

# Appendix 5: Data Sources and Adjustments Used to Estimate Forest Attributes

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## 1. Introduction

The Lolo National Forest uses two main vegetation data sources to assess the current condition of the landscape. The Forest Inventory and Analysis (FIA) dataset is a statistically sampled grid of plots that can be used to estimate the quantities of vegetation in different categories and provides a basis for measuring vegetation change through time. However, FIA is coarse with each plot representing approximately 6,000 acres of land, and it cannot be used to produce a detailed spatial map. The second data source is the Region 1 Existing Vegetation Mapping Program (VMAP) product, which spatially depicts the vegetation on a map of polygons each representing about five acres. VMAP is used primarily for modeling past and projected future conditions, mainly because it can be combined with other spatial datasets of interest, such as road access, or management area. However, VMAP does not necessarily represent an accurate amount of area in each category. Not surprisingly, these two estimates show different vegetation estimates on the forest, particularly in the size class metrics. Part of that difference can be explained by a map correction method which is applied to VMAP. However, there is a large discrepancy in the ten-inch size class and 0–5-inch diameter size class that may warrant more investigation.

## 2. Data sources used in the analysis

### 2.1 Forest Inventory and Analysis Data

The FIA program “collects, analyzes, and reports information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, and how it is changing, as well as how the trees and other forest vegetation are growing and how much has died or has been removed in recent years.” It consists of a grid of inventory plots throughout the nation’s forests. These plots are inventoried every ten years, with approximately 10% of the total number remeasured every year.

There are 363 FIA plots measured and reported on the Lolo National Forest, each representing approximately 6,000 acres of forested area. On the combined Bitterroot and Lolo area, there were 628 plots representing a total of 3.76 million acres of forested land.

FIA estimates of the study area were derived from the 2015 Region 1 Summary Database (Barber et al. 2011, Bush 2014). Plots used in these estimates were measured between 2006 and 2015 and represent the vegetation present on the landscape during that time period. The database uses a bootstrapping algorithm to derive confidence intervals on the amount of vegetation in each class. Table A5.1, Table A5.2, and Table A5.3 show FIA estimates and 90% confidence intervals for cover types, density class and size class for each Region 1 Broad PVT and forestwide for the Lolo National Forest.

Figure A5.1 shows the acre estimates in each size class as well as the 95% confidence interval bars on the combined Lolo and Bitterroot National Forests. For the FIA estimates, the “0-5” size class and “Seedling” size class were combined to depict the “0-5” category. Additionally, the 15-20, 20-25 and 25+ size class categories were combined to show the 15-20+ diameter class. Of the initial 3.76 million acres represented by plots in the FIA database, there were 644,000 acres of land classified as “none”, indicating that there wasn’t enough data to do a collection (such as after a fire or other disturbance) or the land was urban, rock, water, or other non-forested status. After removing areas categorized as “none”, the FIA analysis represents 3.11 million acres of forested lands.

## 2.2 Region 1 Existing Vegetation Mapping Program

The Region 1 Existing Vegetation Mapping Program (VMAP) is a remote-sensing derived map of current vegetation conditions, calibrated and verified with on-site plot measurements. The VMAP product for the Bitterroot and Lolo National Forests was last published in 2016 (Ahl and Brown 2016) and updated for disturbance through 2021. The map is a depiction of all lands within the Bitterroot and Lolo National Forests footprint, including private lands, extended to the 5th Code Hydrologic Unit Code watershed boundaries in which the Forest is located. Table A5.6, Table A5.7, and Table A5.8 show VMAP estimates for National Forest System and non-National Forest System lands separately, for each geographic area. The map includes descriptive metrics for Lifeform, Tree Canopy Cover, Tree Size Class, and Tree Dominance Type (which is used to display Cover Type). A total of 4,404 plots were measured in 2015 to support creation of the map and database of these metrics. A map error matrix is also supplied for each of these categories to depict errors of commission and omission. According to the report:

Errors of commission describe the probability that a feature on the map actually represents that category on the ground and is calculated by dividing the number of agreements for a category by the total number of sites that were mapped into that category. Errors of omission relate to the probability of a reference site being correctly classified and is calculated by dividing the total number of correctly mapped sites for a class by the total number of reference sites for that class.

In the past, VMAP estimates of Lifeform, Tree Canopy Cover and Dominance Type have been reasonably detected directly from a spectral signature of the satellite images used to develop the map product. The most problematic classification has been size class, which is intended to represent “Basal Area Weighted Mean Diameter” of the stand (polygon) in question. There is simply no way for a satellite image to indicate tree size directly. Consider the difference in organization of modeled versus reference Canopy Cover (Figure A5.2) as compared to Size Class (Figure A5.3) on the Flathead National Forest<sup>1</sup> (USDA 2021). While canopy cover maintains its correlation between modeled and reference condition across the

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<sup>1</sup> This data for the Lolo was not reported nor retained in the 2016 report; therefore, the Flathead data is used as a proxy.

measurements, size class becomes somewhat arbitrary at around the 10-inch size class and larger. According to the 2021 Flathead report:

Despite the favorable regression statistics, the tree size attribute is incredibly complex and difficult to map using top-down, 2D representations of the landscape alone. Unlike with canopy cover, where vegetation density on the ground correlates directly with measurable spectral responses (e.g., increase in vegetation = increase in NDVI), once forest stands reach a certain age or size class, there are no clear correlates to the canopy vegetation which can be reliably exploited by the modeling algorithm.

The 2016 VMAP of the Bitterroot and Lolo forests spatially depicts vegetation conditions on 3.85 million acres of land, about 90,000 acres more than that represented by FIA. This is likely due to recent land acquisitions on the Lolo National Forest, which total 177,692 acres between 2000 and 2021, based on Automated Lands Program (ALP) data queried in 2022. There are about 733,000 acres of VMAP polygons classified as non-forested, urban, water, or “transitional forest” meaning they have not yet regenerated. The original map estimate points in Figure A5.1 show the cumulative acres in each size class category of the combined Bitterroot and Lolo National Forest VMAP product. Each estimate represents approximately 3.11 million acres of forest; the acreage left after omitting the non-forested areas.

### 3. Map Correction Methods

A study published by (Olofsson et al. 2013) includes methods to use mapped quantities and an accuracy matrix to both adjust estimates of total quantities as well as compute confidence intervals of the adjusted estimates. These methods were applied to the mapped quantities of size classes in VMAP shown in Table A5.4 using the error matrix shown in Table A5.5. These estimates were conducted on the combined Lolo and Bitterroot National Forest land base due to the underlying data availability and appropriate application of the methods. Plots were collected solely on lands managed by the Forest Service, so the analysis presented here to adjust map quantities applies only to National Forest System lands. This also provides the opportunity to directly compare map estimates with FIA estimates since the FIA estimates reflect only National Forest System Lands. Unfortunately, the plot location data used in the mapped estimates was not retained, so we were unable to distinguish the accuracy assessment between the Lolo and Bitterroot National Forests. Additionally, the original VMAP estimate from 2016 was used in this analysis because of the quantities that were depicted at the time. Elsewhere in the assessment, quantities have been updated to represent disturbances that have happened since 2016 when the original VMAP was created.

### 4. Results and Discussion

Application of the map adjustment factor shifts the estimated quantities of size class closer to the FIA estimates in all size classes. Quantities in the 0-5 and 10-15 classes are decreased and quantities in the 5-10 and 15+ classes are increased (Figure A5.1). For the 5-10 inch and 15+ inch diameter size classes, the adjusted total average estimates are within the associated FIA 95% confidence intervals. Given that these estimates are independently derived and that the map adjustment is made without consideration of the FIA quantities, it is a strong indication that the map adjustment methodology is appropriate to use in this instance. However, the map quantity estimates in the 0–5-inch diameter class and the 10–15-inch diameter class, while closer to each other, are still noticeably different.

There are several differences worth noting. The VMAP analysis represents 3.85 million acres and the FIA represents 3.76 million acres. Most of this difference is likely due to the acquired lands between 2001 and 2021 that are not yet reflected in the FIA database representing plots collected between 2006 and 2015.

The larger discrepancy is in the 10-15” diameter class, where the mean of the adjusted map is still more than 400,000 acres higher than the mean of the FIA estimate. Correspondingly, there are approximately 300,000 more 0-5” acres in the FIA estimate than the VMAP estimate. Given that recent fires would have impacted the 2016 VMAP product more heavily than the 2006-2015 FIA estimate, this outcome seems counterintuitive. One possible explanation is that VMAP identifies 438,000 acres of “transitional forest”, which is designed to indicate areas that had been forested but that recently have experienced a stand-replacing disturbance such as fire or harvest. These acres are not included in the 0-5” diameter size class acre total of VMAP; some of these acres could explain the difference in estimates of this class. The higher estimate in the 10-15” class, however, remains unexplained. Some of this might be due to recently acquired lands falling into this category. Another possibility is that the size class estimation derived from the imagery is so confused that stands default to this size class in an overabundance (Figure A5.3).

A data gap in the map adjustment method is that there is no spatial depiction of the adjustment, only the overall quantities. This is potentially problematic when using a spatial depiction of size to assess management potential in the different suitable classifications of land. In other words, there is presently no way to tell where the unmapped 15” + diameter sized stands that result from the adjustment factor occur on the ground (whether they are in protected areas or as a part of the suitable timber base or other manageable classification of land). More work needs to be done to analyze remote sensing methods, such as the spectral signatures of those stands at the margins, to evaluate whether there is opportunity to reassign them based on the expected quantities and other metrics. The Random Forest regression modeling exercise used to produce the VMAP does not presently consider the expected quantities in each vegetation class (Ahl and Brown 2016).

## 4.1 Potential Vegetation Type mapping

A similar discrepancy also exists between the mapped potential vegetation type and the inventory of these potential vegetation type quantities using FIA on the Lolo National Forest. Inventoried potential vegetation type quantities are used for monitoring purposes, detecting change through time, and movement toward desired conditions. The mapped potential vegetation type product (Roberts 2022) is used for applications that require spatial analysis, such as the amount of each potential vegetation type in each management area.

## 4.2 Tables and Figures

**Table A5.1—Estimates and 90% confidence intervals for current conditions (circa 2015) for Region 1 Cover Types (Milburn et al. 2015) at the forestwide scale and within each Region 1 Broad Potential Vegetation Type (Cold, Cool Moist, Warm Dry and Warm Moist). Source: Forest Inventory and Analysis Data**

Strata	Region 1 Cover Type	Acres Of Estimate	Acres Of Estimate Low	Acres Of Estimate High
Lolo National Forest	Aspen Hardwood	16,883	6,074	27,692
Lolo National Forest	Dry Douglas-fir	42,975	21,291	64,659
Lolo National Forest	Lodgepole pine	310,031	252,508	367,554

Strata	Region 1 Cover Type	Acres Of Estimate	Acres Of Estimate Low	Acres Of Estimate High
Lolo National Forest	Mixed Mesic Conifer	908,607	826,454	990,760
Lolo National Forest	none	310,031	259,598	360,464
Lolo National Forest	Ponderosa pine	118,180	83,661	152,699
Lolo National Forest	Spruce fir	334,588	278,349	390,827
Lolo National Forest	Whitebark Subalpine Larch	15,348	6,074	24,622
Lolo National Forest	Western Larch Mixed Conifer	151,946	116,106	187,786
Cold Broad PVT	Aspen Hardwood	1,563	n/a	3,126
Cold Broad PVT	Lodgepole pine	67,223	40,451	93,995
Cold Broad PVT	Mixed Mesic Conifer	6,253	n/a	12,506
Cold Broad PVT	none	56,279	33,191	79,367
Cold Broad PVT	Ponderosa pine	3,127	n/a	6,254
Cold Broad PVT	Spruce fir	76,603	54,339	98,867
Cold Broad PVT	Whitebark Subalpine Larch	14,070	4,966	23,174
Cool Moist Broad PVT	Aspen Hardwood	6,133	n/a	12,266
Cool Moist Broad PVT	Lodgepole pine	162,523	123,809	201,237
Cool Moist Broad PVT	Mixed Mesic Conifer	220,786	178,484	263,088
Cool Moist Broad PVT	none	73,595	49,799	97,391
Cool Moist Broad PVT	Ponderosa pine	4,600	n/a	9,200
Cool Moist Broad PVT	Spruce fir	234,585	188,726	280,444
Cool Moist Broad PVT	Whitebark Subalpine Larch	1,533	n/a	3,066
Cool Moist Broad PVT	Western Larch Mixed Conifer	62,863	40,746	84,980
Warm Dry Broad PVT	Aspen Hardwood	9,157	1,460	16,854
Warm Dry Broad PVT	Dry Douglas-fir	41,206	19,777	62,635
Warm Dry Broad PVT	Lodgepole pine	68,677	42,191	95,163
Warm Dry Broad PVT	Mixed Mesic Conifer	505,157	456,320	553,994
Warm Dry Broad PVT	none	126,671	95,444	157,898
Warm Dry Broad PVT	Ponderosa pine	103,778	74,079	133,477

<b>Strata</b>	<b>Region 1 Cover Type</b>	<b>Acres Of Estimate</b>	<b>Acres Of Estimate Low</b>	<b>Acres Of Estimate High</b>
Warm Dry Broad PVT	Spruce fir	4,578	n/a	9,156
Warm Dry Broad PVT	Western Larch Mixed Conifer	53,415	32,800	74,030
Warm Moist Broad PVT	Lodgepole pine	7,605	1,133	14,077
Warm Moist Broad PVT	Mixed Mesic Conifer	165,796	143,570	188,022
Warm Moist Broad PVT	none	6,084	n/a	12,168
Warm Moist Broad PVT	Ponderosa pine	4,563	n/a	9,126
Warm Moist Broad PVT	Spruce fir	13,690	3,124	24,256
Warm Moist Broad PVT	Western Larch Mixed Conifer	33,463	17,890	49,036

**Table A5.2—Estimates and 90% confidence intervals for current conditions (circa 2015) for size class (mean basal area weighted diameter at breast height) at the forestwide scale (Lolo) and within each Region 1 Broad Potential Vegetation Type (Cold, Cool Moist, Warm Moist). Source: Forest Inventory and Analysis Data**

Strata	Size Class	Acres of Estimate	Acres of Estimate Low	Acres of Estimate High
Lolo	00.1-04.9	142,737	106,984	178,490
Lolo	05.0-09.9	663,037	594,221	731,853
Lolo	10.0-14.9	600,110	537,438	662,782
Lolo	15.0-19.9	248,639	204,339	292,939
Lolo	20.0-24.9	78,275	54,906	101,644
Lolo	25.0+	36,835	21,291	52,379
Lolo	none	310,031	260,106	359,956
Lolo	seedling	128,924	95,831	162,017
Cold	00.1-04.9	29,703	14,430	44,976
Cold	05.0-09.9	89,109	66,833	111,385
Cold	10.0-14.9	25,013	12,508	37,518
Cold	25.0+	1,563	n/a	3,126
Cold	none	56,279	33,768	78,790
Cold	seedling	23,450	8,275	38,625
Cool Moist	00.1-04.9	44,464	24,685	64,243
Cool Moist	05.0-09.9	259,117	215,803	302,431
Cool Moist	10.0-14.9	226,919	188,404	265,434
Cool Moist	15.0-19.9	82,795	57,880	107,710
Cool Moist	20.0-24.9	18,399	7,459	29,339
Cool Moist	25.0+	12,266	3,304	21,228
Cool Moist	none	73,595	49,570	97,620
Cool Moist	seedling	49,064	27,844	70,284
Warm Dry	00.1-04.9	54,942	33,740	76,144
Warm Dry	05.0-09.9	227,397	186,827	267,967
Warm Dry	10.0-14.9	265,551	225,951	305,151
Warm Dry	15.0-19.9	125,145	95,992	154,298
Warm Dry	20.0-24.9	50,363	32,180	68,546
Warm Dry	25.0+	16,788	6,471	27,105
Warm Dry	none	126,671	95,325	158,017
Warm Dry	seedling	45,785	28,319	63,251
Warm Moist	00.1-04.9	10,647	2,751	18,543
Warm Moist	05.0-09.9	83,659	61,530	105,788
Warm Moist	10.0-14.9	74,532	53,768	95,296
Warm Moist	15.0-19.9	33,463	18,496	48,430
Warm Moist	20.0-24.9	9,126	1,993	16,259
Warm Moist	25.0+	4,563	n/a	9,126
Warm Moist	none	6,084	n/a	12,168
Warm Moist	seedling	9,126	1,285	16,967

**Table A5.3—Estimates and 90% confidence intervals for current conditions (circa 2015) for density class (percent canopy cover) for the Lolo National Forest, at the forestwide scale and within each Region 1 Broad Potential Vegetation Type (Cold, Cool Moist, Warm Dry and Warm Moist). Source: Forest Inventory and Analysis Data**

Strata	Density Class (percent canopy cover)	Acres of Estimate	Acres of Estimate Low	Acres of Estimate High
Lolo National Forest	<40%	1,055,948	982,601	1,129,295
Lolo National Forest	40-59.9%	570,949	512,084	629,814
Lolo National Forest	>=60%	581,692	512,592	650,792
Cold Broad PVT	<40%	134,445	107,593	161,297
Cold Broad PVT	40-59.9%	59,406	39,002	79,810
Cold Broad PVT	>=60%	31,266	14,590	47,942
Cool Moist Broad PVT	<40%	337,312	295,087	379,537
Cool Moist Broad PVT	40-59.9%	208,520	172,803	244,237
Cool Moist Broad PVT	>=60%	220,786	180,837	260,735
Warm Dry Broad PVT	<40%	471,582	425,409	517,755
Warm Dry Broad PVT	40-59.9%	248,763	210,875	286,651
Warm Dry Broad PVT	>=60%	192,295	156,025	228,565
Warm Moist Broad PVT	<40%	50,195	30,916	69,474
Warm Moist Broad PVT	40-59.9%	48,674	31,124	66,224
Warm Moist Broad PVT	>=60%	132,333	108,801	155,865

**Table A5.4—Forest Inventory and Analysis Estimate, Original VMap Estimate, and Adjusted Map Estimate of acres in four size class categories for the Lolo and Bitterroot National Forests**

	0-5" diameter	5-10" diameter	10-15" diameter	15-20" + diameter	Total
FIA estimate	507,296	1,057,766	932,870	618,316	3,116,248
Original Map	148,058	956,373	1,813,307	199,321	3,117,059
Adjusted Map	211,898	961,621	1,371,066	572,474	3,117,059

**Table A5.5—Error matrix for Lolo and Bitterroot National Forests VMAP Size class mapping**

Size	0-5 diameter	5-10 diameter	10-15 diameter	15-20+ diameter	Total	Commission
0-5 diameter	126	39	0	0	165	76%
5-10 diameter	117	755	355	46	1273	59%
10-15 diameter	5	167	497	188	857	58%
15-20+diameter	1	17	148	393	559	70%
Total	249	978	1000	627	2854	Overall



Size	0-5 diameter	5-10 diameter	10-15 diameter	15-20+ diameter	Total	Commission
Omission	51%	77%	50%	63%		62%

**Table A5.6—Current condition of acres of size classes, by Geographic Areas, for National Forest System (NFS) lands and non-NFS lands. Source: VMap**

Geographic Area	Grass Shrub	Seedling Sapling	Pole	Medium	Large	Very Large	Total
Greater Missoula	46,546	8,796	54,203	81,747	4,325	8,486	204,104
<i>Non-NFS</i>	9,711	3,438	13,631	16,030	710	2,759	46,279
<i>National Forest System</i>	36,836	5,358	40,572	65,717	3,616	5,727	157,825
Lolo Creek	42,260	8,110	57,952	54,356	164	68	162,909
<i>Non-NFS</i>	1,965	697	3,035	3,089	50	19	8,855
<i>National Forest System</i>	40,295	7,413	54,917	51,267	114	48	154,054
Lower Clark Fork	105,431	25,421	155,094	259,679	24,935	642	571,201
<i>Non-NFS</i>	19,995	11,110	27,023	22,955	1,450	82	82,615
<i>National Forest System</i>	85,436	14,311	128,070	236,724	23,485	559	488,586
Middle Clark Fork	86,897	23,569	119,703	250,401	18,515	1,888	500,974
<i>Non-NFS</i>	24,308	7,822	15,881	30,455	3,235	759	82,459
<i>National Forest System</i>	62,589	15,747	103,823	219,946	15,280	1,129	418,515
Ninemile/ Petty Creek	20,021	13,914	78,271	122,875	5,355	282	240,719
<i>Non-NFS</i>	3,186	2,104	8,720	13,927	528	86	28,551
<i>National Forest System</i>	16,836	11,810	69,551	108,948	4,827	196	212,167
Rock Creek	60,236	6,827	50,489	92,083	20,382	20,501	250,518
<i>Non-NFS</i>	1,546	31	720	2,348	604	733	5,983
<i>National Forest System</i>	58,690	6,796	49,769	89,735	19,778	19,768	244,535
Saint Regis River	9,865	4,971	46,901	166,085	14,048	413	242,284
<i>Non-NFS</i>	2,286	389	3,414	7,140	382	120	13,730
<i>National Forest System</i>	7,579	4,582	43,488	158,946	13,666	293	228,554
Upper Blackfoot Clearwater	170,020	20,098	67,459	148,971	15,260	12,133	433,942
<i>Non-NFS</i>	15,923	6,220	21,360	34,326	3,873	6,138	87,841
<i>National Forest System</i>	154,097	13,879	46,099	114,645	11,386	5,995	346,101
<b>Total</b>	<b>541,277</b>	<b>111,707</b>	<b>630,072</b>	<b>1,176,198</b>	<b>102,985</b>	<b>44,414</b>	<b>2,606,652</b>

Size classes are defined based on basal area weighted mean diameter: Grass/Shrub (<10% tree cover), Seedling/Sapling (.1-5" diameter at breast height), Pole (5-10" diameter at breast height), Medium (10-15" diameter at breast height), Large (15-20" diameter at breast height), Very Large (>20" diameter at breast height).

**Table A5.7—Current distribution (Acres) of Region 1 Cover Types (Milburn et al. 2015) across Geographic Areas, for National Forest System (NFS) lands and non-NFS lands. Source: VMap**

Geographic Area and Ownership	Grass/ Shrub	Lodge- pole Pine	Mixed Mesic Conifer	Ponderosa pine	Spruce fir	White bark Sub alpine Larch	Western Larch Mixed Conifer	Total
Greater Missoula	46,546	26,815	43,255	37,927	27,369	471	21,721	204,104
<i>Non-NFS</i>	9,711	4,306	8,443	16,629	322	7	6,861	46,279

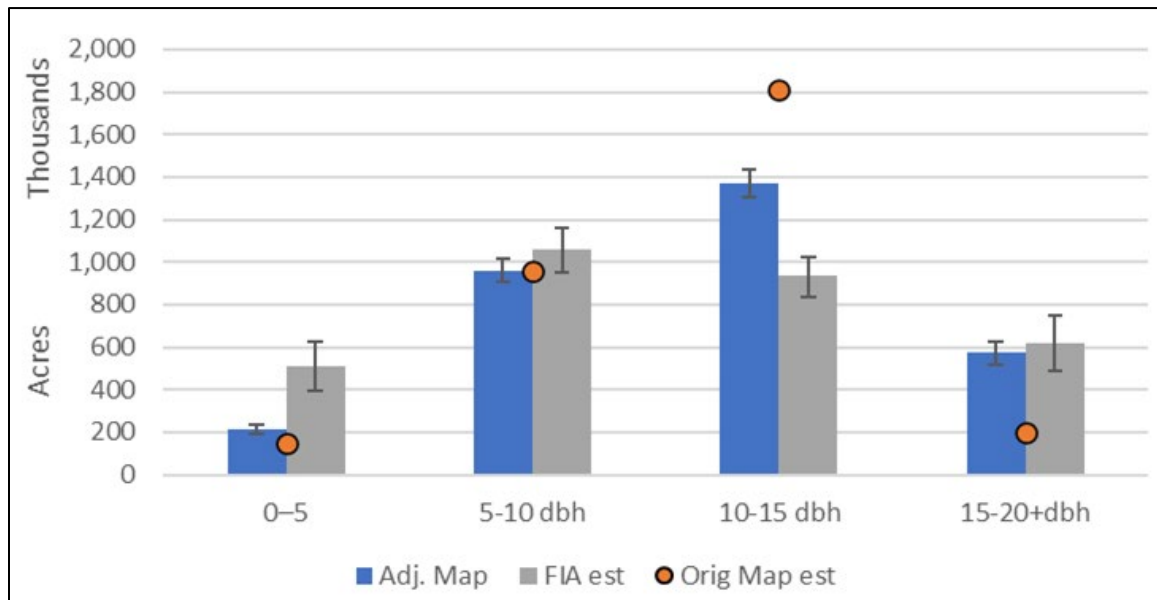
Geographic Area and Ownership	Grass/Shrub	Lodge-pole Pine	Mixed Mesic Conifer	Ponderosa pine	Spruce fir	White bark Sub alpine Larch	Western Larch Mixed Conifer	Total
<i>NFS</i>	36,836	22,509	34,812	21,298	27,047	464	14,860	157,825
Lolo Creek	42,260	51,050	23,599	22,944	13,013	1,507	8,537	162,909
<i>Non-NFS</i>	1,965	2,249	1,269	2,537	30	0	805	8,855
<i>NFS</i>	40,295	48,800	22,330	20,407	12,982	1,507	7,732	154,054
Lower Clark Fork	105,431	102,290	240,575	49,140	21,975	7	51,761	571,178
<i>Non-NFS</i>	19,995	12,898	27,786	12,266	629	0	9,042	82,615
<i>NFS</i>	85,436	89,392	212,789	36,874	21,346	7	42,718	488,563
Middle Clark Fork	86,897	77,871	124,455	90,871	91,879	94	28,892	500,958
<i>Non-NFS</i>	24,308	7,404	16,125	32,792	527	0	1,303	82,459
<i>NFS</i>	62,589	70,466	108,330	58,079	91,351	94	27,589	418,498
Ninemile/Petty Creek	20,021	32,447	69,052	62,293	36,178	13	20,715	240,719
<i>Non-NFS</i>	3,186	2,483	5,618	16,082	133	0	1,049	28,551
<i>NFS</i>	16,836	29,964	63,434	46,210	36,045	13	19,665	212,167
Rock Creek	60,236	46,588	91,333	39,586	9,584	67	3,097	250,492
<i>Non-NFS</i>	1,546	161	2,139	2,049	38	0	50	5,983
<i>NFS</i>	58,690	46,427	89,194	37,538	9,546	67	3,048	244,509
Saint Regis River	9,865	41,475	137,339	13,217	29,992	0	10,395	242,284
<i>Non-NFS</i>	2,286	858	7,022	3,453	73	0	37	13,730
<i>NFS</i>	7,579	40,617	130,317	9,764	29,919	0	10,357	228,554
Upper Blackfoot Clearwater	170,020	35,565	110,332	7,320	74,845	1	35,859	433,942
<i>Non-NFS</i>	15,923	9,004	41,106	4,793	5,692	0	11,322	87,841
<i>NFS</i>	154,097	26,561	69,226	2,526	69,153	1	24,537	346,101
<b>Total</b>	<b>541,277</b>	<b>414,100</b>	<b>839,941</b>	<b>323,298</b>	<b>304,834</b>	<b>2,160</b>	<b>180,976</b>	<b>2,606,586</b>

**Table A5.8—Current condition (acres) of density classes, by Geographic Areas, for National Forest System (NFS) lands and non-NFS lands. Source: VMap**

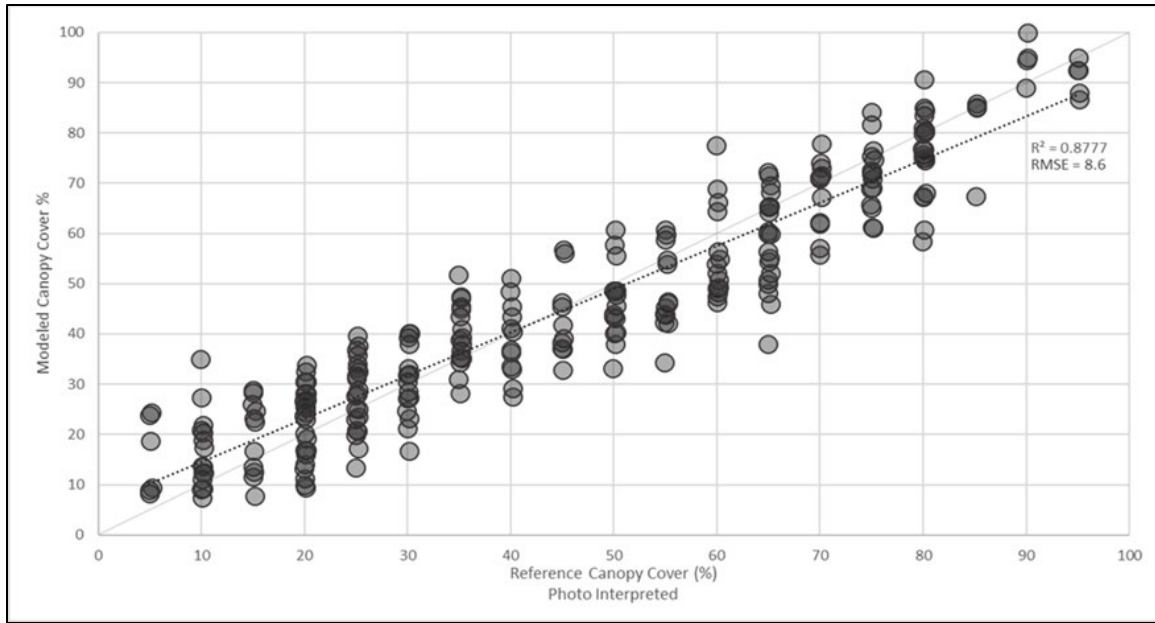
Geographic Area and Ownership	Grass/Shrub	Open	Medium	Closed	Grand Total
Greater Missoula	46,546	48,341	52,266	56,950	204,104
Non-NFS	9,711	15,962	12,446	8,160	46,279
National Forest System	36,836	32,380	39,820	48,790	157,825
Lolo Creek	42,260	43,465	45,218	31,967	162,909
Non-NFS	1,965	3,664	2,146	1,081	8,855
National Forest System	40,295	39,800	43,072	30,886	154,054
Lower Clark Fork	105,431	123,416	147,689	194,666	571,201
Non-NFS	19,995	26,109	17,833	18,679	82,615
National Forest System	85,436	97,307	129,856	175,986	488,586

Geographic Area and Ownership	Grass/Shrub	Open	Medium	Closed	Grand Total
Middle Clark Fork	86,897	141,599	151,420	121,057	500,974
Non-NFS	24,308	37,866	15,500	4,785	82,459
National Forest System	62,589	103,733	135,920	116,272	418,515
Ninemile/ Petty Creek	20,021	76,198	78,106	66,393	240,719
Non-NFS	3,186	15,457	6,834	3,074	28,551
National Forest System	16,836	60,741	71,272	63,319	212,167
Rock Creek	60,236	77,056	76,857	36,369	250,518
Non-NFS	1,546	1,928	1,819	690	5,983
National Forest System	58,690	75,128	75,038	35,679	244,535
Saint Regis River	9,865	43,960	94,528	93,931	242,284
Non-NFS	2,286	5,357	4,532	1,556	13,730
National Forest System	7,579	38,603	89,996	92,375	228,554
Upper Blackfoot Clearwater	170,020	91,127	119,463	53,331	433,942
Non-NFS	15,923	31,229	31,507	9,182	87,841
National Forest System	154,097	59,898	87,957	44,149	346,101
<b>Total</b>	<b>541,277</b>	<b>645,162</b>	<b>765,548</b>	<b>654,665</b>	<b>2,606,652</b>

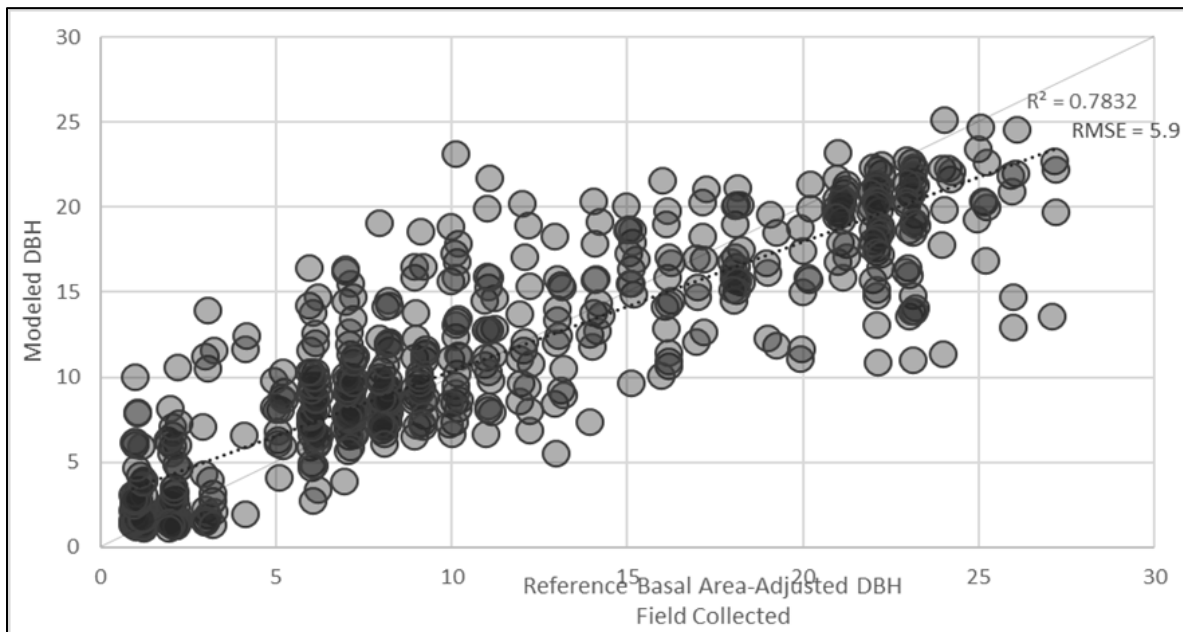
Density is divided in to four classes based on tree canopy cover: Grass/Shrub (<10%), Open (10-40%), Medium (40-60%) and closed (>60%).



**Figure A5.1—Quantities of size class on the Bitterroot and Lolo National Forests, including the original VMAP totals, adjusted VMAP totals using the Olofsson adjustment, and Forest Inventory and Analysis data estimates. Error bars are provided for the adjusted VMAP and FIA estimates**



**Figure A5.2—Regression plot of predicted versus reference canopy cover values. Reference values were assigned at 5% intervals based on photo interpretation. Predicted values are continuous and not restrained to the same intervals**



**Figure A5.3—Regression plot of predicted versus reference tree size values on the Flathead National Forest**

## 6. Literature Cited

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