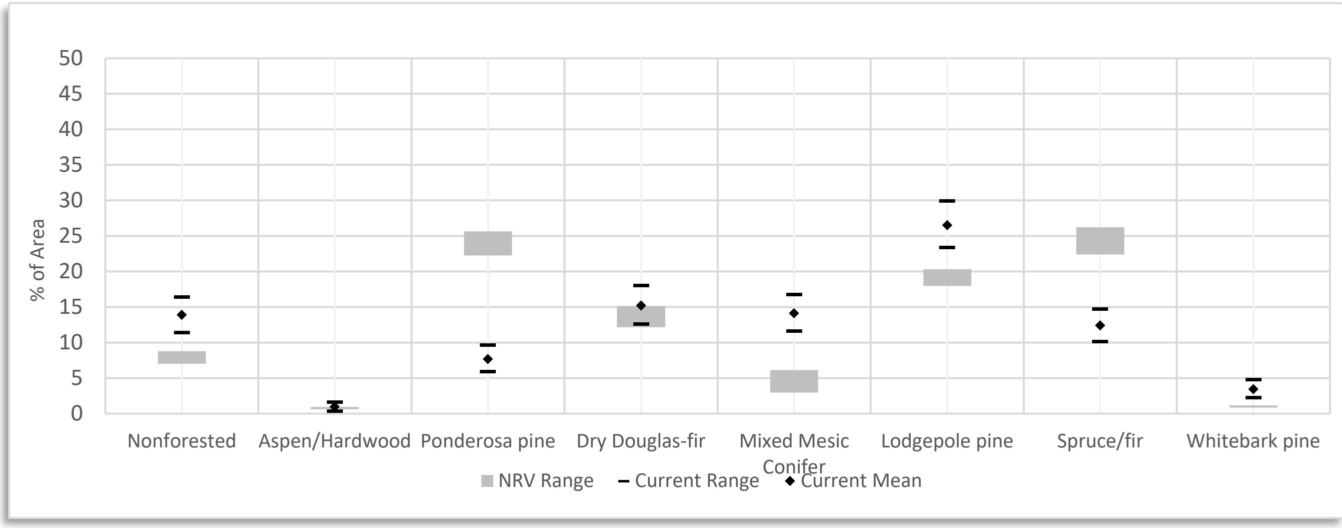


Figure 19. NRV range of cover types compared to existing condition, HLC NF forestwide

The most substantial shifts from the NRV to the existing condition of cover types occurred in the warm dry PVT (Figure 20), where the reduction in the ponderosa pine cover type occurred in favor of mixed mesic conifer (Douglas-fir dominated) and lodgepole pine. Other cover types such as spruce/fir and aspen occurred to a small extent where moisture was less limiting. Warm dry PVTs also support savanna areas on the hottest, driest sites where tree cover is 5-10% canopy cover. These areas are nonforested (dominated by grasses and shrubs), but would have supported widely scattered conifers. Savannas blended into transitional ecotones of true grass and shrublands which may be more prevalent in the future given expected climate and disturbance regimes. While the analysis estimated that the current abundance of nonforested types is higher than the NRV, this is in part due to recent fires, and varies by GA.

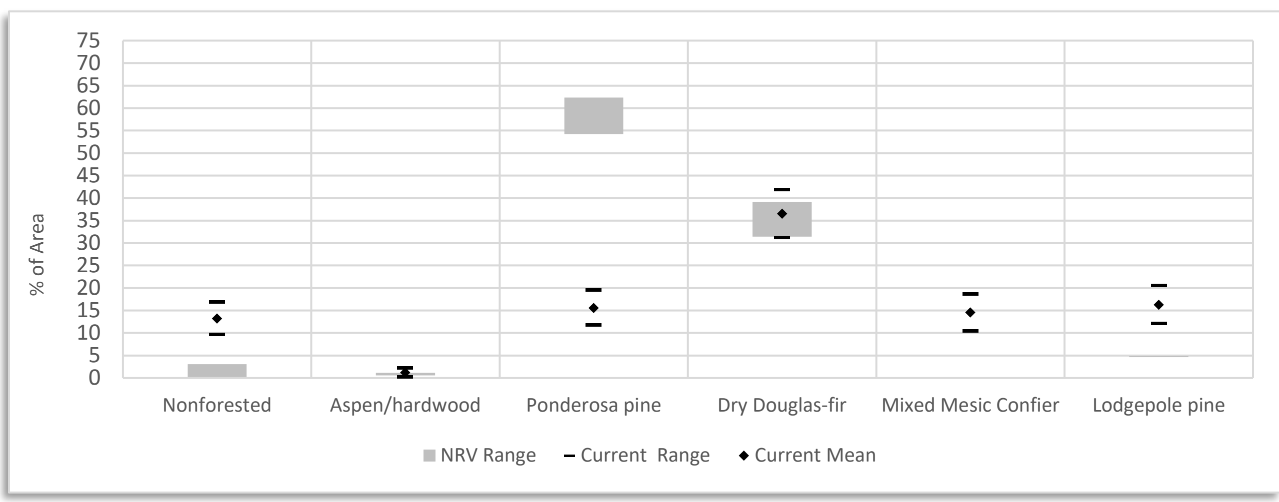
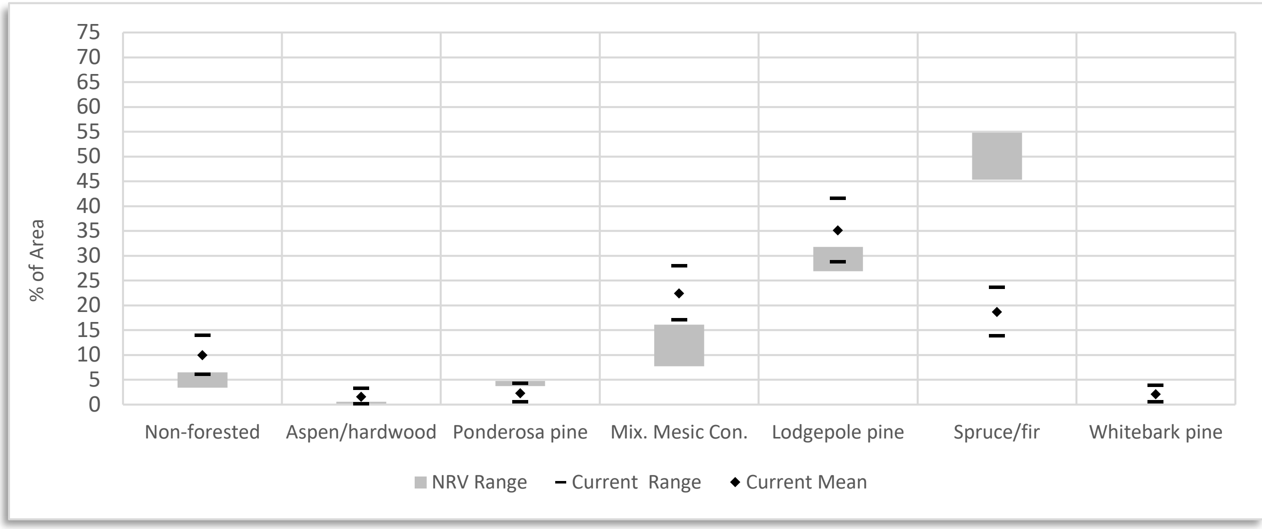


Figure 20. Warm dry potential vegetation type NRV range of cover type compared to existing condition

As shown in Figure 21, in the cool moist PVT the spruce/fir cover type may be less abundant than it was historically, for the reasons described at the forestwide scale. The mixed mesic conifer (Douglas-fir) type and to a lesser extent lodgepole pine may be overrepresented.



Western larch cover type excluded because the NRV and existing estimate are negligible at the forestwide scale.

Figure 21. Cool moist potential vegetation type NRV range of cover type compared to existing condition

In the cold PVT (Figure 22), modeling suggests that the spruce/fir cover type is below the NRV, but likely that includes some whitebark pine cover types. If more accurate labeling were possible, results would likely show a lower NRV range for spruce fir and higher range for whitebark pine. The spruce/fir type may dominate in more productive areas such as moist aspects, swales, moist basins, and riparian areas.

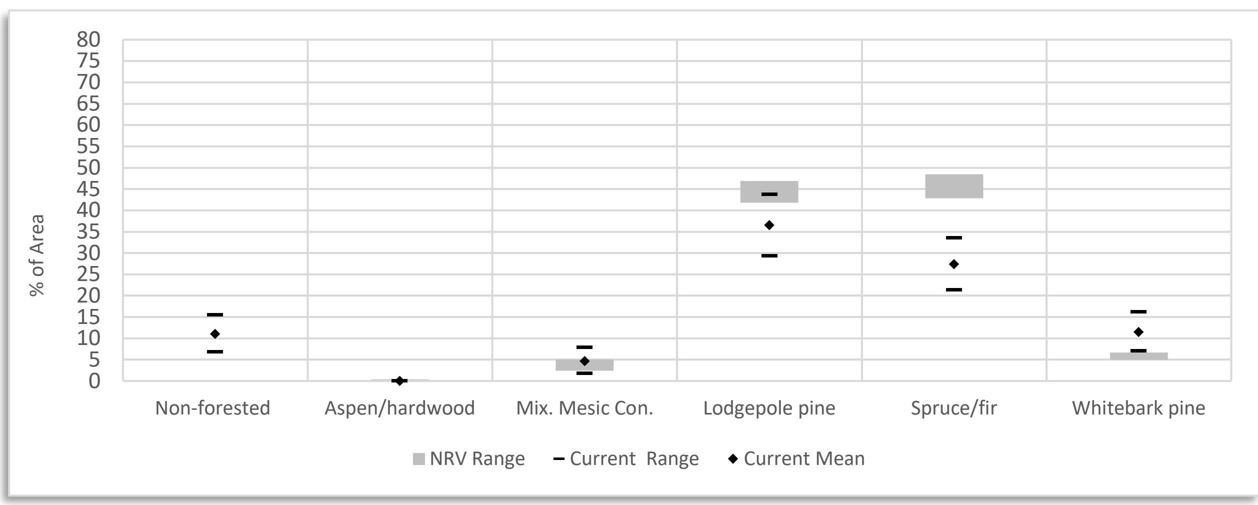


Figure 22. Cold potential vegetation type NRV range of cover type compared to existing condition

At the broad scale, exclusion of fire has resulted in a higher proportion of shade tolerant species at the expense of shade-intolerants. This is most evident in types where high frequency, low severity fires would have been common, such as the warm dry PVT. Low elevation, dry forests have experienced perhaps the greatest magnitude of change in composition, structure and function because of fire suppression, forest management, and climate change (Hessburg and Agee 2003, Hessburg et al. 2005, Westerling et al. 2006). Still, even cover types adapted to long fire return intervals and stand-replacing severities such as lodgepole pine have changed in some areas because these forests also burned in low-to mixed-severity events historically which created variable age structures and patterns (Kashian et al. 2005, Hardy, Keane and Stewart 2000).

In the modeling, the aspen/hardwood, dry Douglas-fir, mixed mesic conifer, whitebark pine, and nonforested cover types tended to be at the higher end of their NRV abundance during warm/dry periods. These cover types are promoted by fire and/or are tolerant of dry conditions. The ponderosa pine cover type tended to peak just before warm/dry periods, and decline during the warm dry period. Although this type (which consists of ponderosa pine and/or limber pine) is one of the most adapted to tolerating drought, this decline may be due to fire and the expansion of nonforested types at the lower margins of where trees grow. Future warm and dry climate conditions will likely be conducive to increasing the abundance of ponderosa pine and nonforested cover types. In general, more fire on the landscape will also be conducive to promoting aspen and whitebark pine, but these species may also be limited by moisture. The potential to increase whitebark pine is particularly uncertain due to contributing stressors such as the exotic disease white pine blister rust.

Spruce/fir generally declines or is at the lower end of its range during warm and dry climate periods, as it is less adapted to drought and fire; therefore, in the face of future warm and dry climates, it is uncertain if it is feasible that this type will fully return to the historic condition. Rather, placing an importance on this habitat where it can thrive, and especially where it meets other ecosystem needs such as providing lynx habitat, will be an important management consideration. Lodgepole pine does not show a tight relationship to climate trend, but is expected to continue to thrive under future fire regimes provided that sites retain enough seed and moisture.

Cover type by geographic area

The existing and NRV proportions of cover types vary across the GAs, driven by fixed factors such as the array of PVTs, topographical isolation, and dynamic processes such as disturbances and human uses.

Nonforested cover types

Nonforested cover types include grass, shrub, and riparian grasses/shrubs, and open savannas; but may also include recently disturbed forest types that have not yet reforested. The forestwide averages indicated that generally the abundance of nonforested cover types is above the NRV. However, this may be due to the inclusion of recovering forested sites in the estimate of the existing condition. Further, the NRV ranges span across cool/moist, normal, and warm/dry climate periods that occurred in the past. Because these types showed a correlation of increasing during warm and dry periods, if only such periods were considered in the average it is likely that the existing condition would be at the low end or below the NRV.

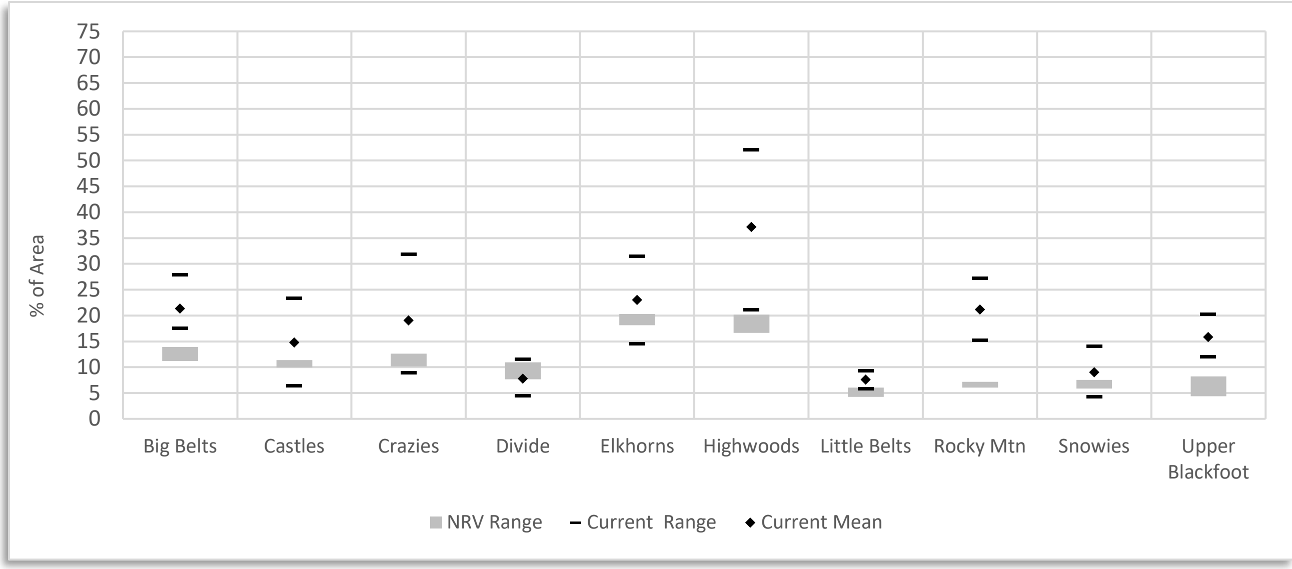


Figure 23. NRV range of nonforested cover types compared to existing condition, by GA

Nonforested PVTs have experienced shifts in specific species composition and structure but are poorly represented in available data sources. Multiple literature sources indicate that nonforested vegetation cover types have declined relative to the historical condition. As described in the Assessment, in the HLC NF plan area there have been declines in acres of fescue, bunchgrass, sagebrush, and native forb cover types, largely attributable to agricultural development but also encroachment of woodland types such as juniper and exotic weed species. One of the key changes that has occurred in the west includes a reduction in native grasslands and shrublands, and an expansion of dry forests and woodlands; grazing and associated reduction in fire frequency (due to the loss of fine fuels) are the primary causes of woodland expansion although climate change and increased atmospheric carbon dioxide are also suggested as contributing factors (Hessburg and Agee 2003). Fire exclusion and drought has allowed conifers and/or sagebrush to invade grasslands, and altered the mosaic of conifer savannah and sagebrush steppe (Barrett et al. 1997, Heyerdahl et al. 2006).

In addition to the abundance of nonforested vegetation cover types, the condition and health of these types has been altered. There is no means to model the potential shift in composition or structure of these types. However, activities such as livestock grazing have likely altered vegetation, especially riparian areas. Also, the introduction of invasive plants has substantially altered some plant communities. Finally, the expansion of conifers into grass and shrublands has occurred as a result of factors such as climate, grazing and fire exclusion. For the most part, if trees are present a site it would be classified as a warm dry forested PVT. Areas in this type that are considered nonforested (less than 10% tree cover) may include open savannas as well as grass/shrub communities perpetuated by fire. Increased conifer expansion in some of these areas is often considered to be undesirable, although the NRV indicates that trees did encroach into nonforested PVTs during cool and moist climate periods.

Aspen/hardwood cover type

The existing condition of the aspen cover type is similar to the modeled NRV in all GAs; however, other literature sources indicate that aspen was likely more prevalent historically (Shepperd et al. 2001, Bartos 2001). Aspen is prevalent in the Highwoods to the greatest extent, as compared to the other GAs; but in all cases, it represents a small proportion of the landscape. It is expected that aspen/hardwood will be promoted with future warm, dry climate conditions, to occur at the high end of the NRV or possibly above. These types showed a correlation of increasing during warm and dry periods. Further, because the aspen cover type may be underrepresented in the NRV species classification, it is likely the NRV range could be slightly higher than shown in Figure 24.

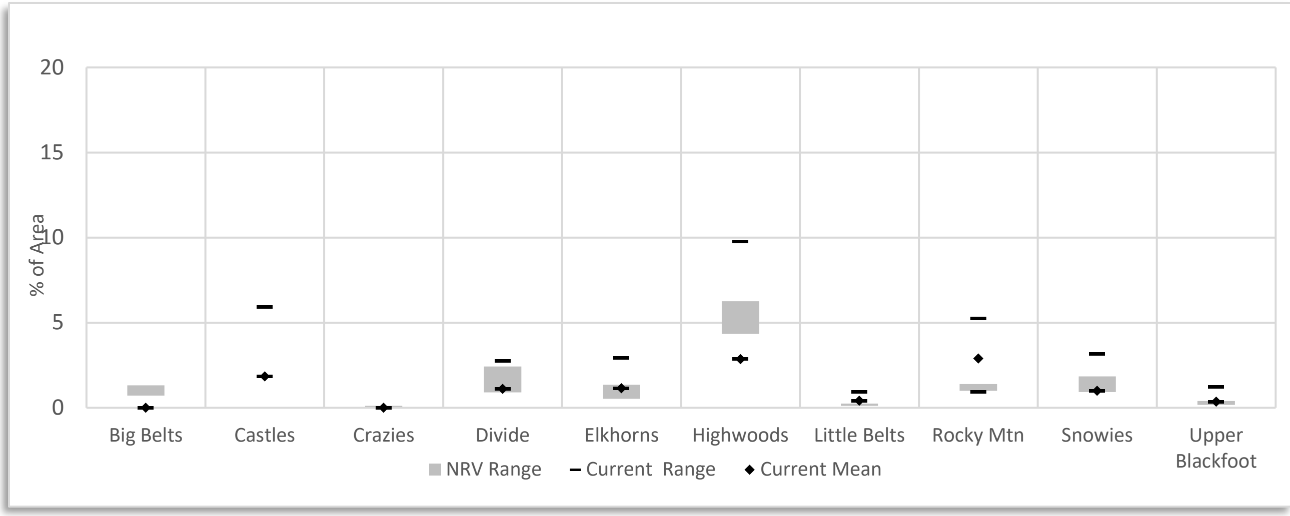


Figure 24. NRV range of the aspen/hardwood cover type compared to existing condition, by GA

Ponderosa pine cover type

The ponderosa cover type is below the NRV for abundance across all GAs except for the Snowies. This type may be promoted with future drought on many sites where it will out-compete Douglas-fir, but conversely may retract on the driest sites where fire and moisture limitations promote nonforested cover types. Therefore, the future may bring an overall increase in many GAs but likely not to fully achieve the NRV ranges. The highest potential to increase or maintain the ponderosa pine cover type can be found in the Big Belts, Little Belts, and Snowies. Some GAs such as the Castles, Crazies, Highwoods and Rocky Mountain Range have a very low to no existing ponderosa pine (and therefore, little seed source), and the species could only be promoted through management interventions such as planting. The Divide, Elkhorns, and Upper Blackfoot GAs have little of this cover type proportionately across the GA, but do have fairly extensive areas with at a ponderosa pine component present on portions of their area and therefore have important opportunities to increase the ponderosa pine cover type.

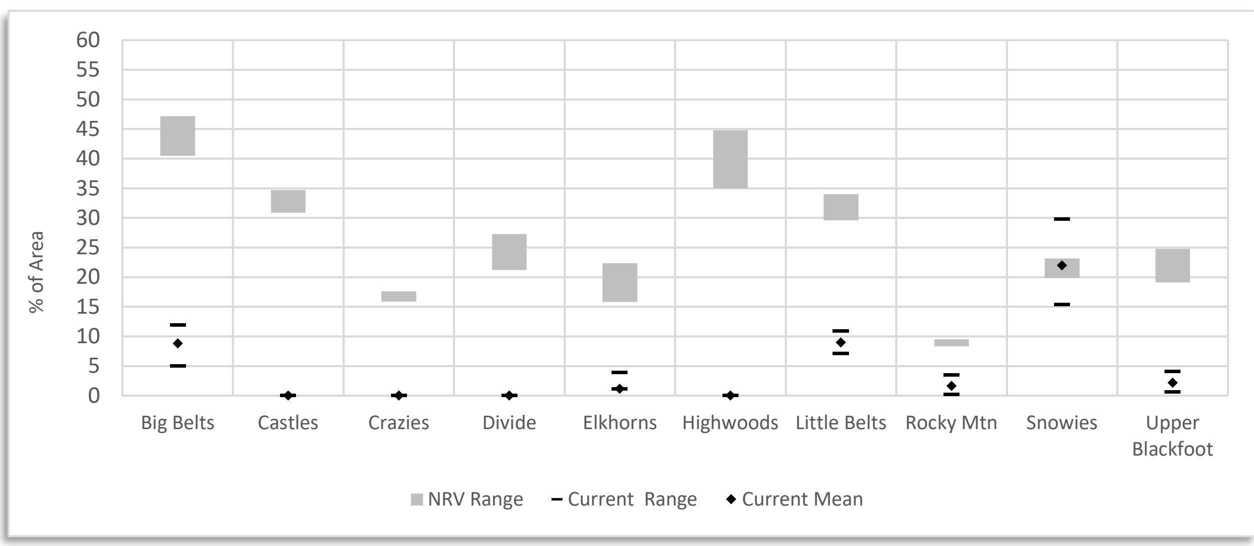


Figure 25. NRV range of the ponderosa pine cover type compared to existing condition, by GA

Dry Douglas-fir and mixed mesic conifer cover types

The dry Douglas-fir and mixed mesic conifer types are dominated by Douglas-fir. The forestwide averages indicate that the mixed mesic conifer type is above the NRV range for abundance, and the dry Douglas-fir type is similar to NRV. By GA, the results for dry Douglas-fir showed a variety of trends (Figure 26). Douglas-fir can function as the most shade intolerant species that dominates on dry sites in areas where ponderosa pine distribution is limited. However, it can also function as a shade tolerant that dominates over ponderosa pine in the absence of disturbance and can encroach into savanna and nonforested plant communities.

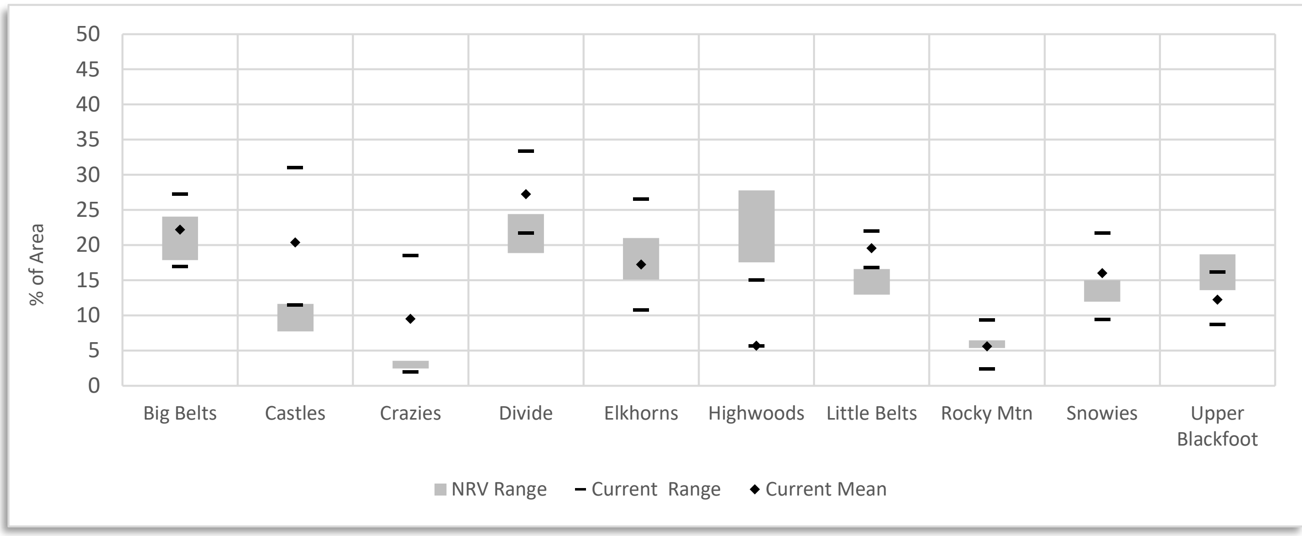


Figure 26. NRV range of the dry Douglas-fir cover type compared to existing condition, by GA

The mixed mesic conifer type was generally above the NRV for all GAs except the Rocky Mountain Range. It is expected that these types will be promoted with future drought on more moist sites where Douglas-fir functions as a shade intolerant species and tolerates drought better than lodgepole pine, spruce, or subalpine fir, but conversely may retract on the driest sites where ponderosa pine can better withstand drought.

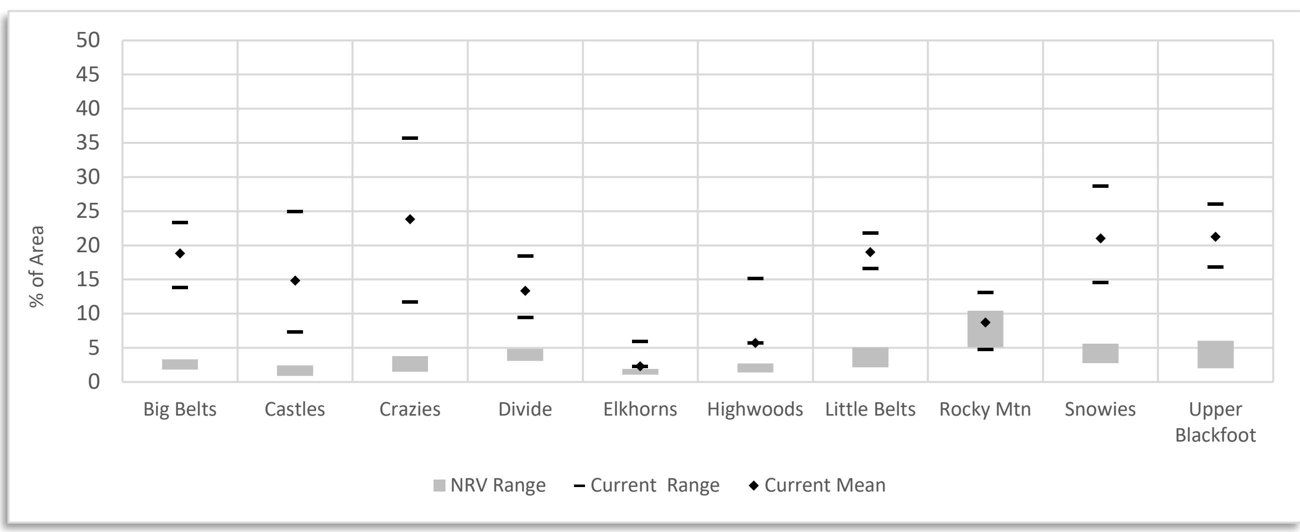


Figure 27. NRV range of the mixed mesic conifer cover type compared to existing condition, by GA

Western larch mixed conifer cover type

The western larch mixed conifer cover type would only potentially occur on the Upper Blackfoot GA, where it is at the farthest east end of its natural distribution range. Because so few individuals are present, they are not well represented with broad scale grid data or remotely sensed mapping, and places where it is a dominant component are very minor. The existing condition shows only a trace (0.1%) of this cover type occurring in the Upper Blackfoot, and the NRV does not extend beyond that amount, although more widespread individual or minor components of this species are known to occur. Given its low water-use efficiency, this species may be expected to be limited to low energy aspects in future warm, dry conditions. However, it would be an important aspect of biodiversity on cooler sites, including areas where cold temperatures might have limited it in the past.

Lodgepole pine cover type

The forestwide averages indicate that this type is generally slightly above or similar to the NRV depending on the broad PVT. Figure 28 shows that this trend varies by GA. In particular, in the Crazies and Snowies GA the lodgepole pine cover type is below the NRV, whereas the Divide, Highwoods, and Little Belts appear to be above. All other GAs are similar to the NRV. Although not particularly drought tolerant, it is expected that future climates may promote this species on moist, high elevation sites where fire disturbance promotes it over shade tolerant species such as spruce and fir, but conversely retract from drier sites where Douglas-fir is more drought tolerant. Therefore, the future may bring slight shifts or maintenance within the NRV ranges depending on the other species present.

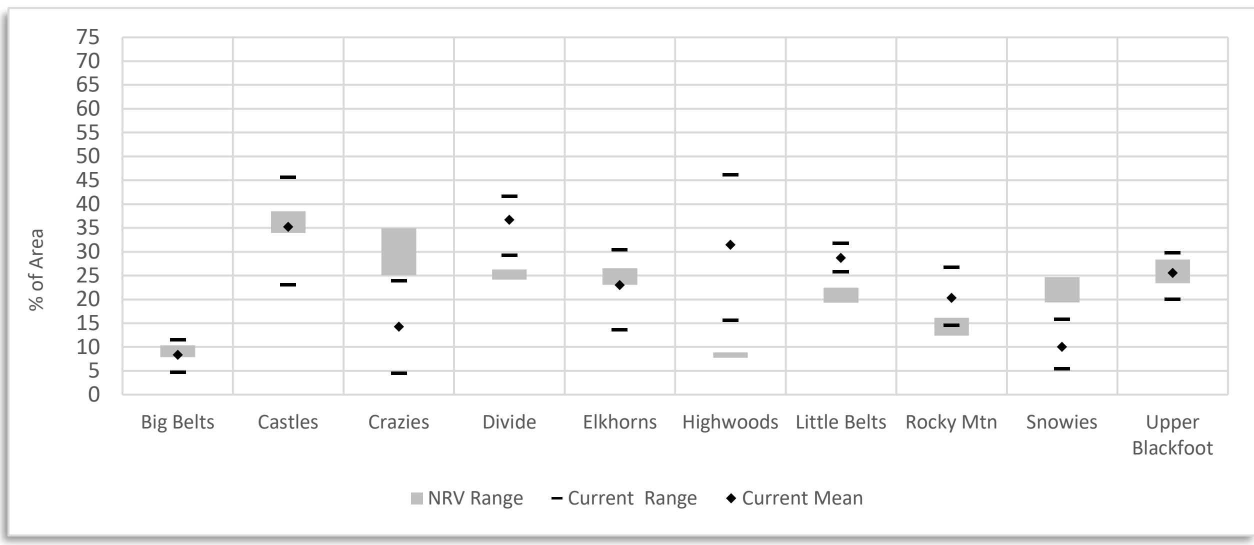


Figure 28. NRV range of the lodgepole pine cover type compared to existing condition, by GA

Spruce/fir cover type

The forestwide averages indicate that spruce/fir is below the NRV, whereas the whitebark type is similar to or above the NRV. By GA, spruce/fir is below the NRV in several large GAs (Rocky Mountain Range, Little Belts, and Upper Blackfoot), but similar to the NRV in all other GAs. This supports the conclusion discussed in the forestwide section, in that recent large fires have played a large role in reducing spruce/fir, as such disturbances have been occurring particularly in the Rocky Mountain Range and Upper Blackfoot. Therefore, retaining healthy spruce/fir in those GAs may be more important than in the other GAs.

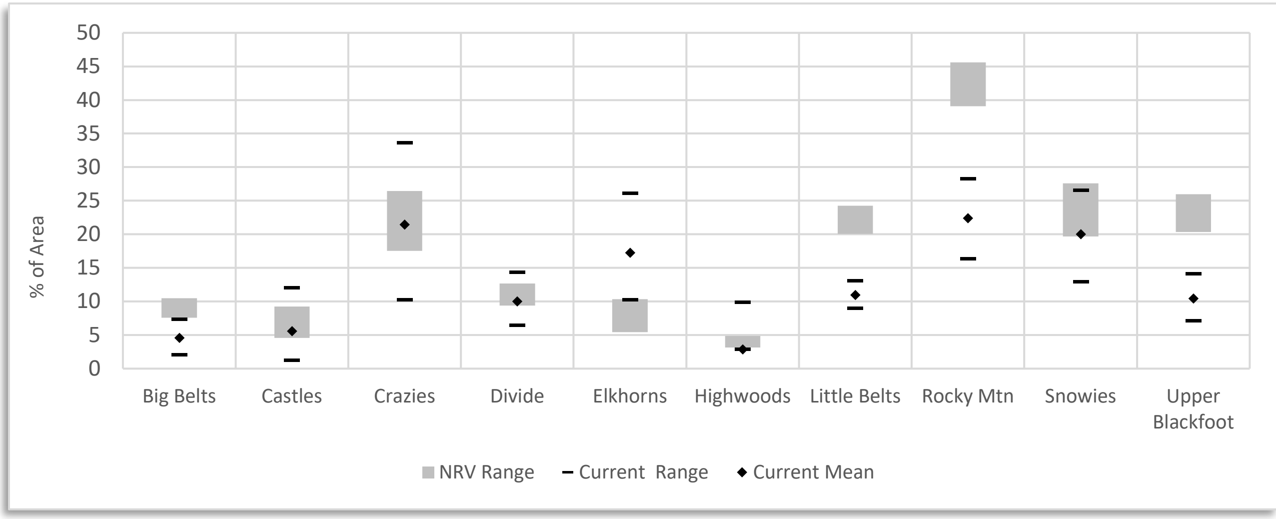


Figure 29. NRV range of the spruce/fir cover type compared to existing condition, by GA

Whitebark pine cover type

The whitebark pine trend is similar for all GAs. As discussed in the forestwide section, it is most likely that the whitebark pine cover type is below NRV. The results for individual tree species in the next section provides more context for subalpine fir, Engelmann spruce, and whitebark pine. It is expected that future climates and disturbances may promote the whitebark pine cover type on the coldest, driest sites where it is more hardy than other species, but its success will also depend on the exotic disease white pine blister rust and restoration efforts.

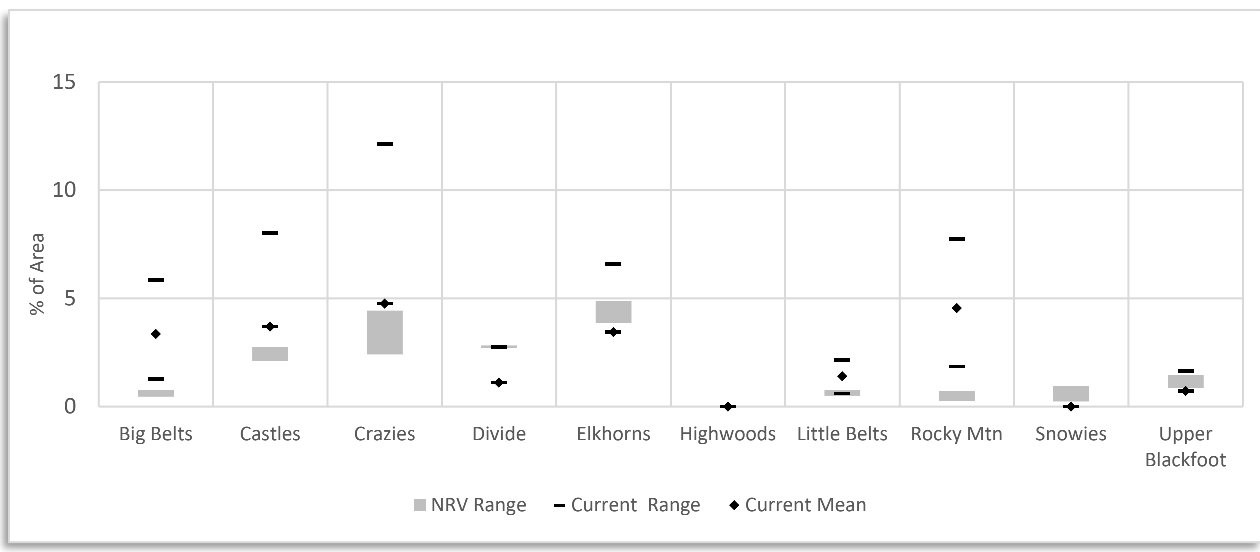


Figure 30. NRV range of the whitebark pine cover type compared to existing condition, by GA

Tree species distribution

In addition to cover type, which is a grouping based on the most dominant species, it is useful to understand the extent and distribution of individual tree species. The distribution of each species is estimated by the percentage of the area that contains at least one live tree per acre. This provide a more detailed assessment of species diversity. Individual tree species can occur in multiple PVTs and cover types. Some species are of particular management interest. For example, whitebark pine is a proposed species for listing under the Endangered Species

Act. Other species are commonly a focus of interest due to their condition, threats, wildlife habitat values, and/or public interest, including aspen, ponderosa pine, limber pine, western larch, and Rocky Mountain juniper.

The modeling cautions described for the cover types do not apply to this attribute. The presence of a species is noted in SIMPPLLE based on whether it is a component of the species label; no cross-walking was needed to relate to the presence of a species noted in the existing condition data. However, it is possible that the species presence in SIMPPLLE does not capture minor or rare species on a site, since the labels only capture the most common 1 to 4 species present. This attribute only reflects whether a species is present or not and does not indicate its condition or abundance; a pixel with 1 tree present of a given species would be counted the same as a pixel with 1,000 trees present of the species. Therefore, important distinctions in structure and condition between the NRV and existing condition cannot be inferred with this attribute alone. Because multiple species are often present on a site, the proportions of all species together add up to more than 100% of the landscape area.

Tree species distribution forestwide and by broad potential vegetation type

Figure 31 shows the NRV range of tree species distribution forestwide, compared to the existing condition. At this scale, the extent of most species are within or near the NRV. However, the extent of ponderosa pine is below the NRV, while the extent of lodgepole pine, Douglas-fir, and Engelmann spruce is above.

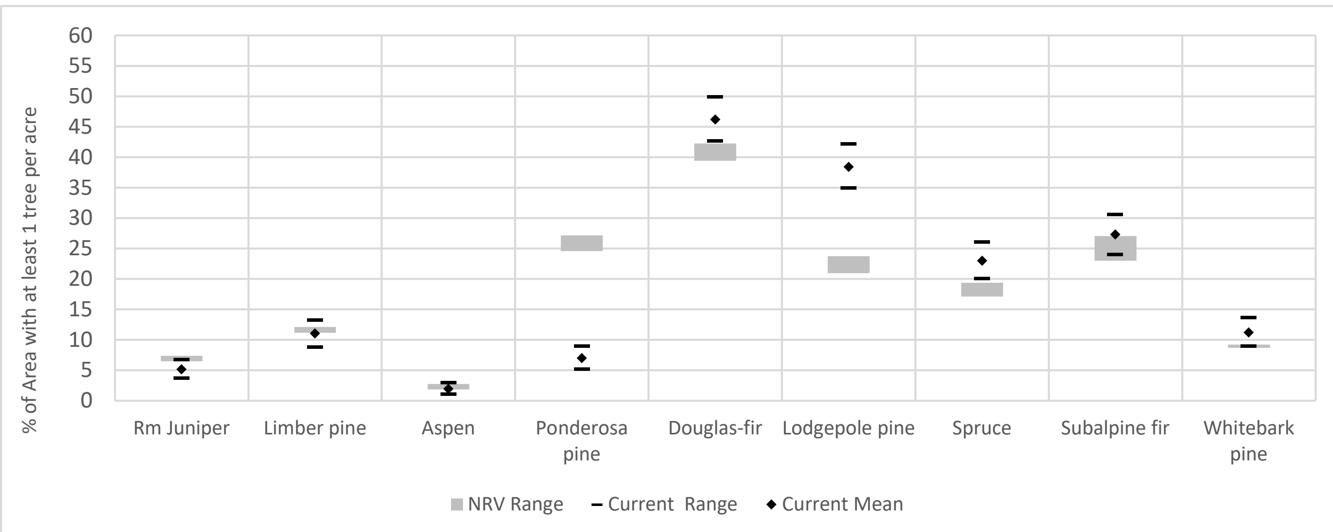


Figure 31. NRV range of the tree species distribution compared to existing condition, forestwide

In the warm dry PVT (Figure 32), the existing distribution of ponderosa pine is below the NRV, and lodgepole pine and Engelmann spruce are above the NRV. The extent of the other species are similar to the NRV. While the extent of Douglas-fir as an individual tree species is similar to the NRV, the previous section showed that the mixed mesic conifer cover type, which is dominated by Douglas-fir, is above the NRV. This may indicate that Douglas-fir as a component is naturally widespread, but should be the dominant species (cover type) on fewer areas than it is currently in this PVT.

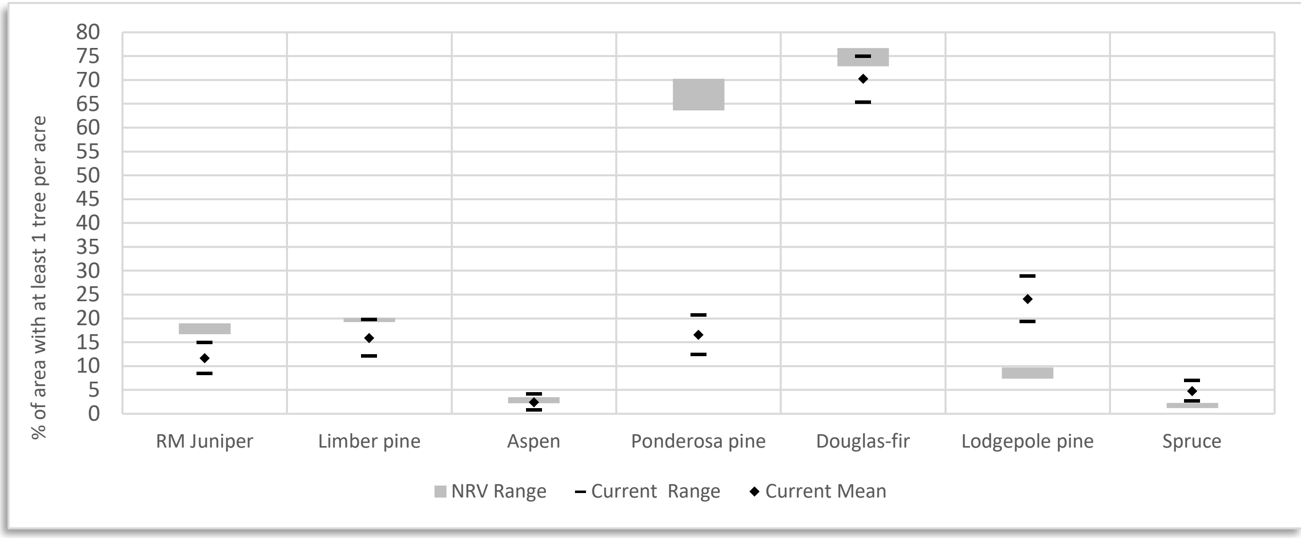


Figure 32. Warm dry PVT tree species distribution NRV compared to existing condition

In the cool moist PVT (Figure 33), distribution of Douglas-fir and lodgepole pine are currently above the NRV, while the other species are similar to the NRV. Engelmann spruce and whitebark pine also appear to be slightly above the NRV but the confidence interval of the estimates nearly overlaps the NRV range.

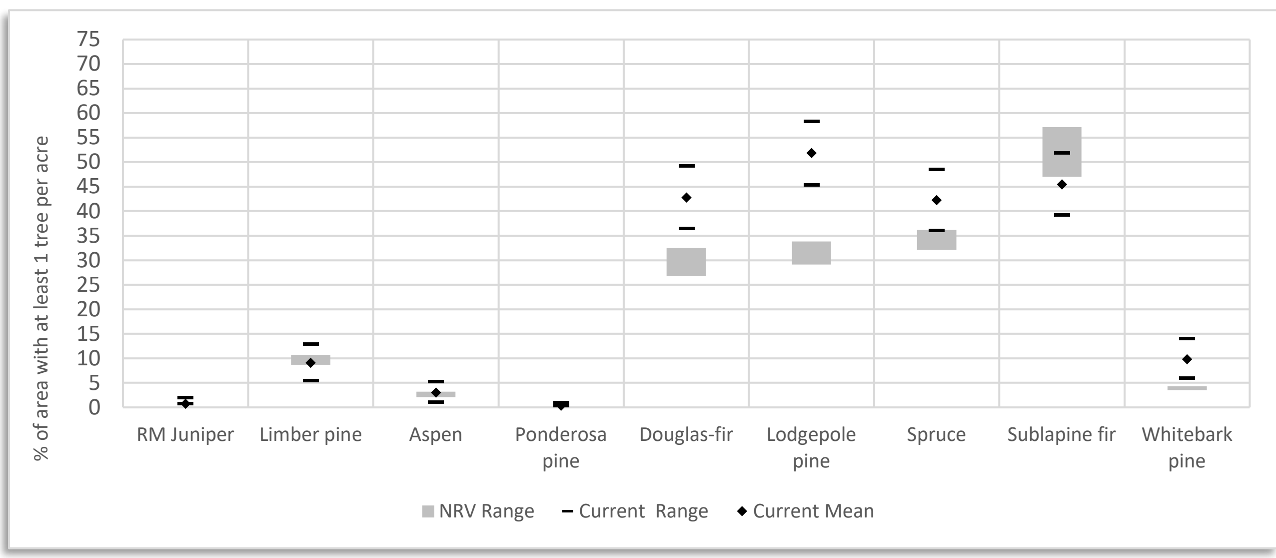


Figure 33. Cool moist PVT tree species distribution NRV compared to existing condition

In the cold PVT (Figure 34), most species are similar in extent to the NRV condition, except that whitebark pine is slightly below and subalpine fir slightly high, although in both cases the confidence interval of the existing condition estimate nearly overlaps with the NRV range.

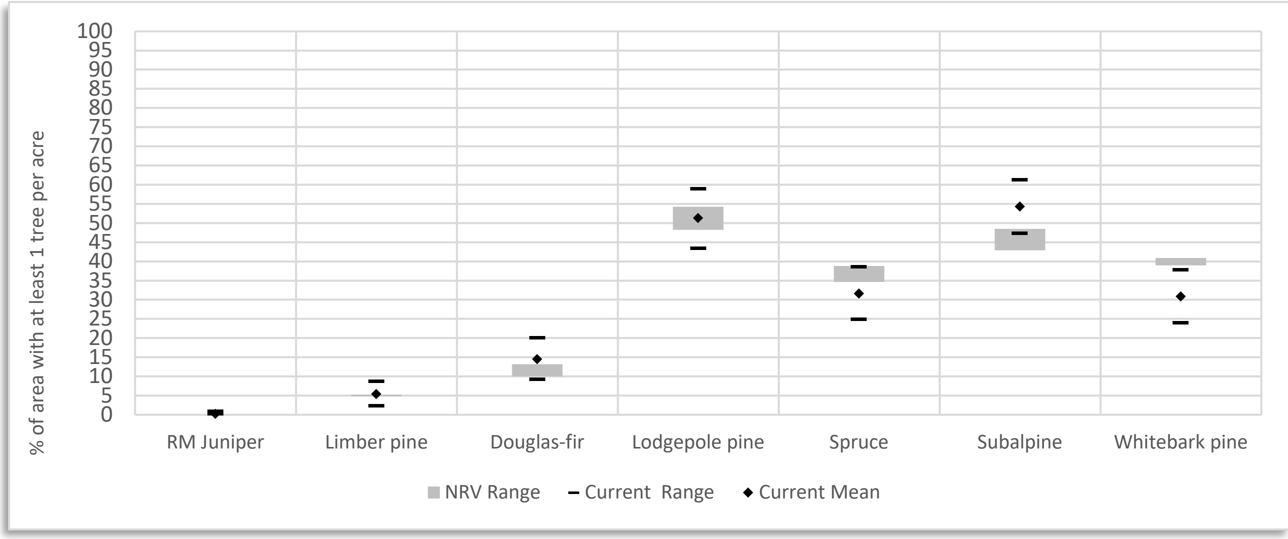


Figure 34. Cold PVT tree species distribution NRV compared to existing condition

The trend of these species according to climate condition in the past may help provide context for the future, which is expected to be warm and dry. In general, Douglas-fir declined during warm/dry periods. This differs from the trend for the dry Douglas-fir cover type, reflecting the relationship that while Douglas-fir may still dominate areas, it declines as a minor species where it may be outcompeted by species such as ponderosa pine. Rocky Mountain juniper and ponderosa pine also decline in warm dry periods; even though they are drought-hardy species, decreases may be due to increased fire that favors nonforested types. In warm dry PVTs, it is likely that ponderosa pine may thrive and outcompete Douglas-fir where moisture remains adequate and fires do not remove the seed source; but some sites may convert to a non-forested or savanna condition. Limber pine and aspen also tend to increase with warm/dry conditions in the past, likely due to increased fire.

At higher elevations, lodgepole pine generally increases during warm/dry periods, while both subalpine fir and Engelmann spruce decrease and become more confined to riparian areas and moist PVTs. Therefore, it is possible that lodgepole may remain above or at the high end of the NRV range in the future. Whitebark pine presence decreases during warm/dry periods, although the whitebark cover type (where it is dominant) increases – this may be because whitebark individuals spread into the cool moist PVTs during cool/moist climate periods, but retract during times of drought and become limited to the cold PVT.

Tree species distribution by geographic area

The existing and NRV distribution of species varies across the GAs, driven by similar factors as described for cover types. The species are addressed in order of where they occur along an elevational gradient.

Rocky Mountain juniper (*Juniperus scopulorum*)

Rocky Mountain juniper tends to become abundant in the later stages of succession in nonforested PVTs or the hottest, driest sites in the warm dry PVT. It is also widespread as a minor component in other forest areas. When dominant, it is considered part of the ponderosa pine cover type, which is below NRV for all scales of interest. As shown in Figure 35, juniper is present on a fairly small proportion of the landscape, and is most notably above NRV in the Big Belts GA. The modeling indicates that it is below the NRV in other GAs (Divide, Highwoods, Little Belts, and Upper Blackfoot), and similar to NRV in the remaining areas. Although it is an important component of the ecosystem, juniper expansion can lead to the decline of grass and shrublands and altered fire regimes. The NRV range includes cool/moist, normal, and warm/dry periods. Given that the species tends to decline during warm/dry periods, in favor of nonforested species promoted by fire, in the future it is likely most appropriate to expect it to occur at the low end of the NRV.

Although the modeling would suggest that the extent of Rocky Mountain juniper is similar to, and slightly less than, the NRV condition in many areas, other studies suggest that this species is likely more extensive than it was historically, invading grass and shrublands in the absence of natural fire regimes (Kitchen 2010). For this species, it is particularly important to reiterate what this attribute does, and does not, indicate. The tree species presence attribute does not indicate the structure or condition of the species on the landscape. The extent of juniper shown in the NRV modeling could include areas where there is only one tree present, whereas in those same areas there may be many more stems present in the existing condition. Therefore, while the overall species extent and distribution may be within the NRV, the density or condition of the species on those sites may not be.

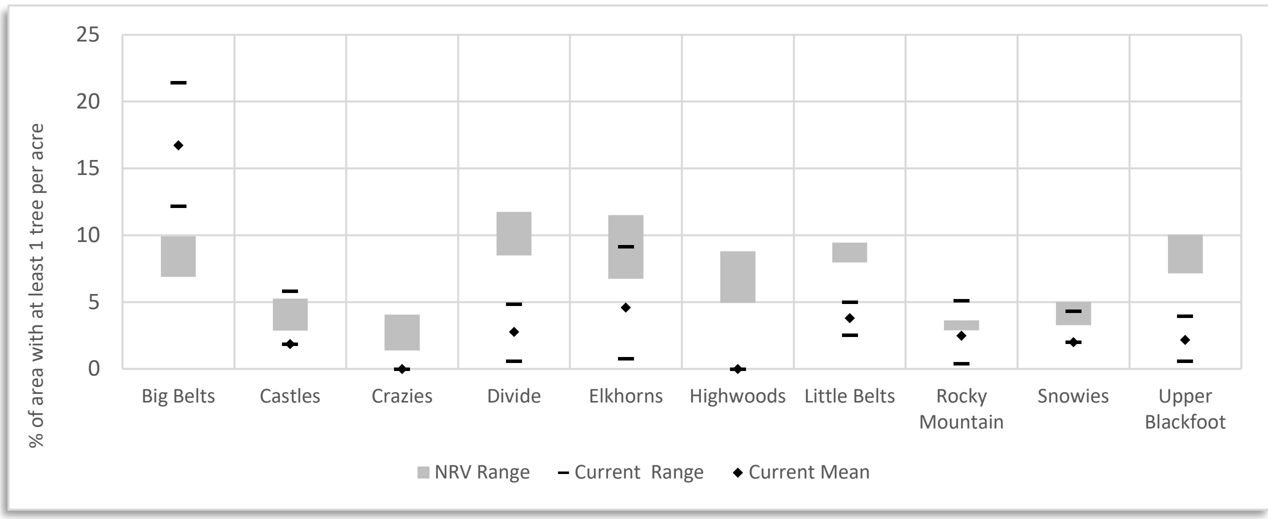


Figure 35. Rocky mountain juniper NRV distribution compared to existing condition, by GA

Limber pine (*Pinus flexilis*)

Limber pine is closely associated to limestone substrates and can occur across a wide range of elevations on the HLC NF. While at the forestwide scale the current abundance is generally within the NRV, it is slightly below the NRV for the warm dry PVT. By GA (Figure 36), it is generally at the low end or below NRV in most areas except for the Snowies and Little Belts, where it is above. The extent of this species is similar to the NRV range for the Rocky Mountain Range and Upper Blackfoot GAs. When this species is dominant, it is considered part of the ponderosa pine cover type, which is below NRV for all scales of interest. Because of the influence of multiple threats, including white pine blister rust and mountain pine beetle, as well as winter damage, drought, and competition from other conifers, the trend of limber pine appears to be a decline. The natural fire regime and the alteration thereof is an important influence on the abundance and health of limber pine. While it tended to increase during warm/dry modeling periods, some sources indicate that limber pine expanded in some areas due to fire exclusion, and may be less viable on the driest sites in drought conditions (Halofsky et al. 2018b).

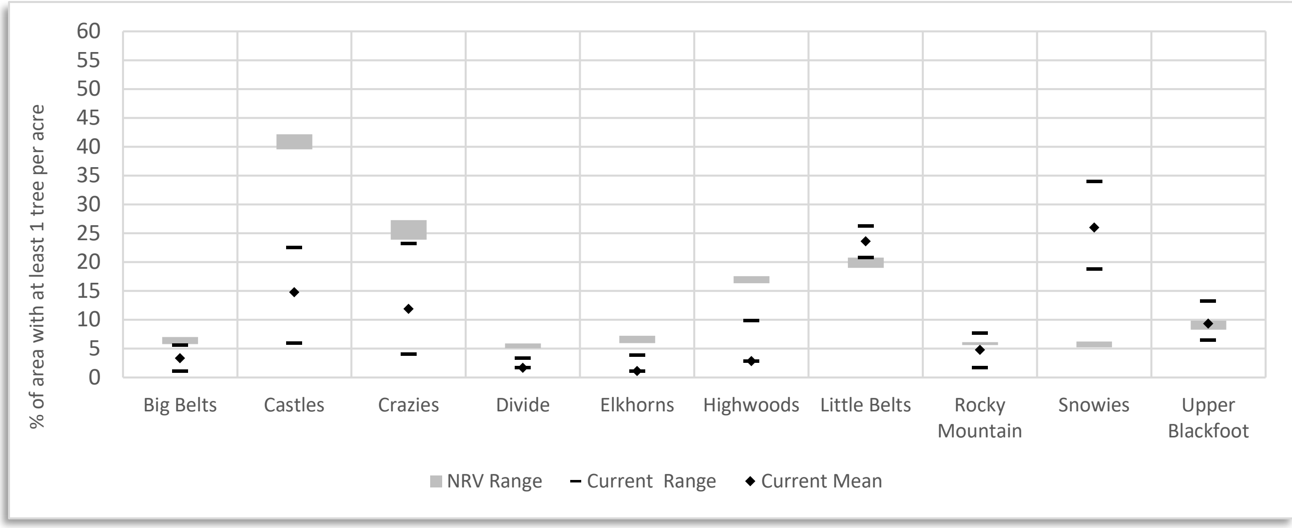


Figure 36. Limber pine NRV distribution compared to existing condition, by GA

Aspen (*Populus tremuloides*)

The modeling showed that at the forestwide scale, and in the warm dry and cool moist PVTs, aspen distribution is generally within its NRV. When this species is dominant, it is part of the aspen/hardwood cover type, which is also generally within the NRV at the forestwide scale. This trend holds true for most GAs (Figure 37), except that this species is below the NRV in the Big Belts and the Snowies. The modeling does not show substantial differences between the existing condition and NRV, in part due to the limitations in the available mapping and data for this species, which is often present in stringers along riparian zones or small upland patches. However, multiple literature sources indicate that aspen is less common than it was historically because of encroachment and overtopping by conifers, overgrazing by cattle and large native herbivores, and the absence of fire (Shepperd et al. 2001, Kaye, Binkley and Stohlgren 2005). Because aspen tended to increase during warm dry climate periods, it would be expected to be at the high end of its NRV in the future, in which case increases in this species would be desirable in most GAs, and may be promoted by fire.

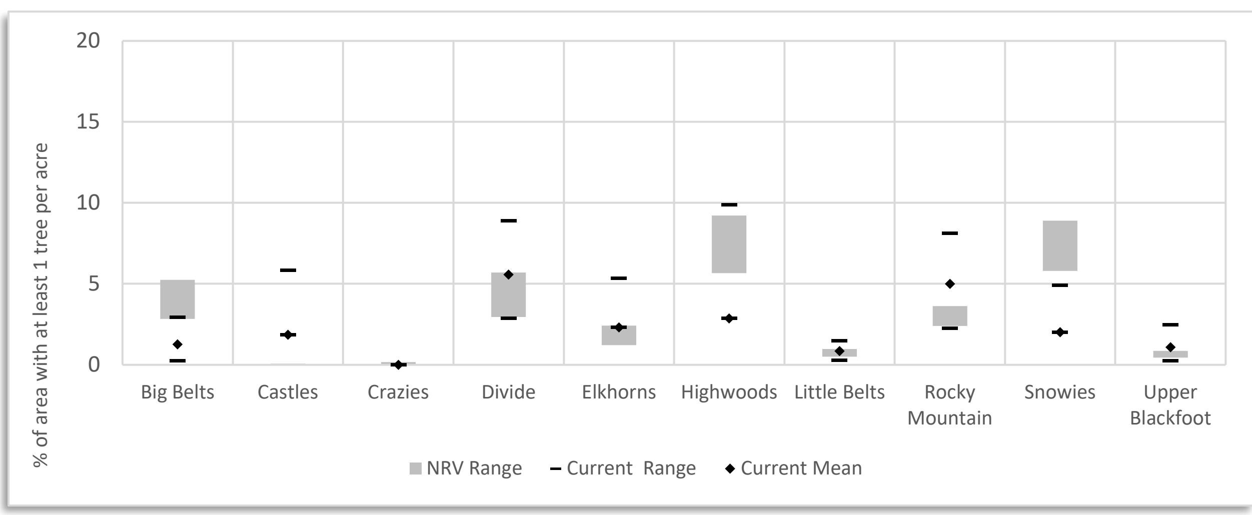


Figure 37. Aspen NRV distribution compared to existing condition, by GA

Cottonwood (*Populus trichocarpa*)

On the HLC NF, cottonwood is confined to riparian areas with fluctuating water tables and is more common on the low lying private lands outside of the Forest boundary. While present in limited areas, it is poorly represented in data sources and modeling, with both only showing trace amounts. This species has likely been reduced from historic conditions, but may suffer further in drought conditions (Halofsky et al. 2018b).

Ponderosa pine (*Pinus ponderosa*)

The modeling showed that ponderosa pine is well below the NRV range forestwide, specifically in the warm dry PVT. This trend holds true in all GAs (Figure 38), except for the Snowies, where ponderosa pine is prevalent on the Little Snowies mountain range. Ponderosa pine is the most heat and drought resistant conifer on the HLC NF and may be expected to increase in areas where it competes with Douglas-fir. Conversely, its establishment may be restricted on the driest habitat types, and it may not regenerate after stand replacing fires that remove the seed source. The distribution and structure of ponderosa pine has been affected by fire exclusion and mountain pine beetle. Fire exclusion has contributed to denser forests with greater competition for resources, higher stress and greater risk of insect attack and stand-replacing fire (Pollet and Omi 2002, Sala et al. 2005). Fire exclusion has allowed succession to promote Douglas-fir over ponderosa pine in some areas. In some GAs, such as the Highwoods, Crazies, and Rocky Mountain Range, this species is currently rare or not present.

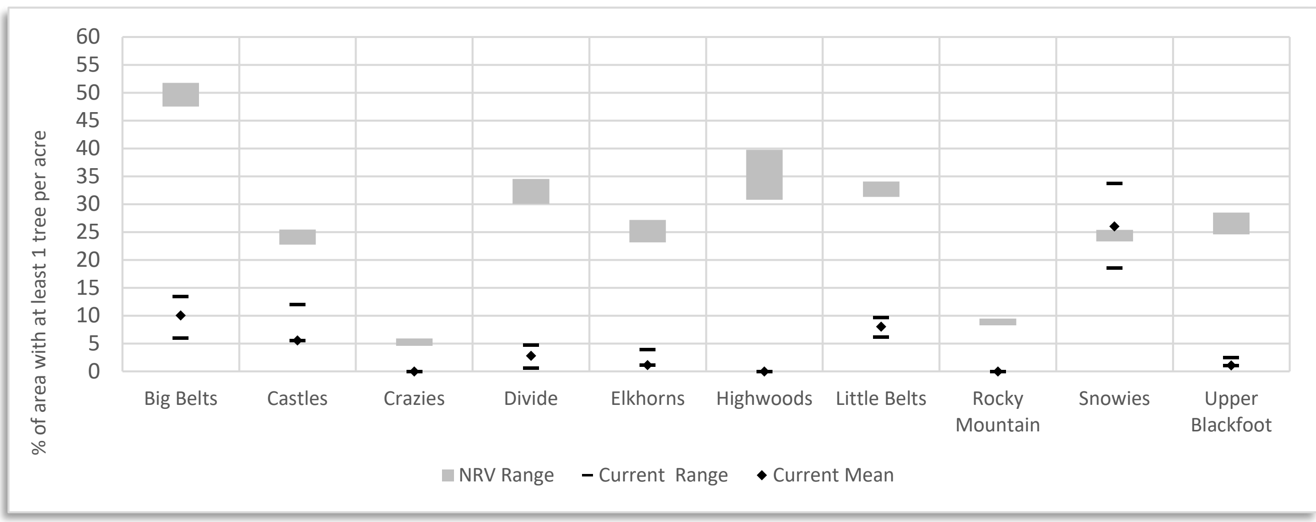


Figure 38. Ponderosa pine NRV distribution compared to existing condition, by GA

Douglas-fir (*Pseudotsuga menziesii*)

At the forestwide scale, Douglas-fir distribution is above the NRV, especially in the cool moist PVT. When it is dominant, Douglas-fir is part of either the dry Douglas-fir or mixed mesic conifer cover type, depending on the moisture regime; the latter is generally above the NRV condition especially in the warm dry PVT. Figure 39 shows that the Castles, Crazies, Little Belts, and Snowies GAs have existing distributions of Douglas-fir well above the NRV. However, other GAs are within the NRV, and the Highwoods and Big Belts are below the NRV. Douglas-fir was at the lowest end of its NRV range during warm and dry climate periods; therefore, in the future a presence at the low end of the NRV may be appropriate. Douglas-fir may have become more common than it was historically because fire exclusion has allowed the species to persist in places where frequent fire would promote more shade intolerant species, primarily ponderosa pine. However, on more mesic sites Douglas-fir functions as the most shade intolerant species and is relatively drought tolerant. Therefore, it may be desirable to promote this species over less drought-tolerant lodgepole pine in some areas. Douglas-fir is one of the primary tree species components on the HLC NF and is expected to remain a dominant component.

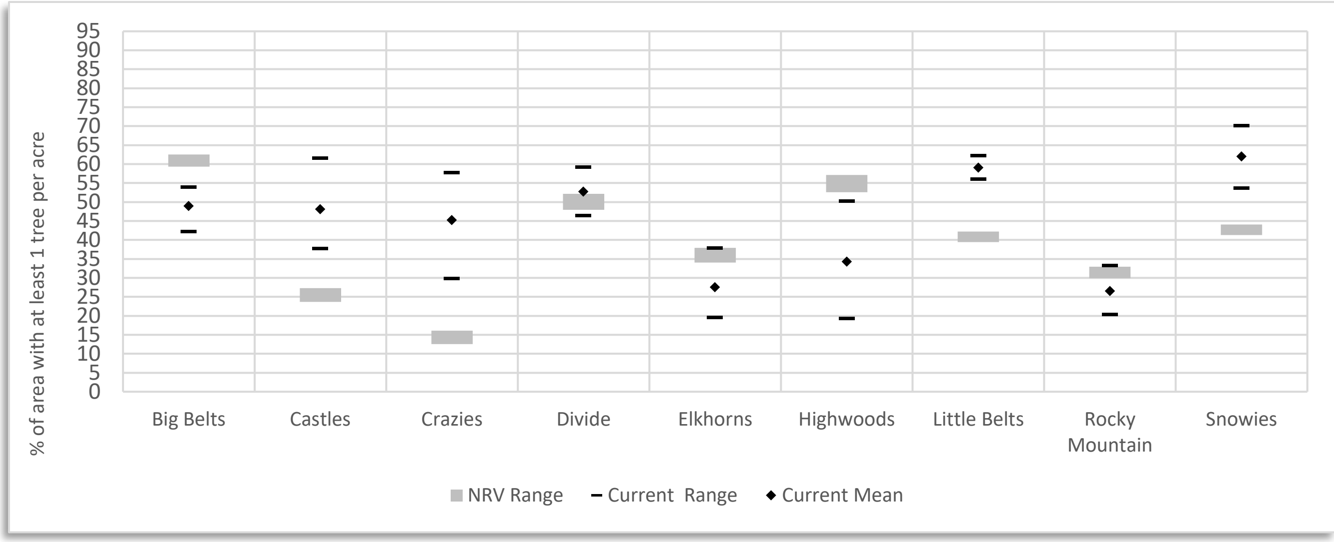


Figure 39. Douglas-fir NRV distribution compared to existing condition, by GA

Western larch (*Larix occidentalis*)

Western larch is, and historically was, only found in the Upper Blackfoot GA (at the far eastern edge of its natural range), primarily in the cool moist PVT. It is likely less abundant than it was historically primarily due to fire exclusion. As with cover type, the data available for larch is not compelling, with the NRV showing only up to 0.1% presence and the existing condition ranging from 1.1-2.1%. Western larch is particularly vulnerable to potential future warming, limiting it to higher elevations and moist sites.

Lodgepole pine (*Pinus contorta*)

Lodgepole pine is a major component of most landscapes, dominating cool moist sites but maintaining a presence in all PVTs. At the forestwide scale and in all PVTs except cold, the distribution of this species is above NRV. When it is dominant, it constitutes the lodgepole pine cover type, which is generally above the NRV forestwide and in the warm dry PVT. As shown in Figure 40, in some GAs lodgepole pine is more extensive than it was historically (Divide, Highwoods, Little Belts, Rocky Mountain Range, and Upper Blackfoot); but similar to the NRV in the other GAs. This species tended to be at the higher end of its NRV during warm/dry periods, and future climates and increased fire would be expected to promote it especially on cool sites. The species may retract to some extent on drier sites where Douglas-fir may be more drought tolerant; but overall is expected to remain a major component on the landscape.

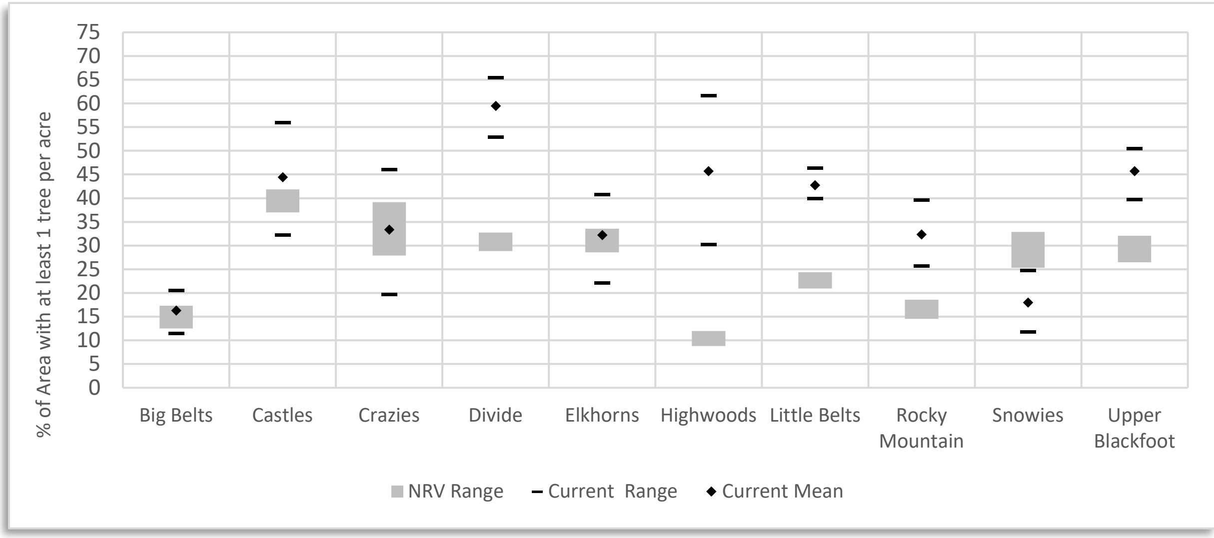


Figure 40. Lodgepole pine NRV distribution compared to existing condition, by GA

Engelmann spruce (*Picea engelmannii*)

Engelmann spruce is often confined to riparian areas and moist sites. Its extent is currently similar to or slightly above the NRV at the forestwide scale, and on all PVTs. When dominant, this species is part of the spruce/fir cover type, which is generally below the NRV, especially on the large GAs (Rocky Mountain Range, Little Belts, and Upper Blackfoot). Trends of Engelmann spruce as an individual species vary by GA (Figure 41). In the Elkhorns, Little Belts, and Snowies, the existing condition is above NRV, but in the other GAs it is similar to the NRV. Subalpine fir, the other component of the spruce/fir cover type, is much more common than Engelmann spruce, and therefore the trends for the cover type are more closely driven by that species. Engelmann spruce was generally at the low end of its NRV during warm and dry climate periods. It is more abundant than it was historically in some areas due to fire exclusion that has allowed advanced succession to occur where it would compete with lodgepole pine and whitebark pine. Engelmann spruce provides an important component of riparian and refugia areas that are protected from disturbance and persist to an old age but may be more restricted to the most moist sites at the lower end of its NRV with expected future climate and disturbances.

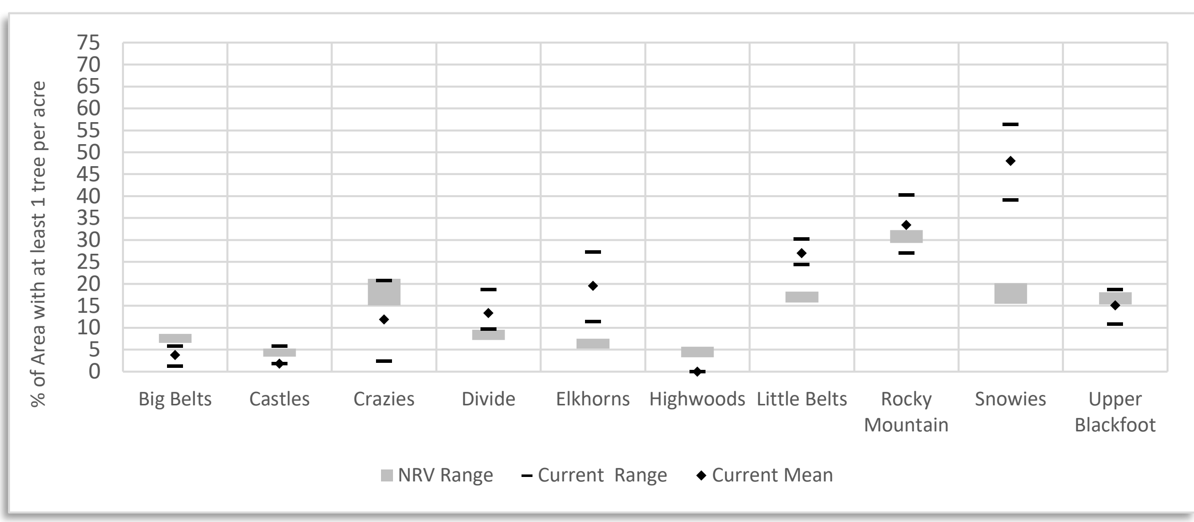


Figure 41. Engelmann spruce NRV distribution compared to existing condition, by GA

Subalpine fir (*Abies lasiocarpa*)

Subalpine fir is a common component on high elevation moist sites across the HLC NF; when dominant, it is part of the spruce/fir cover type. The NRV modeling at the forestwide scale showed that its current distribution is similar to the NRV, but that the spruce/fir cover type is less common than the NRV. This may be due to recent large fires in the Rocky Mountain Range GA where this type was most abundant; in other areas, this species and type may be more abundant than it was historically due to fire exclusion that has allowed advanced succession to occur primarily in lodgepole pine and whitebark pine cover types. As shown in Figure 42, the current distribution is above the NRV in the Crazies, Divide, Elkhorns, and Upper Blackfoot. It is similar to the NRV in the other GAs. Like spruce, this species was at the lowest end of its NRV during warm and dry climate periods and is not well-suited to drought, so in the future it may be expected to persist at the lower end of its NRV, and to occur on the moistest and/or highest elevation sites.

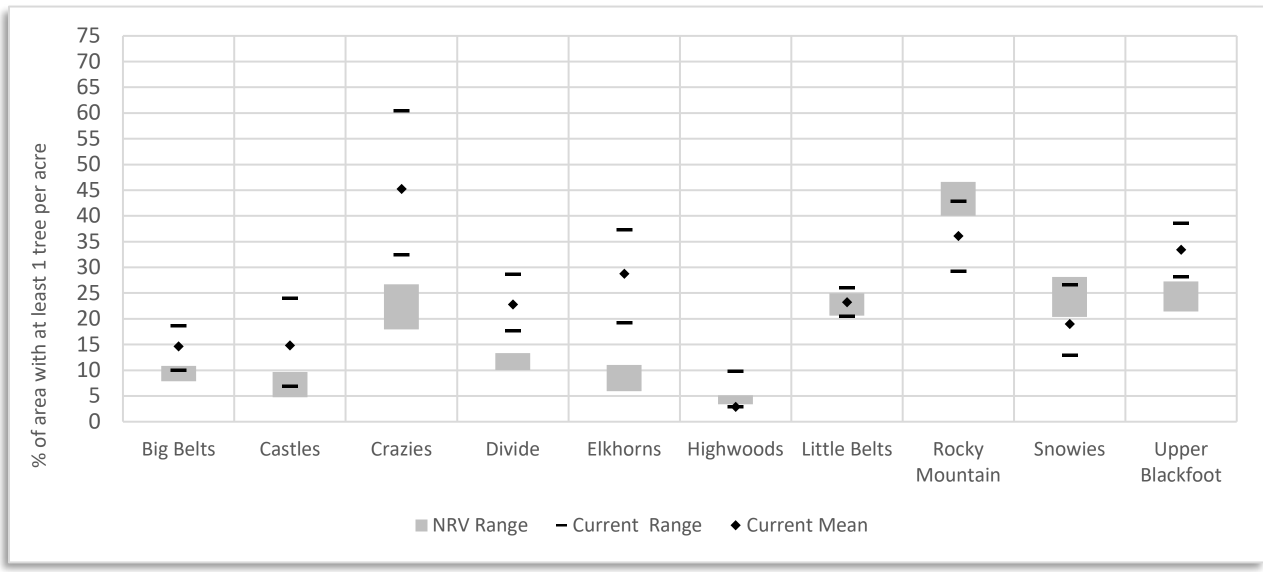


Figure 42. Subalpine fir NRV distribution compared to existing condition, by GA

Whitebark pine (*Pinus albicaulis*)

Whitebark pine is a keystone species that primarily occurs on the cold PVT, and to a lesser extent on cool moist. It is present on most GAs except the Highwoods. At the forestwide scale, the distribution of this species is just below the NRV on the cold PVT, where it is most suited to grow. When dominant, it comprises the whitebark pine cover type, which is similar to or slightly above the NRV depending on the GA. However, the cover type is not well-classified due to the limitations in species abundance as described in the cover type section. Figure 43 shows that the distribution of whitebark pine is generally similar to the NRV, although slightly above in the Castles and slightly below in the Little Belts and Snowies.

Many literature sources have found that whitebark pine is less abundant than it was historically due to a number of factors including fire exclusion, mountain pine beetle outbreaks, climate shifts, and the exotic disease white pine blister rust. The convergence of these threats has led to its status as a proposed species under the Endangered Species Act. Most of the whitebark pine on the HLC NF has been impacted by these factors, as evidenced by "ghost forests"; still, in these areas generally some seedlings or saplings persist, and therefore species presence is still noted in the existing condition. Whitebark pine tended to be at the higher end of its NRV during the warm/dry modeled climate periods, and although the effects of future climates are particularly uncertain for this species it is cold and drought-tolerant.

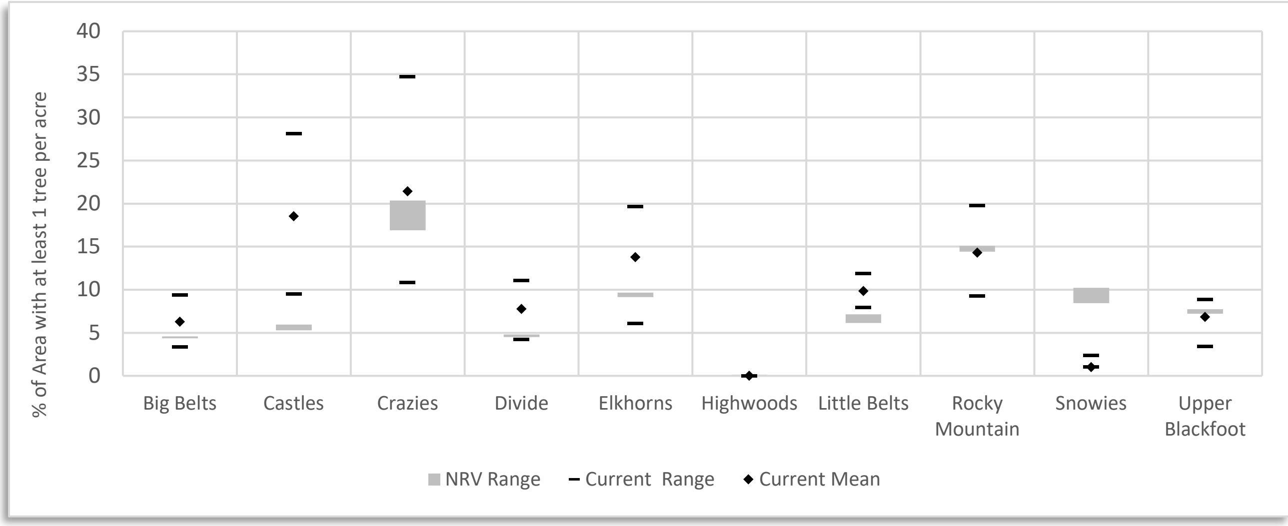


Figure 43. Whitebark pine NRV distribution compared to existing condition, by GA

Structure

The NRV analysis examines four vegetation components of ecosystem structure, all of which are related to forested vegetation types: forest size class, forest density class, forest vertical structure class, and the patch size of early successional forest openings.

Forest size class

Forest size classes are categories of tree size, based on the average basal area weighted diameter of live trees. Appendix D of the 2021 Forest Plan shows the definitions for size class. Size classes change as forests grow, and depend upon individual species traits, site productivity, climate, and disturbances. Some species, such as lodgepole pine, typically do not grow larger than the small or medium class based on their physiology and short-lived nature. Other species such as Douglas-fir or ponderosa pine are long-lived and capable of growing to large sizes especially in open conditions. Size class is not directly relatable to tree age, but can give a general idea of the array of forest successional stages across the landscape.

The way SIMPPLLE and the R1 Classification System classify size class is not the same. The R1 Classification System is based on basal area-weighted diameter (average size), so many areas in a given size class may have trees that are smaller and/or larger than the size class range. In SIMPPLLE, size class is not a product of average diameter, but rather a ruleset reflecting the expected tree sizes present based on age; these assumptions placed emphasis on the largest trees. Therefore, in SIMPPLLE a stand could be classified into a large tree size class, and a similar area might be classified as a medium by the R1 Classifier. This relationship is not generally problematic for the smaller size classes but shows divergent results when comparing the large and very large size classes.

To enable a direct comparison between the existing condition and the NRV, the SIMPPLLE results for the large and very large size classes were adjusted. To do this, the relationship of large tree presence and forest size classes was analyzed in the FIA data, and that relationship used to create a consistent NRV adjustment. This resulted in decreasing the amount of large and very large outputs from SIMPPLLE in proportion to increasing other classes. This methodology is documented further in appendix H of the FEIS.

Forest size class forestwide and by broad potential vegetation type

Figure 44 shows the NRV analysis for size class across the HLC NF. At this scale, the small tree size class is well above the NRV range, and the medium class is at the upper end or slightly higher than the NRV. Conversely, the large and very large size classes are below the NRV. In some areas fire suppression may have caused decreases in the proportion of seedling/sapling forests that would have been created by stand-replacing disturbances. Similarly, the lack of low-intensity disturbances in long-lived cover types may have caused a decrease in the large and very large size classes by perpetuating high densities where individual tree growth is inhibited. The recent mountain pine beetle outbreak may also have contributed to an increase in the small tree size class.

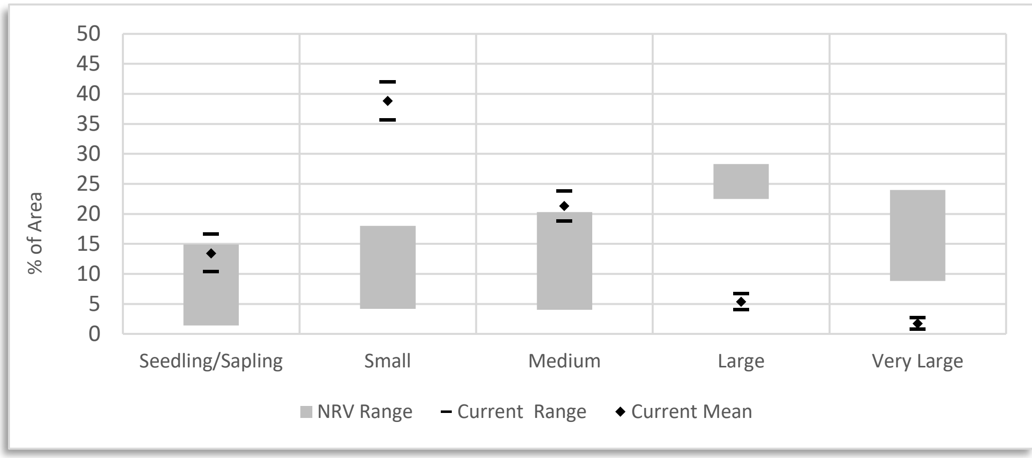


Figure 44. NRV range of size class compared to existing condition, forestwide

In the warm dry PVT (Figure 45), the existing proportions of small and medium size classes are well above the NRV, while the large tree and very large classes are below. Large and very large tree sizes classes would likely have been relatively open or clumpy patch mosaics, with the large tree component being long-lived species capable of surviving moderate or low severity fire when mature (such as ponderosa pine and Douglas-fir). In sheltered riparian areas, groves of large Engelmann spruce could develop. Compared to cool moist and cold PVTs, the warm dry PVT is the most substantially different from the NRV condition, congruent with our understanding of the effects of suppressing fires in these high frequency, low severity fire regimes.

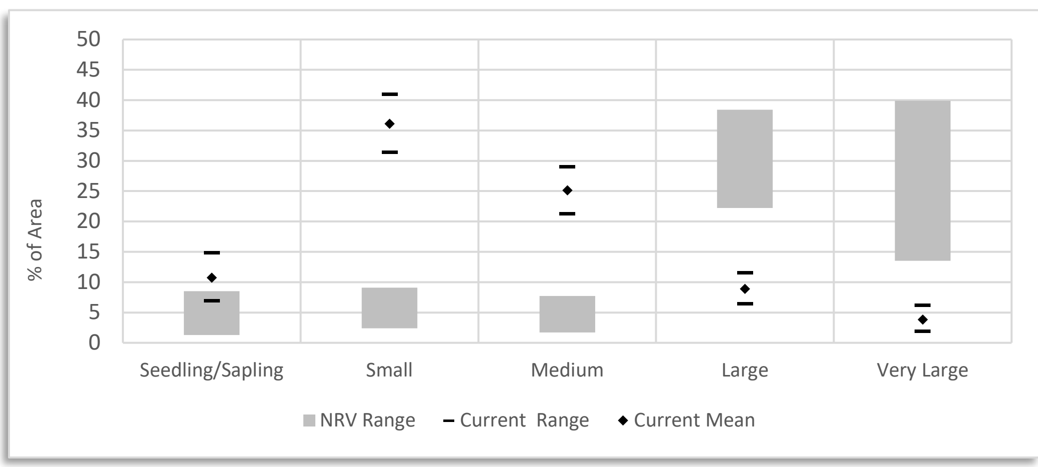


Figure 45. Warm dry PVT NRV range of size class compared to existing condition

For the cool moist PVT (Figure 46) the abundance of the small tree class is above the NRV, while the existing proportion of large and very large size classes are below the NRV. However, the medium class is within the NRV, albeit at the upper end. In large part, this is due to this type being dominated most commonly by lodgepole pine, which naturally does not reach large sizes. In areas with large size classes, a fire tolerant large diameter overstory tree layer would typically exists (Douglas-fir) atop a more dense mid and understory tree layer. Large, old Engelmann spruce could occur in sheltered, moist riparian settings.

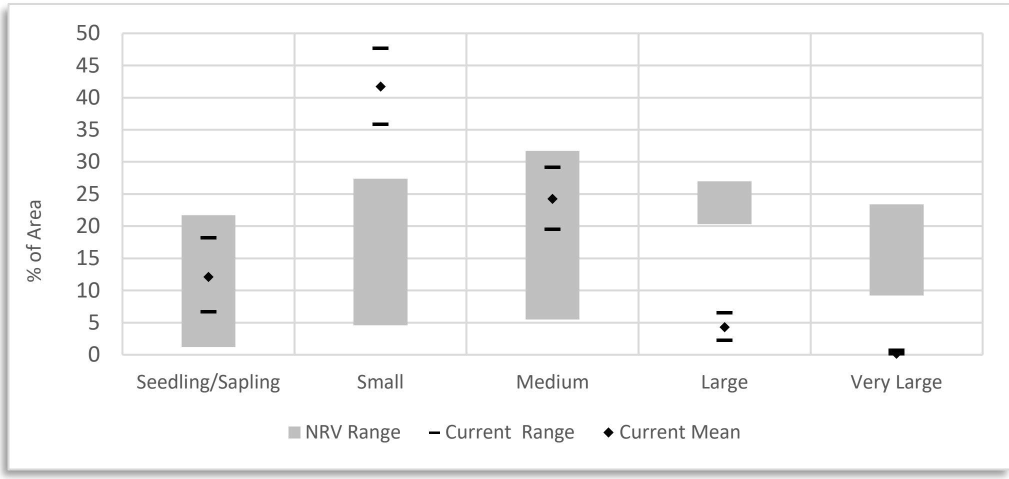


Figure 46. Cool moist PVT NRV range of size class compared to existing condition

For the cold PVT, the existing proportion of the small tree size class is at the upper end or slightly above the NRV, and the large and very large tree size classes are below. The abundance of the very large tree class is naturally low because the harsh conditions and species present on these sites make the achievement of a very large size difficult. Whitebark pine was historically the large tree component, tolerant of the moderate or low severity fires that typically occurred. Large subalpine fir and Engelmann spruce could develop in moist areas.

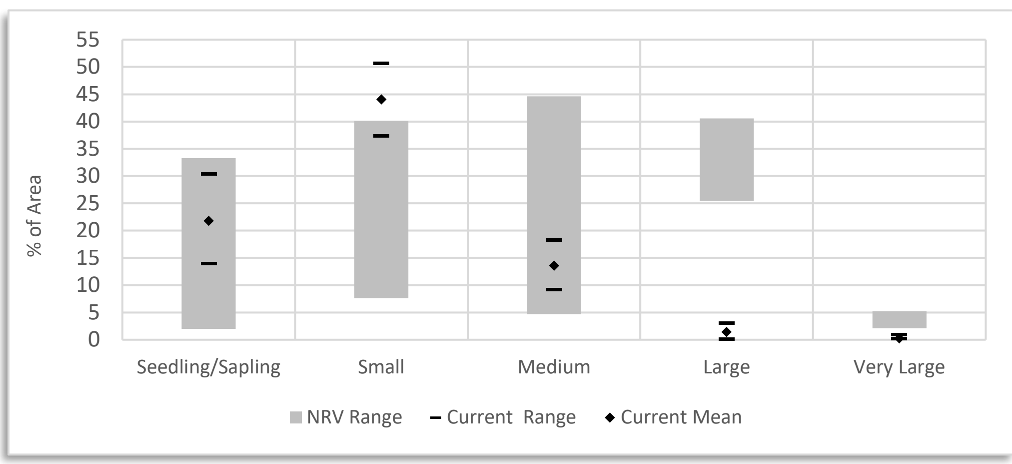
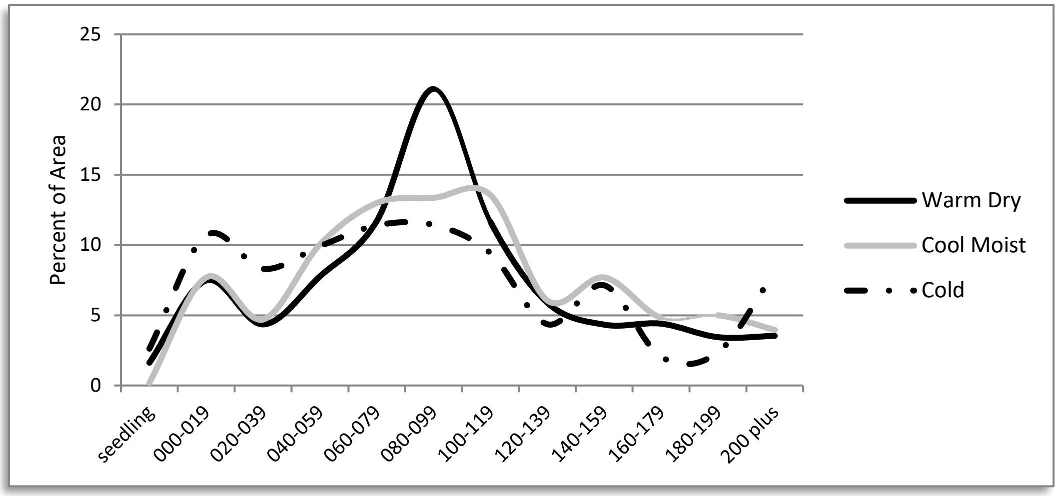


Figure 47. Cold potential vegetation type NRV range of size class compared to existing condition

Size class is not equivalent to age class, and there is no NRV assessment of age class. However, the existing condition of age class distribution by PVT, as shown in Figure 48, supports the trends seen in size class. Particularly in the warm dry PVT, there is a high preponderance of middle-aged forests that may roughly correlate to the small and medium size classes. Across the HLC NF, most forests are between 20 and 199 years old. Old forests over 200 years old are relatively rare, as are large and very large tree size classes. Based on the NRV of size class, the NRV distribution of age classes was likely more evenly distributed. Given that large size classes were more abundant historically, it is reasonable to include that older age classes were also more abundant.



Source: R1 Summary Database (FIA data, Hybrid 2007 dataset, queried 2015).

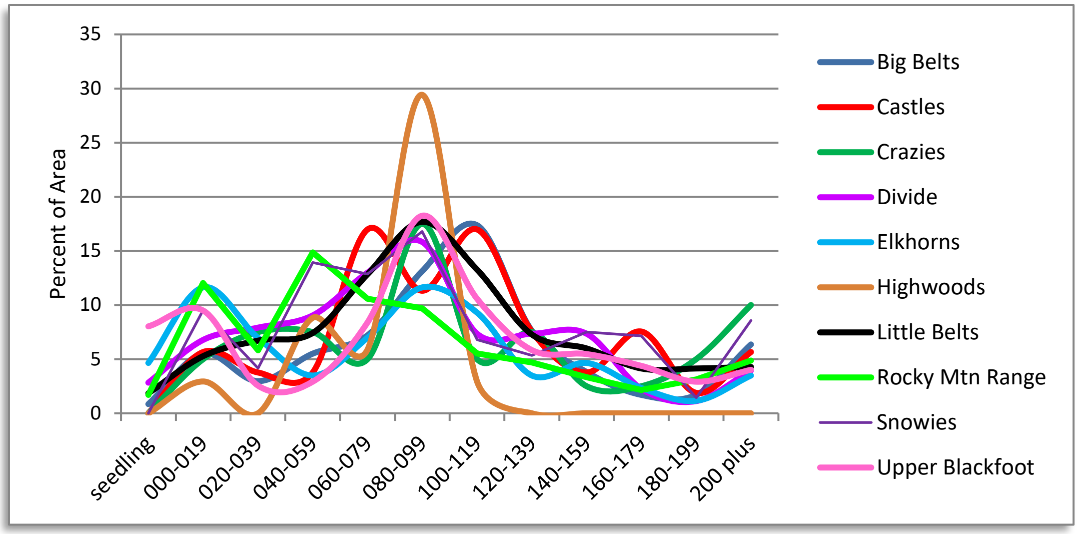
Figure 48. Existing condition age class distribution by broad PVT

The seedling/sapling size class tends to increase and then start falling during warm/dry periods, perhaps in response to increased fire and then growth into small trees. The small tree class consistently increases toward the higher end of its NRV during warm/dry periods, whereas the medium tree class is at the lowest end of its range during these periods. The large and very large tree classes also tend to begin declining during warm/dry periods, perhaps also due to increased fire activity, although they would remain important components on the landscape.

Forest size class by geographic area

The following sections explore the NRV trends for each size class by GA. In general, the GAs show trends similar to forestwide averages.

Age class data was also summarized for each GA, as shown in Figure 49. The Highwoods GA has an especially pronounced bell-shaped curve with the 80-99 year old age class far more abundant than any other classes; this is a function of the disturbance regime in this range. As a small island mountain range, it can be subject to fires that sweep up from the prairie and affect the entire GA. This occurred in the late 1800's, and there has been little disturbance since; therefore, the age class distribution of the Highwoods GA is not diverse. The other GAs follow this trend to a lesser extent because they have had more regular disturbance. For example, the Rocky Mountain Range has a notably different and more regular age class distribution, not only because it is part of a larger connected landscape but also because it has had a more active fire history in the last century.



Source: R1 Summary Database (FIA data, Hybrid 2007 dataset, queried 2015)

Figure 49. Existing condition age class distribution by GA

Seedling/sapling size class

As shown in Figure 50, all GAs contain existing proportions of the seedling/sapling size class within or at the higher end of the NRV range, largely because of recent fires and the mountain pine beetle outbreak. The most notable exception is the Highwoods, which contains essentially no seedling/sapling forests due to a lack of recent disturbance. The wide range of variation of the seedling/sapling class is linked to stand-replacing disturbance regimes, and is most abundant in the cool moist PVT. Forests spend a relatively short amount of time in this successional stage of development, generally growing into the small tree stage within 30 or 40 years, except on poor or harsh growing sites.

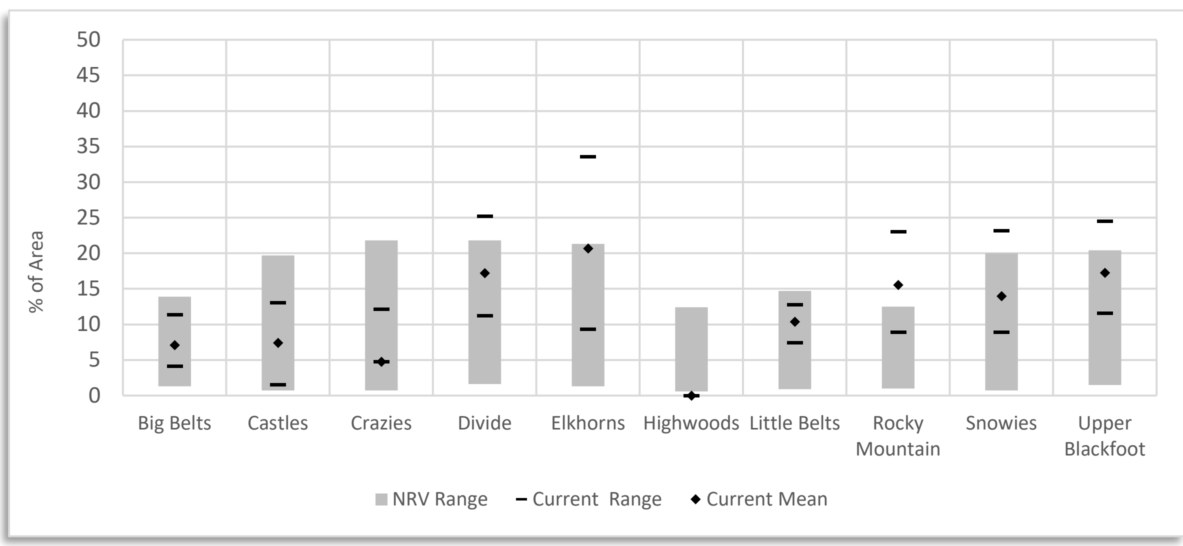


Figure 50. Seedling/sapling size class NRV range compared to existing condition, by GA

Small and medium tree size classes

All GAs have a higher proportion of small tree size class than the NRV, although the confidence intervals for the Elkhorns, Highwoods, and Upper Blackfoot are within or near the upper bound of the NRV. The disparity between existing and NRV conditions is most dramatic for the Big Belts, Castles, Divide, Little Belts, and

Snowies. Some of these were areas hardest hit by the mountain pine beetle. Conversely, for most GAs, the existing proportions of the medium tree size class are within the NRV. The exceptions are the Big Belts, Highwoods, and Little Belts, where results indicate that the medium tree size class is more abundant than the NRV. The small and medium size classes are often associated with densely stocked stands originating from past wildfires or prior harvesting. Forests may be diverse within these classes and may also contain seedling/sapling trees in the understory canopy and/or large trees in the overstory. Forests may remain in the small and medium size classes for many decades. Some forests (i.e. lodgepole pine) may remain in these classes their entire lifespan.

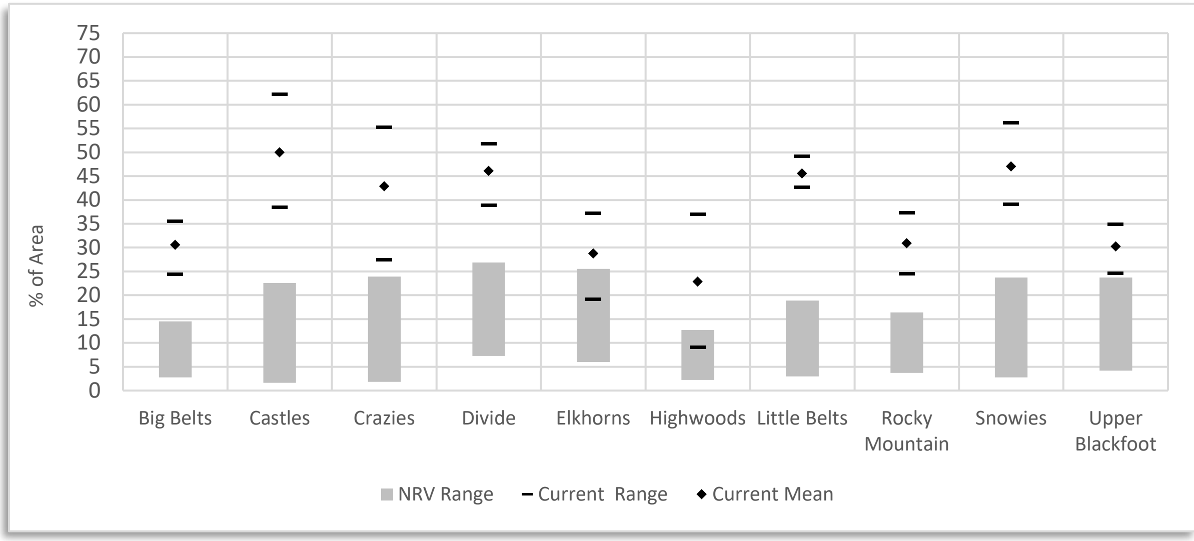


Figure 51. Small tree size class NRV range compared to existing condition, by GA

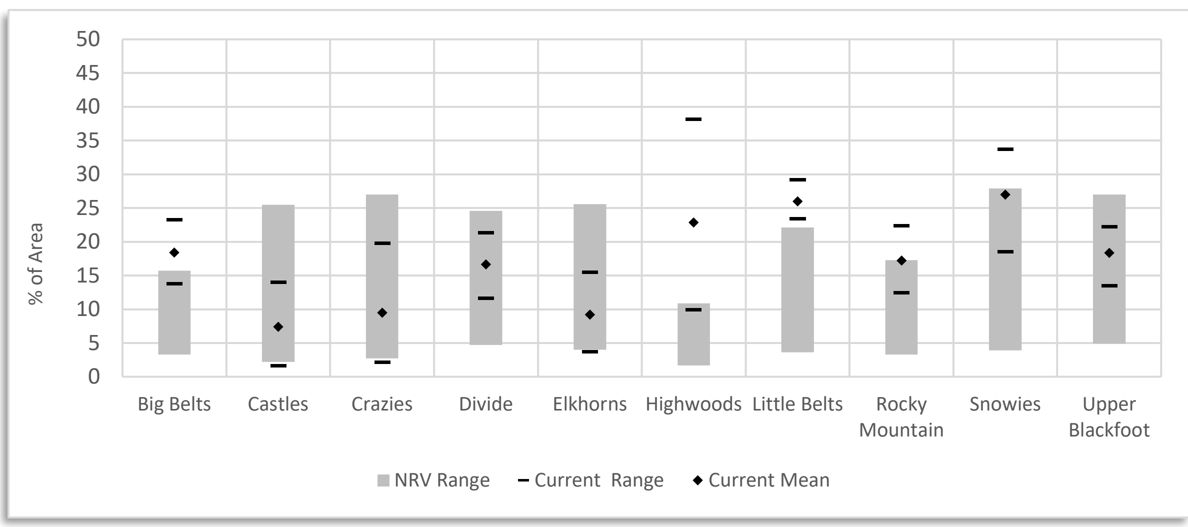


Figure 52. Medium tree size class NRV range compared to existing condition, by GA

Large and very large tree size classes

The large tree size class is currently underrepresented in all GAs as compared to the NRV (Figure 53). In most GAs, the very large tree size class is also more abundant in the NRV than the existing condition (Figure 54). Several GAs, however, are either within or very near the NRV for the very large size class (Castles and Crazies). A proportion of the large and very large size classes may be late successional or old growth forest. In some places, the species and growing sites inhibit tree growth to a large size. The correlation to climate period may indicate that large and very large trees would be at the lower end of their NRV range during warm/dry periods such as those expected in the future; however, this level would still exceed the existing condition.

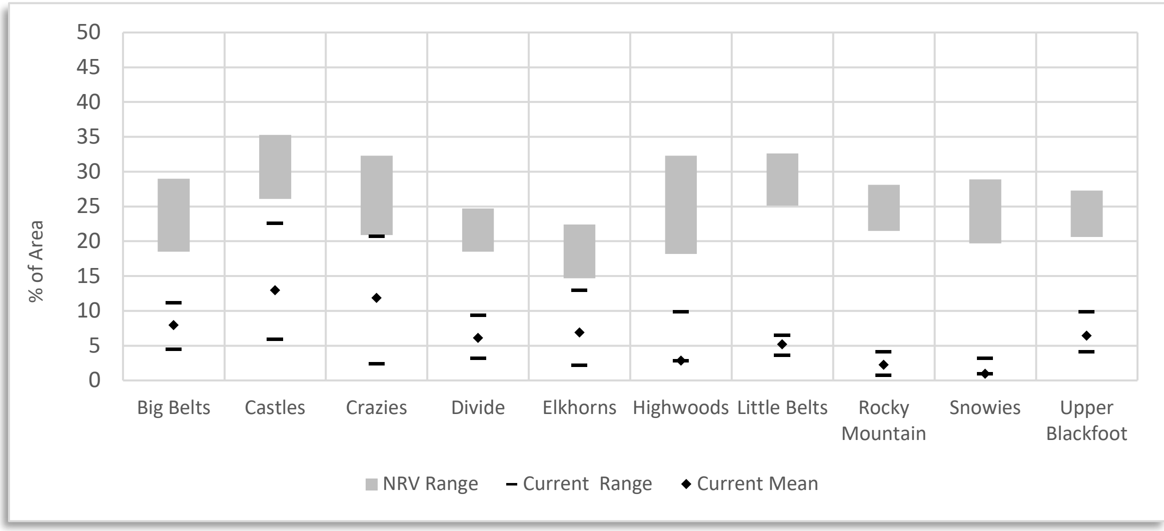


Figure 53. Large tree size class NRV range compared to existing condition, by GA

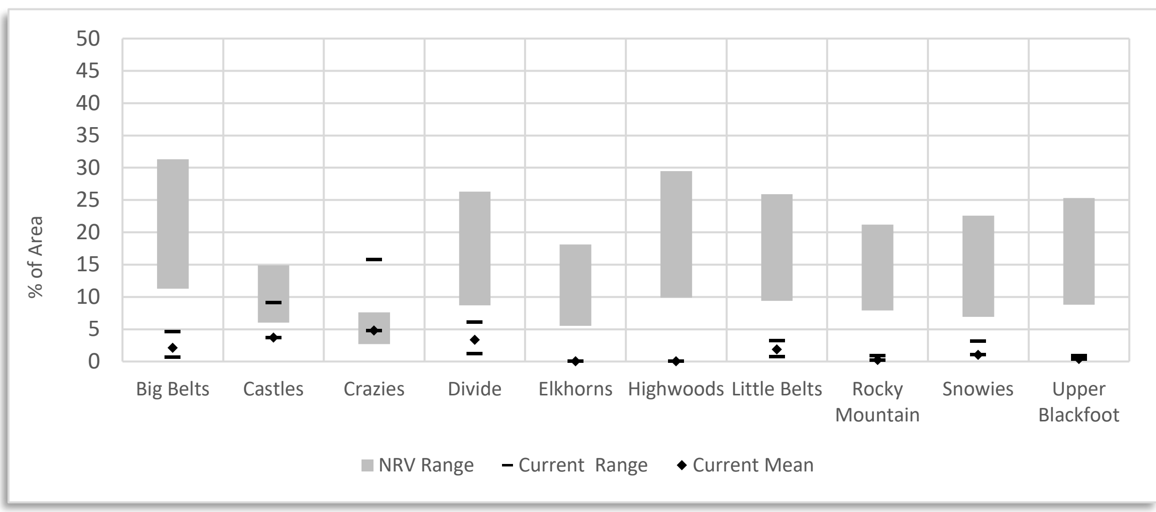


Figure 54. Very large tree size class NRV range compared to existing condition, by GA

Forest Density Class

Forest density class is depicted by using classes of canopy cover, which is a measure of the vertical coverage of tree crowns in a stand as a percentage of the land area; refer to appendix D of the 2021 Forest Plan for definitions of the density classes used. Density is influenced by the carrying capacity of the site as well as disturbances and varies by species. For example, lodgepole pine tends to grow more densely than ponderosa pine. Density class can also shift as forests grow, tending toward higher densities at later successional stages of stand development, for example when shade tolerant understories develop under mature canopies. Density classes can be used to describe habitat qualities and resiliency to disturbances. The existing condition for density class is depicted by the latest R1 VMap, rather than FIA. Canopy cover is more directly measured by remotely sensed imagery, whereas it is estimated based on species and size calculations when FIA data is summarized. In short, the R1 VMap is more accurate for this attribute. As a result of using this information rather than FIA, there are no confidence intervals associated with the existing condition data.

Density Class forestwide and by broad potential vegetation type

Figure 55 displays the NRV analysis for density class across the HLC NF, showing that medium/high forest densities are below the NRV, and the abundance of high density is just above the NRV. This is consistent with the trends of fire exclusion which promotes higher forest density, and the increased abundance of shade tolerant species in some areas which tend to grow at higher densities than their shade intolerant competitors.

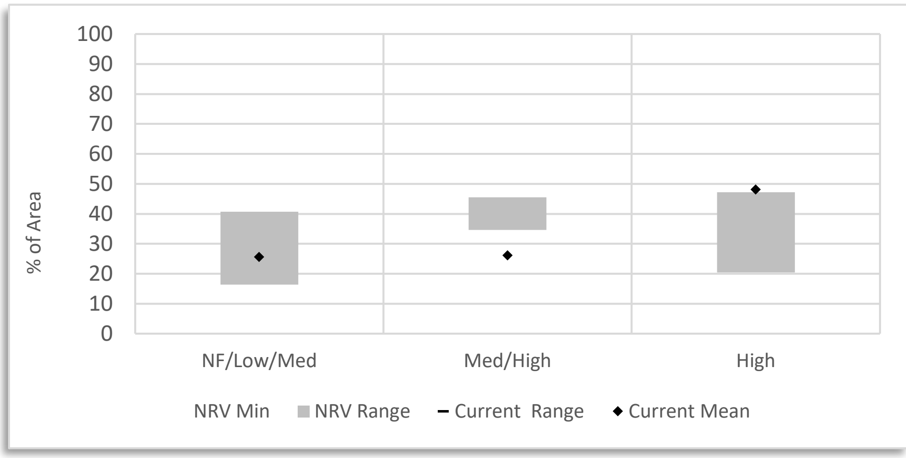


Figure 55. NRV range of density classes compared to existing condition, forestwide

As shown in Figure 56, the distribution of density classes is generally within the NRV for the warm dry PVT. An increase in higher forest densities due to fire exclusion is well-documented in the dry forests found on this PVT; however, recent fire and insect activity that has lowered densities or even created nonforested conditions may have tempered this trend when examined across this type on the HLC NF. The abundance of high density forests is in the upper end of the NRV range while the medium/high forests are at the low end of the range; this should likely shift in the future as lower density forests are more common in warm/dry climate periods such as that expected in the future.

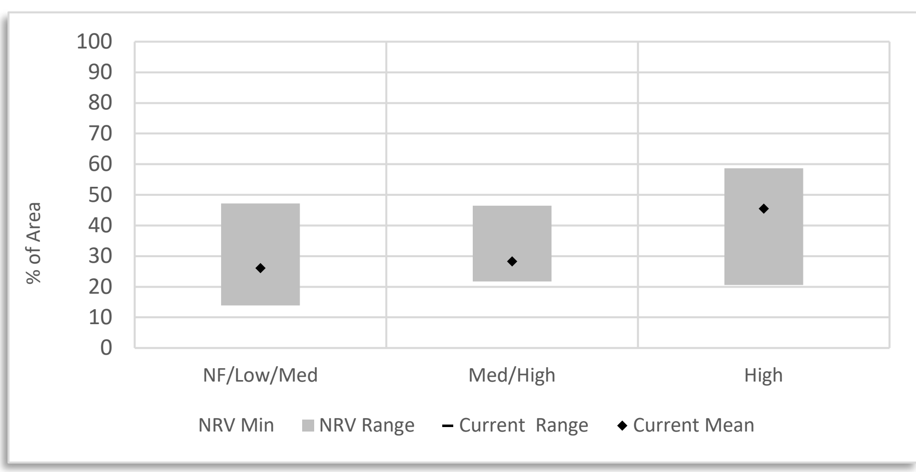


Figure 56. Warm dry PVT NRV range of density classes compared to existing condition

On the cool moist (Figure 57) and cold PVTs (Figure 58), the medium/high density class is lower than the NRV and conversely the high density class is higher than the NRV. This may be indicative of more dense understories of shade tolerant trees developing under lodgepole pine and/or whitebark pine canopies in the absence of fire disturbance, and/or with the release of these components due to mountain pine beetle infestation.

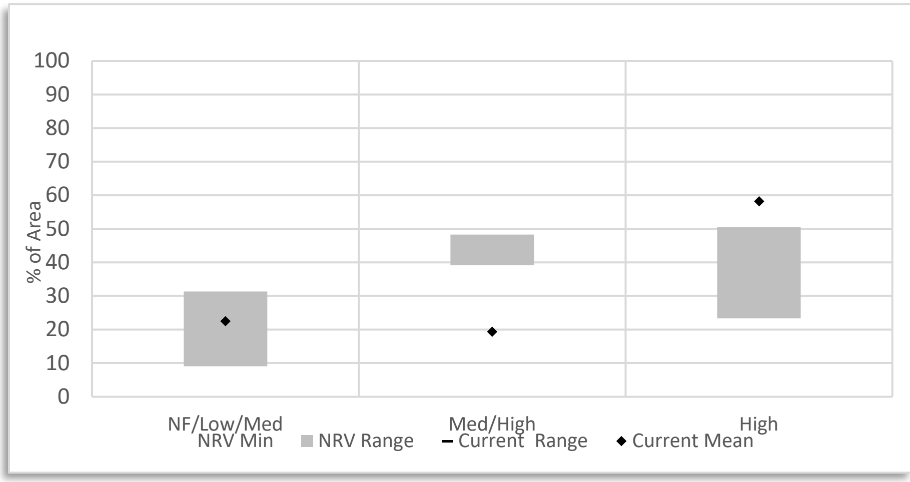


Figure 57. Cool moist PVT NRV range of density classes compared to existing condition

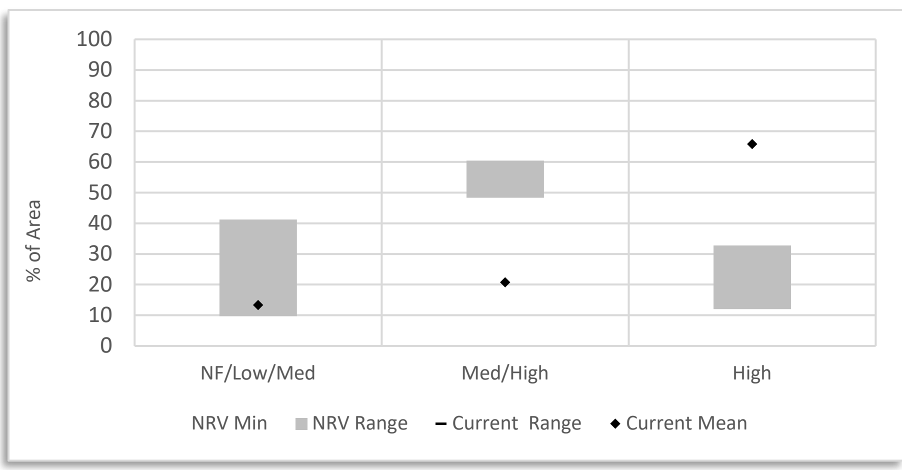


Figure 58. Cold PVT NRV range of density classes compared to existing condition, forestwide

Low and medium density forests were at the higher end of their NRV ranges during warm/dry periods, whereas medium and high-density forests were at the lowest end of their ranges. Similar trends may be expected given expected future climate and disturbances. More open densities tend to be more resilient to both fire as well as insects and diseases. Conversely, higher densities are also important conditions to provide certain wildlife habitat conditions. The differences in density class are fundamentally a function of the PVTs, cover types, size classes found on the landscape, as some forest types and successional stages naturally grow more densely than others.

Density class by geographic area

Nonforested/low/medium density

Nonforested areas are typically defined as those with <10% canopy cover and includes grass/shrub areas (0-5% cover of trees) as well as very open forest savannas maintained by frequent disturbance (5-10% canopy cover). This category may also include forested areas that have not yet regenerated after a disturbance. However, in the SIMPPLLE model the 0-10% canopy cover conditions are combined low density forests (<25% canopy cover), if a forest species type is listed. Further, the medium class was combined with the low class in the 2021 Forest Plan, because the distinction is not crucial for plan components or wildlife species. Therefore, the nonforested, low, and medium forest density classes were combined for this analysis (canopy cover 0-39.9%).

At the forestwide scale and broad PVT, the abundance of nonforested/low/medium density forests is within the NRV range. Figure 59 shows that the existing condition of the nonforested/low/medium density areas are also within the NRV for all GAs except the Elkhorns, where they are underrepresented. The finding in the Elkhorns is supported by a study in that GA which found that there has been a three-fold increase in the amount of closed-canopy forest at the expense of grass, shrub, and open tree stands compared to historical conditions (Barrett 2005a). In other GAs, the abundance of these low-density forests (or nonforested areas) is at the low end of the NRV range, particularly the Divide, Highwoods, Little Belts, and Snowies. Given that lower density forests are more common during warm/dry climate periods, in the future a shift towards the mid or upper range of the NRV for these GAs may be expected or warranted.

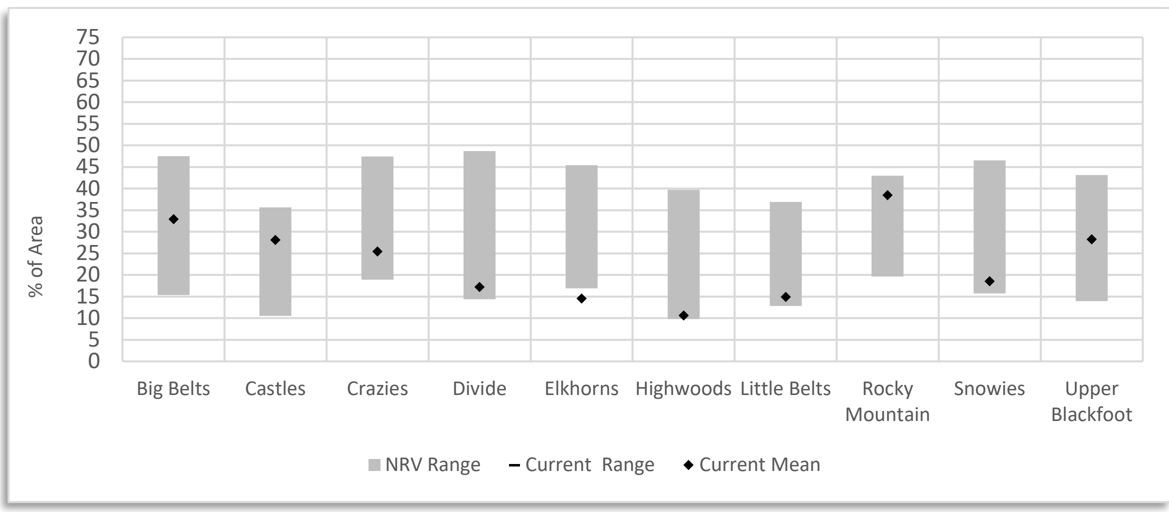


Figure 59. Nonforested/low/medium density class NRV compared to existing condition, by GA

Medium/high density

Medium/high density forests were below the NRV at the forestwide scale, and for the cool moist and cold PVTs. By GA, as shown in Figure 60, this density class is underrepresented in some GAs (Big Belts, Crazies, Highwoods, Little Belts, Rocky Mountain Range, and Snowies); slightly overrepresented in the Castles; and within the NRV for the Divide, Elkhorns, and Upper Blackfoot, although at the low end of the range. The medium/high density class may be underrepresented in some areas due to disturbances that have created nonforested or low-density forests; or conversely, in some areas, a lack of disturbance that has promoted high density forests. The latter case is the most common condition, because high density forests are overrepresented at the forestwide scale and in the cool moist and cold PVTs.

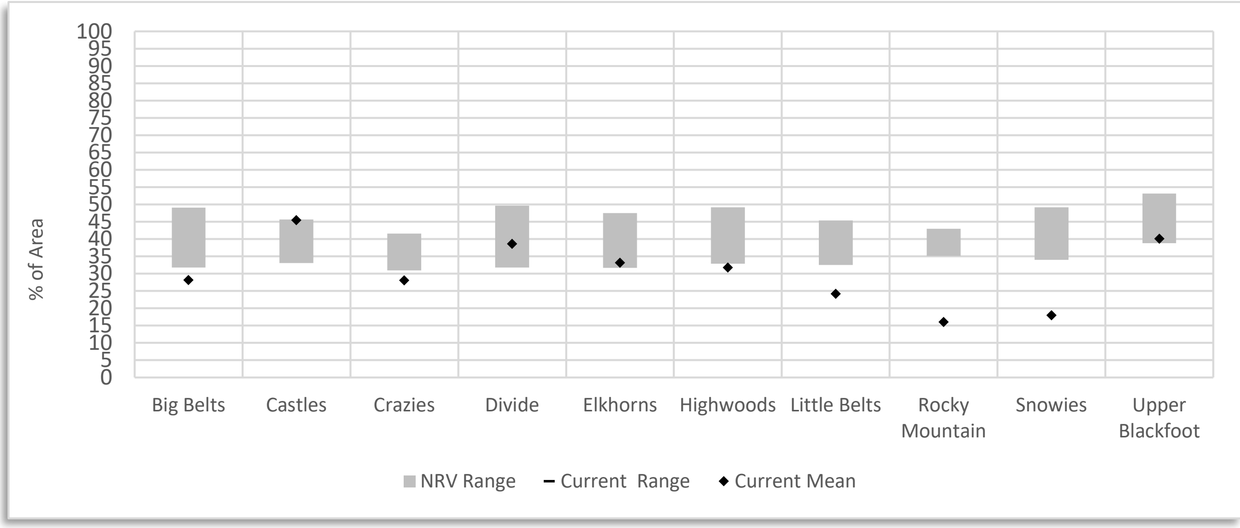


Figure 60. Medium/High density class NRV compared to existing condition, by GA

High density

Medium/high density forests were below the NRV at the forestwide scale, and for the cool moist and cold PVTs, and this generally correlates with high density forests being above the NRV. As shown in Figure 61, high density forests are above the NRV in most GAs except the Big Belts, Castles, Divide, and Upper Blackfoot. The high density forests were overrepresented in the cool moist and cold PVTs, which likely reflect lodgepole pine and spruce/fir forests.

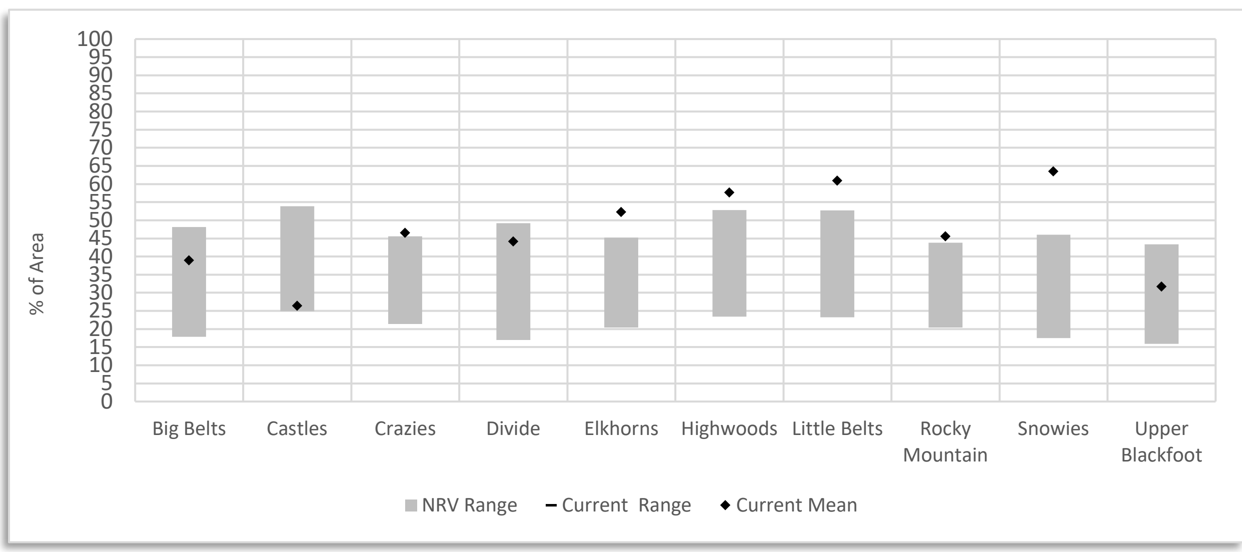


Figure 61. High density class NRV compared to existing condition, by GA

Forest vertical structure class

Vertical structure class is a depiction of the number of canopy layers present. This characteristic is driven by succession, individual species traits, and disturbances. Some cover types, such as spruce/fir, naturally develop a continuous canopy structure made up of multiple layers of shade tolerant species. Other types, such as ponderosa pine, would tend to have the number of canopy layers reduced periodically by frequent natural fires, although these events also promote a multi-storied character with open densities. Conversely, natural fire in some Douglas-fir stands would create small canopy openings where understory layers could establish; in the absence of fires stands remain in a closed single-storied condition. Some types, such as lodgepole pine, tend to grow in a single-storied condition which is perpetuated by periodic stand replacing disturbances. In the absence of disturbance these forests can slowly develop shade tolerant canopy layers. Three vertical structure classes are modeled: single storied (SS); 2-storied; and 3+ or multi-storied (MS). The NRV trends are closely tied to PVT. Figure 62 shows that on the warm dry PVT, the abundance of single storied forests are substantially higher than the NRV, and multi-storied forests less abundant. The single-storied forests may include ponderosa pine or Douglas-fir where low severity disturbance has not opened the canopy to allow understory trees to establish.

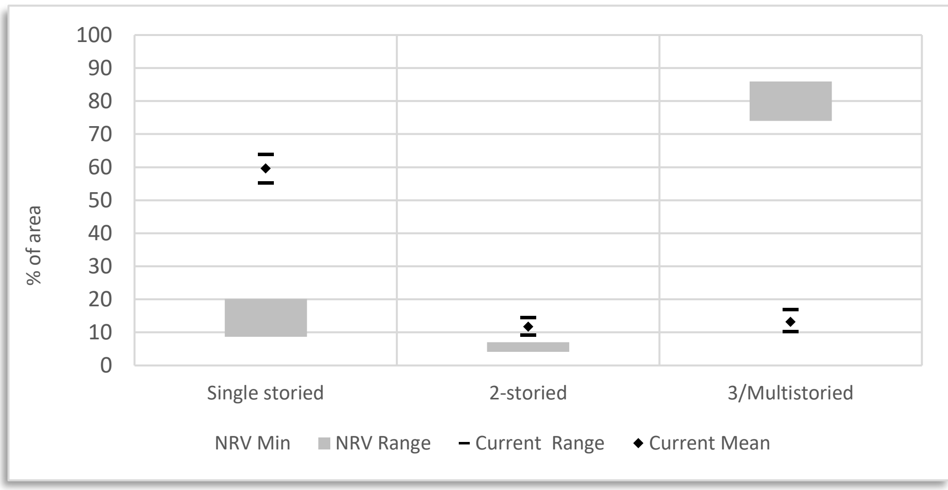


Figure 62. Warm dry PVT NRV of vertical structure class compared to existing condition

On the cool moist PVT (Figure 63), the abundance of single storied forests is slightly above NRV and multistoried forests below, but to a lesser degree than in the warm dry PVT. This may reflect the under-abundance of spruce/fir forests in some areas, which would tend to grow in a multistoried condition. A single storied condition would also naturally be abundant, reflecting the traits of the most common species present on this PVT, lodgepole pine.

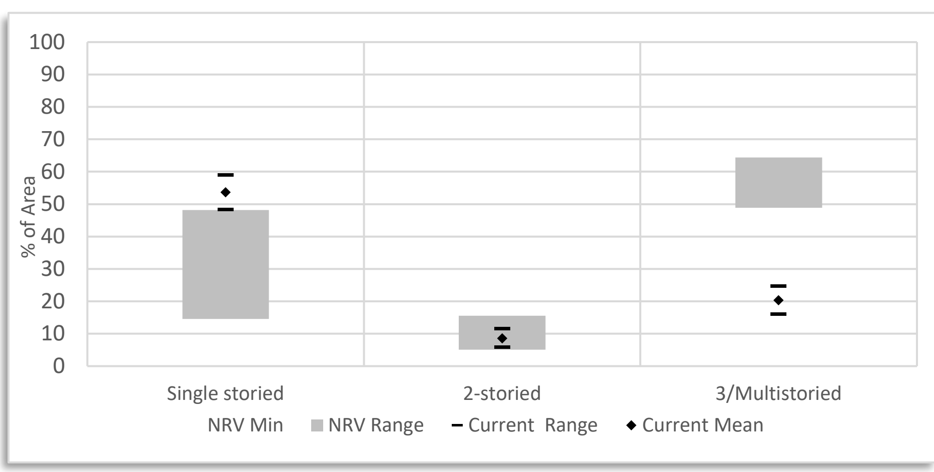


Figure 63. Cool moist PVT NRV of vertical structure class compared to existing condition forestwide

In the cold PVT (Figure 64), single storied forests are within the wide NRV and multistoried forests are below. In the past, fire may have promoted more open and uneven-aged whitebark pine forests. The single storied forests are most likely dominated by lodgepole pine or whitebark pine, given that spruce and fir would more likely grow in a multistoried condition.

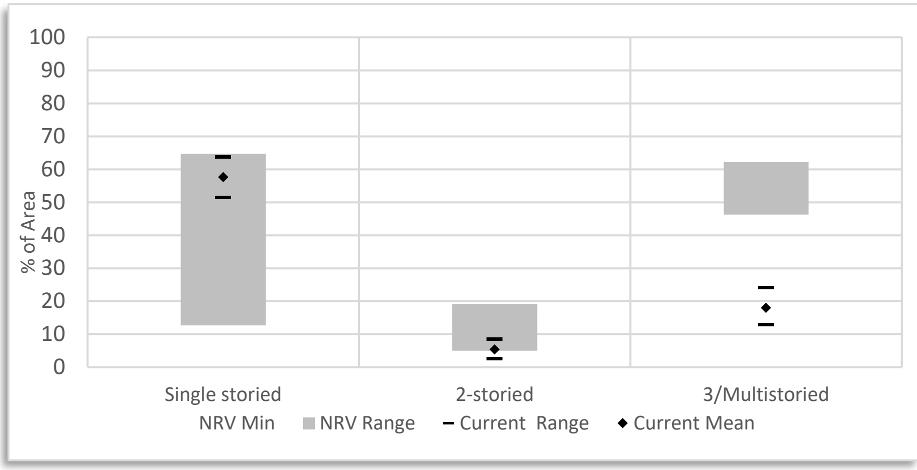


Figure 64. Cold PVT NRV of vertical structure class compared to existing condition

Single-storied forests appear to increase and be at the high end of their NRV ranges during warm/dry periods. Therefore, it is reasonable to expect that even if the single storied forest abundance approaches the NRV, it will remain slightly above or within the upper end of the range. Two storied conditions are overall less abundant and tend to be at the low and but slightly increasing during warm dry periods. Multi-storied conditions decrease and are at the low end of their NRV range during warm/dry periods. A focus on increased resiliency through decreased density may be important given future expected climate and disturbances. For most tree species, the combination of less canopy layering and/or lower tree densities would generally be more resilient to disturbances, although dense multi-layered conditions are also important for certain wildlife habitats.

Landscape pattern: early successional forest openings

The connectivity of ecosystems influences characteristics such as watershed function, wildlife habitat, and the flow of genetic material. The patch and pattern of vegetation has been influenced by many factors including climate, disturbance regimes, and human management. As described in the Assessment, some studies indicate that there has been a general trend of decreasing patch size and increased landscape fragmentation compared to the historic condition in the Upper Missouri River Basin, which includes the HLC NF plan area. There are many ways to assess landscape patch and pattern, depending on the condition or species of interest. For this analysis, early successional forest openings were assessed as one aspect of landscape pattern.

Early successional forests are those in the early stages of stand development, dominated by seedlings and saplings. The dominance of grass, forbs, shrubs and short trees creates a patch with strong contrast (e.g., “edge”) that is distinctly different from adjacent forest patches. Not only does this allow for accurate detection and measurement of the patch and resulting landscape patterns (past, present and future), but the seedling/sapling forest patch type is also meaningful for evaluation of wildlife habitat, forest cover, and connectivity. The larger trees and denser forest cover present in the adjacent forest patches provide the connectivity of habitat important to many wildlife species. Early successional stages also represent the crucial initiation point of forest development and thus greatly influence potential future conditions and patterns.

Both the NRV and existing condition were estimated using SIMPPLLE. The estimates include the seedling/sapling size class and grass/shrub/forb communities on forested PVTs, which are in transition from a recent disturbance but are expected to reforest. Table 4 shows the results for the arithmetic mean size of early successional forest patches.

Table 4. NRV patch size of early successional forests compared to the existing condition

Patches > 5 acres	Forestwide	Warm dry PVT	Cool moist PVT	Cold PVT
NRV mean patch size	78 (45-119)	45 (30-70)	64 (44-84)	59 (39-84)
Existing mean patch size	163	91	133	76

The modeling results indicate that the average seedling/sapling patch size in the existing condition is generally larger than the patches in the NRV. This may be due to recent large fires and the mountain pine beetle outbreak which created large patches and influenced the overall patch size at the broad scale. In particular, the NRV modeling tending to distribute stand-replacing fire on many small patches rather than a few large patches, although the total acres burned was similar or more than the existing fire regimes in most periods and landscapes (as discussed in the wildfire section above). Although the current average patch size is higher than the NRV when averaged at the broad scale, fragmentation and small patch size could still be an issue in some landscapes or at smaller scales.

Early successional patches in the NRV of the warm dry PVT are smaller than in the other PVTs, due to a more frequent low severity disturbance regime which may cause a complex mosaic of within-stand structures including small patches and canopy openings. Patches in the cool moist PVT tend to be larger due to a preponderance of lodgepole pine and infrequent, high severity disturbances. Patch sizes in the cold PVT reflect a mixed fire regime.

The largest patch sizes are correlated with warm/dry climate periods. More fire might mean more, larger openings, resulting in patch sizes that trend towards the upper end of the NRV range with expected future climate and disturbances. Forestwide, fire will continue to be the primary activity that creates early successional forest openings, particularly the large sized openings.

Wildlife habitats

The vegetation key ecosystem characteristics have a direct bearing on wildlife habitat. The concept of a coarse filter approach is that maintaining the appropriate ecosystem diversity for composition, structure, function, and connectivity will provide for the habitat needs of most native terrestrial wildlife species. Therefore, the NRV abundance of terrestrial wildlife habitat conditions is inherently part of the array of vegetation characteristics.

Certain species have specific habitat requirements that may not be met solely by providing for ecosystem integrity at a broad or coarse filter level. These species' habitats may require additional consideration at the fine filter level in order to understand needs and the role that NFS lands may play in meeting them. The potential NRV for habitats of some species are of particular interest because they are 'At-Risk', as defined by the 2015 planning directives, or because of specific public or management interest. Not all at-risk or management interest species require a fine-filter approach, however, or have habitat needs that lend themselves to vegetation modeling. We identified species of either conservation or other management interest for which habitat requirements are highly correlated with specific, quantifiable vegetation attributes. Habitat models were developed to identify the conditions that would meet their habitat requirements. These definitions are based on the best scientific information available and are consistent, to the extent applicable, with recent modeling work done for east-side forests in Region 1. The species selected for the revised NRV analysis include:

- Canada lynx

- Flammulated owl
- Lewis's woodpecker
- Elk

This list is slightly different than the original NRV analysis; namely, elk are included and goshawk are not. Elk habitat was added based on the development of appropriate modeling criteria that were not available at the time of the original NRV analysis. Elk were identified as a management indicator species in the 1986 Forest Plans, and analysis of certain aspects of elk habitat serves as a proxy for other big game species. Elk also remain a focus of significant public interest. Northern goshawks were listed in the 1986 plans as a management indicator species for old growth forest. Research has demonstrated that goshawks are not dependent on old growth and are therefore a poor indicator of that type of forest (Samson 2006b, U.S. Department of Interior 1998, Bush and Lundberg 2008a, Brewer et al. 2009), and information has become increasingly available indicating that goshawks and their habitat may be more widespread and available than previously thought. Samson (2006b) concluded that goshawk nesting habitat is abundant and well-distributed throughout the Region, and goshawks are not a species of conservation concern for the HLC NF.

The type of data and basis for estimates of existing habitat are discussed below for each species. The comparisons displayed and discussed below are intended to be a very broad look at existing conditions compared to the estimated inherent capacity of the HLC NF to provide and sustain these habitats.

Canada lynx

Canada lynx are listed as Threatened under the federal Endangered Species Act. The historic distribution of lynx in Montana is not well documented but it appears that they historically occupied only portions of the HLC NF, with some island ranges occupied only intermittently and others not at all (USFWS 2014). Lynx are highly dependent on snowshoe hare, which in turn are dependent on boreal (primarily spruce-fir) forest (Interagency Lynx Biology Team 2013). Certain structural stages appear to be key to maintaining populations of snowshoe hare. Specifically, hares require forests that provide either dense young conifers, or mature conifer stands with multiple canopy layers. Both types provide horizontal cover that serves as some protection against predation (ibid). Both also have conifers protruding above or hanging down to snow level, providing both protection and forage for snowshoe hares. These structural features are difficult to model using available vegetation data, however, and must be inferred from a combination of tree size class, canopy cover and, where available, disturbance history. Attempts to model lynx/snowshoe hare habitat are further complicated by the fact that certain habitat types develop structure differently depending on landscape features such as slope, aspect, and elevation.

The series of figures below shows the estimated NRV range compared to the existing condition of the four structural stages generally used to describe lynx habitat: *early stand initiation*, *stand initiation*, *mature multistory*, and *other*. These structural conditions are identified only on lands determined to be potential lynx habitat. Detailed information regarding how the structural stages are defined in the model, as well as how potential lynx habitat is identified, is provided in appendix H of the FEIS. The ranges shown reflect the percentages of potential lynx habitat that would be in these various structural stages. For this comparison, the existing condition estimates are taken from the starting point of the SIMPPLLE model. Other data sources and methodologies may be available for other analysis purposes; the values in this report should be used for general comparisons to the NRV.

There is a wide amplitude in the NRV ranges, reflecting the dynamic nature of the structural stage as well as possibly the level of uncertainty regarding the NRV estimates. The structural stage with the narrowest estimated NRV range is the mature multi-storied habitat; at the Forest level and in all GAs, the existing condition is at the low end or below the NRV. The stand initiation conditions are generally at the low end of the NRV range in most landscapes. Early stand initiation habitat is within or above the NRV in all GAs; the Rocky Mountain Range and Upper Blackfoot GAs are above the NRV for this habitat condition due to recent fires. The "other" lynx habitat category is not depicted; it is the most abundant and makes up the remainder of the potential lynx habitat that does not meet one of the structural stage criteria shown in the charts.

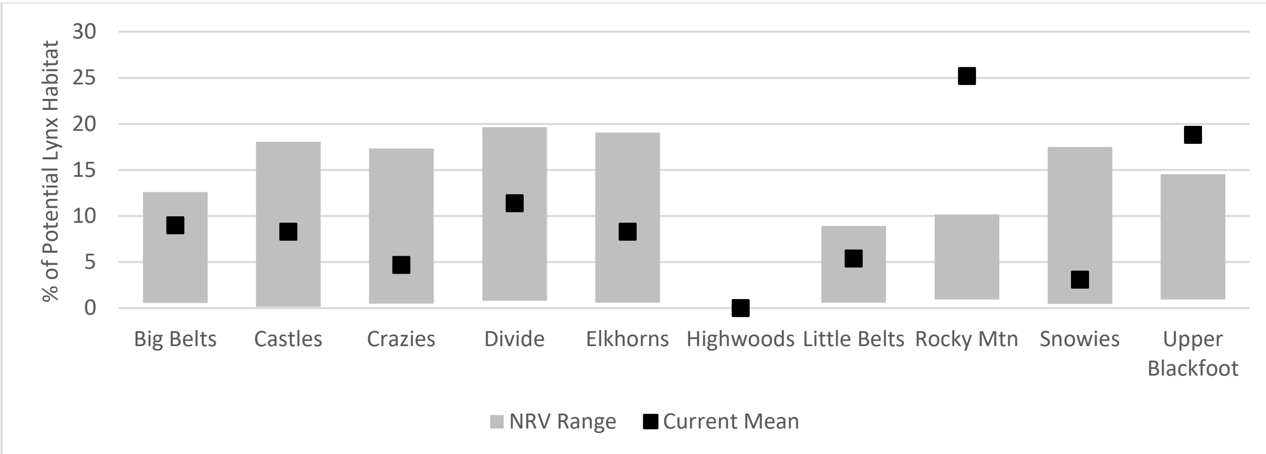


Figure 65. Lynx early stand initiation habitat forestwide and by GA, compared to existing condition

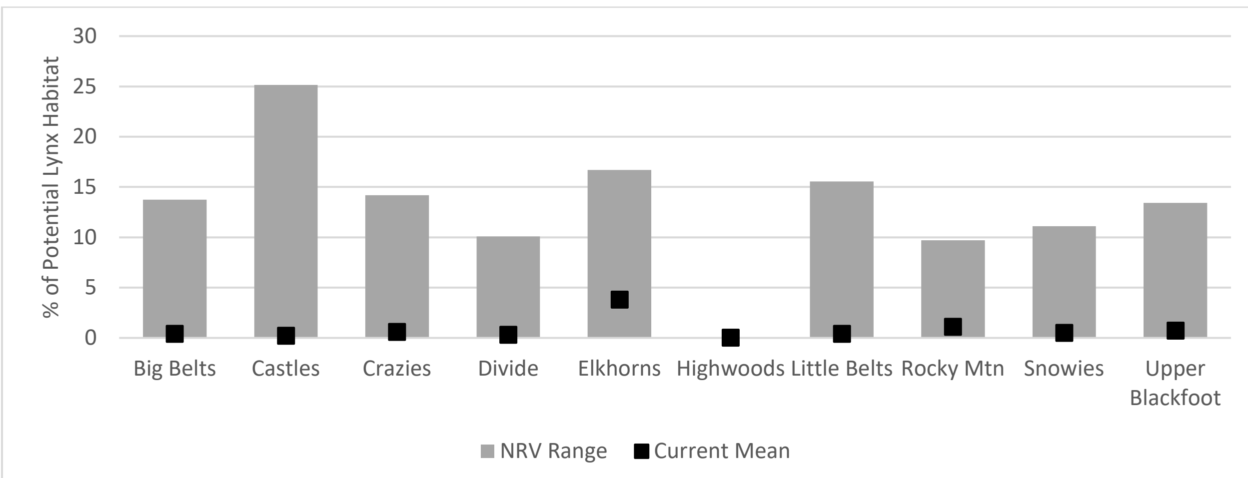


Figure 66. Lynx stand initiation habitat forestwide and by GA, compared to existing condition

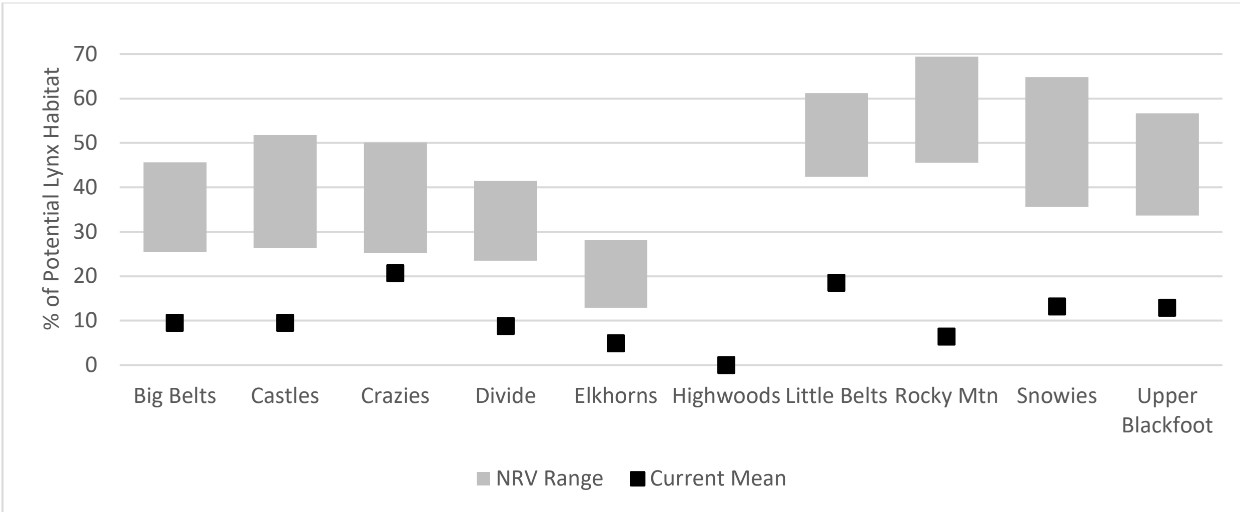


Figure 67. Lynx mature multistory habitat forestwide and by GA, compared to existing condition

Flammulated owl

Flammulated owls are a species of conservation concern for the HLC NF and are known to occur in only four of the ten GAs. They are dependent on large diameter, open ponderosa pine forests, although some literature indicates possible use of large, open Douglas fir types where ponderosa pine is absent (USDA 2011). Although modeling of the ponderosa pine cover type provides some information about potential flammulated owl habitat, the specific combination of cover type (ponderosa pine), tree size, and canopy cover queried from the model better approximates the estimated NRV for this species and for others that may require or use similar habitat. Estimates of existing flammulated owl habitat were made for the Assessment of the HLC NF (U.S. Department of Agriculture 2015) using data and queries described by Samson (Samson 2006a) and Bush and Lundberg (Bush and Lundberg 2008b). Those estimates are not directly comparable with estimates from SIMPPLLE. The estimates in this report should be used for comparisons to the NRV. The range for the estimated NRV and existing habitat is shown in Figure 68.

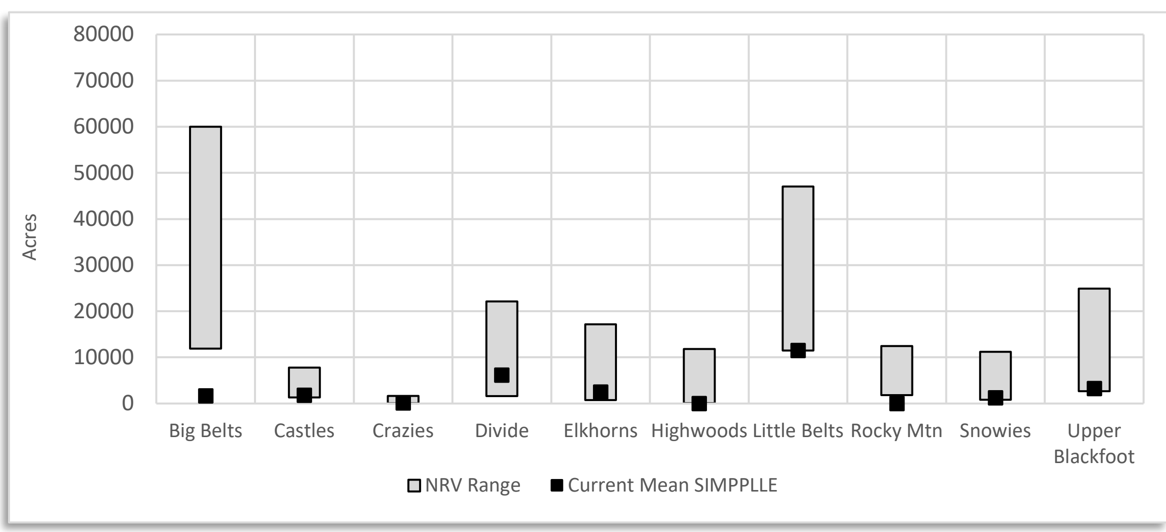


Figure 68. Flammulated owl nesting habitat NRV range of acres compared to existing condition, by GA

In all GAs the current estimates of flammulated owl nesting habitat are below or at the low end of the NRV. This parallels the coarse filter look at the ponderosa pine, which estimates that both abundance and distribution of ponderosa pine is below the NRV range for most GAs (see Figure 25, Figure 31, and Figure 38). Additionally, the existing large tree component of the warm-dry broad PVT, which includes ponderosa pine, appears to be below the estimated NRV (Figure 45), and the existing abundance of large snags in the warm dry broad PVT also appears to be lower than the NRV (Figure 80). Both the coarse filter and fine filter look at flammulated owl nesting habitat indicates that it may be less prevalent in most GAs than the NRV range. The NRV range in some GAs is broad, indicating the dynamic nature of the type as well as the level of uncertainty.

Although we modelled flammulated owl habitat for all GAs, this species has not been documented on the Lewis and Clark portion of the HLC NF (Rocky Mountain Range, Highwoods, Little Belts, Castles, Crazies, and Snowies GAs). All but the Rocky Mountain Range GA of the Lewis and Clark portion of the HLC NF are outside the known distribution of flammulated owls in Montana (Montana Natural Heritage Program and Montana Fish Wildlife and Parks 2019). The Rocky Mountain Range GA lacks ponderosa pine except for a few widely scattered individual trees and small stands, which may explain the absence of flammulated owls. The parameters used to model the NRV for this species included only vegetation types with large ponderosa pine.

Lewis's woodpecker

Lewis's woodpeckers are a species of conservation concern for the HLC NF, and are known to occur in only three of the ten GAs (Divide, Elkhorns, Big Belts), with historic records also in the Divide, Little Belts, Castles, and Highwoods GAs. Habitat for Lewis's woodpeckers is similar to that described for flammulated owls, with the addition of large old cottonwoods in riparian areas and possibly a reliance on forests maintained by fire (Montana Natural Heritage Program and Montana Fish Wildlife and Parks 2019). The existing condition is estimated from the SIMPPLLE input file. The comparison of the estimated NRV and the existing abundance for this habitat is displayed in Figure 69.

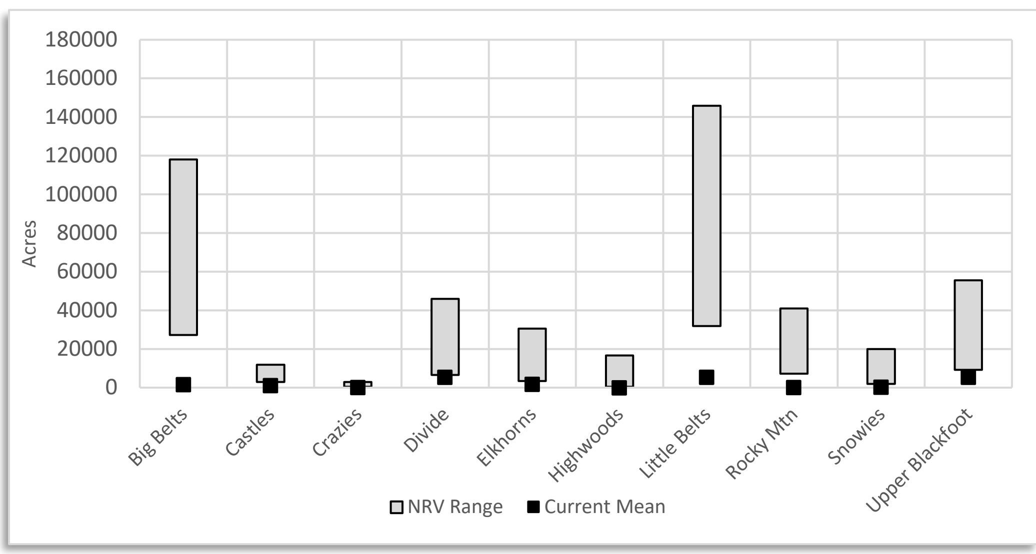


Figure 69. Lewis's woodpecker nesting habitat NRV range of acres, by GA

As with flammulated owl, it appears that the greatest potential for Lewis's woodpecker habitat is in the Big Belts, Little Belts, and Upper Blackfoot GAs and possibly the Rocky Mountain Range, Divide, and Elkhorns. Like flammulated owls, Lewis's woodpeckers may be dependent on ponderosa pine, which does not occur on the Rocky Mountain Range GA except as isolated individual trees and small stands. Nevertheless, the known distribution of Lewis's woodpeckers in Montana includes all GAs on the HLC NF (Montana Natural Heritage

Program and Montana Fish Wildlife and Parks 2019). Recent observations of Lewis's woodpeckers in the Divide GA may reflect presence of additional habitat in surrounding areas, including west of the Continental Divide.

Elk hiding cover

Management of elk habitat and elk distribution on NFS and adjoining lands have been issues of public interest for decades, and have often focused on the concept of elk security as a means to influence elk distribution and vulnerability to harvest. Elk security is defined as "the protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or human activities" (Lyon and Christensen 1992). Management of elk security has often focused on management of human access through road and trail restrictions in combination with consideration or management of hiding cover. Hiding cover is defined as "vegetation capable of hiding ninety percent of a standing adult elk from the view of a human from a distance equal to or less than 200 feet" (ibid). There has been some question about the degree to which hiding cover on NFS lands may or may not influence overall elk distribution, particularly during hunting season. The NRV range presented here provides some insight into the inherent potential for various GAs to provide hiding cover, which may help to provide some context for management planning.

Estimates of hiding cover are usually made using estimates of canopy cover and may be coupled with estimates of other vegetation characteristics, such as Potential Natural Vegetation. The existing condition is estimated using the SIMPPLLE input file. Elk security, which considers distance from open motorized access routes and may include consideration of hiding cover, is usually analyzed and managed at the scale of an elk analysis unit. For this report we are only attempting to understand the natural range of a vegetation characteristic (hiding cover) on the landscape relative to its current condition, so we display hiding cover simply as total acres within a GA. This serves to address the question at a broad scale for forest-level planning, and avoids implications that a specific scale or percent is desired. Hiding cover is evaluated and displayed here by season, reflecting the different areas used seasonally by elk, and the different vegetation conditions that may provide cover in those areas and during those seasons. The estimated NRV for this habitat is displayed in the following figures, which include comparison with the estimated existing acres of available hiding cover.

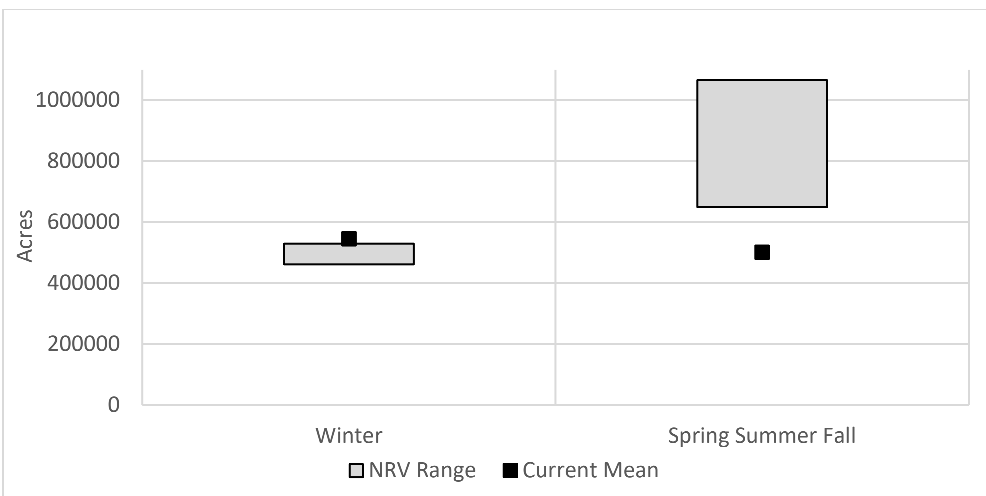


Figure 70. Rocky mountain elk habitat NRV compared to existing condition forestwide

Forestwide, the current amount of winter hiding cover is just above the NRV range, whereas the spring/summer/fall hiding cover is below.

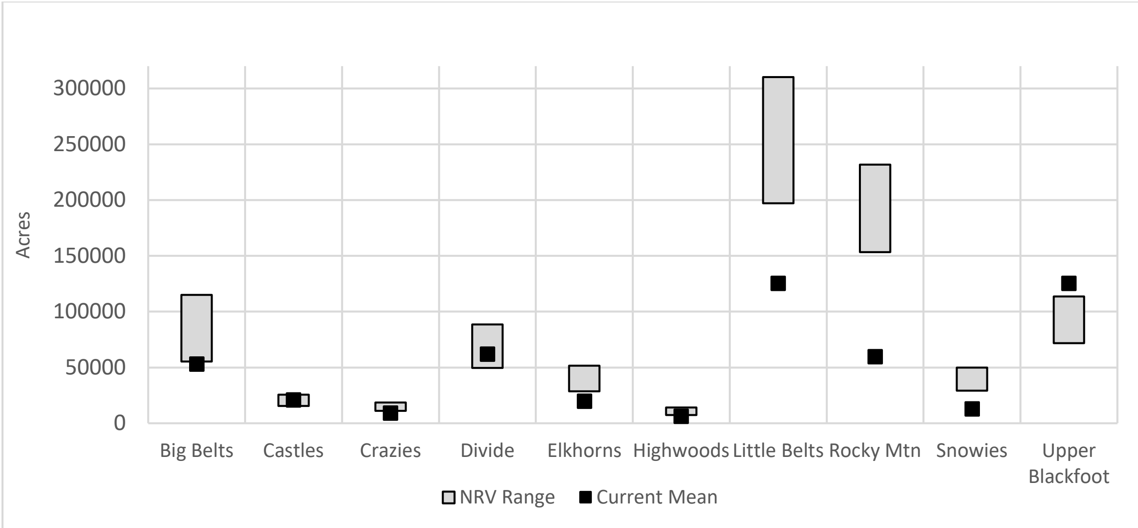


Figure 71. Rocky mountain elk spring/summer/fall hiding cover NRV, by GA, compared to existing condition

For many GAs, the estimated existing spring/summer/fall hiding cover is within the modeled NRV range. This habitat is below the NRV range in the Elkhorns, Little Belts, Rocky Mountain Range, and Snowies GAs; and above the NRV range in the Upper Blackfoot.

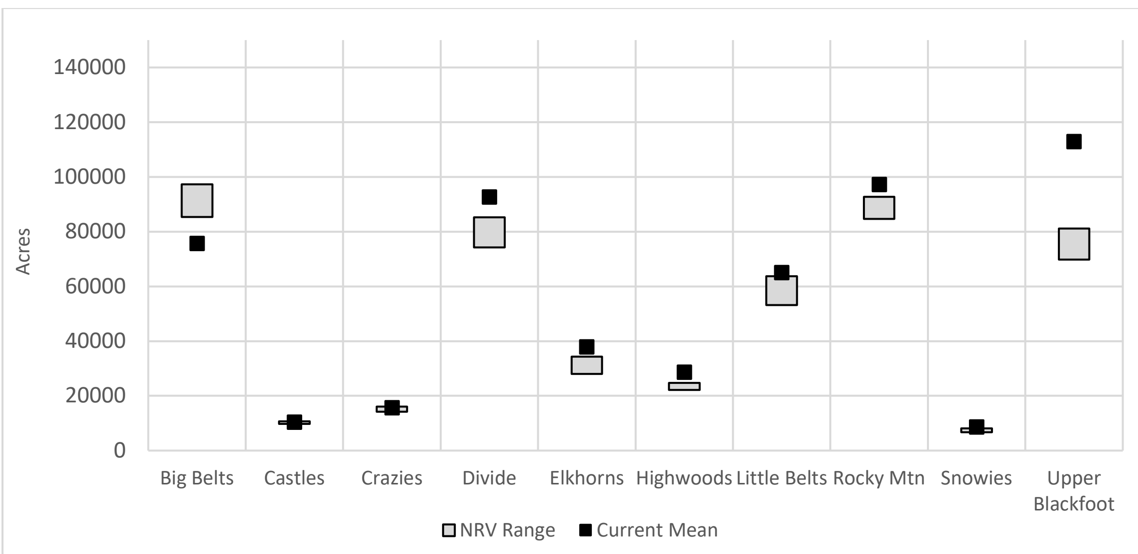


Figure 72. Rocky mountain elk winter hiding cover NRV, by GA, compared to existing condition

Winter hiding cover is estimated only for areas mapped as elk winter range. On some GAs, relatively little winter range occurs on NFS lands compared to the surrounding landscape. Currently, the Big Belts is the only GA that appears to provide less winter hiding cover than the estimated NRV range. All other GAs have an abundance of winter hiding cover within or above the NRV.

Additional key characteristics

Large and very large live trees

Large trees are those greater than or equal to 15” diameter, and very large trees are those greater than or equal to 20” diameter. These trees are important to wildlife species while alive, as snags upon death, and as large downed woody material when they fall. They are also important in creating and sustaining forests resilient to disturbances, in particular if they are fire-tolerant species. They have the potential to survive fires, providing seed to reforest burned areas, and provide live components in landscapes dominated by burned trees. This attribute reflects the average quantity of large and very large live trees on the landscape, distributed in groups or scattered individuals. This attribute is complementary but different than forest size class, which reflects the average diameter. Large and very large live trees are often found in areas classified as large or very large size class, but they also occur as minor components in areas with a smaller average size class where they are too few in numbers to offset the abundance of smaller trees. This attribute was not ultimately included in the 2021 Forest Plan as a desired condition, because the desired condition for large-tree structure (below) sufficiently provides for large and very large trees.

SIMPPLLE does not model large and very large trees per acre. The information source used to assess NRV is an analysis that estimated large and very large trees inside and outside wilderness and roadless areas for NFs east of the Continental Divide in Region 1 (Bollenbacher et al. 2008), with queries of period FIA data updated in 2017. The amount of large and very large trees in wilderness and roadless areas could be indicative of historical levels because these areas have been less impacted by anthropogenic influences (Bollenbacher et al. 2008). The data in wilderness/roadless areas that is used to depict the NRV was summarized prior to the recent mountain pine beetle outbreak. This is compared to existing condition estimates derived from the most recent FIA data (2011), for each snag analysis group. Snag analysis groups are consistent with R1 broad PVTs, except that lodgepole pine dominated forests are broken out because this species is unique relative to its tree size and snag characteristics.

As shown in Figure 73 and Figure 74, the confidence intervals around the existing condition estimates are within or partially overlap the NRV. This indicates that the abundance of large and very large trees is generally within the NRV at the forestwide scale. The data is not available at the GA-area scale; based on the trends for size class, which showed that large and very large size classes are less common than they were historically, it is likely that the abundance of large and very large trees is underrepresented in some areas. However, compared to the large and very large size classes, these trees are present on a larger area of the landscape as minor components.

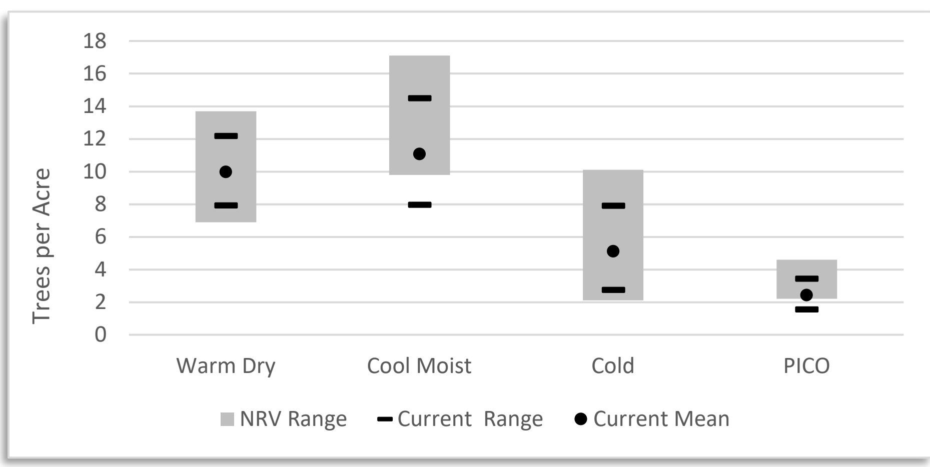


Figure 73. Large trees per acre, NRV compared to existing condition

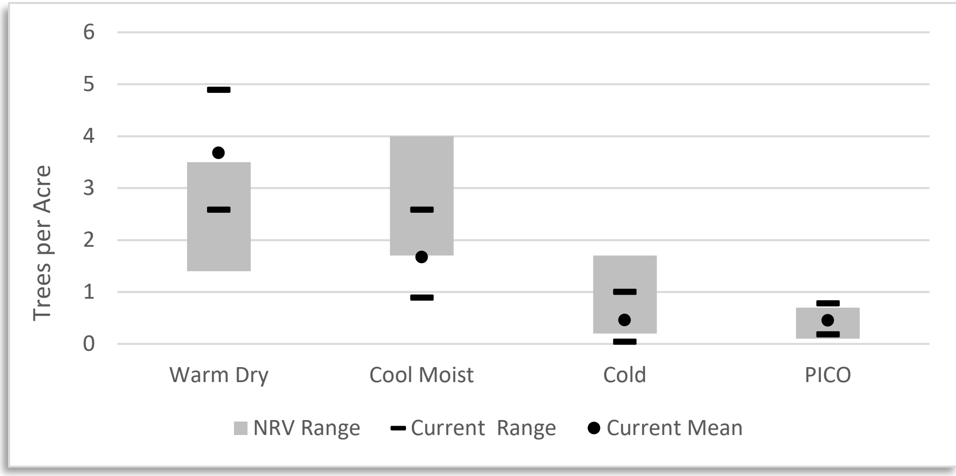


Figure 74. Very large trees per acre, NRV compared to existing condition

The existing condition for large and very large trees per acre is consistent with the NRV (wilderness and roadless areas. This may indicate that the overall quantity of large and very large trees is not substantially different than the amount that would occur naturally. Still, it is likely that in some landscapes large and very large trees are less prevalent than they were historically, given that large and very large size classes are below the NRV, and the understanding that early harvesting practices removed many large trees. These trees also likely declined due to fires and insect and disease activity. In addition, the trend that forest densities are higher than the NRV would indicate that large tree development has been inhibited. Stand density is an important factor that influences the development of large trees; lower densities in young forests may help develop large trees in the future.

Large-tree structure

Several key characteristics have thus far addressed tree size, including size class and the quantity of large and very large trees. Here, a third element is explored called “large-tree structure”. Large-tree structure categories are defined by the presence of certain minimum quantities of large or very-large trees and provides complementary information by displaying the proportion of the landscape that contains enough of these trees to be meaningful for ecosystem functions such as seed dispersal and wildlife habitat. As with individual large and very large trees, large-tree structure may occur in any forest size class. Areas with large-tree structure are defined in appendix D of the 2021 Land Management Plan. These definitions are based on quantities of trees that would be meaningful to wildlife habitat and represent a substantial influence on forest structure and process (such as providing seed).

The way existing data is classified into large-tree structure roughly correlates to the way SIMPPLLE classifies the large/very large size class. Unlike the size class analysis, the SIMPPLLE estimates for the large and very large size class are not adjusted, because the presence of large and very large trees influenced the classification in a similar fashion. The existing condition is estimated using the latest FIA data.

Figure 75 and Figure 76 display the NRV proportion of the landscape with large-tree structure compared to the existing condition, forestwide and by broad PVT. For all PVTs, the existing condition of large category is below the NRV. Except in the cold PVT, the existing distribution of very large category is also below the NRV, but not to a great extent as these trees tend to be rare naturally on the HLC NF. The mechanisms that have caused the large-tree structure to be less than the NRV are the same as described for the large and very large size class.

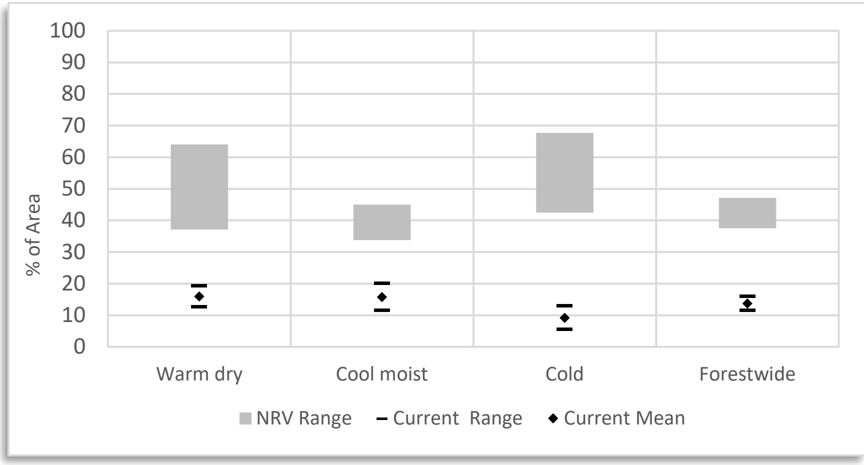


Figure 75. NRV of large-tree structure, large category, compared to existing condition, forestwide and by PVT

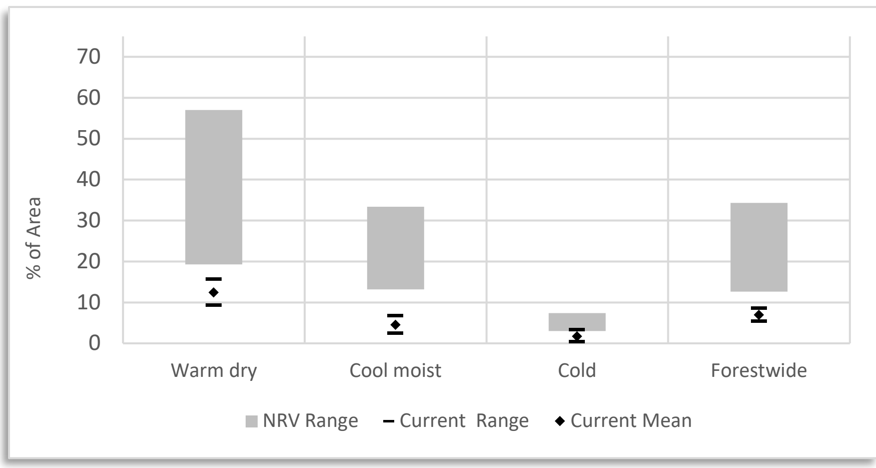


Figure 76. NRV of large-tree structure, very large, compared to existing condition, forestwide and by PVT

Figure 77 and Figure 78 display the comparison of NRV to existing condition for these components by GA. The trends are generally consistent with the forestwide averages, although the range around the existing condition estimate approaches the lower bound of the NRV in the Crazies, Elkhorns, and Highwoods. For the very large category, the Castles, Crazies, and Elkhorns have existing levels similar to the NRV, and all other GAs are below.

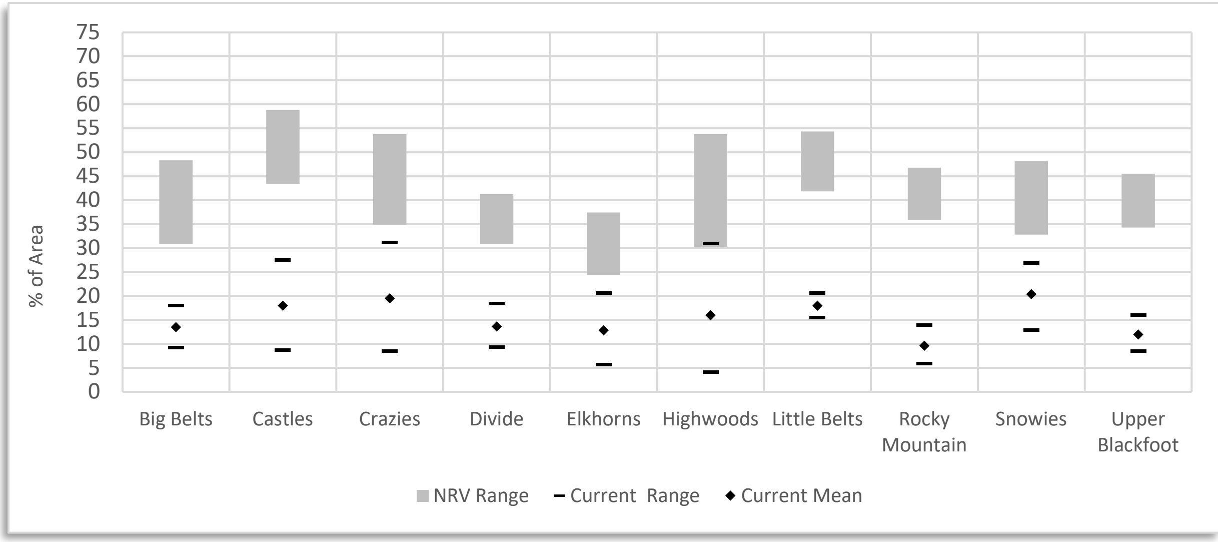


Figure 77. NRV distribution of large-tree structure, large category, compared to existing condition, by GA

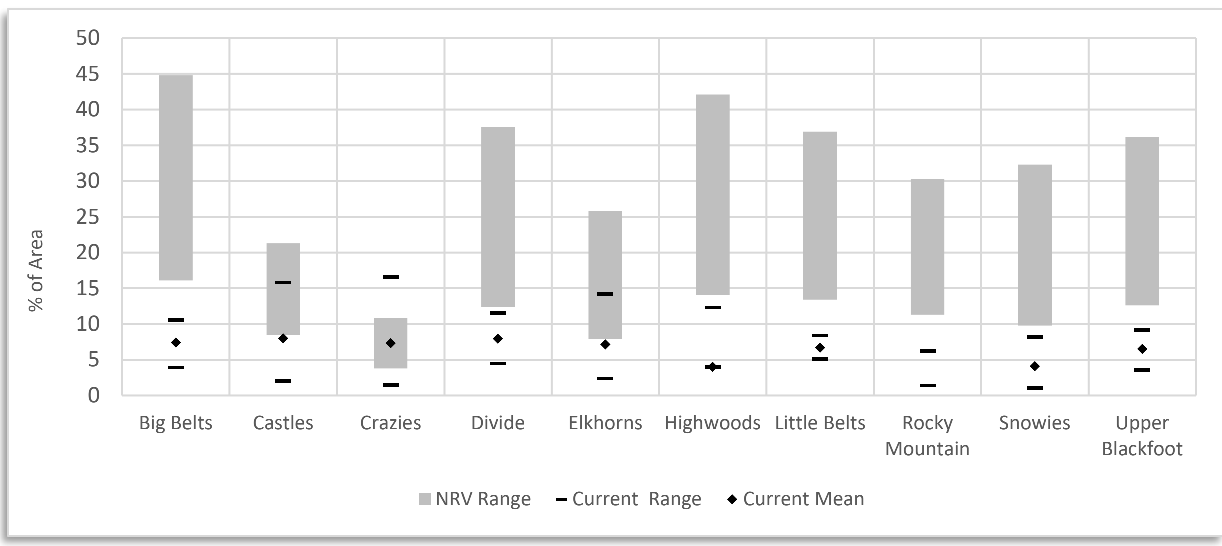


Figure 78. NRV distribution of large-tree structure, very large category, compared to existing condition, by GA

The development of large trees is influenced by growing conditions, disturbances, and species traits. On the HLC NF, the common tree species most likely to reach large and very large size classes are ponderosa pine and Douglas-fir, and to a lesser extent Engelmann spruce, whitebark pine, subalpine fir, and western larch. Large trees may develop where frequent disturbance maintains low density, and/or on productive sites which provide ample moisture and nutrients for individual tree growth. Large tree development also occurs in refugia areas protected from disturbance. The comparison of the NRV of SIMPPLLE size classes to the existing condition indicates that, similar to size class, large-tree structure is less abundant across the landscape than it was historically.

Snags

Snags, or standing dead trees, are important elements of forest structure, diversity, and wildlife habitat. Fire is the dominant natural disturbance process that creates snags. Natural mortality occurs also due to competition, insects, diseases, and other natural events. The availability of large snags depends on the growth of large live trees. Large snags are of particular interest due to their longevity and suitability for wildlife habitat. SIMPPLLE does not provide a quantified NRV for snags. NRV ranges are derived from recent literature (Bollenbacher et al. 2008) for medium (10”+ diameter), large (15” +), and very large (20”+) snags using data within wilderness/roadless areas prior to the mountain pine beetle outbreak. Snag characteristics in these areas may be indicative of a natural condition because disturbances have been allowed to occur and human management is limited (ibid). Updated snag queries were conducted by the Regional Office to augment the Bollenbacher et al 2008 report in March of 2017; these updated figures are used.

Snags are summarized by snag analysis groups, which are synonymous with the broad PVTs, except that lodgepole pine dominated areas (“PICO”) are analyzed separately. Different snag conditions are expected in these types based on the natural disturbance regime. For example, the availability of snags in the warm dry PVT would be influenced by a low severity, high frequency disturbance regime which supplies a fairly constant flow of snags. By contrast, the cool moist PVT would contain more variability in snag quantity and distribution due to a high severity, low frequency regime. Lodgepole is summarized separately because the processes that create and maintain snags are unique for this species. Lodgepole snags tend to be small in diameter and are created by large stand replacing events. Thus, they tend to occur as “pulses” on the landscape. Further, these snags are not windfirm and tend to fall relatively quickly.

As Figure 79 shows, the trees per acre of medium snags tend to be within the NRV, although at the upper end of the range in the warm dry PVT. This is a common tree size and large snag pulses can occur after events such as large wildfires that kill smaller trees of all species.

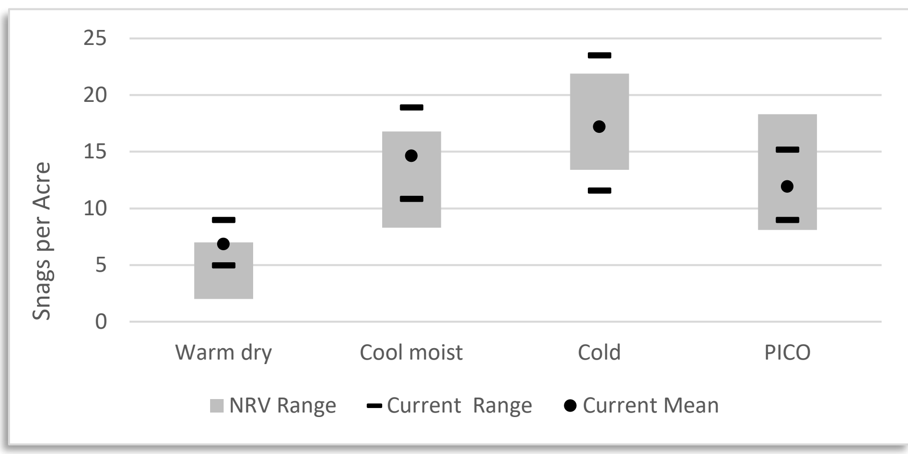


Figure 79. NRV of medium snags per acre compared to the existing condition by snag analysis group

Large snags (Figure 80) are much less common than medium snags; however existing conditions are generally within or slightly higher than the NRV condition, due to recent insect outbreaks and wildfires.

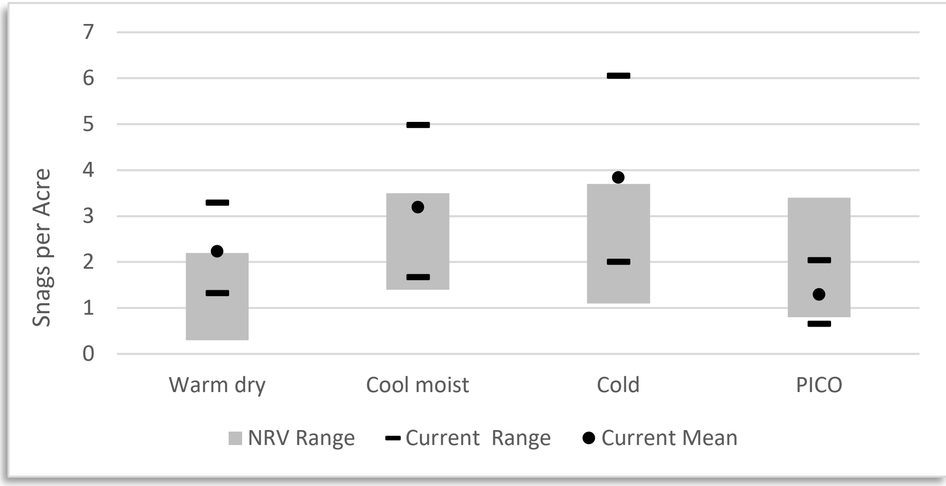


Figure 80. NRV of large snags per acre compared to the existing condition by snag analysis group

Very large snags are rare, as are very large live trees, on the HLC NF. The existing snags per acre of this size are generally consistent with the NRV ranges in the cold and PICO snag analysis groups, but slightly higher than the NRV in warm dry and cool moist due to recent disturbances.

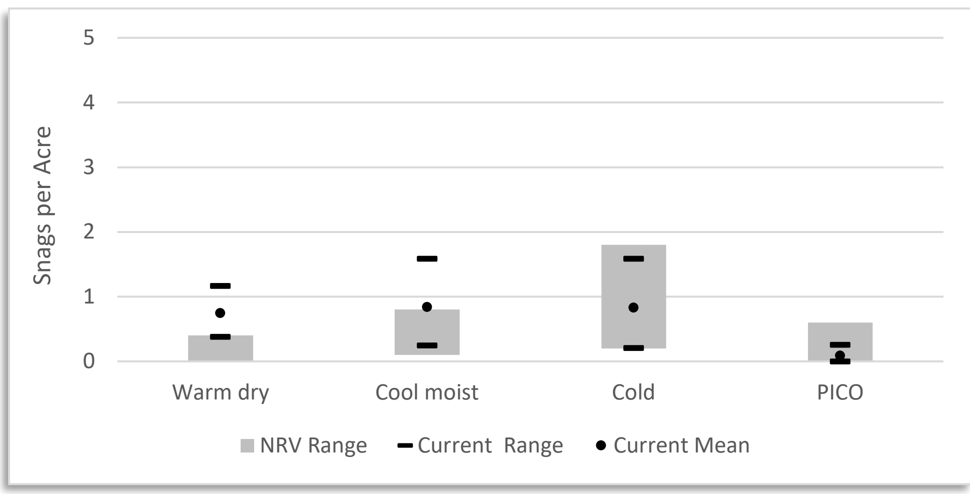


Figure 81. NRV of very large snags per acre compared to the existing condition by snag analysis group

Snags are irregularly distributed. Large and very large snags may be naturally rare on the HLC NF (Bollenbacher et al. 2008), as influenced by the processes that allow large and very large trees to grow. The interactions of processes that influence the snag resource are complex. For example, fire suppression may have caused a reduction in the amount of snags that would otherwise have been created with fire. Conversely, snags could be more abundant currently in places where fire or insect-caused mortality may be more severe than would be expected historically due to increased forest homogeneity or fuel build-up. In the future, we may expect larger pulses of snags with more fires and insect outbreaks. Because large and very large live trees and components may be below the NRV, this indicates that development of large snags may also be below the NRV in the future.

Downed woody debris

Downed woody debris on the forest floor provides for feeding, hiding, denning, and shelter habitat to numerous wildlife species, and is important for long term nutrient cycling and other ecosystem functions. Downed wood is recruited as snags and branches fall and diminish over time through decomposition or by being consumed by wildfire. Therefore, the trend of downed wood is intertwined with all of the disturbances and drivers that affect vegetation. Both quantity and distribution of this material is important. Downed woody debris cannot be modeled with SIMPPLLE. Different amounts, sizes, and distributions are meaningful for different resources (wildlife, fuels, and soils). For wildlife habitat, downed wood of the largest sizes (>10” diameter especially) is the most valuable, and the most meaningful measure is percent cover of downed wood. However, this measure is not available in available data sources. For both fuels and soils considerations, a common measure is tons/acre of woody material greater than 3” diameter; this is quantifiable with FIA data. 3” is also the minimum size for coarse woody debris used in the best available scientific information (Brown, Reinhardt and Kramer 2003).

The quantities and distribution of downed woody debris in wilderness and roadless areas are used to describe the NRV. Table 5 was developed to compare NRV and existing condition in terms of large woody debris distribution (>3” diameter) using FIA plot data; the methodology for these queries is described in appendix H of the FEIS. There is no appreciable difference in the distributions in wilderness/roadless areas versus the landscape as a whole. The information shows that 30 to 50% of the landscape has no woody debris present, and that distribution is greatest on cool moist broad PVT. Most of the woody debris present is <10 tons/acre, with small portions of the landscape containing higher amounts.

Table 5. Distribution of large woody debris (1000-fuels or >3” dbh)

Scale		CWD Distribution (Presence)				
		>=0 tons/ac	>=5 tons/ac	>=10 tons/ac	>=20 tons/ac	>=40 tons/ac
Forest-wide	Wild/IRA	56%	26%	14%	6%	2%
	Existing	55%	25%	15%	6%	2%
Warm dry	Wild/IRA	59%	19%	4%	0%	0%
	Existing	57%	17%	6%	1%	0%
Cool moist	Wild/IRA	64%	42%	26%	10%	3%
	Existing	65%	43%	28%	11%	3%
Cold	Wild/IRA	52%	23%	17%	11%	5%
	Existing	51%	24%	16%	9%	3%

Table 6 shows a potential NRV for quantity of large woody debris (in wilderness and roadless) compared to the existing condition of woody debris >3” diameter. The existing condition is similar to the NRV forestwide and in the warm dry PVT, but slightly less in cool moist and cold.

Table 6. NRV and existing tons/acre of large woody debris >3” diameter by broad PVT

Scale	Tons/ac >3” diameter	
	In wilderness/IRA	Existing condition
Forestwide	5.64 (4.8-6.6)	5.24 (4.57-5.98)
Warm dry	3.4	3.38 (2.66-4.19)
Cool moist	10.6	7.22 (5.81-8.76)
Cold	10.3	7.04 (5.33-8.91)

The best available scientific information regarding the NRV condition for coarse woody debris on the HLC NF was reviewed (Brown et al. 2003, Graham et al. 1994). Brown et al (2003) take into account many considerations of woody debris, including wildlife habitat, soil nutrient cycling, fire hazard and behavior, soil heating, and historic levels of coarse wood. The ecosystem conditions described are relevant to the HLC NF, although they are most specific to conditions found west of the continental divide. The natural range of downed wood, particularly in the warm dry types on the HLC NF, is likely lower than that specified by Brown et al (2003) because the data for this type includes areas which are open savannas, where grass and shrubs dominate and trees are widespread.

The broad PVTs would be expected to have different levels of downed wood based on disturbance ecology. The warm dry PVT would be expected to have the least quantity overall, as well as the least percentage of area with downed wood, indicating that relatively high proportions of this type area may have very low levels of downed wood at any given time consistent with the natural disturbance regimes expected in drier cover types such as ponderosa pine and Douglas-fir. Conversely, the cool moist and cold PVTs would have higher levels of downed wood that is distributed across a higher proportion of the area, especially in spruce/fir and lodgepole pine.

Fire suppression, particularly on dry sites, has likely allowed for a buildup of downed wood in some areas that would otherwise have been maintained at lower levels. Even so, the current average tons per acre of large woody debris is lower on these sites (such as ponderosa pine and dry Douglas-fir) than on moist sites where woody debris would naturally be higher (such as spruce/fir). Recent large scale mortality events such as the beetle outbreak are expected to create high downed woody debris levels across large areas in the short term, particularly in the lodgepole pine cover type. Homogeneity in forest conditions perpetuates pulse in downed wood. Hotter/drier conditions and more fires might mean less downed wood, or possibly wider swings in amounts/distributions.

Old growth

Old growth is a late-stage successional forest condition that is valuable for wildlife habitat and biodiversity. Old growth is defined for Region 1 based on minimum criteria such as tree age, size, stand density, and other components such as snags and downed wood (Green et al. 1992). There is no means to quantify the NRV for old growth, because the characteristics can be determined only through site specific inventory. Further, there is no know best available scientific information to quantify the NRV condition of old growth abundance, distribution, or patch size specific to the landscapes on the HLC NF. However, based on the minimum tree size requirement, old growth is most likely to be found where large-tree structure is distributed. However, only a proportion of areas with large/very large tree components are actually old growth. The FIA data (Table 7) show that nearly half (44%) of the plots with large-tree structure are old growth today.

Table 7. Proportion of plots that are old growth forestwide, base FIA

Large/Very Large Tree Subclass	% old growth
Large Tree Concentrations	20% (14-26)
Large or Very Large Tree Concentrations	24% (17-31)
Large or Very Large Tree Concentrations Not Present	5% (4-7)

Large-tree structure can be compared to large and very large size classes in SIMPPLLE. Therefore, in rough terms, 44% of the areas in the unadjusted large and very large size classes in the NRV may have been old growth (Table 8). The large size class is lower than the NRV and increases are desired; therefore, it is likely that there is also less old growth on the landscape than in the NRV, especially in the warm dry PVT. Although the analysis serves only as a rough proxy of a rigorous NRV analysis, it supports the notion that old growth is likely less abundant on the HLC NF, at the broad scale, than it was historically, with the possible exception of the cool moist broad PVT. This trend may vary by GA and at smaller scales depending on the unique disturbance history and vegetation types of a given area.

Table 8. Existing old growth (Hybrid 2011) and potential NRV abundance

Scale	Existing Condition[1]	Potential NRV[2]
Forestwide	11% (9-13)	20-25%
Warm dry	8% (6-11)	33-52%
Cool moist	14% (10-19)	11-19%
Cold	15% (11-20)	28-40%

1 Existing condition is based on FIA plots, Hybrid 2011 dataset
2 NRV is based on 44% of the large/very large size classes modeled in SIMPPLLE

Literature sources indicate that in fire prone landscapes the historic amount of old growth was probably not very high. For example, in the island mountain range GAs, old growth was not very abundant historically due to frequent prairie fires (Losensky 1993b). Fire exclusion may have altered old growth in all areas. Increasing tree densities and canopy layers may have increased tree stress and vulnerability to mortality from insects, pathogens, and high intensity crown fires. Landscapes with a heterogeneity in age class, species composition, and structure can provide for a more stable proportion of old growth over time than those with a homogeneous character. Old growth will be subject to increased disturbances and may represent important refugia areas for biological legacies, seed sources, habitat, and carbon storage.

Summary

The NRV results displayed in this report provide the context for understanding ecosystem integrity on the HLC NF and will be used as a backdrop throughout the forest plan revision process. One key function of this analysis will be to inform the development of desired future conditions for vegetation key characteristics. Along with NRV, additional considerations will inform the desired conditions, including but not limited to: ecosystem resilience and adaptation given the uncertainties of future climate and disturbances which may differ from the climate conditions of the past; sustaining important wildlife habitat conditions; consideration of social and economic factors; and consideration of other human uses on the landscape. Therefore, while the desired conditions may not always be equivalent to the NRV, they are governed by a prevailing concept to maintain ecosystem resilience as informed by this evaluation of NRV.

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Appendix J. Climate and Carbon, Supplemental Information

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Tables

Figures

Climate change considerations and assumptions

Climate change is expected to have profound effects on the Earth's ecosystems in the coming decades (Intergovernment Panel on Climate Change (IPCC), 2007). Description and analysis of these effects rely on a broad array of scientific literature and a recent meta-analysis of climate change and potential effects published for the Northern Rockies Adaptation Partnership (Halofsky et al., 2018a, 2018b). These publications, and the references cited therein, represent the current state of the science on climate change in the region and on the HLC NF.

There is little debate that atmospheric carbon dioxide is increasing and that this increase will cause changes in climate but there is a great deal of uncertainty about the magnitude and rate of climate change, especially as projections are made at more local scales or for longer time periods (Halofsky et al., 2018b). Despite the uncertainty in downscaled projections, scientists expect the impacts of climate change on forest vegetation to be primarily driven by vegetation responses to shifts in disturbance regimes, and secondarily, through direct effects of vegetation interactions with climate through shifts in regeneration, growth, and mortality processes at both individual plant and community scales (ibid).

Specific to forested vegetation, the Northern Rockies Adaptation Partnership assessed projected climate change responses for 17 tree species, 5 forest vegetation types, and three resources of concern: landscape heterogeneity, carbon sequestration and timber production. The study rated the vulnerability of these elements to climate change. Vulnerability was determined from a number of factors including stressors, exposure, sensitivity to climate change, impact of that response, and adaptive capacity. Forests at all elevations are projected to have increased outbreaks of forest pest species and more frequent fire.

The table below displays the ranking of climate change vulnerability for the tree species found on the HLC NF (Halofsky et al., 2018b). The HLC NF spans across three of the subregions considered by the Northern Rockies Adaptation Partnership. Most of the Forest is in the East subregion, but areas west of the continental divide (in the Upper Blackfoot and Divide GAs) are in the Central subregion and the Crazies GA lies within the Greater Yellowstone Area subregion. There are some key differences in the vulnerabilities across these subregions; for example, Douglas-fir is more vulnerable in the East and Greater Yellowstone subregions than it is in the Central subregion.

Table 1. Ranking of climate change vulnerability tree species found on the HLC NF. A ranking of "1" indicates the highest vulnerability.

Species	Northern Rockies	Central Subregion (western portions of Upper Blackfoot and Divide GAs)	Greater Yellowstone Area (Crazies GA)	NRAP 2018 – East subregion (all other areas of the HLC NF)
Whitebark pine	2	2	1	1
Western larch	3	3	N/A	N/A
Douglas-fir	5	8	2	2
Engelmann spruce	9	11	4	3
Subalpine fir	10	12	5	4
Lodgepole pine	11	10	6	5
Cottonwood	13	13	3	6
Limber pine	15	15	8	7
Aspen	14	14	7	8

Species	Northern Rockies	Central Subregion (western portions of Upper Blackfoot and Divide GAs)	Greater Yellowstone Area (Crazies GA)	NRAP 2018 – East subregion (all other areas of the HLC NF)
Ponderosa pine -east	17	N/A	9	8
Ponderosa pine - west	16	16	N/A	N/A

Considerable uncertainties underlay projections of vegetation under future climates, including:

- Complex interactions of climate with vegetation and disturbance are difficult to predict in time and space making future projections difficult;
- Abundant scale problems in nature and in the literature that made it difficult to generalize species and ecosystem trends at consistent temporal and spatial scale; and
- Uncertainty in climate projections (22 GCMs, 6 scenarios) made it difficult to project climate change responses at the local level.

The 2021 Land Management Plan and EIS incorporate models, plan components, and resource management strategies developed using the latest understanding of climate and potential changes into the future. The climate section of the EIS describes specific future expectations for temperature, precipitation, and potential resource effects based on information found in Halofsky et al. (2018). 2021 Land Management Plan direction incorporates strategies to address the uncertainties associated with climate change and its potential impacts to vegetation. While many effects of climate change are anticipated to be gradual, we also recognize the potential for interacting disturbances such as insects, drought and fire to dive systems towards sudden large-scale transformations (Millar & Stephenson, 2015).

As noted by Halofsky et al. (2018), a warming climate will rarely be the direct agent of change for terrestrial vegetation on the HLC NF. Rather, most of the changes will likely result from responses to climate change-induced disturbance or to some combination of other climate-exacerbated stressors. Whether it is invasive species, drought, uncharacteristic wildfires, elevated native insect and disease levels, loss of fire-adapted trees, or unusually high forest densities, the most significant effect of climate change is likely to be further exacerbating these stressors and “stress complexes”. Plan direction, which emphasizes ecological integrity and resilience, will be critical to minimizing the undesirable effects of these increasing and interacting stressors. Nevertheless, managers and the public should expect climate change to drive changes on ecosystem structure, function and composition in the coming decades.

Incorporating climate change in vegetation modeling

It is not possible to model or predict if, when, and where megadisturbances, regeneration failures, or shifts to novel ecosystems may occur on the HLC NF. As noted in the literature, prediction of potential tree mortality, or future forest decline, is currently difficult if not possible given scientific uncertainties and the complex interactions of contributing factors (Allen, Breshears, & McDowell, 2015; Anderegg et al., 2013; Wong & Daniels, 2016).

To the extent feasible, the SIMPPLLE model was calibrated to encompass likely future scenarios. This included applying an increase in expected wildfire acres burned, up to 2x the current levels. Regeneration pathways were calibrated to the best available information on tree species seeding dispersal and establishment mechanisms. Finally, the model was run assuming that all future periods are warm and dry, which affects disturbances and vegetation pathways. The model results did not indicate future forest die-backs or massive regeneration failures. However, the model is limited in its capacity to incorporate all possible scenarios, and is based on known successional pathways which may be altered in the future. The model results are used to compare the differences across alternatives and are not precise predictions of the future. All alternatives were relatively similar with regards to future vegetation, and therefore the potential risk to and outcomes of large disturbances and regeneration failures (although unquantifiable) would also be similar across alternatives.

Incorporating climate change into plan components

Approaches to address forest and ecosystem management in the face of an uncertain and variable future should be flexible, emphasize ecological processes, and have the capacity to be adaptive to new information as it becomes available (Millar, Stephenson, & Stephens, 2007). Approaches published in the literature include promoting resilience to change, creating resistance to change, and enabling forests to respond to change (Halofsky et al., 2018b, 2018c; Holling, 1973; M. K. Janowiak et al., 2014; Millar et al., 2007).

Resilience is defined as the degree to which forests and ecosystems can recover from one or more disturbances without a major shift in composition or function, and is the most commonly suggested adaptation option discussed in a climate-change context (Millar et al., 2007). Resilient forests accommodate gradual changes related to climate and are able to cope with disturbances. *Resistance* is the ability of the forest or ecosystem to withstand disturbances without significant loss of structure or function, in other words, to remain unchanged. From a management perspective, resistance includes both the degree to which communities are able to resist change, such as from warming climate; and the manipulation of the physical environment to counteract and resist physical or biological change, such as through burning or harvest treatments (Halofsky et al., 2018b). The *response* approach intentionally accommodates change rather than resists it, with a goal of enabling or facilitating forest ecosystems to respond adaptively as environmental changes accrue. Treatments would mimic, assist or enable ongoing natural adaptive processes, anticipating events outside the historical conditions, such as extended fire seasons or increased summer water deficits. Response tactics may include such practices as shifting desired species to new potentially more favorable sites through planting, managing early successional forests to “re-set” normal successional trajectories to create desired future patterns and structures, and promoting connected landscapes (Millar et al., 2007). Integration of various adaptive approaches and management practices is the best strategy (Millar et al., 2007; Spittlehouse & Stewart, 2003).

For the development of the programmatic management direction in the 2021 Land Management Plan, all of approaches described above are integrated to one degree or another, though promoting resilience is the primary approach. The resistance approach is integrated, for example with protection of highly valued habitats, species or other resources. Approaches that could be considered response options are promotion of landscape connectivity and treatments in young stands to develop desired future forest patterns and structures. Another key plan component that is critical in the context of future climate change is the establishment of a monitoring plan to inform an adaptive management approach. This enables the intentional use of monitoring to evaluate effectiveness of plan direction and resulting management actions.

To date, there is not broad agreement within the research community about the degree to which forests are vulnerable globally; however, while there is evidence to support perspectives of both relatively lesser and greater vulnerabilities, there are some drivers with high confidence that point toward the perspective of greater vulnerabilities (Allen et al., 2015). The vulnerabilities described by Halofsky and others (2018) are used as the best available information for the HLC NF. Rather than attempting to predict and quantify the unknowable, the 2021 Land Management Plan prepares the vegetation on the HLC NF for potential future climate-driven change by focusing on resilience of vegetation and maintenance of the suite of biodiversity currently present, as guided in the framework of law, regulation, and policy. This guides management actions within FS control, as well as FS responses to events that are outside FS control.

The literature indicates that there is risk of elevated tree mortality, and the potential for large disturbances that combined with drought and climate conditions could push some vegetation communities into new or novel states (such as a shift to nonforested plant communities) at some point in the future. This risk is acknowledged at the broad scale, but it is impossible to quantify or predict this spatially or temporally for landscapes on the HLC NF, because a myriad of site-specific factors would influence these events and outcomes. Instead, the plan relies on the best information available to quantify appropriate vegetation conditions, while acknowledging potential risks and alternate scenarios, and providing the framework for monitoring and adaptive management to allow managers to respond to future conditions.

As a cornerstone, the Plan relies on desired condition envelopes that are informed by the natural range of variation (NRV), but also incorporate adjustments that reflect possible future conditions, such as allowing for more nonforested plant communities. Specific best available scientific information (BASI) is cited in cases where the desired condition differs from the modeled NRV (see appendix H of the EIS). Desired conditions are consistent with concepts for increasing forest resiliency, such as promoting fire-resistant species, large trees, and lower stand densities. These conditions are appropriate for the anticipated life of the plan (15 years), were extensively reviewed by forest specialists, and are consistent with the findings of expert reviews on similar efforts (Hansen et al., 2018; Timberlake, Joyce, Schultz, & Lampman, 2018). Moving towards these desired conditions would help ensure the maintenance of biodiversity, species habitat, and ecosystem services regardless of whether future conditions may change after the planning period. Management actions designed to mitigate the effects of drought are supported by the desired conditions, including the following described by Vose and others (2016):

- Implement structural changes by thinning or density management of planted forests;
- Favor or plant more drought-adapted species; and
- Manage for a diversity of species to reduce vulnerability to drought given uncertainty in future climate.

It is possible that at some point in the future, the desired conditions as currently outlined in the 2021 Land Management Plan may no longer be appropriate or achievable (for example, if sites shift to novel ecosystems). It is even possible that large disturbances and site-specific shifts could occur within the planning period. It is not possible to quantify desired conditions that reflect novel ecosystems, because predictions of species shifts in the literature are made at the broad scale using climate envelopes, and do not encompass site-specific conditions that would influence species persistence at the local scale. Further, it is not possible to predict or quantify potential megadisturbances, or broad-scale die-off events, although the risk of such events is noted. If such events do occur, or monitoring shows that species shifts are occurring within the plan period, it would be possible to amend the plan regarding appropriate desired conditions.

Climate adaptation strategies

The Northern Rockies Adaptation Partnership publication (Halofsky et al., 2018b, 2018c) is the main source of information on possible strategies and approaches. Initiated in 2013, this is a science-management partnership consisting of multiple agencies, organizations, and stakeholders who worked together over a period of two years to identify issues relevant to resource management in the Northern Rocky Mountains and to find practical solutions that can make ecosystems adaptable to the effects of a changing climate. Climate adaptations strategies that are supported by plan components in the 2021 Land Management Plan include but are not limited to the following. Many of these strategies would also be possible with the no-action alternative.

- Build aquatic ecosystem resilience to changing climate, higher peak flows, and higher variability.

- Respond to climate-induced occurrence of disturbances such as drought and flooding.
- Reduce erosion potential to protect water quality.
- Increase stream flows and moderate changes in instream flows.
- Increase habitat resilience for cold-water aquatic organisms by restoring structure and function of streams.
- Provide opportunities for native fish to move and find suitable stream temperatures.
- Manage non-native fish populations to eliminate or reduce their impact on native fish.
- Increase resilience to fire-related disturbance.
- Maintain/enhance species and structural diversity at multiple scales; protect forests from severe and uncharacteristic disturbances; and reduce impacts of stressors such as insects and disease and invasive species.
- Maintain/create areas where ecological processes are generally allowed to function with minimal human influence.
- Maintain particular species or community types of concern/high vulnerability.
- Incorporate increased knowledge and new science related to climate change and species responses.

Forest carbon assessment for the HLC NF

Alexa Dugan, Duncan McKinley, and Amanda Milburn – October 2019

Introduction

Carbon uptake and storage are some of the many ecosystem services provided by forests and grasslands. Through the process of photosynthesis, growing plants remove carbon dioxide (CO2) from the atmosphere and store it in forest biomass (plant stems, branches, foliage, roots) and much of this organic material is eventually stored in forest soils. This uptake and storage of carbon from the atmosphere helps modulate greenhouse gas concentrations in the atmosphere. Estimates of net annual storage of carbon indicate that forests in the U.S. constitute an important carbon sink, removing more carbon from the atmosphere than they are emitting (Yude Pan, 2011). Forests in the U.S. remove the equivalent of about 12 percent of annual U.S. fossil fuel emissions or about 206 teragrams of carbon after accounting for natural emissions, such as wildfire and decomposition (Hayes et al., 2018; U.S. Enviornmental Protection Agency, 2015).

The Intergovernmental Panel on Climate Change (IPCC) has summarized the contributions of global human activity sectors to climate change in its Fifth Assessment Report (Intergovernment Panel on Climate Change, 2014). From 2000 to 2009, forestry and other land uses contributed just 12 percent of human-caused global CO2 emissions. Fluxes from forestry and other land use (FOLU) activities are dominated by CO2 emissions. Non-CO2 greenhouse gas emissions from FOLU are small and mostly due to peat degradation releasing methane and were not included in this estimate. The forestry sector contribution to greenhouse gas emissions has declined over the last decade (FAOSTAT, 2013; (Intergovernment Panel on Climate Change, 2014; P. Smith et al., 2014). Globally, the largest source of these emissions in the forestry sector is deforestation (Houghton et al., 2012; Intergovernment Panel on Climate Change, 2014; Yude Pan, 2011), defined as the removal of all trees to convert forested land to other land uses that either do not support trees or allow trees to regrow for an indefinite period (Intergovernment Panel on Climate Change (IPCC), 2000). However, the U.S. is experiencing a net increase in forestland in recent decades because of the reversion of agricultural lands back to forest and regrowth of cut forests (Richard Birdsey, Pregitzer, & Lucier, 2006), a trend expected to continue for at least another decade (U.S. Department of Agriculture, 2016; Wear, Huggett, Li, Perryman, & Liu, 2013).

Forests are dynamic systems that naturally undergo fluctuations in carbon storage and emissions as forests establish and grow, die with age or disturbances, and re-establish and regrow. When trees and other vegetation die, either through natural aging and competition processes or disturbance events (e.g., fires, insects), carbon is transferred from living carbon pools to dead pools, which also release carbon dioxide through decomposition or combustion (fires). Management activities include timber harvests, thinning, and fuel reduction treatments that remove carbon from the forest and transfer a portion to wood products. Carbon can then be stored in commodities (e.g., paper, lumber) for a variable duration ranging from days to many decades or even centuries. In the absence of commercial thinning, harvest, and fuel reduction treatments, forests will thin naturally from mortality-inducing disturbances or aging, resulting in dead trees decaying and emitting carbon to the atmosphere.

Following natural disturbances or harvests, forests regrow, resulting in the uptake and storage of carbon from the atmosphere. Over the long term, forests regrow and often accumulate the same amount of carbon that was emitted from disturbance or mortality (McKinley et al., 2011). Although disturbances, forest aging, and management are often the primary drivers of forest carbon dynamics in some ecosystems, environmental factors such as atmospheric CO2 concentrations, climatic variability, and the availability of limiting forest nutrients, such as nitrogen, can also influence forest growth and carbon dynamics (Caspersen et al., 2000; Yude Pan, Birdsey, Hom, & McCullough, 2009).

In this section, we provide an assessment of the amount of carbon stored on the HLC NF and how disturbances, management, and environmental factors have influenced carbon storage overtime. This assessment primarily used two recent USFS reports: the Baseline Report (U.S. Department of Agriculture, 2015) and Disturbance Report (R. Birdsey et al., 2019). Both reports relied on Forest Inventory and Analysis (FIA) and several validated, data-driven modeling tools to provide nationally consistent evaluations of forest carbon trends across NFS lands. The Baseline Report applies the Carbon Calculation Tool (CCT) (J. E. Smith, Heath, & Nichols, 2007), which summarizes available FIA data across multiple survey years to estimate forest carbon stocks and changes in stocks at the scale of the NF from 1990 to 2013. The Baseline Report also provides information on carbon storage in harvested wood products for each Forest Service region. The Disturbance Report provides a NF-scale evaluation of the influences of disturbances and management activities, using the Forest Carbon Management Framework (ForCaMF) (S. P. Healey et al., 2016; Sean P. Healey, Urbanski, Patterson, & Garrard, 2014; Raymond, Healey, Peduzzi, & Patterson, 2015). This report also contains estimates of the long-term relative effects of disturbance and nondisturbance factors on carbon stock change and accumulation, using the Integrated Terrestrial Ecosystem Carbon (InTEC) model (W. J. Chen, J. Chen, & J. Cihlar, 2000; F. M. Zhang et al., 2012). Additional reports, including the most recent Resource Planning Act assessment (U.S. Department of Agriculture, 2016) and regional climate vulnerability assessments (Halofsky et al., 2018b, 2018c) are used to help infer future forest carbon dynamics. Collectively, these reports incorporate advances in data and analytical methods, representing the best available science to provide comprehensive assessments of NFS carbon trends.

Primary forest carbon models and carbon units

The following models were used to conduct this carbon assessment:

- Carbon Calculation Tool (CCT): Estimates annual carbon stocks and stock change from 1990 to 2013 by summarizing data from two or more Forest Inventory and Analysis (FIA) survey years. CCT relies on allometric models to convert tree measurements to biomass and carbon.

- Forest Carbon Management Framework (ForCaMF): Integrates FIA data, Landsat-derived maps of disturbance type and severity, and an empirical forest dynamics model, the Forest Vegetation Simulator, to assess the relative impacts of disturbances (harvests, insects, fire, abiotic, disease). ForCaMF estimates how much more carbon (non-soil) would be on each NF if disturbances from 1990 to 2011 had not occurred.
- Integrated Terrestrial Ecosystem Carbon (InTEC) model: A process-based model that integrates FIA data, Landsat-derived disturbance maps, as well as measurements of climate variables, nitrogen deposition, and atmospheric CO2. InTEC estimates the relative effects of aging, disturbance, regrowth, and other factors including climate, CO2 fertilization, and nitrogen deposition on carbon accumulation from 1950 to 2011. Carbon stock and stock change estimates reported by InTEC are likely to differ from those reported by CCT because of the different data inputs and modeling processes.

The following table provides a crosswalk among various metric measurements units used in the assessment of carbon stocks and emissions.

Table 2. Carbon stock and emission metric measurement units

Tonnes				Grams		
Multiple	Name	Symbol		Multiple	Name	Symbol
				10^0	Gram	G
				10^3	kilogram	Kg
10^0	tonne	t		10^6	Megagram	Mg
10^3	kilotonne	Kt		10^9	Gigagram	Gg
10^6	Megatonne	Mt		10^{12}	Teragram	Tg
10^9	Gigatonne	Gt		10^{15}	Petagram	Pg
10^{12}	Teratonne	Tt		10^{18}	Exagrame	Eg
10^{15}	Petatonne	Pt		10^{21}	Zettagram	Zg
10^{18}	Exatonne	Et		10^{24}	yottagram	Yg

1 hectare (ha) = 0.01 km2 = 2.471 acres = 0.00386 mi2
1 Mg carbon = 1 tonne carbon = 1.1023 short tons (U.S.) carbon
1 General Sherman Sequoia tree = 1,200 Mg (tonnes) carbon
1 Mg carbon mass = 1 tonne carbon mass = 3.67 tonnes CO2 mass
A typical passenger vehicle emits about 4.6 tonnes CO2 a year

Background

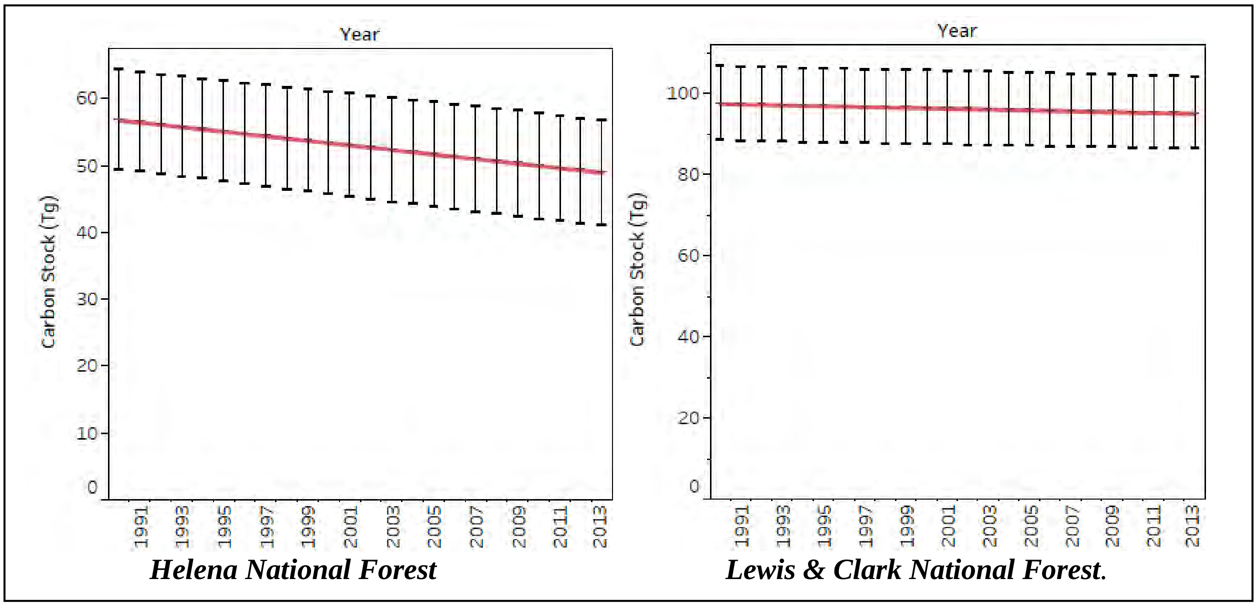
The HLC NF, located in the Rocky Mountains of Montana, covers approximately 1,074,000 ha of forestland. The HLC NF is made up of a distinct series of island mountain ranges, as well as portions of landscapes located along the Continental Divide. For planning purposes, the HLC NF is described in terms of ten “Geographic Areas” (GAs). The Helena and Lewis and Clark NFs were recently combined; however, the data in this report is summarized separately for each Forest due to the organization of available data. Douglas-fir and lodgepole pine forest types are the most abundant across the HLC NF. The carbon legacy of these and other NFs in the region is tied to the history of Euro-American settlement, land management, and disturbances, as described in the NRV report (appendix I).

Baseline carbon stocks and flux

Forest carbon stocks and stock change

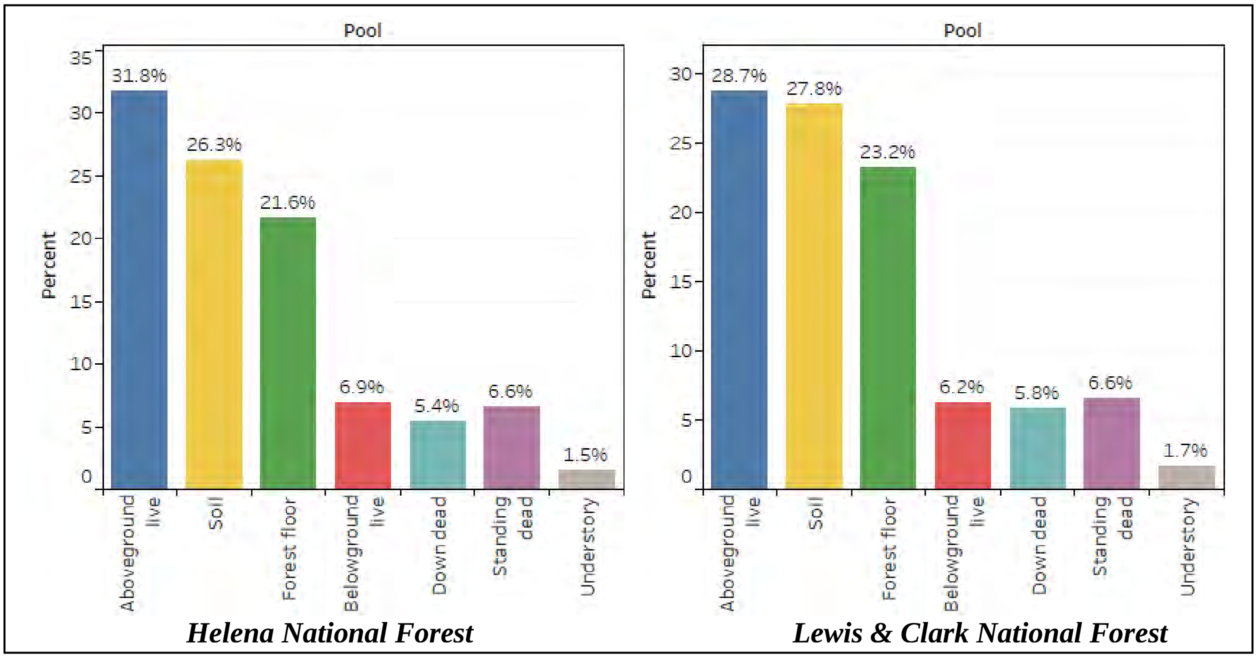
According to results of the Baseline Report (U.S. Department of Agriculture, 2015), carbon stocks in the Helena NF decreased from 56.7±7.5 teragrams of carbon (Tg C) in 1990 to 48.9±7.8 Tg C in 2013, a 14 percent decrease in carbon stocks over this period (Figure 1). On the Lewis & Clark NF, carbon stocks decreased from 97.8±9.2 Tg C in 1990 to 94.9±8.9 Tg C in 2013, a 2.44 decrease. For context, the total 143.8 Tg C present on both Forests in 2013 is equivalent to emissions from approximately 115 million passenger vehicles in a year. Despite some uncertainty in annual carbon stock estimates, reflected by the 95 percent confidence intervals, there is a high degree of certainty that carbon stocks on the these NF have been stable or decreased from 1990 to 2013 (Figure 1).

Figure 1. Total forest carbon stocks (Tg) from 1990 to 2013 for the HLC NF, bounded by 95 percent confidence intervals. Estimated using the CCT model.



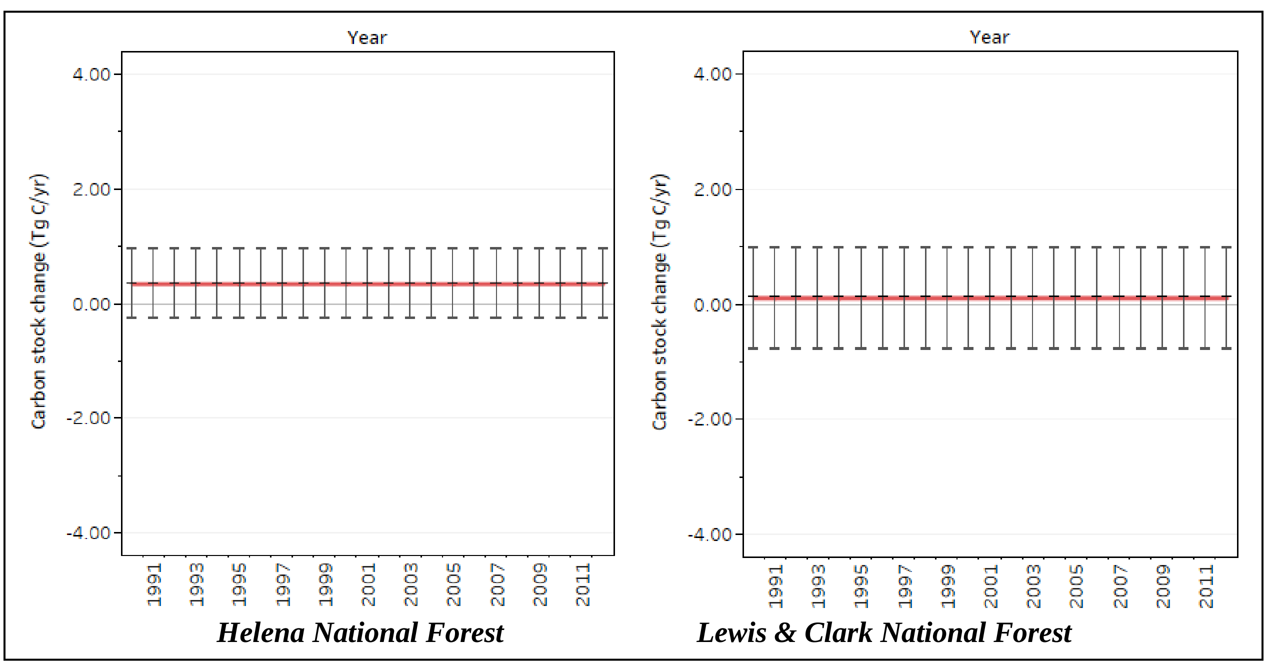
On the HLC NF, about 32 and 29 percent (respectively) of forest carbon stocks are stored in the aboveground portion of live trees, which includes all live woody vegetation at least one inch in diameter (Figure 2). Soil carbon contained in organic material to a depth of one meter (excluding roots) is the second largest carbon pool, storing another 26 and 28 percent respectively of the forest carbon stocks. Recently, new methods for measuring soil carbon have found that the amount of carbon stored in soils generally exceeds the estimates derived from using the methods of the CCT model by roughly 12 percent across forests in the U.S. (Domke et al., 2017).

Figure 2. Percentage of carbon stocks in 2013 in each of the forest carbon pools, for the HLC NF. Estimated using the CCT model



The annual carbon stock change can be used to evaluate whether a forest is a carbon sink or source in a given year. Carbon stock change is typically reported from the perspective of the atmosphere. A negative value indicates a carbon sink: the forest is absorbing more carbon from the atmosphere (through growth) than it emits (via decomposition, removal, and combustion). A positive value indicates a source: the forest is emitting more carbon than it takes up.

Figure 3, Carbon stock change (Tg/yr) from 1990 to 2012, bounded by 95 percent confidence intervals. A positive value indicates a carbon source, and a negative value indicates a carbon sink. Estimated using the CCT model



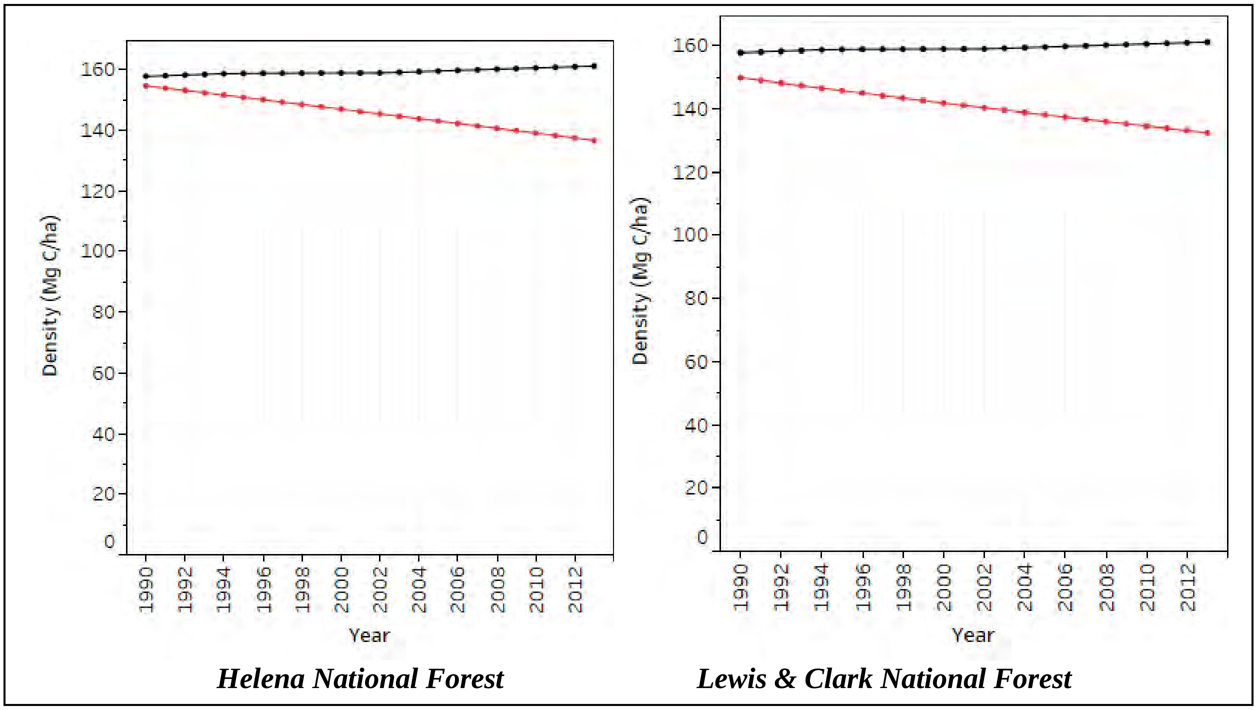
Annual carbon stock changes in the Helena NF were 0.3 ± 0.6 Tg C per year (loss) in both 1990 and 2012; on the Lewis & Clark NF, the annual carbon stock changes were 0.1 ±0.9 Tg C per year (loss) in both 1990 and 2012 (Figure 3). The uncertainty between annual estimates can make it difficult to determine whether the forest is a sink or a source in a specific year (i.e., uncertainty bounds overlap zero) (Figure 3). However, the trend of decreasing carbon stocks from 1990 to 2013 (Figure 1) over the 23-year period suggests that the HLC NF are stable on the Lewis & Clark NF portion, and a modest carbon source on the Helena NF portion.

Changes in forested area may affect whether forest carbon stocks are increasing or decreasing. The CCT estimates from the Baseline Report are based on FIA data, which may indicate changes in the total forested area from one year to the next. According to the FIA data used to develop these baseline estimates, the forested area in the Lewis & Clark NF has increased from 649,149 ha in 1990 to 716,287 ha in 2013, a net change of 67,138 ha. On the Helena NF, the forested area has decreased slightly from 367,058 ha in 1990 to 357,738 ha in 2013, a net change of -9,320 ha. Forested area used in the CCT model may differ from more recent FIA estimates, as well as from the forested areas used in the other modeling tools. When forestland area increases, total ecosystem carbon stocks typically also increase, indicating a carbon sink. Conversely, when forestland area decreases, the total stocks typically decrease, indicating a carbon source. The CCT model used inventory data from two different databases. This may have led to inaccurate estimates of changes in forested area, potentially altering the conclusion regarding whether or not forest carbon stocks are increasing or decreasing, and therefore, whether the NF is a carbon source or sink (W., Heath, Domke, & Nichols, 2011).

Carbon density, which is an estimate of forest carbon stocks per unit area, can help identify the effects of changing forested area. In the Helena NF and Lewis & Clark NFs, carbon density decreased from about 155 and 150 Megagrams of carbon (Mg C) per ha in 1990 to 137 and 133 Mg C per ha in 2013, respectively (Figure 4). This decrease in carbon density suggests that total carbon stocks may have indeed decreased.

Carbon density is also useful for comparing trends among units or ownerships with different forest areas. Most NFs in the Region 1 have experienced increasing stable carbon densities from 1990 to 2013. In contrast, carbon density in the HLC NF has been declining more than the average for all NF units in the Region 1 (Figure 4). Differences in carbon density between units may be related to inherent differences in biophysical factors that influence growth and productivity, such as climatic conditions, elevation, and forest types. These differences may also be affected by disturbance and management regimes.

Figure 4. Carbon stock density (Megagrams per hectare) in the HLC NF (red lines) and the average carbon stock density for all forests in the Recommended Wilderness Analysis Process (black line) from 1990 to 2013. Estimated using CCT.



Uncertainty associated with baseline forest carbon estimates

All results reported in this assessment are estimates that are contingent on models, data inputs, assumptions, and uncertainties. Baseline estimates of total carbon stocks and carbon stock change include 95 percent confidence intervals derived using Monte Carlo simulations, shown by the error bars (Figure 1, Figure 3). A Monte Carlo simulation performs an error analysis by building models of possible results by substituting a range of values – a probability distribution – for any factor that has inherent uncertainty (e.g., data inputs). It then calculates results over and over, each time using a different set of random values for the probability functions. These confidence intervals indicate that 19 times out of 20, the carbon stock or stock change for any given year will fall within error bounds. The uncertainties contained in the models, samples, and measurements can exceed 30 percent of the mean at the scale of a national forest, sometimes making it difficult to infer if or how carbon stocks are changing.

The baseline estimates that rely on FIA data include uncertainty associated with sampling error (e.g., area estimates are based on a network of plots, not a census), measurement error (e.g., species identification, data entry errors), and model error (e.g., associated with volume, biomass, and carbon equations, interpolation between sampling designs). As mentioned in Section 2.1, one such model error has resulted from a change in FIA sampling design, which led to an apparent change in forested area. Change in forested area may reflect an actual change in land use due to reforestation or deforestation. However, given that the these NF have experienced minimal changes in land use or adjustments to the boundaries of the national forests in recent years, the change in forested area incorporated in CCT is more likely a data artefact of altered inventory design and protocols (Woodall, Smith, & Nichols, 2013).

The inventory design changed from a periodic inventory, in which all plots were sampled in a single year to a standardized, national, annual inventory, in which a proportion of all plots is sampled every year. The older, periodic inventory was conducted differently across states and tended to focus on timberlands with high productivity. Any data gaps identified in the periodic surveys, which were conducted prior to the late 1990s, were filled by assigning average carbon densities calculated from the more complete, later inventories from the respective states (W. et al., 2011). The definition of what constitutes forested land also changed between the periodic and annual inventory in some states, which may also have contributed to apparent changes in forested area.

In addition, carbon stock estimates contain sampling error associated with the cycle in which inventory plots are measured. FIA plots are resampled about every 10 years in the western U.S., and a full cycle is completed when every plot is measured at least once. However, sampling is designed such that partial inventory cycles provide usable, unbiased samples annually but with higher errors. These baseline estimates may lack some temporal sensitivity, because plots are not resampled every year, and recent disturbances may not be incorporated in the estimates if the disturbed plots have not yet been sampled. For example, if a plot was measured in 2009 but was clearcut in 2010, that harvest would not be detected in that plot until it was resampled in 2019. Therefore, effects of the harvest would show up in FIA/CCT estimates only gradually as affected plots are re-visited and the differences in carbon stocks are interpolated between survey years (Woodall et al., 2013). In the interim, re-growth and other disturbances may mute the responsiveness of CCT to disturbance effects on carbon stocks. Although CCT is linked to a designed sample that allows straightforward error analysis, it is best suited for detecting broader and long-term trends, rather than annual stock changes due to individual disturbance events.

In contrast, the Disturbance Report integrates high-resolution, remotely-sensed disturbance data to capture effects of each disturbance event the year it occurred. This report identifies mechanisms that alter carbon stocks and provides information on finer temporal scales. Consequently, discrepancies in results may occur between the Baseline Report and the Disturbance Report (Dugan et al., 2017).

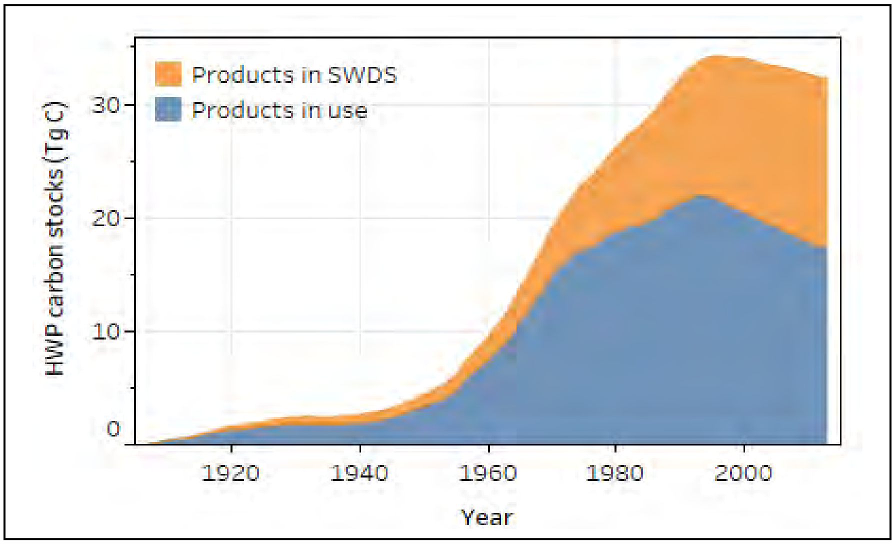
Carbon in harvested wood products

Although harvest transfers carbon out of the forest ecosystem, most of that carbon is not lost or emitted directly to the atmosphere. Rather, it can be stored in wood products for a variable duration depending on the commodity produced. Wood products can be used in place of other more emission intensive materials, like steel or concrete, and wood-based energy can displace fossil fuel energy, resulting in a substitution effect (Gustavsson et al., 2006); (Lippke et al., 2011). Much of the harvested carbon that is initially transferred out of the forest can also be recovered with time as the affected area regrows.

Carbon accounting for harvested wood products contained in the Baseline Report was conducted by incorporating data on harvests on national forests documented in cut-and-sold reports within a production accounting system (Loeffler et al., 2014; J. E. Smith, Heath, Skog, & Birdsey, 2006). This approach tracks the entire cycle of carbon, from harvest to timber products to primary wood products to disposal. As more commodities are produced and remain in use, the amount of carbon stored in products increases. As more products are discarded, the carbon stored in solid waste disposal sites (landfills, dumps) increases. Products in solid waste disposal sites may continue to store carbon for many decades.

In NFs in the Northern Region, harvest levels remained low until the 1940s when they began to rise, which caused an increase in carbon storage in harvested wood products (Figure 5). Timber harvesting and subsequent carbon storage increased rapidly in the 1960s and 1970s. Storage in products and landfills peaked at about 34 Tg C in 1995. However, because of a significant decline in timber harvesting in the late 1990s and early 2000s (to 1950s levels) carbon accumulation in products in use began to decrease. In the Northern Region, the contribution of national forest timber harvests to the harvested wood product carbon pool is less than the decay of retired products, causing a net decrease in product-sector carbon stocks. In 2013, the carbon stored in harvested wood products was equivalent to approximately 2.2 percent of total forest carbon storage associated with NFs in the Northern Region.

Figure 5. Cumulative total carbon (Tg) stored in harvested wood products (HWP) sourced from national forests in Recommended Wilderness Analysis Process[1]



[1] Carbon in HWP includes products that are still in use and carbon stored at solid waste disposal sites (SWDS). Estimated using the IPCC production accounting approach.

Uncertainty associated with estimates of carbon in harvested wood products

As with the baseline estimates of ecosystem carbon storage, the analysis of carbon storage in harvested wood products also contains uncertainties. Sources of error that influence the amount of uncertainty in the estimates include: adjustment of historic harvests to modern national forest boundaries; factors used to convert the volume harvested to biomass; the proportion of harvested wood used for different commodities (e.g., paper products, saw logs); product decay rates; and the lack of distinction between methane and CO2 emissions from landfills. The approach also does not consider the substitution of wood products for emission-intensive materials or the substitution of bioenergy for fossil fuel energy, which can be significant (Gustavsson et al., 2006). The collective effect of uncertainty was assessed using a Monte Carlo approach. Results indicated a ±0.05 percent difference from the mean at the 90 percent confidence level for 2013, suggesting that uncertainty is relatively small at this regional scale (Loeffler et al., 2014).

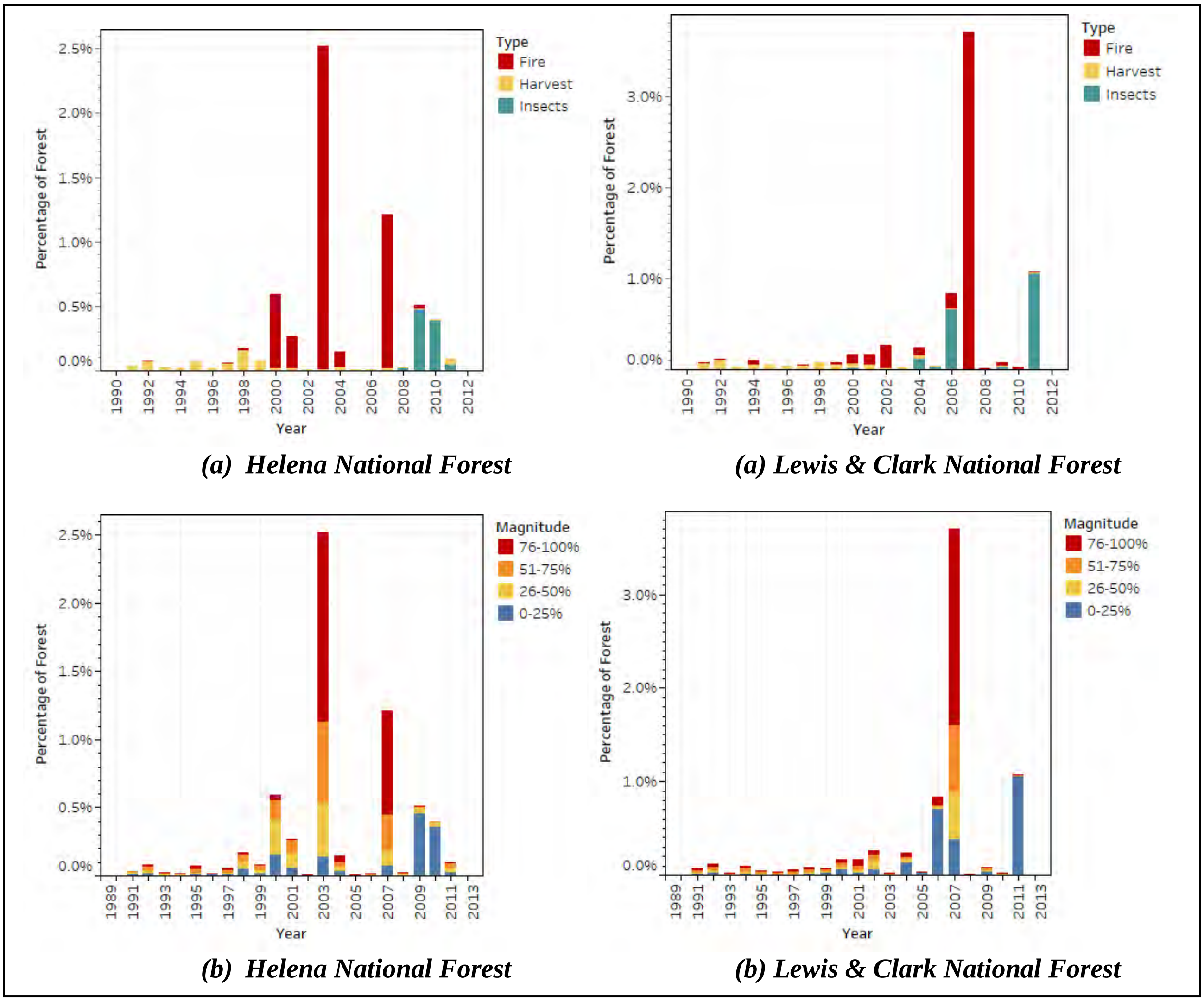
Factors influencing forest carbon

Effects of disturbance

The Disturbance Report builds on estimates in the Baseline Report by supplementing high-resolution, manually-verified, annual disturbance data from Landsat satellite imagery (Sean P. Healey et al., 2018). The Landsat imagery was used to detect land cover changes due to disturbances including fires, harvests, insects, and abiotic factors (e.g., wind, ice storms). The resulting disturbance maps indicate that wildfire and insects have been the dominant disturbance types detected on the HLC NF from 1990 to 2011, in terms of the total percentage of forested area disturbed over the period (Figure 6a). However, according to the satellite imagery, these disturbance agents affected a relatively small area of the forest during this time. In most years, wildfire affected less than 1 percent of the total forested area of either the Helena or Lewis & Clark NFs in any single year from 1990 to 2011. However in 2003, approximately 2.5 percent of the Helena NF burned, while in 2007 about 3.7 percent of the Lewis & Clark NF experienced fire. On the Lewis & Clark NF, wildfire in total affected less than 5 percent (approximately 31,500 ha) of the average forested area during this period (679,799 ha); and insects impacted less than 2 percent (approximately

13,200 acres). Wildfire also affected less than 5 percent of the Helena NF from 1990 to 2011, (roughly 17,000 acres of the average forested area of 362,800 ha); and insects affected just under 1 percent, 3,500 acres. Harvest also occurred on both forests but impacted less than 1 percent of either the Lewis & Clark or Helena NFs, 4,495 ha and 3,500 ha respectively. Wildfires resulted in a range of canopy cover loss, including a high proportion of 76-100 percent loss. Insect disturbances, in contrast, generally resulted in less than 25 percent canopy loss (Figure 6b). It is important to note that the impacts of the widespread mountain pine beetle outbreak (2006-2012) may not be entirely reflected in the data sources used.

Figure 6. Percentage of forest disturbed from 1990 to 2011 by (a) disturbance type including fire, harvests, insects, and abiotic (wind), and (b) magnitude of disturbance (change in canopy cover). Estimated using annual disturbance maps derived from Landsat satellite imagery.



(a) Helena National Forest

(a) Lewis & Clark National Forest

(b) Helena National Forest

(b) Lewis & Clark National Forest

The Forest Carbon Management Framework (ForCaMF) incorporates Landsat disturbance maps summarized in Figure 6, along with FIA data in the Forest Vegetation Simulator (FVS) (Crookston & Dixon, 2005). The FVS is used to develop regionally representative carbon accumulation functions for each combination of forest type, initial carbon density, and disturbance type and severity (including undisturbed) (Raymond et al., 2015). The ForCaMF model then compares the undisturbed scenario with the carbon dynamics associated with the historical disturbances to estimate how much more carbon would be on each NF if the disturbances and harvests during 1990-2011 had not occurred. ForCaMF simulates the effects of disturbance and management only on non-soil carbon stocks (i.e., vegetation, dead wood, forest floor). Like CCT, ForCaMF results supply 95 percent confidence intervals around estimates derived from a Monte Carlo approach (Sean P. Healey et al., 2014).

Wildfire on the HLC NF was the primary disturbance influencing carbon stocks from 1990 to 2011 (Figure 7). Wildfire accounted for nearly 82 percent of the total non-soil carbon lost from the forest due to disturbances on the Helena NF, and 76 percent on the Lewis & Clark NF. Losses from insects and harvest made up the remainder of the total non-soil carbon loss, affecting similar proportions(U.S. Department of Agriculture, 2015). The ForCaMF model indicates that, by 2011, the Helena NF contained 2.2Mg C per ha less non-soil carbon (i.e., vegetation and associated pools) due to wildfire since 1990, as compared to a hypothetical undisturbed scenario (Figure 7). As a result, non-soil carbon stocks in the Helena NF would have been approximately 2.1 percent higher in 2011 if wildfire had not occurred since 1990 (Figure 8). Similarly, the data indicate that, by 2011, the Lewis & Clark NF contained 1.9 Mg C per ha less non-soil carbon due to wildfire since 1990, indicating that carbon stocks would have been approximately 2 percent higher in 2011 if wildfires had not occurred during this time. For both portions of the Forest, insects and harvest resulted in less than 0.5 Mg/ha less non-soil carbon each, with percent losses less than 0.5 percent.

Figure 7. Lost potential storage of carbon (Megagrams) as a result of disturbance for the period 1990-2011 in HLC NF. The zero line represents a hypothetical undisturbed scenario. Gray lines indicate 95% confidence intervals. Estimated using the ForCaMF model.

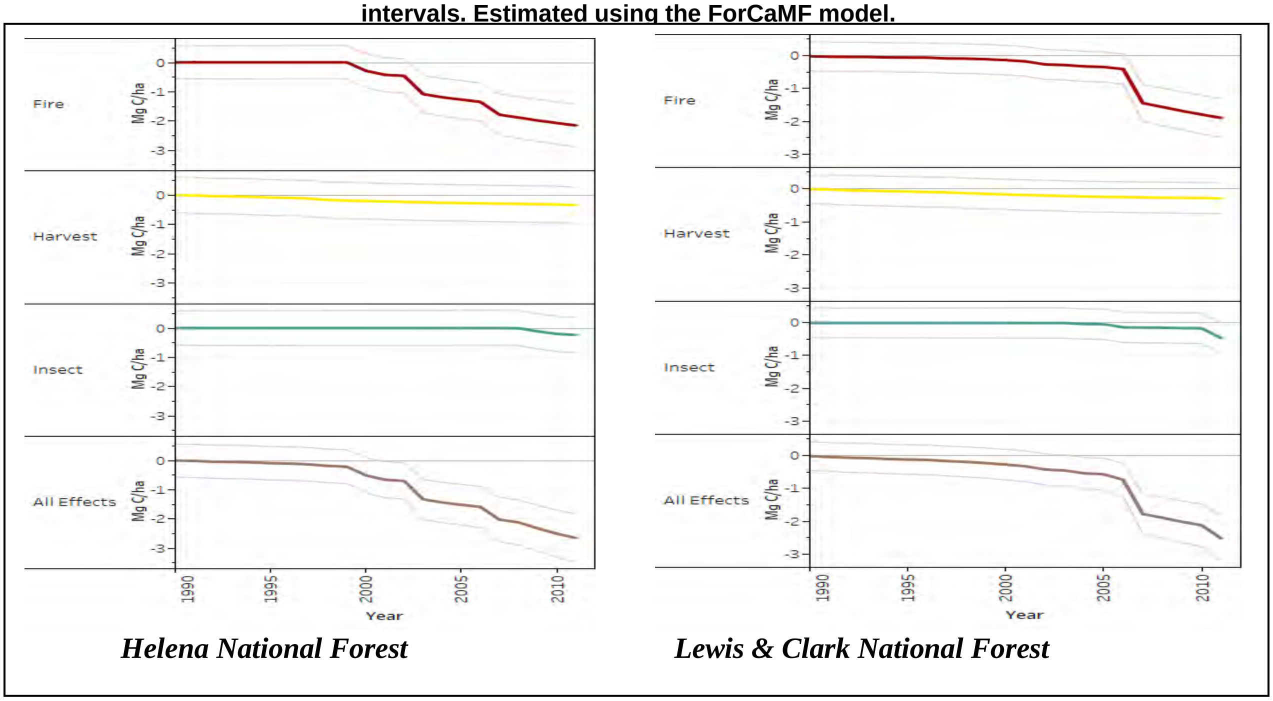
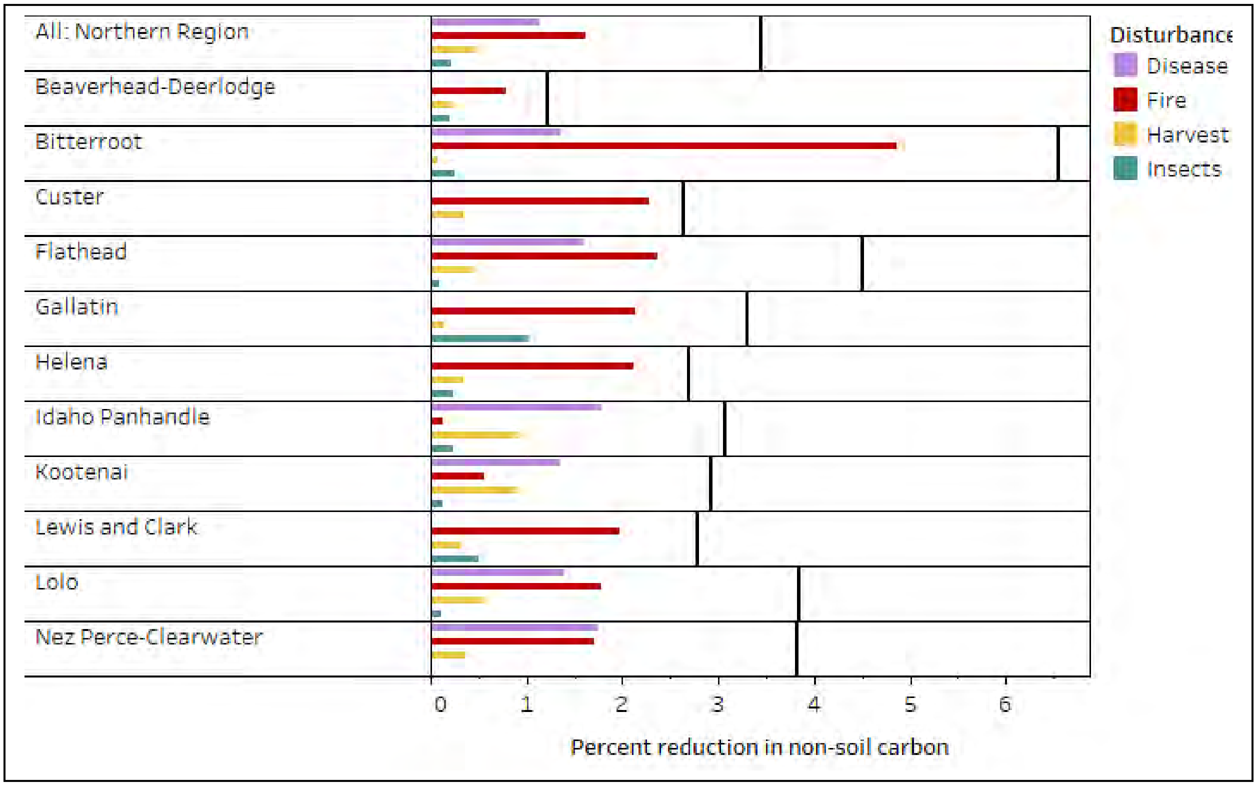


Figure 8. The degrees to which 2011 carbon storage on each NF in the FEIS Appendix J Climate Carbon was reduced by disturbance from 1990 to 2011 relative to a hypothetical baseline with no disturbance.



The black line indicates the effect of all disturbances types combined. Estimated using disturbance effects from ForCaMF and non-soil carbon stock estimates from CCT.

Across all NFs in Region 1 wildfire has been the most significant disturbance affecting carbon storage since 1990, causing non-soil forest ecosystem carbon stocks to be 1.62 percent lower by 2011 (Figure 8). Considering all NFs in the Region 1, by 2011, disease accounted for the loss of 1.13 percent of non-soil carbon stocks, harvest 0.48 percent, and insects 0.22 percent. There were no non-soil carbon stock reductions caused by abiotic factors such as wind and ice storms.

The ForCaMF analysis was conducted over a relatively short time. After a forest is harvested, it will eventually regrow and recover the carbon removed from the ecosystem in the harvest. However, several decades may be needed to recover the carbon removed depending on the type of the harvest (e.g., clear-cut versus partial cut), as well as the conditions prior the harvest (e.g., forest type and amount of carbon) (Wear et al., 2013). The ForCaMF model also does not track carbon stored in harvested wood after it leaves the forest ecosystem. In some cases, removing carbon from forests for human use can result in lower net contributions of GHGs to the atmosphere than if the forest was not managed, when accounting for the carbon stored in wood products, substitution effects, and forest regrowth (Dugan et al., 2018; Lippke et al., 2011; McKinley et al., 2011; Skog et al., 2014). Therefore, the IPCC recognizes wood as a renewable resource that can provide a mitigation benefit to climate change (Intergovernment Panel on Climate Change (IPCC), 2000).

ForCaMF helps to identify the biggest local influences on continued carbon storage and puts the recent effects of those influences into perspective. Factors such as stand age, drought, and climate may affect overall carbon change in ways that are independent of disturbance trends. The purpose of the InTEC model was to reconcile recent disturbance impacts with these other factors.

Effects of forest aging

InTEC models the collective effects of forest disturbances and management, aging, mortality, and subsequent regrowth on carbon stocks from 1950 to 2011. The model uses inventory-derived maps of stand age, Landsat-derived disturbance maps (Figure 6), and equations describing the relationship between net primary productivity and stand age. Stand age serves as a proxy for past disturbances and management activities (Y. Pan et al., 2011). In the model, when a forested stand is disturbed by a severe, stand-replacing event, the age of the stand resets to zero and the forest begins to regrow. Thus, peaks of stand establishment can indicate stand-replacing disturbance events that subsequently promoted regeneration.

Stand-age distribution for the HLC NF derived from 2011 forest inventory data indicates elevated stand establishment around 1880-1930 (Figure 9a) in both Forests. This period of elevated stand regeneration came after large wildfires in the late 1800s and early 1900s, as well as harvest activities associated with railroad and mining developments, followed by moist climate conditions conducive to forest establishment. Both portions of the HLC NF have also experienced a pulse in stand establishment following wildfires in the early 2000's. Stands regrow and recover at different rates depending on forest type and site conditions. Forests are generally most productive when they are young to middle age, then productivity peaks and declines or stabilizes as the forest canopy closes and as the stand experiences increased respiration and mortality of older trees (He, Chen, Pan, Birdsey, & Kattage, 2012; Pregitzer & Euskirchen, 2004), as indicated by the in net primary productivity-age curves (Figure 9b), derived in part from FIA data.

InTEC model results show that the HLC NF was accumulating carbon steadily at the start of the analysis in the 1950s through the mid-1970s (Figure 10) (positive slope) as a result of regrowth following disturbances and heightened productivity of the young to middle-aged forests (30-60 years old). As stand establishment declined and more stands reached slower growth stages around the 1980s, the rate of carbon accumulation declined (negative slope). Of all the factors modeled in InTEC, forest regrowth and aging following historical disturbances (early 1900s harvesting and land-use change), have collectively been responsible for the majority of carbon accumulation since 1950 in the HLC NF (Figure 10).

Figure 9. (a) Stand age distribution in 2011 and (b) net primary productivity-stand age curves by forest type group in the HLC National Forest. Derived from forest inventory data.

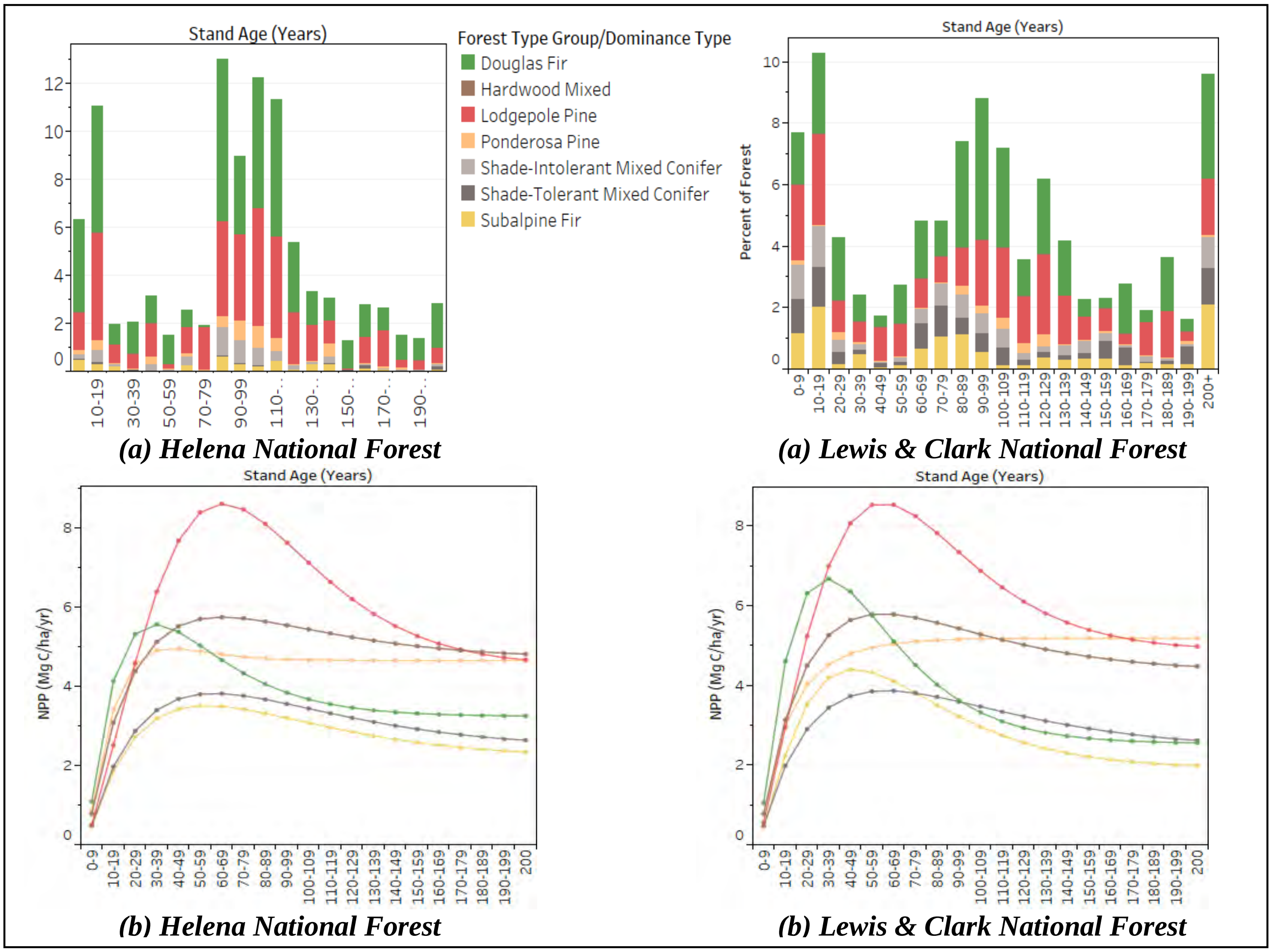
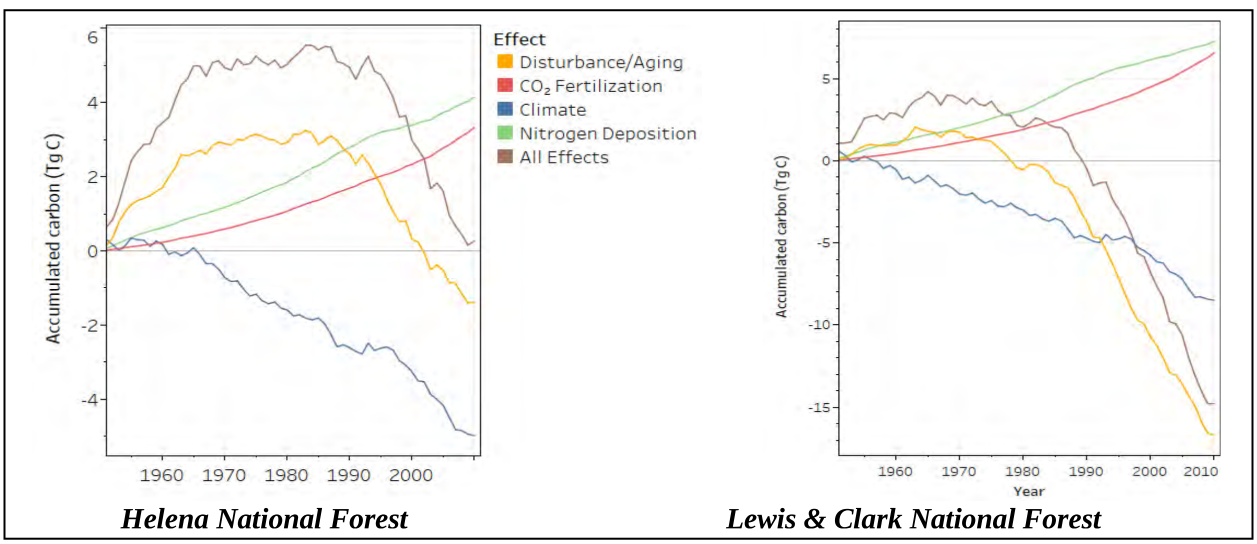


Figure 10. Accumulated carbon in the HLC NF due to disturbance/aging, climate, nitrogen deposition, CO_2 fertilization, and all factors combined for 1950–2011, excluding carbon accumulated pre-1950.



Estimated using the InTEC model.

Effects of climate and environment

The InTEC model also isolates the effects of climate (temperature and precipitation), atmospheric CO2 concentrations, and nitrogen deposition on forest carbon stock change and accumulation. Generally annual precipitation and temperature conditions fluctuate considerably. The modeled effects of variability in temperature and precipitation on carbon stocks has varied from year-to-year, but overall, climate since 1950 has had a negative effect on carbon stocks in the HLC NF relative to other factors (Fig. 10). Warmer temperatures can increase forest carbon emissions through enhanced soil microbial activity and higher respiration (Ju, Chen, Harvey, & Wang, 2007; Melillo et al., 2017), but warming temperatures can also reduce soil moisture through increased evapotranspiration, causing lower forest growth (Xu et al., 2013).

In addition to climate, the availability of CO2 and nitrogen can alter forest growth rates and subsequent carbon uptake and accumulation (Caspersen et al., 2000; Yude Pan et al., 2009). Increased fossil fuel combustion, expansion of agriculture, and urbanization have caused a significant increase in both CO2 and nitrogen emissions (W. Chen, J. Chen, & J. Cihlar, 2000);(F. M. Zhang et al., 2012). According to the InTEC model, higher CO2 has consistently had a positive effect on carbon stocks in the HLC NF, tracking an increase in atmospheric CO2 concentrations worldwide (Figure 10). However, a precise quantification of the magnitude of this CO2 effect on terrestrial carbon storage is one of the more uncertain factors in ecosystem modeling (Jones, Scullion, Ostle, Levy, & Gwynn-Jones, 2014; F. Zhang et al., 2015). Long-term studies examining increased atmospheric CO2 show that forests initially respond with higher productivity and growth, but the effect is greatly diminished or lost within 5 years in most forests (Zhu et al., 2016). There has been considerable debate regarding the effects of elevated CO2 on forest growth and biomass accumulation, thus warranting additional study (Korner et al., 2005; Norby, Warren, Iversen, Medlyn, & McMurtie, 2010; Zhu et al., 2016).

Modeled estimates suggest that overall nitrogen deposition had a positive effect on carbon accumulation in the HLC NF (Figure 10). Like CO2, the actual magnitude of this effect remains uncertain. Elevated nitrogen deposition can also decrease growth in some species for a variety of reasons, such as leaching of base cations in the soil, increased vulnerability to secondary stressors, and suppression by more competitive species (Pardo, Robin-Abbott, & Driscoll, 2011). The InTEC model simulated that rates of carbon accumulation associated with nitrogen deposition decreased as deposition rates declined. Overall, the InTEC model suggests that CO2 and nitrogen fertilization only partially offset the declines in carbon accumulation associated with historical disturbance, aging, and regrowth, and climate.

Uncertainty associated with disturbance effects and environmental factors

As with the baseline estimates, there is also uncertainty associated with estimates of the relative effects of disturbances, aging, and environmental factors on forest carbon trends. For example, omission, commission, and attribution errors may exist in the remotely-sensed disturbance maps used in the ForCaMF and InTEC models. However, these errors are not expected to be significant given that the maps were manually verified, rather than solely derived from automated methods. ForCaMF results may also incorporate errors from the inventory data and the FVS-derived carbon accumulation functions (Raymond et al., 2015). To quantify uncertainties, the ForCaMF model employed a Monte Carlo-based approach to supply 95 percent confidence intervals around estimates (Sean P. Healey et al., 2014).

Uncertainty analyses such as the Monte Carlo are not commonly conducted for spatially explicit, process-based models like InTEC because of significant computational requirements. However, process-based models are known to have considerable uncertainty, particularly in the parameter values used to represent complex ecosystem processes (Zaehle, Sitch, Smith, & Hatterman, 2005). InTEC is highly calibrated to FIA data and remotely-sensed observations of disturbance and productivity, so uncertainties in these datasets are also propagated into the InTEC estimates. National-scale sensitivity analyses of InTEC inputs and assumptions (Schimel, Stephens, & Fisher, 2015), as well as calibration with observational datasets (F. M. Zhang et al., 2012) suggest that model results produce a reasonable range of estimates of the total effect (e.g., Figure 10). However, the relative partitioning of the effects of disturbance and nondisturbance factors as well as uncertainties at finer scales (e.g., NF scale) are likely to be considerably higher.

Results from the ForCaMF and InTEC models may differ substantially from baseline estimates (CCT), given the application of different datasets, modeling approaches, and parameters (F. M. Zhang et al., 2012). The baseline estimates are almost entirely rooted in empirical forest inventory data, whereas ForCaMF and InTEC involve additional data inputs and modeling complexity beyond summarizing ground data.

Carbon on nonforest lands

The HLC NF contains 178,000 hectares of nonforest lands. Grasslands, shrublands, and riparian and wetland areas cover most of these lands, accounting for approximately 15 percent of the total area on the Forest. The vast majority of the carbon in these nonforest systems, such as grasslands and shrublands, is stored belowground in soil and plant roots (M. Janowiak et al., 2017; McKinley & Blair, 2008). By contrast, forests typically store roughly one-half of the total carbon belowground (Domke et al., 2017). Soils generally provide a stable ecosystem carbon pool relative to other ecosystem carbon pools.

Many grasslands are highly dependent on frequent fire and grazing, which temporarily remove above ground vegetation (Knapp, Briggs, Harnett, & Collins, 1998). For example, fire suppression and overgrazing is implicated in allowing many grasslands to convert to shrublands with dense woody vegetation by altering wildfire regimes (Van Auken, 2009). Replacement of grasslands with woody plants generally tends to increase total ecosystem carbon storage, but can alter ecosystem function and structure (McKinley & Blair, 2008; Van Auken, 2009). Conversely, invasive species, such as *Bromus tectorum*, can reduce carbon in shrublands by propagating more intense fire that cause mortality of co-occurring woody species (Bradley, Houghton, Mustard, & Hamburg, 2006; Koteen, Baldocchi, & Harte, 2011). The Forest supports relatively low amounts of invasive annual species, such as *Bromus tectorum*, compared with other areas in the western United States.

The greatest lasting influence in nonforest ecosystem carbon stocks is land-use and land-cover change. For example, it is generally assumed that federal grassland areas have negligible changes in carbon due to limited land use and management change (U.S. Environmental Protection Agency, 2019). Because soil carbon in grasslands is generally stable, substantial changes are typically a result of dramatic changes in land use or vegetation cover that persist indefinitely. The majority of grasslands in Great Plains have been converted to agricultural use since European settlement, which has led to substantial losses of soil carbon. Like forests, managing the health of grasslands and other nonforest ecosystems and avoiding land use and land cover change are key concerns for maintaining carbon stocks. Land use change generally does not occur on the Forest, although there is increasing development on private lands in the region.

Grazing has long played an important role in plant composition and nutrient cycling in many nonforest ecosystems in the Great Plains (Knapp et al., 1998). Large grazing ungulates, including domesticated livestock and bison, produce a variety of greenhouse gas emissions. Livestock and wild ruminates produce methane from enteric fermentation, resulting from their digestive process. Nitrous oxide can be produced as a byproduct from soil microbial processes that chemically transform nitrogen in animal waste. The Environmental Protection Agency (2019) estimates that about 47 percent of the total greenhouse gas emissions in the agricultural sector are attributed to livestock. In turn, the agricultural sector contributes to about 9 percent of total greenhouse gas emissions in the United States. The USDA's National Agricultural Statistics Service estimated in January 2019 that the United States had about 94.8

million cattle (National Agricultural Statistics Service, 2019). By comparison, the Forest maintains fewer than 30,000 cows, pairs, and yearlings. However, many of these animals are not typically present on the Forest year round.

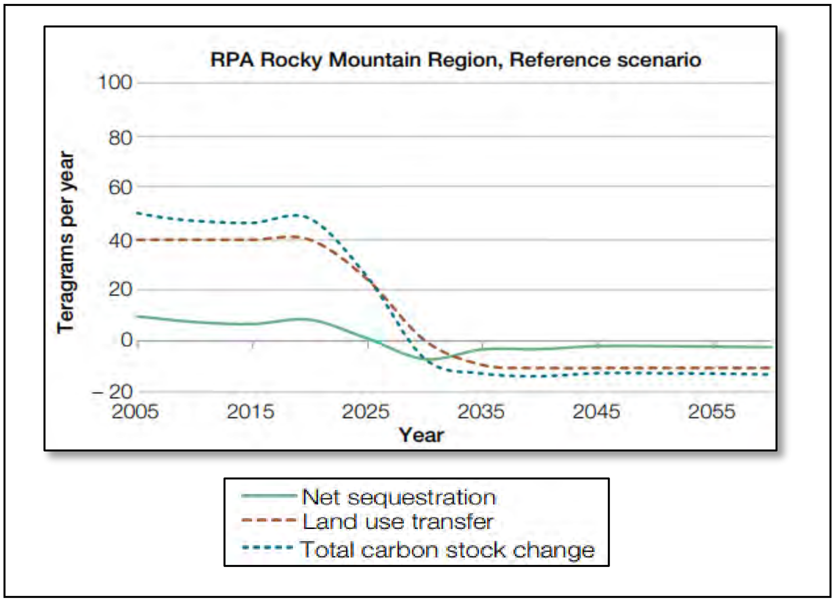
Future carbon conditions

Prospective forest aging effects

The retrospective analyses presented in the previous sections can provide an important basis for understanding how various factors may influence carbon storage in the future. For instance, 60 and 68 percent of the Helena and Lewis & Clark NFs, respectively, are middle-aged and older (greater than 80 years), although there is also a strong representation of stands less than 20 years old due to recent wildfires (Figure 9a). There is also a pulse of stands over 200 years old on the Lewis & Clark NF. If the Forests continues on this aging trajectory, the pulse of middle-aged stands will reach a slower growth stage in coming years and decades (Figure 9b), potentially causing the rate carbon accumulation to decline and the Forests may eventually transition to a steady state in the future. However, the pulse of young stands will also be moving into a maximum productivity stage, which may offset the declines in the middle-aged stands to a degree. In the middle aged stands, although yield curves indicate that biomass carbon stocks may be approaching maximum levels (Figure 9b), ecosystem carbon stocks can continue to increase for many decades as dead organic matter and soil carbon stocks continue to accumulate (Luyssaert et al., 2008). Furthermore, while past and present aging trends can inform future conditions, the applicability may be limited, because potential changes in management activities or disturbances could affect future stand age and forest growth rates (Davis, Hessl, Scott, Adams, & Thomas, 2009; Keyser & Zarnoch, 2012).

For RPA’s Rocky Mountain Region (equivalent to a combination of the FS’s Northern, Rocky Mountain, Intermountain West, and Southwest Region boundaries, but includes all land ownerships), projections indicate that the rate of carbon sequestration will decline fairly rapidly in the 2020s mostly due to the loss of forestland (land-use transfer), causing the region’s forests to shift to a carbon source. The net sequestration rate is also projected to decline slightly further resulting in a shift to a carbon source (Figure 11).

Figure 11. Projections of forest carbon stock changes in the North Region[1] for the RPA reference scenario.[2]



1 Equivalent to a combination of the Forest Service's Northern, Rocky Mountain, Intermountain West, and Southwest Region boundaries, but includes all land tenures.
2 Net sequestration of forests is the total carbon stock change minus losses associated with land-use change.

Prospective climate and environmental effects

The observational evidence described above and in previous sections highlights the role of natural forest development and succession as the major driver of historic and current forest carbon sequestration that is occurring at the these NF and elsewhere in across the region. Climate change introduces additional uncertainty about how forests—and forest carbon sequestration and storage—may change in the future. Climate change causes many direct alterations of the local environment, such as changes in temperature and precipitation, and it has indirect effects on a wide range of ecosystem processes (James M. Vose, Peterson, & Patel-Weynand, 2012). Further, disturbance rates are projected to increase with climate change (J. M. Vose et al., 2018), making it challenging to use past trends to project the effects of disturbance and aging on forest carbon dynamics.

A climate change vulnerability assessment of the Northern Rocky Mountains (Halofsky et al., 2018b), which encompasses the HLC NF indicates that average warming across the five Northern Region Adaptation Partnership subregions is projected to be about 4 to 5 °F by 2050, depending on greenhouse gas emissions. Precipitation may increase slightly in the winter, although the magnitude is uncertain. Climatic extremes will probably be more common, driving biophysical changes in terrestrial and aquatic ecosystems. Droughts of increasing frequency and magnitude are expected, promoting an increase in wildfire, insect outbreaks, and non-native species. These periodic disturbances will rapidly alter productivity and structure of vegetation, potentially altering the distribution and abundance of dominant plant species and animal habitat. Increasing air temperature, through its influence on soil moisture, will cause gradual changes in the abundance and distribution of tree, shrub, and grass species, with more drought tolerant species becoming more competitive. Natural disturbance will be the primary facilitator of vegetation change, and future forest landscapes may be dominated by younger age classes and smaller trees. As wildfires and insect outbreaks become more common, the supply of timber and other forest products could become less reliable. A longer growing season will increase productivity of rangeland types. Carbon sequestration may decline if disturbances increase as expected.

Elevated temperatures may increase soil respiration and reduce soil moisture through increased evapotranspiration, which would negatively affect growth rates and carbon accumulation (Ju et al., 2007; Melillo et al., 2017). Modeled results of recent climate effects using the InTEC model indicate that years with elevated temperatures have generally had a negative effect on carbon uptake in the HLC NF (Figure 10).

Longer, warmer growing seasons may increase growth rates; however, greater soil water deficits and increased evapotranspiration in the summer may offset this and increase plant stress. Growing sites on the HLC NF are generally moisture-limited. Therefore, warm/dry climatic periods generally result in slower growth. Competition-based mortality also increases during dry periods, and stress can lead to higher mortality rates indirectly through susceptibility to insects or disease. Increasing soil water deficits can cause eventual shifts in species presence across the landscape as they become less able to regenerate or survive. Species located on sites at the margin of their optimal range would be most vulnerable. On the HLC NF, the species expected to be most vulnerable to climate change on the HLC NFs include aspen, limber pine, cottonwood, and ponderosa pine (Halofsky et al., 2018b). Changes in climate are expected to drive many other changes in forests through the next century, including changes in forest establishment and composition (Maria K. Janowiak et al., 2018). Climate-driven failures in species establishment further reduce the ability of forests to recover carbon lost after mortality-inducing events or harvests. Although future climate conditions also allow for other future-adapted species to increase, there is greater uncertainty about how well these species will be able to take advantage of new niches that may become available (Duveneck, Thompson, Gustafson, Liang, & de Bruijn, 2017; Iverson et al., 2017).

Carbon dioxide emissions are projected to increase through 2100 under even the most conservative emission scenarios (Intergovernment Panel on Climate Change, 2014). Several models, including the InTEC model (Figure 10), project greater increases in forest productivity when the CO_2 fertilization effect is included in modeling (Aber et al., 1995; Ollinger, Goodale, Hayhoe, & Jenkins, 2008; Yude Pan et al., 2009; F. M. Zhang et al., 2012). However, the effect of increasing levels of atmospheric CO_2 on forest productivity is transient and can be limited by the availability of nitrogen and other nutrients (Norby et al., 2010). Productivity increases under elevated CO_2 could be offset by losses from climate-related stress or disturbance.

Given the complex interactions among forest ecosystem processes, disturbance regimes, climate, and nutrients, it is difficult to project how forests and carbon trends will respond to novel future conditions. The effects of future conditions on forest carbon dynamics may change over time. As climate change persists for several decades, critical thresholds may be exceeded, causing unanticipated responses to some variables like increasing temperature and CO_2 concentrations. The effects of changing conditions will almost certainly vary by species and forest type. Some factors may enhance forest growth and carbon uptake, whereas others may hinder the ability of forests to act as a carbon sink, potentially causing various influences to offset each other. Thus, it will be important for forest managers to continue to monitor forest responses to these changes and potentially alter management activities to better enable forests to better adapt to future conditions.

Summary

The HLC NF may be functioning as a slight carbon source, although the confidence interval overlaps zero. This determination is also unclear because the modeling and uncertainty analyses were split based on the historical Helena and Lewis and Clark National Forests, which are now combined. Forest carbon stocks decreased by about 14 percent between 1990 and 2013 on the Helena NF, and by about 2.44

percent on the Lewis & Clark NF. This trend is also observed in the carbon density data although less pronounced. The negative impacts on carbon stocks have primarily been caused by disturbances and environmental conditions and have been greater than the gains from forest growth. According to satellite imagery, wildfire has been the most prevalent disturbance detected on the Forest since 1990. These fire disturbances were variable in terms of severity. Forest carbon losses associated with wildfire have nevertheless been small compared to the total amount of carbon stored in the Forest, resulting in a loss of 2.1 and 1.2 percent of non-soil carbon from 1990 to 2011 on the Helena and Lewis & Clark NFs respectively. Carbon storage in HWPs sourced from national forests increased since the early 1900s. Recent declines in timber harvesting have slowed the rate of carbon accumulation in the product sector.

The biggest influence on current carbon dynamics on the HLC NF is the legacy of large wildfires and some timber harvesting for the railroad and mining industries during the 19th century, followed by a period of forest recovery beginning in the early to mid-20th century. Over half of the stands on the HLC NF are now middle to older aged, although there is also a pulse of young stands that established after fires since 2000. The rate of carbon uptake and sequestration generally decline as forests age. Accordingly, projections from the RPA assessment indicate a potential age-related decline in forest carbon stocks in the Region 1 (all land ownerships) beginning in the 2020s.

Climate and environmental factors, including elevated atmospheric CO2 and nitrogen deposition, have also influenced carbon accumulation on the HLC NF. Climate conditions along with disturbance and aging have had a negative impact on carbon accumulation since the 1950s. Conversely, increased atmospheric CO2 and nitrogen deposition may have enhanced growth rates and helped to counteract ecosystem carbon losses due to historical disturbances, aging, and climate.

The effects of future climate conditions are complex and remain uncertain. However, under changing climate and environmental conditions, forests of the HLC NF may be increasingly vulnerable to a variety of stressors. These potentially negative effects might be balanced somewhat by the positive effects of longer growing season, greater precipitation, and elevated atmospheric CO2 concentrations. However, it is difficult to judge how these factors and their interactions will affect future carbon dynamics on the HLC NF.

Forested area on the HLC NF will be maintained as forest in the foreseeable future, which will allow for a continuation of carbon uptake and storage over the long term. The HLC NF will continue to have an important role in maintaining the carbon sink, regionally and nationally, for decades to come.

Additional description of potential effects on carbon

This section provides additional discussion of how the management objectives management direction may potentially affect forest carbon.

All action alternatives provide the same desired conditions for terrestrial ecosystems, and the standards and guidelines that help achieve or maintain those conditions. Using management activities to achieve this desired mix of conditions would enhance the overall ecological integrity of the forest ecosystems, improving their ability to adapt to potential stressors. These activities would help maintain critical ecosystem functions into the future, in part by balancing the maintenance of carbon stocks and rates of carbon uptake.

One desired condition in the 2021 Land Management Plan is to provide for old growth on the landscape. Older forest stands are desirable because they provide a range of ecosystem services, including storing more carbon than do younger stands. The current stand-age structure on the HLC NF indicates over half of the forests are middle-aged and older, with a pulse of young stands that have established after large fires in the early 2000’s. As the middle-aged forests age, rates of carbon uptake may decline after several decades, although carbon stocks will continue to increase.

Under all alternatives, management activities involving timber harvesting and thinning can result in both long-term carbon storage off site and substitution effects through the use of harvested wood products. Carbon can be stored in wood products for days to centuries, depending on the commodity produced and end use. As more commodities are produced and remain in use, the amount of carbon stored in products increases, creating a cumulative benefit when considered with forest regrowth. Even as more wood products are discarded, the carbon stored in solid waste disposal sites also increases. Harvested wood products can also substitute for more fossil fuel-intensive materials like steel, concrete, and plastic, resulting in a net decline in emissions (Dugan et al., 2018; Gustavsson et al., 2006; Lippke et al., 2011; McKinley et al., 2011). Likewise, harvested wood and discarded wood products can be burned to produce heat or electrical energy, also producing a benefit by substituting for more carbon-producing energy sources. The IPCC recognizes wood and fiber as a renewable resource that can provide lasting climate-related mitigation benefits that with active management can accrue over time (IPCC 2000).

Prescribed fires would also be conducted under all alternatives, which typically target surface and ladder fuels and are less severe than wildfires (Agee & Skinner, 2005), because they are conducted within predetermined conditions. Fire-dependent forest types that are targeted for prescribed burning also typically contain species with thicker bark, which offers protection from heat-related damage. Thus, in some situations, prescribed fires and thinning can lower overstory tree mortality (Hurteau & North, 2009), potentially reducing amounts of carbon emissions that might be emitted if the same area were to burn in a high-severity wildfire (Wiedinmyer & Hurteau, 2010). By promoting natural fire-adapted vegetation through the use of thinning and prescribed burns, thereby reducing the threat of wildfire, all alternatives might create more advantageous conditions to support long-term forest health in a changing climate (adaptation) and reduce carbon emissions and maintain carbon stocks (mitigation) (Intergovernment Panel on Climate Change (IPCC), 2007).

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Appendix K. Potential Recreation Direct Effects

Table of Contents

Tables

Introduction

Access to and through the forest is facilitated year-round, and in several ways. Visitors select their access based on their preferred setting, experience, and mode of transportation. Roads, motorized trails, nonmotorized trails, rivers, and airstrips penetrate the forest for visitors to walk, bike, boat, ride, drive, or fly to their destinations.

As described in the Recommended Wilderness Area section, the 2021 Land Management Plan and associated decision would establish the suitability for various types of recreation access in RWAs. Identification of RWAs only establishes suitability of motorized and mechanized means of transportation within them. A site-specific analysis and decision would be required to alter the number of roads, motorized trails, motorized groomed trails, and motorized over-snow areas available for motorized and mechanized means of transportation.

Additionally, in alternatives C and F, changes to the ROS settings within the Elkhorns GA have potential to affect the suitability of motorized and mechanized recreation opportunities within the Elkhorns core area. A site-specific analysis and decision would be required to alter the motorized and mechanized means of transportation recreation opportunities within this area.

This appendix provides a supplemental analysis of the direct effects to recreation access that would result from implementation of the suitability plan components for motorized and mechanized means of transportation within RWAs, changes to winter ROS, and suitability restrictions on certain landscapes. The direct effects described in this section would not occur as a result of the 2021 Land Management Plan or ROD; rather, they may occur as a result of subsequent decisions and/or closure orders that would be made to meet the suitability requirements in the 2021 Land Management Plan.

Issues

A number of issues regarding recreation access were raised during the scoping period for the proposed action and the comment period for the DEIS. The issues that drove alternatives for site-specific changes to recreation access were:

- The specific roads, trails, and areas that may be closed to motorized recreation uses and mechanized means of transportation within RWA's on the Forest.
- The specific trails that may be closed to mechanized means of transportation within the core area of the Elkhorns.
- The motorized over-snow area that may be closed to motorized uses within the Elkhorns GA.

Measurement Indicators

Potential direct effects that may occur in the future as a result of decisions designed to meet the suitability requirements of the 2021 Land Management Plan would be measured by the following indicators:

- Miles of open road
- Miles of motorized trail
- Miles of trail open to mechanized means of transportation
- Miles of groomed over-snow trail
- Miles of ungroomed over-snow trail
- Acres open to motorized over-snow uses
- Specific numbers and names of roads, trails, and areas closed to types of recreation access

Analysis area

The geographic scope of the analysis is the lands administered by the HLC NF. All lands within the forest boundary form the geographic scope for cumulative effects. The temporal scope is the life of the plan (approximately 15 years).

Changes between draft and final

A number of changes to recreation access were made for the FEIS; however, all changes are within the scope of the DEIS analysis:

- Analysis for Alternative F was added to the FEIS.
- Potential future direct effects of the suitability plan components were moved from the primary analysis in the FEIS and placed in this appendix.

Assumptions

Since adoption of the 1986 plans, recreation activities in the planning area have changed. This analysis assumes that changes to recreational use patterns would occur naturally as a result of factors associated with recreation trends, advances in technology, aging population, aging infrastructure, and climate changes.

Regulatory framework

Please see the regulatory framework for Recreation Settings.

Best available scientific information used

Please refer to the BASI description under the recreation settings section. All road and trail miles are derived from the Infrastructure database and are approximate.

Affected Environment

Recreation access to and through the HLC NF is facilitated year-round most commonly by roads, trails, waterways, and airstrips. Forest access, through roads and trails, links local communities with forest settings and facilitates backyard recreation opportunities. In some cases, travel routes are recognized by unique designations, such as the Kings Hill scenic byway, the Continental Divide National Scenic Trail, and the Lewis and Clark National Historic Trail.

Most often, main access to the National Forest is provided via public roads and rights-of-way and through easements with private land holders. Once on forest, direction for recreation access is provided through travel management plans. Roads, motorized trails, nonmotorized trails, rivers, and airstrips provide access for visitors to walk, bike, ride, drive, boat, or fly to their destinations.

Recreation through roads and airstrips generally occurs in motorized ROS settings. Trails occur across all ROS settings, depending upon the mode of transport used for the trail use and whether an area is designated for motorized or nonmotorized uses.

The direct effects described in this appendix would occur in most GAs as a function of the suitability within RWAs as well as various approaches to the management of recreation in the Elkhorns GA.

Travel plan direction

Travel plan direction has been established for all areas of the HLC NF. These travel plans provide direction to users as to which parts of the NF can be accessed for motorized recreation activities. Table 1 lists the name of the travel plans that provide direction for the HLC NF.

Table 1. Travel plans by GA

GA	Name of travel plan	Decision signed (ROD or DN)
Big Belts	North Belts	2005
	South Belts Summer	2007
	South Belts Winter	1999
Castles	Little Belts, Castles, and Crazies*	2007
Crazies	Little Belts, Castles, and Crazies*	2007
Divide	Divide Travel Plan	2016
	Soundwood Salvage	1998
	Clancy Unionville	2003
Elkhorns	Elkhorns Travel Plan	1995
	North Elkhorns	2014
Highwoods	Highwoods Access	1993
Little Belts	Little Belts, Castles, and Crazies*	2007
Rocky Mountain Range	Badger Two Medicine	2009
	Birch Creek South	2007
Snowies	Big Snowies Access and Travel Management*	2002
	Little Snowies Vegetative Management and Public Access	1993
Upper Blackfoot	Blackfoot Winter Travel Plan	2013
	Blackfoot Non-Winter Travel Plan	2018

*Decisions that underwent additional resolution or court review.

Roads

Roads are the primary routes that recreationists use to access the HLC NF. Roads often provide direct access to recreational facilities. Forest travel plans dictate which roads are open and for how long. Table 2 displays the current miles of road by GA and type of road access on the HLC NF.

Table 2. Miles of road by GA and by type of road access

GA	Miles of road open year-round	Miles of road open seasonally	Miles of road closed year-round	Total miles of road
Big Belts	187	198	329	714
Castles	53	9	47	109
Crazies	30	2	90	122
Divide	180	7	309	496

GA	Miles of road open year-round	Miles of road open seasonally	Miles of road closed year-round	Total miles of road
Elkhorns	62	105	132	299
Highwoods	18	0	0	18
Little Belts	424	347	1,014	1,785
Rocky Mountain Range	96	21	27	144
Snowies	42	7	68	117
Upper Blackfoot	204	82	426	712
Totals	**1,296**	**778**	**2,442**	**4,516**

Trails

Table 3 displays the miles of trails broken out by GA within the planning area. Trails are further identified by motorized trails, nonmotorized trails outside of wilderness, and wilderness trails.

Table 3. Miles and types of trail by GA

GA	Miles of motorized trail	Miles of nonmotorized trails outside of wilderness	Miles of wilderness trail	Total miles trail
Big Belts	61	101	37	199
Castles	89	12	0	101
Crazies	32	46	0	78
Divide	60	110	0	170
Elkhorns	6	110	0	116
Highwoods	28	10	0	38
Little Belt Mountains	486	210	0	696
Rocky Mountain Range	50	376	553	979
Snowies	14.1	106	0	120.1
Upper Blackfoot	24	109	96	229
Totals	**850.1**	**1,190**	**686**	**2,726.1**

Motorized over-snow trails and motorized over-snow areas

The motorized over-snow trails on the HLC NF include both groomed and ungroomed trails and are often only a small portion of a larger network of over-snow trails that extend onto state, county, and private roads and lands. The groomed trails are often maintained by local snowmobile clubs. Table 4 shows the number of miles of groomed and ungroomed trails on the HLC NF.

Table 4. Miles of motorized over-snow trail by GA

GA	Miles of groomed trail	Miles of ungroomed trail	Total for GA
Big Belts	73	15	88
Castles	0	38	38
Crazies	0	20	20
Divide	100	25	125
Elkhorns	0	0	0
Highwoods	0	36	36
Little Belt Mountains	292	168	460

GA	Miles of groomed trail	Miles of ungroomed trail	Total for GA
Rocky Mountain Range	0	55	55
Snowies	0	54	54
Upper Blackfoot	85	58	143
Totals	**550**	**469**	**1,019**

In addition, the Forest has approximately 854,704 acres open for over-snow motorized use during the winter season. Over-snow motorized use is very popular on the Forest. See Table 5.

Table 5. Acres open to motorized over-snow use by GA

GA	Acres open to motorized over-snow recreation use
Big Belts	80,026
Castles	55,105
Crazies	21,278
Divide	114,263
Elkhorns	25,349
Highwoods	0
Little Belt Mountains	368,755
Rocky Mountain Range	27,653
Snowies	34,543
Upper Blackfoot	127,732
Total	**854,704**

Aviation recreation

Another recreation activity that receives considerable attention within the HLC NF planning area and is growing in popularity is aviation recreation. Owners of small aircraft use backcountry air strips to access dispersed campgrounds or dispersed recreation areas. Table 6 displays these air strips and the GAs in which they are located.

Table 6. Airstrips and the GAs where they are located

GA	Name of air strip	Location
Little Belt Mountains	Russian Flats Backcountry Airstrip	T11N R11E Sections 7, 12, and 13
Rocky Mountain Range	Benchmark Backcountry Airstrip	T20N R10W Sections 15, 16, and 22
Upper Blackfoot	Lincoln Community Airport	T14N R08W Sections 19 and 20

Environmental consequences

Effects Common to All Alternatives

In all alternatives, natural disturbances, recreation use patterns, and emerging technologies would continue to influence recreation access across the HLC NF. Travel plans would continue to provide site-specific direction for where motorized and nonmotorized uses can take place. The three current airstrips would remain available under all alternatives.

Effects Common to All Action Alternatives

Desired ROS settings would provide a variety of recreation access opportunities across the HLC NF and travel plans would provide site-specific determinations on where motorized uses may and may not occur. Potential changes to existing travel plans or associated miles of open roads, motorized trails, nonmotorized trails open to mechanized means of transportation, motorized over-snow trails, acres open to motorized over-snow uses, or airstrips may be necessary to meet the suitability direction in the 2021 Land Management Plan.

Effects from forest plan components associated with other resources

Please see the Recreation Access section of the FEIS (Section 3.19.6).

Alternative A – no action

No direct effects. No changes to existing travel plans would be made.

Alternative B

Alternative B identifies nine (9) RWAs on the HLC NF. Motorized and mechanized means of transportation would not be suitable within RWAs in this alternative. In alternative B, changes to the existing travel plans within RWA’s would be necessary to meet the intent of the suitability plan components within this alternative.

Approximately 13 miles of open road may be closed in a future decision based on the suitability requirements for RWAs in Alternative B. These miles of open road are in the Snowies and Upper Blackfoot GAs. Table 7 displays the miles of road by GA and the type of road access that would remain available in Alternative B.

Table 7. Miles of road by GA by type of road access (alternative B)

GA	Miles of road open year-round	Miles of road open seasonally	Miles of road closed year-round	Total miles of road
Big Belts	187	198	328	713
Castles	53	9	47	109
Crazies	30	2	90	122
Divide	181	7	308	496
Elkhorns	62	105	132	299
Highwoods	18	0	0	18
Little Belts	424	347	1,014	1,785
Rocky Mountain Range	96	21	27	144
Snowies	30	7	81	118
Upper Blackfoot	202	82	428	712
Totals	**1,283**	**778**	**2,455**	**4,516**

The total miles of trail on the HLC NF would remain the same in alternative B. However, motorized and mechanized means of transportation (including bicycles) would not be suitable within RWAs. Recreation access on approximately 0.1 mile of motorized trail may be closed in alternative B. This short segment of motorized trail would be converted to a nonmotorized trail and all nonmotorized recreation uses would be suitable on it except mechanized means of transportation. This trail segment is in the Snowies GA and within the Snowies RWA.

Additionally, in alternative B, approximately 204 miles of nonmotorized trails may be closed to mechanized means of transportation, including bicycles. These trails are located within RWAs within the Big Belts, Divide, Little Belts, Snowies, and Upper Blackfoot GAs. Table 8 displays the miles of trails broken out by GA within the planning area. Trails are further identified by motorized, nonmotorized/nonwilderness, and wilderness trails.

Table 8. Miles of trail by GA and type of trail (alternative B)

GA	Miles of motorized trail	Miles of nonmotorized trails outside of wilderness	Miles of wilderness trail	Total miles of trail
Big Belts	61	101	37	199
Castles	89	12	0	101
Crazies	32	46	0	78
Divide	60	110	0	170
Elkhorns	6	110	0	116
Highwoods	28	10	0	38
Little Belts	486	210	0	696
Rocky Mountain Range	50	376	553	979
Snowies	14	106.1	0	120.1
Upper Blackfoot	24	109	96	229
Totals	**850**	**1,190.1**	**686**	**2,726.1**

There are approximately 2 miles of motorized ungroomed over-snow trail within the Big Snowies RWA that may be closed in a future decision to meet the suitability requirements in Alternative B. Table 9 displays the miles of motorized over-snow trail by GA that would remain open in alternative B.

Table 9. Miles of motorized over-snow trail by GA (alternative B)

GA	Miles of groomed trail	Miles of ungroomed trail	Total for GA
Big Belts	73	15	88
Castles	0	38	38
Crazies	0	20	20
Divide	100	25	125
Elkhorns	0	0	0
Highwoods	0	36	36
Little Belt Mountains	292	168	460
Rocky Mountain Range	0	55	55
Snowies	0	52	52
Upper Blackfoot	85	58	143
Totals	**550**	**467**	**1,017**

There are a number of motorized over-snow areas within identified RWAs in alternative B. Motorized uses in RWAs would not be suitable in alternative B. Therefore, motorized over-snow areas would be reduced by approximately 24,403 acres (8,857 acres in Divide GA, 13,148 acres in Big Snowies GA, and 2,398 acres in Upper Blackfoot GA). Table 10 displays the total acres of motorized over-snow areas that would remain open in alternative B.

Table 10. Acres of motorized over-snow use by GA (alternative B)

GA	Acres open to motorized over-snow recreation use
Big Belts	80,026
Castles	55,105
Crazies	21,278
Divide	105,406
Elkhorns	25,349
Highwoods	0
Little Belt Mountains	368,755
Rocky Mountain Range	27,653
Snowies	21,395
Upper Blackfoot	125,333
Total	**830,300**

Big Log RWA

Big Log RWA is adjacent to the Gates of the Mountain Wilderness Area in the Big Belts GA. The majority of the Big Log RWA lies along the southern boundary of the Gates of the Mountains. However, there are also several small isolated parcels on the northern boundary of the wilderness that are included in the RWA. The majority of the Big Log RWA was identified in the 1986 Helena NF Plan as a RWA. There are currently no existing motorized recreation uses or open roads within the Big Log RWA. However, approximately 4.3 miles of nonmotorized trail would be closed to mechanized means of transportation. Specific trail numbers, names, and mileages are identified below. See Table 11.

Table 11. Nonmotorized trails that would be closed to mechanized means of transportation in the Big Log RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
252	Big Log Gulch	2.1
255	Hunters Gulch	1.0
259	Refrigerator Canyon	1.2
Total		4.3

Mount Baldy RWA

Mount Baldy RWA is in the Big Belts GA. This RWA consists of high elevation ecosystems dotted with several alpine lakes and unique granite rock formations (the Needles). The Mount Baldy RWA was identified as one of the three RWAs in the 1986 Helena Forest Plan. There are currently no motorized recreation uses or open roads within the Mount Baldy RWA. However, there are approximately 14.4 miles of nonmotorized trail that would be closed to mechanized means of transportation (including bicycles) within this RWA. See Table 12.

Table 12. Nonmotorized trails that would be closed to mechanized means of transportation in Mount Baldy RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
149	Needles	2.2
150	Gipsy/Birch Creek	5.7

Trail number	Trail name	Miles
151	Hidden Lake	3.4
152	Edith Lake	2.1
155	Grace Lake	1.0
Total		14.4

Electric Peak RWA

The Electric Peak RWA (named Blackfoot Meadows RWA in the DEIS) is located within the Divide GA. Electric Peak RWA lies along the Continental Divide National Scenic Trail and includes several mountain peaks that are well over 8000 feet in elevation. Portions of this RWA are also identified as a RWA in the current 1986 Helena Forest Plan. However, the Electric Peak RWA in alternative B is not the exact same acreage or configuration as identified in the 1986 Helena Forest Plan.

There are no motorized trails or open roads within the Electric Peak RWA. Approximately 16.6 miles of nonmotorized trail would be closed to mechanized means of transportation (including bicycles) within the Electric Peak RWA. See Table 13. Additionally, an estimated 11.1 acres of motorized over-snow area would also be closed in this alternative.

Table 13. Nonmotorized trails that would be closed to mechanized means of transportation in Electric Peak RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
326	Kading	<0.1
328	Bison-Blackfoot	1.6
329	Blackfoot Meadows	6.9
330	Bison MT	1.0
337	Continental Divide	1.3
359	Larabee Gulch	2.8
362	Monarch Creek	3.0
Total		16.6

Deep Creek RWA

Deep Creek RWA is in the northwestern corner of the Little Belt Mountains GA. This area is bordered by the Smith River on the west, private lands to the north and south, and by motorized national recreation trails to the south and east. The primary access to this area is from the Smith River, private lands, and from the motorized national recreation trails. There are currently no motorized recreation uses or open roads within the Deep Creek RWA in alternative B. However, there are 12.8 miles of nonmotorized trail that would be closed to mechanized means of transportation within this RWA. See Table 14.

Table 14. Nonmotorized trails that would be closed to mechanized means of transportation in Deep Creek RWA to meet the suitability requirements in alternative B

Trail number	Trail name	Miles
303	North Fork Deep Creek	2.3
308	Temple Gulch	4.5
309	Parker Ridge	4.4
311	Smith River	1.6

Trail number	Trail name	Miles
Total		12.8

Big Snowies RWA

The Big Snowies RWA is in the Big Snowies GA south of Lewistown, Montana. The primary ridgeline of this island mountain formation is oriented east-west and is 25 miles long and 10 miles wide. The area is dominated by limestone geology and karst topography which conceals many caves including an ice cave on West Peak. The RWA is also characterized at its highest elevations by a treeless plateau of alpine with rock and tundra.

The Big Snowies RWA is popular with mountain bike users in the summer and snowmobile users in the winter months. There are 11.8 miles of open road and 0.1 mile of motorized trail within the Big Snowies that would be closed to motorized use and mechanized means of transportation to meet the suitability requirements of alternative B. There are approximately 96.1 miles of nonmotorized trail that would be closed to mechanized means of transportation. See Table 15, Table 16, and Table 17.Additionally, an estimated 13,148 acres of motorized over-snow uses would be closed to motorized use and mechanized means of transportation in this alternative.

Table 15. Roads that would be closed to motorized and mechanized means of transportation in Big Snowies RWA to meet the suitability requirements of alternative B

Road number	Road name	Miles
270	Timber Creek	0.1
656	656	1.8
8954	Snowy Ridge	1.3
15862	Webbers Road	0.1
15869	Careless Canyon	0.1
15852	Dry Coulee Loop	0.7
8950	Dry Coulee Permit Road	1.4
8955	Rogers Guard Station – Permit Road	0.6
210001	Permit Road	2.2
410001	Permit Road	1.9
8954001	Permit Road	0.5
8954002	Permit Road	0.1
8954004	Permit Road	1.0
Total		11.8

Table 16. Motorized trail that would be closed to motorized and mechanized means of transportation in Big Snowies RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
652	Southside	0.1

Table 17. Nonmotorized trails that would be closed to mechanized means of transportation in Big Snowies RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
403	Grandview	4.1
403-A	Grandview Point	<0.1
405	V.J. Springs	0.1
406	Jump Off Peak	5.3
410	E FK Big Spring Creek	9.3
421	Green Pole Ski	0.2
445	Crystal Cascades	2.7
445-A	Crystal Cascades Connector	1.7
481	Dry Pole Creek	4.8
483	Logan Ridge	2.3
489	East Fork Cottonwood Creek	8.5
490	West Peak	7.1
490-A	West Peak Alt Spur	0.8
491	Promontory Point	0.4
492	Hidden Basin Wildflower	<0.1
493	Ulhorn	18.4
494	Maynard Ridge	4.8
627	Swimming Woman	2.2
627-A	Swimming Woman Alt	2.2
650	Big Snowy Trail	6.6
654	Neil Creek	1.9
655	Blake Creek Summit	1.5
670	Timber Creek	3.6
671	Bad Canyon	2.7
Total		96.1

Silver King RWA

The Silver King RWA (named Dearborn Silver King in the DEIS) is in the Upper Blackfoot GA north and east of Lincoln, Montana. This RWA lies adjacent to the Scapegoat Wilderness Area in the upper reaches of the Alice Creek and Landers Fork drainages.

There are 0.6 miles of road within the Silver King RWA that would be closed to motorized use and mechanized means of transportation to meet the suitability requirements of alternative B. See Table 18. There are also 21.1 miles of nonmotorized trail that would be closed to mechanized means of transportation (including bicycles). See Table 19. Additionally, approximately 17.2 acres of motorized over-snow areas would be closed to motorized winter uses and mechanized means of transportation (including bicycles). There are no motorized trails in the Silver King RWA.

Table 18. Open roads that would be closed to motorized and mechanized means of transportation in the Silver King RWA to meet the suitability requirements of alternative B

Road number	Road name	Miles
PVT-1077	PVT-GRIZ1077	0.60
PVT-1078	PVT-GRIZ1078	<0.1
Total		0.6

Table 19. Nonmotorized trails that would be closed to mechanized means of transportation in the Silver King RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
219	East Fork Falls Creek	0.2
420	Silver King Trail	2.9
438	Landers Fork Trail	3.8
440	Continental Divide Trail	6.0
477	Lone Mountain Trail	2.3
481	Mainline Trail	1.2
490	Alice Creek	4.7
Total		21.1

Red Mountain RWA

The Red Mountain RWA is located south and east of Red Mountain Peak in Red Creek, within the Copper Creek drainage. This small RWA borders the Scapegoat Wilderness Area and is also a research natural area. There are no motorized uses or open roads within this RWA. However, there is one very short segment (<0.1 miles) of nonmotorized trail that would be closed to mechanized means of transportation (including bicycles) and is described in Table 20.

Table 20. Nonmotorized trails that would be closed to mechanized means of transportation in Red Mountain RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
423	Red Mountain Trail	<0.1

Arrastra Creek RWA

The Arrastra Creek RWA is located in the Upper Blackfoot GA north and west of Lincoln, Montana. This RWA lies adjacent to the Scapegoat Wilderness Area in the upper reaches of the Beaver Creek and Dry Creek drainages and includes Arrastra Mountain.

There are no open roads or motorized trails within the Arrastra Creek RWA. However, there are 8.7 miles of nonmotorized trail that would be closed to mechanized means of transportation. See Table 21. Additionally, approximately 2,240 acres of motorized over-snow areas would be closed to motorized winter uses and mechanized means of transportation.

Table 21. Nonmotorized trails that would be closed to mechanized means of transportation in Arrastra Creek RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
482	Arrastra Creek Trail	4.2
483	Dry Creek Trail	1.5
488	Porcupine Basin	3.0
Total		8.7

Nevada Mountain RWA

Nevada Mountain RWA is located south and west of Lincoln, Montana in the Upper Blackfoot GA. This large area includes Nevada Mountain, Black Mountain, and the head end of many drainages such as Nevada Creek and Washington Creek, as well as several smaller drainages that flow into Poorman Creek. Portions of the Continental Divide National Scenic Trail also cross through this RWA.

There are 1.1 miles of open road within the Nevada Mountain RWA. There are no motorized trails. See Table 22. There are 29.8 miles of nonmotorized trail that would be closed to mechanized means of transportation. See Table 23. Additionally, approximately 8,977 acres of motorized over-snow areas would be closed to motorized winter uses and mechanized means of transportation (including bicycles).

Table 22. Open roads that would be closed to motorized use and mechanized means of transportation in the Nevada Mountain RWA to meet the suitability requirements of alternative B

Road number	Road name	Miles
296-A2	Huckleberry Creek	1.1
Total		1.1

Table 23. Nonmotorized trails that would be closed to mechanized means of transportation in the Nevada Mountain RWA to meet the suitability requirements of alternative B

Trail number	Trail name	Miles
337	Continental Divide Trail	4.2
405	Washington Gulch Trail	2.1
440	Continental Divide Trail	6.9
466	Nevada Creek Trail	4.3
467	Gould/Helmville Trail	7.2
487	Prickly/Nevada Trail	5.1
Total		29.8

Alternative C

Alternative C was developed to address several comments received during public scoping of the proposed action. Specifically, the mountain bike community was concerned about potential loss of access to areas identified as RWA's, especially in the Elkhorns and Snowies GAs. To address these concerns, alternative C identifies the same nine (9) RWAs as alternative B, but motorized and mechanized means of transportation would be suitable within alternative C, so long as these uses do not affect the wilderness characteristics within the RWAs. Therefore, there would be no road, trail, or over-snow acres closed within RWAs in alternative C and the miles of open roads, motorized trails, and motorized over-snow areas in the RWAs would remain the same as those in alternative A, the no action.

Elkhorns Winter Recreation Area

A change to ROS settings in the core area of the Elkhorns (see the Recreation Settings section) would affect the recreation access within the Elkhorns GA in alternative C. Currently, in the winter, the Elkhorns are open to motorized over-snow uses within a semi-primitive motorized ROS setting. In alternative C, the semi-primitive motorized setting would be changed to a semi-primitive nonmotorized setting, and over-snow motorized recreation uses would no longer be suitable. This change in winter ROS would reduce the amount of available motorized over-snow acres in the current Elkhorns winter recreation area by approximately, 18,752 acres. Table 24 displays the total acres of motorized over-snow areas that would remain open in alternative C, to meet the suitability requirements of this alternative.

Table 24. Acres of motorized over-snow use by GA (alternative C)

GA	Acres open to motorized over-snow recreation use
Big Belts	80,026
Castles	55,105
Crazies	21,278
Divide	114,263
Elkhorns	0
Highwoods	0
Little Belt Mountains	368,755
Rocky Mountain Range	27,653
Snowies	34,543
Upper Blackfoot	127,732
Total	**829,355**

Mechanized uses with a core area of the Elkhorns

Public comments led the HLC NF to consider an alternative that would close the core area of the Elkhorns GA to mechanized means of transportation, including bicycles, for the protection of wildlife habitat. In alternative C, approximately 62.14 miles of nonmotorized trails would be closed to mechanized means of transportation to meet the suitability requirements of this alternative. These trails would remain on the landscape and open to other nonmotorized uses and would only exclude mechanized means of transportation. Table 25 lists the specific trails that would be closed to this use in the core area of the Elkhorns GA.

Table 25. Nonmotorized trails that would be closed to mechanized means of transportation in the core of the Elkhorns GA to meet the suitability requirements alternative C

Trail number	Trail name	Miles
101	Eagle Interpretive	0.10
109	Crow Creek	4.54
110	Poe Park	2.26
112	Longfellow Clear Creek	8.71
113	Elk Park	4.35

Trail number	Trail name	Miles
114	Moose Creek	3.09
115	Beaver Creek	7.31
116	Sheep Park	1.83
117	Pole Creek	0.50
127	South Crow Lakes	1.30
129	Manley Park	0.80
130	Little Tizer Creek	1.66
131	Leslie Lake	1.77
133	Crazy Creek Longfellow	2.96
134	Falls Creek	1.85
135	Long Park	3.97
301	Montgomery Park	4.03
302	McClellan Creek	5.19
343	Casey Meadows	3.99
344	Jackson Creek	0.75
347	Willard Creek	0.09
374	Casey Peak	1.09
TOTAL		62.14

Alternative D

Alternative D responds to comments received during public scoping asking the Forest to consider an alternative that increases the number and acreage of RWAs and primitive recreation opportunities on the Forest. To address these concerns, additional RWAs and several primitive, undeveloped areas are identified in alternative D. Motorized and mechanized means of transportation (including bicycles) would not be suitable within RWAs in alternative D. Identifying additional RWAs would create a need for reductions in motorized and mechanized means of transportation to meet the suitability requirements in the 2021 Land Management Plan, in alternative D.

Alternative D also identifies additional primitive, undeveloped areas outside of RWAs. Motorized uses would not be suitable in these primitive undeveloped areas. However, mechanized means of transportation (including bicycles) would be suitable within them.

Approximately 34 miles of open road within RWAs would be closed in alternative D. Road closures would occur within RWAs in the Big Belts, Castles, Divide, Little Belt Mountains, Big Snowies, and Upper Blackfoot GAs. Table 26 displays the miles of road by GA and the type of road access that would be available in alternative D.

Table 26. Miles of road by GA by type of road access (alternative D)

GA	Miles of road open year-round	Miles of road open seasonally	Miles of road closed year-round	Total miles of road
Big Belts	187	197	329	713
Castles	47	9	53	109
Crazies	30	2	90	122

GA	Miles of road open year-round	Miles of road open seasonally	Miles of road closed year-round	Total miles of road
Divide	179	7	310	496
Elkhorns	62	105	132	299
Highwoods	18	0	0	18
Little Belts	413	346	1,026	1,785
Rocky Mountain Range	96	21	27	144
Snowies	30	7	81	118
Upper Blackfoot	202	82	428	712
Totals	**1,264**	**776**	**2,476**	**4,516**

[1.] Miles of road outside of GA boundaries that the FS manages on private or other public lands.

Approximately 60 miles of motorized trail would be closed to motorized uses within RWAs in the Castles, Divide, Little Belt Mountains, and Big Snowies GAs to meet the suitability requirements of this alternative. These motorized trails would be converted to nonmotorized trails and all nonmotorized recreation uses would be suitable except mechanized means of transportation.

An additional 328 miles of nonmotorized trails would be closed to mechanized means of transportation within RWAs in alternative D. These trails are located within the Big Belts, Castles, Crazies, Divide, Little Belt Mountains, Snowies, and Upper Blackfoot GAs.

Table 27 displays the miles of trails broken out by GA within the planning area. Trails are further identified by motorized, nonmotorized/nonwilderness and wilderness trails.

Table 27. Miles of trail by GA and type of trail (alternative D)

GA	Miles of motorized trail	Miles of nonmotorized trails outside of wilderness	Miles of wilderness trail	Total miles of trail
Big Belts	61	101	37	199
Castles	57	44	0	101
Crazies	32	46	0	78
Divide	54	116	0	170
Elkhorns	6	110	0	116
Highwoods	28	10	0	38
Little Belt Mountains	464	232	0	696
Rocky Mountain Range	50	376	553	979
Snowies	14	106.1	0	120.1
Upper Blackfoot	24	109	96	229
Totals	**790**	**1,250.1**	**686**	**2,726.1**

Motorized over-snow trails would not be suitable with RWAs in alternative D. Therefore, approximately 9 miles of motorized over-snow trail (both groomed and ungroomed) would be closed to meet the suitability requirements of this alternative. These motorized over-snow trails are located within the Big Belt (Electric Peak RWA), Little Belt (Big Horn Thunder and Tenderfoot Creek RWAs), and Big Snowies (Big Snowies RWA) GAs. Table 28 displays the miles of motorized over-snow trail that would remain available by GA in alternative D.

Table 28. Miles of motorized over-snow trail by GA (alternative D)

GA	Miles of groomed trail	Miles of ungroomed trail	Total for GA
Big Belts	73	15	88
Castles	0	38	38
Crazies	0	20	20
Divide	98	25	123
Elkhorns	0	0	0
Highwoods	0	36	36
Little Belt Mountains	292	163	455
Rocky Mountain Range	0	55	55
Snowies	0	52	52
Upper Blackfoot	85	58	143
Totals	**548**	**462**	**1,010**

Several motorized over-snow areas are also located within identified RWAs in alternative D. Motorized over-snow recreation use within RWAs would not be suitable in alternative D. Therefore, in alternative D the amount of motorized over-snow acres would be reduced by approximately 79,192 acres (4 acres in the Big Belts GA, 26,331 in Castles GA, 4,745 acres in Crazies GA, 19,388 acres Divide GA, 13,178 in the Little Belts GA, 13,148 acres in Big Snowies GA, and 2,398 acres in Upper Blackfoot GA). Table 29 displays the total acres of motorized over-snow areas that would remain open in alternative D.

Table 29. Acres of motorized over-snow use by GA (alternative D)

GA	Acres open to motorized over-snow recreation use
Big Belts	80,022
Castles	28,773
Crazies	16,533
Divide	94,875
Elkhorns	25,349
Highwoods	0
Little Belt Mountains	355,577
Rocky Mountain Range	27,653
Snowies	21,395
Upper Blackfoot	125,333
Total	**775,510**

Big Log; Mount Baldy; Deep Creek; Big Snowies; Silver King; Red Mountain; and Arrastra Creek RWAs

The potential direct effects to recreation access to meet the RWA suitability requirements in these RWAs would be the same as those described above in alternative B.

Camas Creek RWA

Camas Creek RWA is in the Big Belts GA. This RWA contains the high peaks of Boulder Mountain and Boulder Baldy. Additionally, it contains the Boulder Lakes and Camas Lakes areas.

There are currently 0.3 mile of open road and 3.8 acres of motorized over-snow areas within the Camas Creek RWA. This open road and these acres would be closed to motorized and mechanized means of transportation to meet the suitability requirements in alternative D. There are no motorized trails within the Camas Creek RWA, but there are approximately 16.1 miles of nonmotorized trail that would be closed to mechanized means of transportation. See Table 30 and Table 31.

Table 30. Open road that would be closed to motorized and mechanized means of transportation in Camas Creek RWA to meet the suitability requirements of alternative D

Road number	Road name	Miles
383	Camas	0.3

Table 31. Nonmotorized trails that would be closed to mechanized means of transportation in the Camas Creek RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
118	Belt Mountain Divide	6.4
140	Camas	2.3
140A	Camas Lake	0.9
141	Pickfoot	1.9
142	Boulder Lakes	4.5
143	Spruce Creek	0.1
Total		16.1

Wapiti Peak RWA

Wapiti Peak RWA is in the west side of the Castles GA. This RWA contains a series of high peaks including Beartrap Peak, Woodchuck Mountain, Wapiti Peak, Elk Peak, and Castle Mountain. The area is characterized by numerous castle-like outcrops of granite. Most of the higher elevations are covered by forest with large open grasslands dominating the lower elevations.

There are currently 6.2 miles of open road, 32.1 miles of motorized trail, and 26,332 acres of motorized over-snow area within the Wapiti Peak RWA. These areas would be closed to motorized and mechanized means of transportation to meet the suitability requirements in alternative D. Additionally, there are approximately 9.1 miles of nonmotorized trail that would be closed to mechanized means of transportation. See Table 32, Table 33, and Table 34.

Table 32. Open roads that would be closed to motorized and mechanized means of transportation in Wapiti Peak RWA to meet the suitability requirements of alternative D

Road number	Road name	Miles
8878	South Castle Lake	2.8
8880	South Castle Lake/Reynolds	0.6
15991	Cumberlin Divide	0.7
15993	Wapiti Burn	0.3
15995	Frontier Road	0.6
15998	Little Oly Can Road	1.2
Total		6.2

Table 33. Motorized trail that would be closed to motorized and mechanized means of transportation in the Wapiti Peak RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
618	Willow Creek/Warm Springs Creek	2.2
622	Castle Elk Connector	3.2
624	Alabough-Castle Lake	1.3
713	Fourmile Creek	0.4
713-A	Fourmile Connector	1.3
716	Grasshopper	2.1
717	Wapiti Peak	6.8
718	Elk Peak	5.4
719	Manger Park	4.7
723	Horse Park	2.5
725	Woodchuck	2.2
Total		32.1

Table 34. Nonmotorized trails that would be closed to mechanized means of transportation in the Wapiti Peak RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
617	Loweth	0.7
618	Willow Creek/Warm Springs Creek	4.4
713	Fourmile Creek	1.3
716	Grasshopper	2.7
Total		9.1

Loco Mountain RWA

Loco Mountain RWA is in the east side of the Crazies GA. This RWA lies at the north end of the Crazy Mountain range and shares a border with the Gallatin NF. The area contains several high, craggy peaks that are often covered in talus, scree, and boulder areas. Vegetation on the upper ridges is mostly alpine and lacks forest cover. Glaciation has imparted many of these landforms with sharp and scoured edges.

There are no open roads or motorized trails in the Loco Mountain RWA. Approximately 4,754 acres would be available for motorized over-snow areas. These motorized recreation uses would be unsuitable in alternative D. Additionally, there are approximately 22.9 miles of nonmotorized trail that would be closed to mechanized means of transportation within this RWA to meet the suitability requirements of alternative D. See Table 35.

Table 35. Nonmotorized trails that would be closed to mechanized means of transportation in the Loco Mountain RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
630	Boundary	2.9
630-A	South Boundary	0.5

Trail number	Trail name	Miles
631	Little Elk	0.6
632	Loco Creek	1.7
633	Loco Creek/Castle Creek Connector	0.8
634	Groveland	0.4
636	Crow Creek	6.8
640	Shields Big Elk	4.8
641	Castle Creek	4.4
641-A	Old 634 Off Castle	0.0
Total		22.9

Electric Peak RWA

The size and configuration of the Electric Peak RWA in alternative D is different from the Electric Peak RWA identified in alternatives B and C. In alternative D, the RWA would be expanded north of the Little Blackfoot River and would extend along the Continental Divide National Scenic Trail east of Bison Mountain.

In alternative D there would be no open roads within the Electric Peak RWA but there would be approximately 2.4 miles of motorized trail closed to motorized and mechanized means of transportation to meet the suitability requirements of alternative D. Approximately 22.5 miles of nonmotorized trail would be closed to mechanized means of transportation. See Table 36 and Table 37. Additionally, an estimated 5,107 acres of motorized over-snow area would be closed to motorized and mechanized means of transportation.

Table 36. Motorized trails that would be closed to motorized and mechanized means of transportation in the Electric Peak RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
501	Limburger Spring	1.9
1870-T	Baldy Ridge	0.5
Total		2.4

Table 37. Nonmotorized trails that would be closed to mechanized means of transportation in the Electric Peak RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
326	Kading	1.6
328	Bison-Blackfoot	1.6
329	Blackfoot Meadows	7.7
330	Bison MT	0.9
337	Continental Divide	4.9
359	Larabee Gulch	2.8
362	Monarch Creek	3.0
Total		22.5

Colorado Mountain RWA

Colorado Mountain RWA is in the upper reaches of the Colorado Gulch drainage in the Divide GA, south and west of Helena, MT. This RWA also extends into the Tenmile watershed on its north and western edges. The busy, dispersed recreation area known as the South Hills makes up its eastern boundary. This RWA also contains the high mountain peaks of Black Mountain and Colorado Mountain as well as the Lazyman IRA.

There would be no open roads or motorized trails within this RWA. Approximately 1,241 acres of motorized over-snow area would also be closed to motorized and mechanized means of transportation to meet the suitability requirements in this alternative. Additionally, there is one nonmotorized trail (1.9 miles in length) that would be closed to mechanized means of transportation. See Table 38.

Table 38. Nonmotorized trails that would be closed to mechanized means of transportation in the Colorado Mountain RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
375	Tenmile Environmental	1.9

Tenderfoot Creek RWA

The Tenderfoot Creek RWA is located within the Tenderfoot Creek drainage in the Little Belt Mountains GA. This RWA extends from the Smith river drainage on the west to just west of Williams Mountain in the east. The southern border of the RWA follows Tenderfoot and South Fork Tenderfoot Creek and skirts larger parcels of private land on the southern border.

The Tenderfoot Creek RWA does not contain any open roads. However, there are approximately 5.9 miles of motorized trails and 5, 872 acres of motorized over-snow areas that would be closed to motorized and mechanized means of transportation to meet the suitability requirements of this alternative. Additionally, there are 29.8 miles of nonmotorized trails that would be closed to mechanized means of transportation. See Table 39 and Table 40.

Table 39. Motorized trail that would be closed to motorized and mechanized means of transportation in the Tenderfoot Creek RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
301	Old Baldy	0.1
343	Balsinger to Taylor	0.8
345	Bald Hills	5.0
Total		5.9

Table 40. Nonmotorized trails that would be closed to mechanized means of transportation in the Tenderfoot Creek RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
301	Old Baldy	4.9
310	Bear Gulch	2.8
317	Strawberry Ridge	4.2
331	Cow Coulee	1.5

Trail number	Trail name	Miles
342	Tenderfoot	12.2
345	Bald Hills	1.2
354	Double Gulch	3.0
Total		29.8

Bighorn Thunder RWA

The Bighorn Thunder RWA is located east of Logging Creek and north of the Divide Road in the Little Belt Mountains GA. This RWA contains the high mountain peaks of Big Horn Mountain and Thunder Mountain. Pilgrim Creek runs north-south and bisects the area.

This RWA contain approximately 5.9 miles of open road, 15.7 miles of motorized trail, and 2,309 acres of motorized over-snow recreation area. Motorized and mechanized means of transportation would not be suitable on these roads nor in areas within RWAs. Additionally, there are 16.0 miles of nonmotorized trails that would be closed to mechanized means of transportation in this RWA. See Table 41, Table 42, and Table 43.

Table 41. Open roads that would be closed to motorized and mechanized means of transportation in Big Horn Thunder RWA to meet the suitability requirements of alternative D

Road number	Road name	Miles
839-F	Lower Pilgrim Trailhead	0.1
3384	Big Timber Gulch - ATM	3.0
6384	Log Spur Wilson 9-Part	2.4
839067	839067	0.1
6384001	UND6384001	0.3
Total		5.9

Table 42. Motorized trail that would be closed to motorized and mechanized means of transportation in the Big Horn Thunder RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
304	Pilgrim Creek	9.3
305	Deer Creek	1.6
315	Tobins Gulch	4.8
Total		15.7

Table 43. Nonmotorized trails that would be closed to mechanized means of transportation in the Big Horn Thunder RWA to meet the suitability requirements in alternative D

Trail number	Trail name	Miles
304	Pilgrim Creek	2.5
318	Dry Gulch	2.6
322	Tillinghast Creek	4.8
336	Bighorn	6.1

Trail number	Trail name	Miles
Total		16.0

Middle Fork Judith RWA

The Middle Fork Judith RWA is in the Little Belt Mountains GA. This area includes the lower Lost Fork and Middle Fork of the Judith River with the major high points being Yogo Peak, Cabin Mountain, Grendah Mountain, Sandpoint Mountain, and Lost Fork Ridge. A large portion of this RWA is also designated as the Middle Fork Judith WSA. Only the northeastern portion of the WSA is not included in the RWA boundary.

There are 4.8 miles of open road and approximately 4,997 acres of motorized over-snow recreation uses within this RWA. These motorized miles and acres would be unsuitable for motorized and mechanized means of transportation in alternative D. There are no motorized trails within the Middle Fork Judith RWA. However, there are approximately 56 miles of nonmotorized trail that would be unsuitable for mechanized means of transportation. See Table 44 and Table 45.

Table 44. Open roads that would be closed to motorized and mechanized means of transportation in Middle Fork Judith RWA to meet the suitability requirements of alternative D

Road number	Road name	Miles
6534	Ettien Ridge NO 3	4.2
6538	Middle Fork Cabin #1	0.6
Total		4.8

Table 45. Nonmotorized trails that would be closed to mechanized means of transportation in the Middle Fork Judith RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
407	Doerr Creek	3.6
409	Lost Fork Judith River	12.2
422	West Fork Lost Fork	5.1
428	Prospect Ridge	5.3
429	King Creek	1.9
433	Burris-Ettien	2.3
434	Halzel Coulee	3.5
436	Sand Point Ridge	4.4
441	Cleveland Creek	7.0
442	Stiner Creek	3.7
444	Woodchopper Ridge	3.4
450	Yogo Creek	3.6
Total		56.0

Nevada Mountain RWA

The size and configuration of the Nevada Mountain RWA in alternative D is different than the Nevada Mountain RWA identified in alternatives B and C. In alternative D, the Nevada Mountain RWA would be expanded to include a greater portion of Deadman Creek.

There are approximately 1.3 miles open road and 3.4 miles of motorized trails that would be closed to motorized and mechanized means of transportation within this RWA in alternative D to meet the suitability requirements of this alternative. In alternative D, 30.7 miles of nonmotorized trail would be closed to mechanized means of transportation. See Table 46, Table 47, and Table 48. Additionally, an estimated 13,171 acres of motorized over-snow areas would be closed to motorized winter uses and mechanized means of transportation.

Table 46. Open roads that would be closed to motorized and mechanized means of transportation in Nevada Mountain RWA to meet the suitability requirements of alternative D

Road number	Road name	Miles
774	Cottonwood Gulch	1.0
774-B1	Cottonwood Gulch Spur B1	0.3
1845	Towsley Gulch	0.0
Total		1.3

Table 47. Motorized trail that would be closed to motorized and mechanized means of transportation in the Nevada Mountain RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
1811-T	Jerusha Gulch	3.4

Table 48. Nonmotorized trails that would be closed to mechanized means of transportation in the Nevada Mountain RWA to meet the suitability requirements of alternative D

Trail number	Trail name	Miles
337	Continental Divide Trail	5.1
405	Washington Gulch Trail	2.1
440	Continental Divide Trail	6.9
466	Nevada Creek Trail	4.3
467	Gould/Helmville Trail	7.2
487	Prickly/Nevada Trail	5.1
Total		30.7

Alternative E

There are no RWAs identified in alternative E. Therefore, there would be no closures, or changes to current travel plans resulting from this alternative.

Alternative F

Alternative F responds to comments regarding mechanized means of transportation (including bicycles) and concerns about ROS settings received during of the comment period on the DEIS. This alternative identifies seven (7) RWAs, which is fewer than the number identified in the proposed action. Similar to alternatives B and D, motorized and mechanized means of transportation (including bicycles) would be unsuitable within RWAs in alternative F. Identifying RWAs would create a need for reductions in access of motorized and mechanized means of transportation to meet the suitability requirements in the 2021 Land Management Plan, in alternative F.

Alternative F also identifies several additional primitive, undeveloped areas outside of RWA boundaries that would be managed for a primitive ROS setting. Motorized uses would not be suitable in these primitive undeveloped areas. However, mechanized means of transportation (including bicycles) would be suitable within them.

Approximately 8 miles of open road would be closed within RWAs in alternative F. Road closures would occur in the Big Snowies and Upper Blackfoot GAs. Table 49 displays the miles of road by GA and the type of road access that would be available to meet the suitability requirements in alternative F.

Table 49. Miles of road by GA by type of road access (alternative F)

GA	Miles of road open year-round	Miles of road open seasonally	Miles of road closed year-round	Total miles of road
Big Belts	187	198	328	713
Castles	53	9	47	109
Crazies	30	2	90	122
Divide	181	7	309	497
Elkhorns	62	105	132	299
Highwoods	18	0	0	18
Little Belts	424	347	1,014	1,785
Rocky Mountain Range	96	21	27	144
Snowies	35	7	75	117
Upper Blackfoot	202	82	428	712
Totals	**1,288**	**778**	**2,450**	**4,516**

Approximately 0.2 miles of motorized trail would be closed to motorized uses within RWAs in the Big Snowies and Upper Blackfoot GAs. These motorized trails would be converted to nonmotorized trails and all nonmotorized recreation uses would be suitable except mechanized means of transportation. An additional 135 miles of nonmotorized trails would be closed to mechanized means of transportation within RWAs in alternative F. These trails are located within the Big Belts, Divide, Snowies and Upper Blackfoot GAs. Table 50 displays the miles of trails broken out by GA within the planning area. Trails are further identified by motorized, nonmotorized/nonwilderness and wilderness trails.

Table 50. Miles of trail by GA and type of trail (alternative F)

GA	Miles of motorized trail	Miles of nonmotorized trails outside of wilderness	Miles of wilderness trail	Total miles of trail
Big Belts	61	101	37	199
Castles	89	12	0	101
Crazies	32	46	0	78
Divide	60	110	0	170
Elkhorns	6	110	0	116
Highwoods	28	10	0	38
Little Belts	486	210	0	696

GA	Miles of motorized trail	Miles of nonmotorized trails outside of wilderness	Miles of wilderness trail	Total miles of trail
Rocky Mountain Range	50	376	553	979
Snowies	14	106.1	0	120.1
Upper Blackfoot	24	109.1	96	229.1
Totals	**850**	**1,190.2**	**686**	**2,726.2**

There are approximately 2 miles of ungroomed motorized over-snow trail in the Big Snowies RWA in alternative F. Table 51 displays the miles of motorized over-snow trail available by GA in alternative F.

Table 51. Miles of motorized over-snow trail by GA (alternative F)

GA	Miles of groomed trail	Miles of ungroomed trail	Total in GA
Big Belts	73	15	88
Castles	0	38	38
Crazies	0	20	20
Divide	100	25	125
Elkhorns	0	0	0
Highwoods	0	36	36
Little Belt Mountains	292	168	460
Rocky Mountain Range	0	55	55
Snowies	0	52	52
Upper Blackfoot	85	58	143
Totals	**550**	**467**	**1,017**

Several motorized over-snow areas are located within identified RWAs in alternative F. Motorized uses within RWAs would not be suitable in alternative F. Therefore, the amount of motorized over-snow areas would be reduced by approximately 8,046 acres (7,355 acres in Divide GA, 40 acres in Big Snowies GA, and 651 acres in Upper Blackfoot GA) to meet the suitability requirements of this alternative. Table 52 displays the total acres of motorized over-snow areas that would remain open in alternative F.

Table 52. Acres open to motorized over-snow use by GA (alternative F)

GA	Acres open to motorized over-snow recreation use
Big Belts	80,026
Castles	55,105
Crazies	21,278
Divide	106,908
Elkhorns	25,349
Highwoods	0
Little Belt Mountains	368,755
Rocky Mountain Range	27,653
Snowies	34,503

GA	Acres open to motorized over-snow recreation use
Upper Blackfoot	127,081
Total	**846,658**

Big Log and Electric Peak RWAs

The direct effects to recreation access to meet the RWA suitability requirements in these RWAs would be the same as those described above in alternative B.

Mount Baldy RWA

Mount Baldy RWA is located in the Big Belts GA. This RWA consists of high elevation ecosystems dotted with a number of alpine lakes and unique granite rock formations (the Needles). The Mount Baldy RWA was identified as one of the three RWAs in the 1986 Helena Forest Plan. The northwest boundary of the Mount Baldy RWA was set back from the private property boundary line to allow for flexibility in other resource management in that area.

There are currently no motorized recreation uses or open roads within the Mount Baldy RWA in alternative F. However, there are approximately 14.3 miles of nonmotorized trail that would be closed to mechanized means of transportation within this RWA. See Table 53.

Table 53. Nonmotorized trails that would be closed to mechanized means of transportation in Mount Baldy RWA to meet the suitability requirement of alternative F

Trail number	Trail name	Miles
149	Needles	2.1
150	Gipsy/Birch Creek	5.7
151	Hidden Lake	3.4
152	Edith Lake	2.1
155	Grace Lake	1.0
Total		14.3

Big Snowies RWA

The Big Snowies RWA is in the Big Snowies GA south of Lewistown, Montana. The primary ridgeline of this island mountain formation is oriented east-west and is 25 miles long and 10 miles wide. The area is dominated by limestone geology and karst topography which conceals many caves including an ice cave on West Peak. The Big Snowies RWA changes in size and shape from the proposed action (alternative B) in alternative F. The western 1/3 of the mountain range is designated as the Grandview Recreation Area in alternative F. See the Grandview Recreation Area in Section 3.21.31 and 3.21.32 in the FEIS.

Approximately 6.2 miles of open road and 0.1 mile of motorized trail would be closed to motorized and mechanized means of transportation in the Big Snowies RWA in alternative F. Additionally, there are approximately 59.3 miles of nonmotorized trail that would be closed to mechanized means of transportation within the Big Snowies RWA. The following tables describe the specific open roads, motorized trail, and nonmotorized trails that would be closed to motorized and mechanized means of transportation in the Big Snowies RWA to meet the suitability requirements in alternative F.

Table 54. Open roads that would be closed to motorized and mechanized means of transportation in Big Snowies RWA to meet the suitability requirements of alternative F

Road number	Road name	Miles
270	Timber Creek	0.1
656	656	1.7
8950	Dry Coulee-Permit Road	1.1
8954	Snowy Ridge	1.3
15862	Webbers Road	0.1
15852	Dry Coulee Loop – Permit Road	0.3
8954001	Permit Road	0.5
8954002	Permit Road	0.1
8954004	Permit Road	1.0
Total		6.2

Table 55. Motorized trail that would be closed to motorized and mechanized means of transportation in Big Snowies RWA to meet the suitability requirements of alternative F

Trail number	Trail name	Miles
652	Southside	0.1

Table 56. Nonmotorized trails that would be closed to mechanized means of transportation in Big Snowies RWA to meet the suitability requirements of alternative F

Trail number	Trail name	Miles
406	Jump Off Peak	0.9
410	E FK Big Spring Creek	9.0
489	East Fork Cottonwood Creek	8.4
493	Ulhorn	14.2
494	Maynard Ridge	5.35
627	Swimming Woman	2.2
627-A	Swimming Woman Alt	2.2
650	Big Snowy Trail	6.7
652	Southside	4.9
670	Timber Creek	3.6
671	Bad Canyon	2.8
Total		59.3

Silver King RWA

The Silver King RWA is located in the Upper Blackfoot GA north and east of Lincoln, Montana. This RWAs lies adjacent to the Scapegoat Wilderness Area in the upper reaches of the Alice Creek and Landers Fork drainages.

There are no open roads or motorized trails within the Silver King RWA. However, there are 19.3 miles of nonmotorized trail that would be closed to mechanized means of transportation. See Table 57. Additionally, approximately 12.5 acres of motorized over-snow areas would be closed to motorized winter uses and mechanized means of transportation (including bicycles).

Table 57. Nonmotorized trails that would be closed to mechanized means of transportation in the Silver King RWA to meet the suitability requirements of alternative F

Trail number	Trail name	Miles
420	Silver King Trail	2.9
438	Landers Fork Trail	3.8
440	Continental Divide Trail	4.3
477	Lone Mountain Trail	2.3
481	Mainline Trail	1.2
490	Alice Creek	4.8
Total		19.3

Red Mountain RWA

The Red Mountain RWA is located south and east of Red Mountain Peak in Red Creek, within the Copper Creek drainage. This small RWA borders the Scapegoat Wilderness Area and is also a research natural area. The size of the Red Mountain RWA would increase in alternative F, as the southern boundary extends to include the entire Red Creek drainage.

There are no motorized uses or open roads within this RWA. However, there is one very short segment (<0.1 miles) of nonmotorized trail that would be closed to mechanized means of transportation (including bicycles) and is described in Table 58.

Table 58. Nonmotorized trails that would be closed to mechanized means of transportation in Red Mountain RWA to meet the suitability requirements of alternative F

Trail number	Trail name	Miles
423	Red Mountain Trail	<0.1

Nevada Mountain RWA

Nevada Mountain RWA is located south and west of Lincoln, Montana in the Upper Blackfoot GA. This large area includes Nevada Mountain, Black Mountain, and the head end of many drainages such as Nevada Creek and Washington Creek, as well as several smaller drainages that flow into Poorman Creek. Portions of the Continental Divide National Scenic Trail also cross through this RWA.

There are no open roads within this RWA. However, there is approximately 0.1 mile of motorized trail and 21 miles of nonmotorized trail that would be closed to mechanized means of transportation (including bicycles). See Table 59 and Table 60. Additionally, approximately 7,345 acres of motorized over-snow areas would be closed to motorized winter uses and mechanized means of transportation (including bicycles).

Table 59. Motorized trail that would be closed to motorized and mechanized means of transportation in Nevada Mountain RWA to meet the suitability requirements of alternative F

Trail number	Trail name	Miles
312	Cellar Gulch	0.1

Table 60. Nonmotorized trails that would be closed to mechanized means of transportation in Nevada Mountain RWA to meet the suitability requirements of alternative F

Trail number	Trail name	Miles
337	Continental Divide Trail	5.6
405	Washington Gulch Trail	2.0
440	Continental Divide Trail	6.4
466	Nevada Creek Trail	4.3
487	Prickly/Nevada Trail	2.7
Total		21.0

Elkhorns Winter Recreation Area

Similar to alternative C, a change to ROS settings in the core area of the Elkhorns (see the Recreation Settings section) would affect the recreation access within the Elkhorns GA in alternative F. Currently, in the winter, the Elkhorns are open to motorized over-snow uses within a semi-primitive motorized ROS setting. In alternative C, the semi-primitive motorized setting would be changed to a semi-primitive nonmotorized setting, and over-snow motorized recreation uses would no longer be suitable. This change in winter ROS would reduce the amount of available motorized over-snow acres in the current Elkhorns winter recreation area by approximately, 19,000 acres. Table 61 displays the total acres of motorized over-snow areas that would remain open in alternative C, to meet the suitability requirements of this alternative.

Table 61. Acres open to motorized over-snow use by GA (alternative F)

GA	Acres open to motorized over-snow recreation use
Big Belts	80,026
Castles	55,105
Crazies	21,278
Divide	114,263
Elkhorns	0
Highwoods	0
Little Belt Mountains	368,755
Rocky Mountain Range	27,653
Snowies	34,543
Upper Blackfoot	127,732
Total	**829,355**

Cumulative Effects

Please see the cumulative effects analysis for the Recreation Access section of the FEIS (Section 3.19.6).

Conclusions

In alternative A, recreation access would continue to be managed under the 1986 plans. Travel plans would continue to provide the direction for where motorized uses can and cannot occur. Wilderness and other laws may determine where future changes to recreation access may occur.

Alternative E does not identify RWAs and there would be no changes to travel plans in this alternative.

The direct effects that would result from implementation of the suitability requirements of the 2021 Land Management Plan would vary in alternatives B, C, D, and F. These changes would generally be minor in the context of the total amount and types of recreation access that would remain available across the HLC NF. There are currently 3 airstrips located in the HLC NF and there would be no changes to those airstrips in any of the alternatives.

Table 62 compares the miles of open road, motorized trails, trails that would remain open for mechanized means of transportation, and trails and acres open to motorized over-snow uses by alternative. Table 63 compares the miles of open road, motorized trail, nonmotorized trail open to mechanized means of transportation, and trails and acres available to motorized over-snow uses that would be closed in each alternative.

Table 62. Miles of existing open road; motorized trail; and trails open to mechanized means of transportation, and trails and acres of motorized over-snow uses that would *remain open* by alternative

Measurement Indicators	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt F
Miles of open road (year-round and seasonally)	2,074	2,061	2,074	2,040	2,074	2,066
Miles of motorized trails	850.1	850	850.1	790	850.1	850
Miles of nonmotorized trail outside of wilderness	1,190	1,190.1	1,128	1,250.1	1,190	1,190.2
Miles of motorized over-snow trail	1,019	1,017	1,019	1,010	1,019	1,017
Acres of motorized over-snow use	854,704	830,300	829,355	775,510	854,704	846,658

Table 63. Miles of existing open road; motorized trail; and trails open to mechanized means of transportation; and trails and acres of motorized over-snow uses that would be *closed* by alternative

Measurement Indicators	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Miles of road closed	NA	13.0	0	34	0	8.0
Miles of motorized trails closed	NA	0.1	0	60.1	0	0.1

Measurement Indicators	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Miles of nonmotorized trail closed to mechanized transportation closed	NA	204	62	328	0	135
Miles of motorized over-snow trail closed	NA	2	0	9	0	2
Acres of motorized over-snow use closed	NA	24,404	25,349	79,194	0	8,046

Appendix L. Surrounding Plans

Table of Contents

Introduction

The HLC NF is in a diverse landscape intermixed with land of other ownerships that are managed by a variety of federal, state, and local land management agencies. As required by the 2012 Planning Rule, the HLC NF has thoroughly reviewed applicable land and resource management plans that apply to areas within or adjacent to the planning area.

A productive working relationship between the Forest and local governments and other land management agencies is vital for successfully implementing the 2021 Land Management Plan. The HLC NF will continue to strive for constructive partnerships with local government officials through cooperating agency agreements, regular briefings, the Resource Advisory Councils, and ongoing engagement between the Forest and other agency officials. These relationships result in better communication of information that is essential to making sound, responsible land management decisions.

Many goals are included in the 2021 Land Management Plan that highlight key working relationships and partnerships with surrounding landowners and land management agencies. These plan components are designed to foster a viable “all lands approach” to management of the natural resources across the planning area and surrounding landscapes.

The HLC NF acknowledges that some county representatives may perceive issues regarding economic effects related to expected timber outputs and motorized access. The HLC NF also recognizes the local economic base is dependent on access and use of the forest. The FEIS discloses the social and economic impacts to the counties.

Many land and resource management plans applicable to lands within and adjacent to the HLC NF were considered (Table 1) while developing alternatives for the FEIS. The review of the plans did not identify any conflicts that could not be addressed between the 2021 Land Management Plan and plans from other land management agencies. Additional narrative discussion is provided below the table, as needed, to describe key consistencies as well as how potential conflicts were resolved. The cumulative effects section for each resource in the FEIS provides discussions on the consistency with the plans relevant to that resource.

In Table 1 the following codes are used to describe the consistency between each surrounding land management plan and the 2021 Land Management Plan:

- **C** – Consistent **-** the plans are consistent with each other
- **CON**—Conflict **-** there is a conflict between the plans
- **NA** – Not Applicable **-** the resource did not affect nor was affected by other agency plans
- **G** – General **-** the other agency plan is too general to discern effects
- **SB** – See below for further explanation

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Table 1. Review of consistency between the 2021 Land Management Plan and surrounding land and resource management plans

Surrounding Land or Resource Management Plan	Aquatics & Soils	Fire, Fuels, Air	Vegetation & Timber	Plants at Risk & Pollinators	Grazing & Invasive Plants	Wildlife	Recreation	Scenery	Designated Areas	Cultural	Lands	Infra-structure	Social/ Economic	Geology, Min Energy	Carbon Climate
TRIBAL GOVERNMENTS															
2018 Blackfeet Wildland Fire Mgt. Plan	C	C, SB	C, SB	NA	C, SB	C, SB	NA	NA	C	C	NA	NA	NA	NA	C, SB
BUREAU OF LAND MANAGEMENT															
2009 BLM Butte ROD Resource Management Plan	C	C, SB	C, SB	C	C, SB	C	C	C	C	C	C	C	C		C, SB
2016 BLM Missoula Analysis of the Management Situation	C	C, SB	C, SB	C	C	C	C	C	C	C	C	C	C	C	C, SB
2020 BLM Lewistown RMP FEIS (and 2014 AMS)	C	C, SB	C, SB	C	C	C	C	C	C	C	C	C	C	C	C, SB
BUREAU OF RECLAMATION															
2003 BOR Canyon Ferry Resource Management Plan	C	C, SB	C, SB	C	C, SB	C, SB	C	C	C	C	C	NA	NA	C	C, SB
2012 BOR Canyon Ferry Shoreline Management Plan	C	C, SB	C, SB	C	NA	C, SB	C	C	C	C	C	NA	NA	C	C, SB
COUNTY GROWTH POLICIES															
2003 Broadwater County Growth Policy	C	C, SB	C, SB	C	C	C	C	C	NA	NA	C	C	C	C, SB	C, SB
2003 Gallatin County Growth Policy	C	C, SB	C, SB	C	C	C	C	C, SB	NA	NA	C	C	C	NA	C, SB
2003 Jefferson County Growth Policy	C	C, SB	C, SB	C	C	C	NA	C, SB	NA	NA	C	C	C	C, SB	C, SB
2004 Lewis and Clark County Growth Policy	C	C, SB	C, SB	C	C	C	C	C	C, SB	NA	C	C	C	C, SB	C, SB
2006 Powell County Growth Policy	C	C, SB	C, SB	C	C	C	NA	NA	NA	NA	C	C	C	C, SB	C, SB
2011 Fergus County Land Use Plan	CON, SB	C, SB	C, SB	NA	CON, SB	CON, SB	C, SB	NA	CON	NA	C	NA	CON	C, SB	C, SB
2011 Glacier County Growth Policy	C	C	C	C	C	C	C	NA	NA	NA	C	NA	C	NA	C
2011 Pondera County Growth Policy	C	C, SB	C, SB	C	C, SB	C, SB	C, SB	C, SB	NA	NA	C	NA	C	NA	C, SB
2014 Cascade County Growth Policy	C	C, SB	C, SB	C	C	C	C	C, SB	NA	NA	C	NA	C	C, SB	C, SB
2014 Wheatland County Growth Policy	C	C	C	C	C	C, SB	NA	C, SB	NA	NA	C	NA	C	C	C
2014-2020 Sweet Grass County Growth Policy	C	C, SB	C, SB	C	C	C	NA	NA	C, SB	NA	C	NA	C	C, SB	C, SB
2015 Meagher County Growth Policy	C	C, SB	C, SB	C	C	C	C	NA	NA	NA	C	NA	C	C	C, SB
2016 Golden Valley Growth Policy	C	C, SB	C, SB	C	C	C	NA	C	NA	NA	C	NA	C	C	C, SB
2016 Judith Basin County Growth Policy	C	C	C	C	C	C	C	NA	NA	NA	C	NA	C	C	C
2016 Teton County Growth Policy	C	C	C	C	C	C	C	C, SB	NA	NA	C	NA	C	C, SB	C
2017 Chouteau County Growth Policy	C	C	C	C	C	C	C	C	NA	NA	C	NA	C	C	C
2017 Park County Growth Policy	C	C	C	C	C	C	C	C	NA	NA	C	NA	C	C, SB	C
COUNTY WILDFIRE PROTECTIN PLANS															
2004 Judith Basin County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2005 Powell County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2005 Teton County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2005 Tri County Regional County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2007 Chouteau County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2007 Musselshell County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2007 Pondera County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2008 Cascade County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2008 Sweet Grass County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2008 Wheatland County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C

Surrounding Land or Resource Management Plan	Aquatics & Soils	Fire, Fuels, Air	Vegetation & Timber	Plants at Risk & Pollinators	Grazing & Invasive Plants	Wildlife	Recreation	Scenery	Designated Areas	Cultural	Lands	Infra-structure	Social/ Economic	Geology, Min Energy	Carbon Climate
2014 Meagher County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2015 Tri County Wildfire Protection Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2017 Golden Valley County Fire Management Plan	C	C	C	C	C	C	NA	NA	NA	NA	NA	NA	NA	NA	C
USDA FOREST SERVICE															
1986 USFS Lolo Forest Plan	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
2009 USFS Beaverhead-Deerlodge Forest Plan, FEIS, ROD	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
2012 Beaverhead Deerlodge SEIS Winter Motorized Routes	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
2014 Beaverhead Deerlodge SEIS Temp Roads	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
2018 Flathead Plan, FEIS, ROD	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
NATIONAL RESOURCE CONSERVATION SERVICE															
2015 The MT NRCS Soil Health Strategy	C	NA	C	C	C, SB	C	NA	NA	NA	NA	NA	NA	NA	NA	C
2016 The MT NRCS Sage Grouse Initiative 2.0 Strategy	C	NA	NA	C	C, SB	C, SB	NA	NA	NA	NA	NA	NA	NA	NA	NA
MONTANA STATE															
2004 MT FWP Statewide Elk Mgt Plan	NA	NA	NA	NA	C, SB	C, SB	NA	NA	NA	NA	NA	NA	NA	C, SB	NA
2010 MT FWP Bighorn Sheep Cons. Strategy	NA	NA	NA	NA	C, SB	C, SB	NA	NA	NA	NA	NA	NA	NA	C, SB	NA
2010 MT DNRC and USFWS Habitat Conservation Plan EIS	C	NA	NA	NA	C, SB	C	NA	NA	NA	NA	NA	NA	NA	C, SB	NA
2010 MT DNRC Montana Statewide Forest Resource Strategy	C	C	C	C	C	C				NA	C	NA	NA	NA	C
2014–2018 Statewide Comprehensive Outdoor Rec Plan	C	C	NA	NA	NA	C, SB	C	NA	NA	NA	NA	NA	NA	C, SB	NA
2015 –2020 Montana State Parks & Recreation Strategic Plan	NA	NA	C	NA	NA	C, SB	C	NA	NA	NA	NA	NA	NA	NA	NA
2015 MT FWP Montana’s State Wildlife Action Plan	C	C	C	NA	C	C	NA	NA	NA	NA	NA	NA	NA	C, SB	C
2015 MT State Water Plan	C	NA	NA	NA	C	C	NA	NA	NA	NA	NA	NA	NA	C	C
2019-2027 MT FWP Statewide Fisheries Mgt Program Guide	C	NA	NA	NA	C, SB	C	NA	NA	NA	NA	C	NA	NA	NA	NA
2020 MFAAC Assessment of Forest Condition	C	C	C	NA	C	C	C	C	C	NA	C	C	NA	C	C
2020 MFAAC Forest Action Plan	C	C	C	NA	NA	C	C	C	C	NA	NA	NA	NA	NA	C
GLACIER NATIONAL PARK															
1999 NPS Glacier Natl Park General Mgt. Plan	C	C	C	C	NA	C	C	C	C	C	NA	NA	NA	NA	C
2010 NPS Glacier Natl Park Bear Mgt. Plan	NA	NA	NA	NA	NA	C, SB	NA	NA	NA	C	NA	NA	NA	NA	NA
MONTANA ARMY NATIONAL GUARD															
2014 Montana Army Natl Guard Integrated Natural Resources Management Plan for Limestone Hills Training Area	C	C	C	C	C, SB	C	C	NA	C	C	NA	NA	NA	C	C
CITY PLANS															
2010 City of Helena, MT Parks, Recreation & Open Space Plan	C	C, SB	C, SB	NA	C, SB	C, SB	C, SB	NA	NA	NA	C	NA	NA	NA	C, SB

Additional Information for Surrounding Plans

The following section is arranged in the same order as Table 1. It includes further detail, as needed, from the various resources to highlight key areas of consistency between the plans, as well as to discuss the resolution of conflicts if applicable. For those plans not listed in this section, no key highlights were identified. Refer to the FEIS Chapter 3 for consistency discussions for the plans relevant to each resource area.

2018 Blackfeet Wildland Fire Management Plan

Fire, Fuels, and Air

The Blackfeet Wildland Fire Management Plan (WFMP) is a strategic plan designed to guide fire management activities, in support of land management plans. As such, it is analogous to operational fire management plans that the HLC NF would develop in support of the 2021 Land Management Plan. This plan applies to areas that are adjacent to NFS lands in the Rocky Mountain Range geographic area. The framework for fire management on Blackfeet lands (e.g., NEPA, the National Fire Plan, Federal Wildland Fire Policy, National Wildfire Coordinating Group standards) also applies to the HLC NF; therefore, the plans are consistent by virtue of their consistency with these policies. The Blackfeet plan emphasizes the restoration of fire as a part of ecosystems while protecting values at risk; this is consistent with plan components in the 2021 Land Management Plan. The WFMP establishes resource management units; while the 2021 Land Management Plan does not delineate such areas, a similar emphasis on fire management that applies in certain areas (e.g., wildland urban interface) is similar. The fire management plan discusses fuel treatments and strategies, as well as air quality considerations, in a manner consistent with the HLC NF. The Blackfeet plan goes on to define Fire Management Units as well as other operational direction such as specific fire preparedness and staffing levels; these concepts are not applicable to the programmatic direction provided in the 2021 Land Management Plan.

Terrestrial Vegetation and Timber

The Blackfeet Wildland Fire Management Plan recognizes trends and threats related to fire regimes, climate, and the potential for increasing acres burned; these concepts are consistent with the terrestrial vegetation analysis. This plan also recognizes resource uses such as timber management. Specifically, within certain Resource Management Units, the management emphasis is on timber management and the Blackfeet plan stresses fire suppression to support economic values. Although the 2021 Land Management Plan does not stress the need for fire suppression in such areas, it does include a desired condition that mortality from natural disturbances such as wildfire are less in lands suitable for timber production than in lands not suitable for timber production. The Blackfeet plan also includes planned timber harvest as part of the fuel reduction strategy.

Grazing and Invasive Plants

The Blackfeet plan recognize range and agricultural areas and livestock and big-game forage as a primary management emphasis. A primary goal in Resource Management Unit - Rangelands North and South is to reduce fuel loading and promote forage and range health as well as prevent the spread of noxious weeds from other land uses. Damage should be minimized to livestock, fencing and related infrastructure, and the range resource during suppression activities.

Wildlife

The Blackfeet plan includes reference to use of resource advisors in fire suppression and rehabilitation efforts, identifies areas of wildlife and habitat emphasis, and includes consideration of wildlife species (particularly those listed under the federal Endangered Species Act) in response and in planning of fuels management. The plan uses different emphasis areas, including an identified wildland urban interface, which is consistent with fire and fuels management on NFS lands and allows the potential for consistent application of wildlife-related constraints on management.

Carbon and Climate

This plan recognizes the role climate has in wildland fire size, intensity, and frequency, in a manner consistent with the HLC NF analysis.

2009 Bureau of Land Management, Butte Resource Management Plan – Record of Decision

Fire, Fuels, and Air

This plan covers lands adjacent to the Divide, Big Belts, and Elkhorns geographic areas. The resource management plan contains components related to wildland fire management which are highly similar to the direction found in the 2021 Land Management Plan, including an emphasis on public safety, restoration of the role of natural fire, and protecting values at risk including those in the wildland urban interface. The resource management plan includes specific actions related to coordinating with the HLC NF specifically on fire preparedness, prevention, and suppression. The resource management plan also includes plan components for air quality that are similar the 2021 Land Management Plan.

Terrestrial Vegetation and Timber

The resource management plan contains components related to resilient terrestrial vegetation and would be complementary to the plan components for the HLC NF. Vegetation communities were a key issue. The resource management plan emphasizes maintaining and restoring healthy, diverse, and productive native plant communities, which is consistent with the array of vegetation plan components found in the 2021 Land Management Plan. Another key similarity is that there is an emphasis on moving toward historic vegetation conditions. Although the resource management plan goes into more detail on anticipated vegetation treatment methods, these methods are not inconsistent with what would be permissible under the 2021 Land Management Plan and those described in appendix C (Possible Management Approaches). There is a high degree of similarity with plan's specific goals for each vegetation type and the HLC NFs desired conditions. While the resource management plan does less to emphasize large trees and old growth as the HLC NF defines it, it does include goals for the management of old forest structure. Similarly, while there is less detail and emphasis, there are plan components in the resource management plan to provide for snags and downed woody material.

The resource management plan also includes projections for timber products ("Probable Sale Quantity"). This plan includes an objective to produce 9 to 25 MMBF per decade, which is analogous to the objective for the HLC NF proportionate to the land area considered. Both the resource management plan and 2021 Land Management Plan contain a suite of components designed to ensure that timber harvest provides wood products to local economies in a sustainable manner while also protecting other resources.

Grazing and Invasive Plants

Sustainable livestock grazing would be authorized at levels that would progress towards or maintain Land Health Standards. Prevention and control of invasive weeds is a high priority and would be done in a cooperative integrated approach with neighboring landowners. Use of domestic sheep and goats for a weed control in occupied bighorn sheep habitat would generally be prohibited but could be authorized if a series of protocols were followed combined with close coordination with Montana Department of Fish, Wildlife, and Parks. Analyzing risk of prescribed grazing in proximity to wild bighorn sheep herds is consistent with forestwide and Elkhorn and Big Belts geographic area plan components.

Designated Areas

The resource management plan identifies the Elkhorns as an area of "critical environmental concern", which is consistent with the emphasis placed on this area as the Elkhorn Wildlife Management Unit in the 2021 Land Management Plan.

Carbon and Climate

While the resource management plan does not have plan components related specifically to carbon or climate, many of its plan components are related to overall resiliency and sustainability, which is compatible with the plan components in the 2021 Land Management Plan, which would contribute to maintaining the ability of lands to sequester carbon and be resilient to climate changes.

2016 Bureau of Land Management, Missoula Resource Management Plan Analysis of the Management Situation

Fire, Fuels, and Air

This document is analogous to the Assessment for the HLC NF revision process. Although not a decision document, it provides a summary of the resource conditions and expected trends for the landscape, which includes lands near and adjacent to the Divide and Upper Blackfoot GAs. The AMS utilizes a similar framework for describing fuels, fire regimes, and wildland fires as the Assessment did for the HLC NF. One primary difference is that the AMS utilizes the specific condition classes defined in the FRCC (Fire Regime Condition Class), while the HLC NF does not. Nevertheless, the trends and forecast related to wildland fires is consistent.

Terrestrial Vegetation and Forest Products

This document is analogous to the Assessment for the HLC NF revision process. Although not a decision document, it provides a summary of the resource conditions and expected trends for the landscape, which includes lands near and adjacent to the Divide and Upper Blackfoot GAs. Timber and forest products are addressed briefly, and the overall trends are complementary to the HLC NF. Vegetation communities are assessed in detail, describing similar species and classifications as the HLC NF Assessment. The overall analysis and expected trends are similar.

Carbon and Climate

This document is analogous to the Assessment for the HLC NF revision process. Although not a decision document, it provides a summary of the resource conditions and expected trends for the landscape, which includes lands near and adjacent to the Divide and Upper Blackfoot GAs. The conditions and trends described for climate and carbon are consistent with the analysis in FEIS (appendix J).

2020 Bureau of Land Management, Lewistown Resource Management Plan FEIS; and 2014 Analysis of the Management Situation

Fire, Fuels, and Air

The analysis of the management situation is analogous to the Assessment for the HLC NF revision process. Although not a decision document, it provides a summary of the resource conditions and expected trends for the landscape, which includes lands near and adjacent to the Castles, Crazies, Highwoods, Little Belts, Rocky Mountain Range, Snowies, and Upper Blackfoot GAs. The AMS utilizes a similar framework for describing fuels, fire regimes, and wildland fires as the Assessment did for the HLC NF. One primary difference is that the analysis of the management situation utilizes the specific condition classes defined in the Fire Regime Condition Class, while the HLC NF does not. Nevertheless, the trends and forecast related to wildland fires are consistent. The resource management plan is also consistent with the 2021 Land Management Plan.

Terrestrial Vegetation and Forest Products

Timber and forest products are addressed briefly in the analysis of the management situation, and the overall trends are complementary to the HLC NF. Vegetation communities are assessed in detail, describing similar species as the HLC NF Assessment. The overall analysis and expected trends are similar.

2003 Bureau of Reclamation Canyon Ferry Resource Management Plan

Fire, Fuels, and Air

Air quality was addressed in the resource management plan, and there would be negligible impacts to air from the actions allowed. Wildland fire was not addressed, aside from assuring cooperation with the neighboring Bureau of Land Management lands with regards to burned area recovery plans in the Bucksnort fire area. The plan does not conflict with any of the management direction found in the 2021 Land Management Plan.

Terrestrial Vegetation and Timber

The resource management plan analyzes vegetation, which are dominated by nonforested and riparian types, with some hardwoods and conifer forests, and focuses mainly on noxious weeds. The uses of Canyon Ferry are different than NFS lands, but goals related to healthy native vegetation are complementary to the 2021 Land Management Plan. There are minimal trees and no timber product uses or management direction.

Grazing and Invasive Plants

The resource management plan recognizes the need for integrated weed management on their lands as well as surrounding lands and utilizes agreements with the Broadwater County Weed District.

Wildlife

Restrictions on activities with ‘unacceptable’ adverse impacts on the natural environment, limits on motorized access including prohibitions on off-road vehicle use, restrictions on conversion of day use areas to overnight use, riparian protection measures, cooperation with Montana Fish, Wildlife, & Parks and others to manage Canyon Ferry Wildlife Management Area and other habitat areas all would contribute to maintaining some wildlife habitat in an otherwise fragmented area, and potentially retain some potential connectivity between public lands in the Elkhorns and Big Belts mountain ranges. Management is generally consistent with approaches in the 2021 Land Management Plan.

Carbon and Climate

The resource management plan is silent on the topics of carbon sequestration and climate change. However, even taken cumulatively with the 2021 Land Management Plan, the management actions allowed in this plan would not be likely to have a measurable impact on climate change or carbon sequestration. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with this plan.

2012 Bureau of Reclamation Canyon Ferry Shoreline Management Plan

Fire, Fuels, and Air; Terrestrial Vegetation, and Timber; Climate and Carbon

The shoreline plan is primarily focused on the recreational uses along Canyon Ferry reservoir, in addition to a wildlife management area. Wildland fire, fuels, air quality, terrestrial vegetation, timber, climate and carbon are not addressed in this plan. However, there is nothing in this plan that conflicts with the management direction found in the 2021 Land Management Plan for these resources.

Wildlife

Limits on shoreline development, establishment of management area categories, coordination with Montana Fish, Wildlife, & Parks in the management of Canyon Ferry Wildlife Management Area all would contribute to maintaining some wildlife habitat in an otherwise fragmented area, and potentially retain some potential connectivity between public lands in the Elkhorns and Big Belts mountain ranges. Management is generally consistent with approaches in the 2021 Land Management Plan.

2003 Broadwater County Growth Policy

Fire, Fuels, and Air

This growth policy defines the wildland urban interface, in a general fashion. It states that in high-risk wildland fire interface areas, reducing fire risk should be a high priority along with fire fighter safety. The growth policy includes a goal of minimizing exposure within wildland urban interface and other high fire hazard areas, with policies to encourage development in areas of low fire hazard. This is consistent with the fire plan components found in the 2021 Land Management Plan that focus on minimizing fire hazard in wildland urban interface area and other values at risk.

Terrestrial Vegetation and Timber

The county growth policy notes that the manufacturing of wood products generates 18% of the County's earnings and 12% of the jobs; and discusses the trend of harvesting since the 1980's. The trends displayed are consistent with the HLC NF analysis. The growth policy also makes specific note that one challenge for the county is that public land management agencies have been decreasing timber harvest on public lands; and includes a policy that the county work with the Forest Service to explore the reasonable increase of supply of timber and wood products from federal lands. The HLC NF has been responsive to this concern through the development of alternatives and identification of a preferred alternative which includes objectives for the timber products.

Carbon and Climate

The county growth policy does not address climate change or carbon sequestration. It does include policies related to protecting natural resources when planning and approving subdivisions; to the extent that this maintains native vegetation on the landscape, this would help maintain the carbon storage potential. To the extent that community expansion and subdivision growth is encouraged, the policy would allow for the reduction and removal of native vegetation on the landscape. This would underscore the importance of maintaining resilient native vegetation on NFS lands, as provided for in the plan components in the 2021 Land Management Plan. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is outdated, but consistent with the 2021 Land Management Plan.

2003 Gallatin County Growth Policy

Fire, Fuels, and Air

The county growth policy includes a goal and associated policies to protect air quality, and therefore is complementary the 2021 Land Management Plan components for air quality. The growth policy also discourages development in areas prone to wildland fire to protect property and life and to encourage mitigation of fire hazards and reducing fuels loads. Plan components related to protecting values at risk are consistent and complementary with the growth policy.

Terrestrial Vegetation and Timber

This county growth policy does not explicitly address terrestrial vegetation, timber or other forest products, although it does encourage agricultural uses and conservation of open space. It does not conflict with any components in the 2021 Land Management Plan.

Scenery

In Chapter 3: County-wide Goals and Policies, conserving scenic resources and views was identified as a priority. Section 3.11/2 states that "development should work to conserve scenic resources and views, consider ridgetops and hill sides, signage, off-premises advertising, telecommunication towers, lighting, and landscape buffering". This policy is consistent with the plan components addressing scenery in the 2021 Land Management Plan.

Carbon and Climate

Although the policy does allow for development and loss of native vegetation, and therefore would not protect the carbon sequestration potential of all lands, the Gallatin growth policy encourages "compact development", and includes a goal to conserve open space. These policies will help lessen the loss of native vegetation and consequently the ability to store carbon, and in this aspect is complementary to the 2021 Land Management Plan. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

2003 Jefferson County Growth Policy

Fire, Fuels, and Air

This growth policy includes an objective to promote fire prevention measures with emphasis on the hazards in the wildland urban interface, as well as a goal with associated objectives to minimize risk of fire by management and planning, and to permit the effective and efficient suppression of fires to protect persons, property and forested areas. The plan describes the threat of wildfire in the county. A policy is included to protect air quality, and to develop a wildfire prevention strategy. These elements of the growth policy are all consistent with and complement the air quality and fire plan components in the 2021 Land Management Plan.

Terrestrial Vegetation and Timber

This growth policy includes an objective of aiding in the development of timber harvest businesses, as well as an objective to conserve forests and rangelands. It also promotes vegetation policies that reduce fire hazards. It includes a goal to foster the continuance of forestry, and an economic objective related to retaining and expanding businesses including forest products. The plan describes and notes the value of the natural forests and rangelands in the county, including the extraction of forest products. These elements are complementary to the 2021 Land Management Plan.

Scenery

The second goal of the Jefferson County Growth Policy is so "preserve the scenic beauty of Jefferson County" and to "conserve its forests, rangelands and streams, with their abundant wildlife and good fisheries." This goal is consistent with the 2021 Land Management Plan.

Carbon and Climate

Although the policy does allow for development and loss of native vegetation, and therefore would not protect the carbon sequestration potential of all lands, this plan includes a goal to encourage efficient of use land, with an objective to preserve open space. These policies will help lessen the loss of native vegetation and consequently the ability to store carbon, and in this aspect is complementary to the 2021 Land Management Plan. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is outdated, but consistent with the 2021 Land Management Plan. Geothermal energy is emphasized.

2004 Lewis and Clark County Growth Policy

Fire, Fuels, and Air

A policy is included to discourage development in areas of high to severe fire hazard, unless developed in a manner consistent with "Fire Protection Guidelines for Wildland Residential Interface Development". A key issue in the growth policy is that the county is situated in a wildland fire prone ecosystem, and developments into wildland/urban interface areas is increasing; the policy includes goals and policies related to minimizing exposure to fire hazards as well as recognizing that wildland fires are a natural part of the ecosystem. The policies for this issue include specific designs for developments in the wildland/urban interface, inter-agency cooperation, and encouraging landowners to manage vegetation to be resistant to fire. All of the policies are highly consistent and complement the fire and fuels plan components in the 2021 Land Management Plan. The planning priorities for the county also include actions to promote good air quality which would complement the air quality components in the 2021 Land Management Plan.

Terrestrial Vegetation and Timber

There is a policy in this plan that encourages landowners to "manage forest ecosystem processes by developing and maintaining a diversity of native species, ages, and stand densities to serve as a natural deterrent to pests and fires." This is consistent with the desired condition framework for vegetation in the 2021 Land Management Plan, which emphasizes conditions that are within the natural range of variation and that are resilient to disturbances. There is also a policy to support opportunities for natural resource-based businesses including building materials made from locally harvested timber, as well as several policies and actions related to following best management practices (related to water quality) when removing timber. There is nothing in the growth plan that is inconsistent with plan components in the 2021 Land Management Plan.

Designated Areas

The Lewis and Clark County growth plan recognizes the importance of the Missouri River corridor in Issue D which states "The character and quality of the Missouri River Corridor is impacted by increased development and recreational pressure.:" To protect the corridor, the plan establishes Goal 4 to "preserve, improve, and protect the Missouri River Corridor" and Policy 4.1 which states the county intends to "work cooperatively with local watershed groups conservation districts, private landowners, and other entities involved with Missouri River issues." This goal and policy are consistent with the plan components established for the Missouri River Corridor special emphasis area within the Divide geographic area.

Carbon and Climate

Although carbon and climate are not specifically addressed, the growth policy includes a policy to create incentives for cluster developments, to maintain undeveloped lands. This would help mitigate the loss of native vegetation to urban developments, helping to provide for some level of carbon sequestration, complementing the plan component for carbon sequestration in the 2021 Land Management Plan. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan, and it includes support for abandoned mine reclamation.

2006 Powell County Growth Policy

Fire, Fuels, and Air

In its issues and concerns section, this growth policy discusses high fire risk areas, including wildland interface areas. Although a specific growth policy isn't listed, this discussion identifies the need to implement fire protection guidelines and limit new development in high risk areas, as well as improving fire safety. The 2021 Land Management Plan components related to protecting values at risk and reducing hazardous fuels in wildland urban interface areas are consistent and help address these concerns.

Terrestrial Vegetation and Timber

This growth policy notes that the largest public landowner in the county is the Forest Service. It includes natural resource objectives such as encouraging continued use and protection of timberlands capable of producing forest products as well as noncommercial timberlands for other natural values; and to encourage federal resource management plants to be consistent with the growth policy. Specific policies toward this objective include working with federal agencies in developing long-term plans that promote economic benefits derived from publicly owned lands, while protecting resources. Several land zones identified emphasize timber activities and open space. The planning process for the HLC NF encouraged involvement from the county, and the plan components in the 2021 Land Management Plan are consistent with the growth policy in terms of promoting resilient vegetation and opportunities to remove timber products sustainably from NFS lands.

Carbon and Climate

A growth policy is included to promote and retain open space, through tools such as conservation easements, as well as identifying land zones where open space is a priority. This policy will help lessen the potential loss of native vegetation through development, and consequently the ability to store carbon; in this aspect is complementary to the 2021 Land Management Plan. The policies related to providing forest products and protecting natural resources are also consistent with the HLC NF in terms of promoting resilient vegetation. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan, and it includes BMPs for mines.

2011 Fergus County Growth Policy

Aquatics and Soils

The Fergus County Plan Wildlife/Endangered Species policy states: The property rights of individuals is [sic] recognized as more important than [sic] fish, wildlife, and endangered or threatened species. The 2021 Land Management Plan does not disclose anything about private property rights but must comply with the law on Threatened or Endangered Species.

Fire, Fuels, and Air

The policy does not contain any information specific to fire, fuels, or air quality. There are no elements in the growth policy that conflict with the 2021 Land Management Plan.

Terrestrial Vegetation and Timber

The business policy notes the promotion of multiple uses of land and natural resources. There is a forestry policy as well, that specifically protects timber resources and promotes the continuation of an economically viable and sustainable wood products industry. This policy includes statements that the federal government shall consult with the county before setting policies, recognizes a need for intensive management of federal lands to promote timber growth, and endorses the planning efforts of any governmental agency in promoting healthy forests which involves timber harvesting. The HLC NF planning process provided opportunities for county involvement, and the plan includes components that allow for the sustainable production of timber products on NFS lands.

Grazing and Invasive Plants

While the 2021 Land Management Plan and Fergus County Growth Policy both recognize the importance of livestock grazing and multiple resource uses to the local economies, the plans differ in their possible approaches to balancing permitted livestock grazing and wildlife habitat needs. The growth policy supports a “no net loss of livestock grazing animal use months for any permittee due to increasing wildlife populations and habitat. If an increase in public habitat for wildlife and game numbers can increase, there will be a proportionate increase in livestock animal use months.” While the 2021 Land Management Plan is not a site-specific decision document for livestock grazing allotments, plan components are designed to manage livestock grazing while providing for quality wildlife habitat and forage. The 2021 Land Management Plan does not propose to increase or decrease permitted livestock grazing in any geographic area. However, allotment plan revisions within the Snowies GA would occur under direction of the 2021 Land Management Plan, with site specific analysis determining proposed stocking levels and other livestock management practices to meet desired resource conditions.

Wildlife

The introduction to the Fergus County Land Use Plan establishes county priorities as the protection of private property rights, the “customs and cultures” of county citizens, and “facilitation of a free market economy”. The Wildlife/Endangered Species policy within the plan states that federal and state agencies should “manage their wildlife populations …taking into consideration local economics, heritage, cultures, and private property rights”. This policy also states: “The property rights of individuals is [sic] recognized as more important than [sic] fish, wildlife, and endangered or threatened species.” It also reiterates the importance of private property rights over protection of “habitat for fish, wildlife, and threatened or endangered species.” Cumulatively this policy, along with emphasis on development of resources for economic purposes and on development of recreation resources, is not consistent with the 2021 Land Management Plan components designed to sustain wildlife habitats and native wildlife species, including those listed as threatened, endangered, proposed, or candidate under the Endangered Species Act.

Recreation

Fergus County recognizes the importance of recreational access to public lands in the Tourism and Recreation section of their growth policy. This policy is consistent with the recreation access and lands components of the 2021 Land Management Plan.

Designated Areas

Fergus County has a growth policy to “not endorse any federal or state monument, wilderness, or wildland designations unless it has support of the Fergus County constituents and the Fergus County Commissioners.” The 2021 Land Management Plan designates a recommended wilderness area, a primitive recreation area, and an eligible wild and scenic river in the Big Snowy Mountains.

The recommended wilderness area and the eligible wild and scenic river segment are administrative designations. Only Congress has the authority to designate a federal wilderness and/or a national wild and scenic river and these designations would be created by an act of Congress. It is very likely that additional public consultation and discussion would take place prior to any formal designation.

The Grandview Recreation Area would be a local, administrative designation and would not be considered in conflict with the Ferus County growth policy.

Carbon and Climate

The policy does not contain any information specific to climate or carbon, nor does it explicitly address open space or other considerations for maintaining native vegetation aside from noxious weeds concerns. There are policies included related to promoting sustainable timber lands, which would help maintain carbon sequestration potential. The 2021 Land Management Plan is consistent in that it also provides for sustainable timber products. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan, and it provides a summary of the 1872 Mining Law.

2011 Pondera County Growth Policy

Fire, Fuels, and Air

The background section of this plan notes that a county wildfire protection plan has been completed, and that local jurisdictions in the county should consider risks of wildland fire for proposed development. The policy includes a planning strategy to implement strategies from the wildfire protection plan. The plan components related to wildland urban interface and protecting values at risk in the 2021 Land Management Plan are consistent with these policies. Although the plan notes that air quality is important, there are no policies, objectives, or strategies specifically related to air quality.

Terrestrial Vegetation and Timber

The growth policy does include planning directions specifically for the 10% of the county within NFS lands; these directions include focusing on multiple use policies and that the FS should coordinate with the county on proposed actions and plans. The HLC NF planning process provided opportunities for involvement with the county, and the 2021 Land Management Plan components provide for multiple uses.

Grazing and Invasive Plants

Livestock grazing is important to the local economy. The county has had a weed plan since 1987 and updates it every two years. Reducing noxious weeds, especially near Swift Reservoir, is consistent with forestwide and Rocky Mountain GA plan components.

Wildlife

The Policy acknowledges the “extraordinary natural… resources of our county” in its vision statement and includes in its Natural Areas goal retention of “natural areas for a variety of uses including wildlife habitat, hunting and fishing…”. Additional goals include retaining agricultural lands in that use and focusing residential development in existing communities. Although agriculture is not always consistent with wildlife values, it retains open space and the potential for wildlife habitat and use depending on how it is managed. Strategies related to wildlife focus on management to reduce crop damage by wildlife, and to maintain wildlife populations that allow for hunting, fishing, and other recreation opportunities. The plan includes reference to coordination with the Forest Service.

Recreation

“70% listed recreation as very important or somewhat important.”

Scenery

From the Pondera County Growth Policy June 2011, page 23: “About half of the 2010 survey respondents selected “scenic beauty/mountain views” as a very important reason for why they live or own property in Pondera County.”

Carbon and Climate

This growth policy includes a goal of retaining natural areas for a variety of uses. It does not explicitly address climate or carbon, or native vegetation, aside from limiting noxious weeds. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

2014 Cascade County Growth Policy

Fire, Fuels, and Air

This growth policy contains a goal to minimize the risk of wildland fire by management and planning, and to permit the effective and efficient suppression of fires to protect persons, property, and forested areas. Under this goal there are objectives that include encouraging fire protection measures especially in the wildland/urban interface, designing subdivisions to minimize the risk of fire, cooperating with federal agencies to develop a wildfire educational program, supporting adequate ingress/egress in subdivision planning, and promoting vegetation policies that reduce fire hazards. The fire plan components related to wildland urban interface and protecting values at risk in the 2021 Land Management Plan are consistent with these policies.

Terrestrial Vegetation and Timber

The policy includes an objective related to the retention and expansion of businesses related to forest products, fostering the continuance of forestry in recognition of its economic contribution as well as the natural beauty of forests. There is also an objective to support the development of natural resources including timber. In addition, there is a “working landscapes” goal designed to foster the heritage of forestry in the area. The growth policy does describe the vegetation in various land units but does not include specific policies related to vegetation, although the implementation plan does state that the county planning board will review management proposals submitted by the Forest Service to determine their compatibility with the growth plan. The HLC NF planning process provided opportunities for county involvement, and the plan includes components that allow for the sustainable production of timber products on NFS lands.

Scenery

Goal 2/Objective B: “Preserve Cascade County’s scenic beauty and conserve its forests, rangelands and streams, with their abundant wildlife and good fisheries.”

Carbon and Climate

The growth policy includes an objective to preserve open space. This policy will help lessen the potential loss of native vegetation through development, and consequently the ability to store carbon; in this aspect is complementary to the 2021 Land Management Plan. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan and is supportive of mineral development.

2014 Wheatland County Growth Policy

Wildlife

One stated purpose is to “foster cooperation and coordination between federal and state management agencies…” to include wildlife considerations, among others. The plan describes wildlife resources, acknowledges the importance of hunting opportunities, and notes the presence of the state-owned Haymaker Wildlife Management Area. Goals encourage future residential, commercial, and industrial growth to occur within or near presently existing communities, which would have the effect of retaining open space and the potential for wildlife use, depending on how those non-residential lands are managed. Another goal is to maintain, preserve, and enhance the environmental and ecological qualities of the county, which includes protecting such things as critical wildlife habitat through coordination and cooperation with state and federal agencies.

2014-2020 Sweet Grass County Growth Policy

Fire, Fuels, and Air

There is a land use objective to continue evaluation of the potential for fire and wildland fire in the county and measures to mitigate that fire potential, with recommended actions that include coordinating mitigation measures with the county wildfire protection plan and exploring partnerships to reduce hazardous fuels and improve fire prevention and suppression capabilities. There is also an implementation measure to encourage active and responsible timber harvesting to reduce fire hazards, and a policy to adopt subdivision regulations that address wildland fire risks. Plan components related to wildland urban interface and protecting values at risk in the 2021 Land Management Plan are consistent with these policies.

Terrestrial Vegetation and Timber

The growth policy includes a detailed description of vegetation in the county and notes the importance of county involvement in federal planning decisions. The description also notes that timber harvest has not been a significant part of the economy in recent years. There is a policy to support continued multiple use of federal lands and to be consulted with land use decisions on federal lands and encourage those agencies to be consistent with the county plan. There are also policies to support proper forest management including timber harvest. Implementation measures are included to encourage active and responsible timber harvesting to reduce fire hazards and promote healthier, sustainable timberlands on both public and private property. The HLC NF planning process provided opportunities for county involvement, and the plan includes components that allow for the sustainable production of timber products on NFS lands.

Designated Areas

Sweet Grass County does provide direction for designated areas in the Natural Resources Section of their plan/4.2.3/New policies/e/page 90: “Designation of any resource area, wilderness, wild and scenic rivers, or national monuments must be done in consultation and coordination with Sweet Grass County and its residents, to the maximum extent allowed by law.”

Carbon and Climate

The growth policy does not contain measures specific to climate or carbon but does include recommended actions related to protecting areas of environmental significance such as wetlands, floodplains, and critical wildlife habitat. To a degree, this policy will help lessen the potential loss of native vegetation through development, and consequently the ability to store carbon; in this aspect is complementary to the 2021 Land Management Plan. There is nothing in the 2021 Land Management Plan related to carbon and climate that conflicts with the growth policy.

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan and is supportive of mineral development.

2015 Meagher County Growth Policy

Fire, Fuels, and Air

A goal is included to mitigate hazardous wildland fuels in the wildland urban interface, with an objective to use firewise hazardous fuels mitigation principles. There is also a goal to encourage coordination with federal agencies in land use planning in the wildland urban interface for residential developments adjacent to federal land.

Terrestrial Vegetation and Timber

Although the description of the county discusses the history of timber harvest in the county, there are no specific goals or objectives related to it included in the growth policy. There is nothing in the 2021 Land Management Plan that conflicts with the county growth plan with respect to terrestrial vegetation, timber, and other forest products.

Carbon and Climate

Although the description of the county discusses the natural resources of the area, there are no specific goals or objectives related to carbon and climate change included in the growth policy. There is nothing in the 2021 Land Management Plan that conflicts with the county growth plan with respect to these resources.

2016 Teton County Growth Policy

Scenery

Issue 4.3 Goal A: Preserve high quality of life by protecting natural heritage such as wildlife, clean air, scenic vistas, and cultural resources." Policies for the Issue point to working with public agencies to discourage development in high natural resource areas the to preserve valued resources. This direction is complementary to the 2021 Land Management Plan components.

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan, but it includes an outdated reference to the 1986 Forest Plan and No Surface Occupancy.

2017 Park County Growth Policy

Geology, Minerals and Energy

The growth policy language on minerals and energy is consistent with the 2021 Land Management Plan, but it includes an references to an outdated mining laws.

2008 Wheatland County Wildfire Protection Plan

Scenery

4.2.1 Land Use Goal/Objective c: "Maintain the pleasant visual environment of the area…..by encouraging development that maintains or enhances the beauty of the area."

2015 USDA The Montana Natural Resources Conservation Service Soil Health Strategy

Grazing and Invasive Plants

The Soil Health Strategy promotes the adoption of soil health concepts for agricultural land uses and encourages other agencies to adopt and promote soil health practices. Soil health concepts are compatible with forestwide plan components.

2016 USDA, The Montana Natural Resources Conservation Service Sage Grouse Initiative 2.0 Strategy

Grazing and Invasive Plants

One of the Sage Grouse Initiative Strategy's objectives is to improve livestock grazing management in sage grouse habitat, which could include ranches near the Crazy and Castles geographic areas.

Wildlife

Portions of the eastern part of the HLC NF adjoin identified general habitat for sage grouse. Conservation focus is on private lands. Primary threats include cultivation of grazing lands, exurban development, grazing, nonnative plants, range management infrastructure, mesic area loss and degradation, conifer encroachment, and fence collisions. Conservation of sage grouse habitat also provides habitat for grass/shrub associated species that use HLC NF lands for part of life history needs.

2004 Montana Fish, Wildlife, and Parks Statewide Elk Management Plan

Grazing and Invasive Plants

The 2003 FWP Elk Management Plan is consistent with the 2021 Land Management Plan as plan components of both promote collaboration between agencies and producers to implement cooperative grazing management when and where elk habitat concerns are identified.

Wildlife

The Forest Service relied heavily on the 2004 Montana Statewide Elk Management Plan (Elk Plan) to understand the status, trend, objectives, and management challenges regarding elk and elk habitat across the planning area and on adjacent lands. The Elk Plan was used in development of the project record document "Elk Status Report", in discussion and development of elk-related plan components, and in analyzing the effects of the 2021 Land Management Plan.

Geology, Minerals and Energy

The Elk Management Plan language on minerals and energy is consistent with the 2021 Land Management Plan, and it includes language to seek to provide input on minerals projects.

2010 Montana Fish, Wildlife, and Parks Bighorn Sheep Conservation Strategy

Grazing and Invasive Plants

The 2021 Land Management Plan follows guidance in the Montana Fish, Wildlife, & Parks Bighorn Sheep Conservation Strategy in that appropriate separation techniques would be employed at site specific levels. Separation techniques would be proportionate to the co-mingling risk and implemented after communication between agencies and producers. The 2021 Land Management Plan defers to the Montana Fish, Wildlife, & Parks Plan in its risk analysis determined that co-mingling may be likely, targeted grazing with domestic goats or sheep would not be used for noxious weed control. Neither plan prescribes a minimum buffer zone between domestic and wild sheep, but the strategy explains the pros and cons of implementing buffers. 2021 Land Management Plan components set the side boards for determining suitability if and when domestics would be considered for noxious weed control or stocking of vacant sheep allotments.

Wildlife

The strategy is intended to provide management guidance for bighorn sheep at least through 2020. Objectives include monitoring, development of population objectives and management within those objectives, coordinate with private landowners and other agencies, and augmenting existing or re-establishing historic bighorn sheep populations as well as establishing new populations. The plan emphasizes maintenance of bighorn sheep health through separation of wild and domestic sheep, which is consistent desired conditions and other plan components in the 2021 Land Management Plan. The sheep management plan was used in assessing the status of and management issues related to bighorn sheep and habitat on NFS lands while developing the 2021 Land Management Plan. This plan is complementary to and supports desired conditions and other plan components for bighorn sheep in the 2021 Land Management Plan.

Geology, Minerals and Energy

The Bighorn Sheep Conservation Strategy language on minerals and energy is consistent with the 2021 Land Management Plan, but it does say that mining could decrease habitat.

2010 MT DNRC and USFWS Habitat Conservation Plan EIS

Geology, Minerals and Energy

The EIS includes language on minerals and energy is consistent with the 2021 Land Management Plan, but only includes minor mention of mineral activity.

2014 – 2018 Montana Fish, Wildlife, and Parks Statewide Comprehensive Outdoor Recreation Plan

Wildlife

This plan addresses recreation on lands of all jurisdictions. Objectives focus on strengthening the role of outdoor recreation in the lives and communities of Montanans, promoting economic benefits of recreation, protecting natural and cultural resources, developing ongoing funding mechanisms for management of recreation areas and facilities, and enhancing coordination among agencies. While not specifically addressing wildlife species or habitats, plan emphasis on stewardship, maintaining open spaces, and inclusion of a wide array of recreational activities that include hunting, fishing, wildlife viewing, and availability of wild lands are consistent with wildlife-related desired conditions in the 2021 Land Management Plan.

Geology, Minerals and Energy

This plan includes language on minerals and energy is consistent with the 2021 Land Management Plan, but only includes minor mention of oil and gas activity.

2015 – 2020 Montana Fish, Wildlife, and Parks State Parks and Recreation Strategic Plan

Wildlife

These plans guide the management of state parks, and are generally focused on specific recreational, historic, cultural, or scenic values, depending on the specific park. Goals include managing for those values in a manner consistent with available resources. These goals would not necessarily contribute to the desired conditions as described for the HLC NF, but overall could be consistent with maintaining wildlife diversity on NFS lands.

2015 MT FWP Montana's State Wildlife Action Plan

Geology, Minerals and Energy

This plan includes language on minerals and energy is consistent with the 2021 Land Management Plan and includes language on the development of mine clean-up plans with USFS.

2019-2027 MT FWP Statewide Fisheries Mgt Program Guide

Grazing and Invasive Plants

Both the 2021 Land Management Plan and the Fisheries Management Program guide have goals and objectives of improved grazing management to improve aquatic habitat, riparian vegetation, and streambank stability.

1999 National Park Service Glacier National Park General Management Plan

Wildlife

This plan covers area immediately north of northern portion (Badger-Two Medicine Area) of the Rocky Mountain Range geographic area. Bear management plan goals include long-term survivability of grizzly bears in Glacier National Park and in the Northern Continental Divide Ecosystem as a whole and minimizing conflicts. Objectives include training, information, reporting, enforcement, research, and collaboration and cooperation with other agencies and tribes. These goals and objectives are consistent with and complementary to desired conditions and other plan components regarding grizzly bears in the 2021 Land Management Plan.

2014 Montana Army National Guard Integrated Natural Resources Management Plan for Limestone Hills Training Area, Broadwater County

Grazing and Invasive Plants

The Limestone Hills Training Area plan is consistent with plan components for the Elkhorns geographic area for combatting invasive species using an Early Detection Rapid Response approach for new infestations and integrated pest management strategy to long term noxious weed and cheatgrass management. Livestock grazing would continue in cooperation with the Bureau of Land Management plans in place.

2010 City of Helena Montana Parks, Recreation and Open Space Plan

Fire, Fuels, and Air

There is a forest management goal for these lands that emphasizes returning disturbance regimes and vegetation to historic conditions. This plan also includes a goal for wildfire mitigation on all city parks and lands, which includes forest fuels reduction in areas at high to severe wildfire risk. Recommendations for this goal include wildfire education and implementing forest fuel reduction programs. These measures are directly compatible with the 2021 Land Management Plan components in the Divide geographic area, including the South Hills Recreation Area, and would contribute toward reducing hazardous fuels conditions across ownerships.

Terrestrial Vegetation and Forest Products

Recommendations for the recreation and trail management goal on these lands include ensuring that wildlife and other natural resources are protected. There is a forest management goal for these lands that emphasizes returning disturbance regimes and vegetation to historic conditions, reducing noxious weeds, improving forest health and reducing forest pest impacts and outbreak potential, with associated recommendations for thinning, seeding, and working with Forest Service foresters, biologists, and entomologists to develop prescriptions. These recommendations also mention creating conditions resilient to change climatic regimes. These measures are directly compatible with the 2021 Land Management Plan components in the Divide geographic area, including the South Hills Recreation Area.

Grazing and Invasive Plants

There is a noxious weed management goal for these lands which includes recommendations for weed treatments (both herbicide and biocontrols). These measures are directly compatible with the 2021 Land Management Plan components in the Divide geographic area, including the South Hills Recreation Area, and would reduce the presence of noxious weeds across ownerships.

Wildlife

Recommendations for the recreation and trail management goal on these lands include ensuring that wildlife and other natural resources are protected. This plan also includes a goal for wildlife protection, including recommendations to create seasonal restrictions to minimize recreationist/wildlife conflicts and education to reduce negative interactions between wildlife and people. These measures complement the 2021 Land Management Plan components in the Divide geographic area, including the South Hills Recreation Area.

Recreation

Specific to the open lands adjacent to NFS lands, recommendations include public interpretation and education, trail construction and signage standards, and includes coordination with the HLC NF in relation to signs. These measures complement the 2021 Land Management Plan components in the Divide geographic area, including the South Hills Recreation Area.

Carbon and Climate

There is a forest management goal for these lands that emphasizes returning disturbance regimes and vegetation to historic conditions. These recommendations also mention creating conditions resilient to change climatic regimes. These measures are directly compatible with the 2021 Land Management Plan components in the Divide geographic area, including the South Hills Recreation Area.