

Appendix I - Wildlife Habitat Capability Models

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Appendix I - Wildlife Habitat Capability Models

Modeling and Analysis

A mixture of quantitative and qualitative tools were used to assess the environmental consequences of the proposed alternatives on Endangered, Threatened, Candidate, Sensitive and Management Indicator Species (MIS).

For most species analyzed, the primary methodology used was the Habitat Capability Model (HCM). Developed by the Forest Service, these are descriptions of physical and biological habitat variables for a particular species, or a group of species, based on the best available research and information. The variables are described in terms of "high," "moderate" or "low" habitat capabilities. High quality habitat is assumed to be preferred by the species, moderate quality habitat is assumed to be required by the species and low quality habitat is assumed to be marginal for the species.

In terms of viability, moderate and high quality habitat are assumed to be required for long-term viability, while low habitat quality represents habitat which is not acceptable for reproduction. The HCMs used in this analysis appear at the end of this narrative. Most of these were assembled and developed by biologists at the Six Rivers National Forest. There are some changes, either in the models themselves or in the capability ratings of the forest vegetation types and seral stages. These changes were made in order to better represent conditions on the Klamath National Forest (Forest).

Not all attributes displayed in the HCMs were used in the analysis. The limited habitat information available in the timber strata database did not allow for all attributes to be considered. It is anticipated that site-specific analysis will occur prior to project implementation and will include consideration of additional habitat attributes displayed in the models.

Several of the species discussions in Chapter 4 of the EIS included a projection in the trend of the Forest-wide habitat capability values. These projections were obtained by assigning a habitat suitability index value (high, medium, low or zero) for each seral stage and forest type. FORPLAN outputs were obtained, which displayed the acres by forest type

and seral stage at the end of each of the first 5 decades. The habitat suitability index values were used, in conjunction with the FORPLAN outputs, to project future Forest-wide trends in habitat capability. These values are presented to show a general overall trend only. They do not reflect spatiality or configuration of habitats.

Chapter 2 of the EIS displays future population projections for certain wildlife species under each alternative. These figures (except for bald eagle and peregrine falcon) were based on the projected amount of moderate and high quality habitat. Wildlife population dynamics are inherently complex and affected by numerous factors not accounted for in the analysis. Therefore, these projected populations should be used within the limited context of relative comparison of the effects of the proposed alternatives. The following describes the methodology and assumptions used in calculating future populations.

Bald eagle and peregrine falcon: None of the alternatives show an increase or decrease in the populations, because the amount of available habitat is not a reasonable predictor of future populations. Factors outside the scope of the Forest Plan such as shooting, poisoning and pesticides are other important factors which limit populations at this time.

Pairs of northern spotted owls: Based on information compiled within the Inter-agency Scientific Committee's (ISCs) Conservation Strategy, the following assumptions were used to calculate the projected number of pairs for each alternative:

1. Median home range = 3,500 acres.
2. Median proportion of home range in moderate and high quality habitat = 2,500 acres.
3. There is a 25% overlap between pairs.
4. All acres of moderate and high quality habitat are occupied by pairs.

Pairs of northern goshawk: Based on nest stand information collected on the Forest and habitat guidelines presented in Management Recommendations for the northern goshawk in the southwestern United States, the following assumptions were used to calculate the projected number of pairs for each alternative:

1. Average home range = 6,000 acres.
2. The amount of older seral stage (4A, 4B/C, 5C) forest is a limiting factor influencing occupancy.
3. 40% of each home range (2,500 acres) must be in older seral stage forest.
4. Each available 2,500 acres of older seral stage forest represents a pair.

Black-tailed deer: The amount of high and medium quality forage habitat was assumed to be the limiting factor for black-tailed deer, and thus was the basis for estimating future populations. A conver-

sion factor for future populations was obtained by dividing the current population estimate by the present amount of high and medium forage habitat available within the forest types. This conversion factor was multiplied by acres of high and moderate quality forage habitat obtained from FORPLAN runs for each of the alternatives.

Elk: A model developed by the Pacific Northwest Region of the Forest Service for western Oregon will be used to analyze elk habitat.

Table I-1. Spotted Owl Habitat Capability Model (*Strix occidentalis caurina*)
 Species Status - Federal Threatened

Season: All year Habitat Variable:	High Capability (Preferred)	Moderate Capability (Marginal)	Low Capability (Required)
1. Vegetation Type:	Douglas-fir, east- and westside mixed conifer, east- and westside true fir, ponderosa pine.		
2. Patch Size: a. Cover b. Foraging	> 300 acre > 400 acre	150-300 acre 250-400 acre	< 150 acre < 250 acre
3. Seral Stages: a. Foraging b. Cover c. Reproduction	> 36 inches > 36 inches > 36 inches	21-36 inches 21-36 inches 21-36 inches	< 21 inches 12-21 inches ...
4. % Canopy Closure: (over- and mid-story) a. Foraging b. Cover c. Reproduction	> 70 > 85 > 85	40-70 70-85 70-85	10-40 40-70 40-70
5. Vertical Diversity: (layers)	4	2-3	1
6. Snag Densities: (1/2 11-21in, 1/2 >21in)	>= 8	5-7	2-4
7. Log Densities: (>= 20" dia. >= 10' long, >= 1/3 over 30")	>= 20	10-20	≤ 10
8. Background Information:			
a. Habitat	>21 inches, >70 years old, = increase quality		
b. Conifers (DBH Class = Average stems/acre)	5-11 = 30 11-21 = 19.5 > 21 = 21.5		
c. Hardwoods (DBH Class = Average stems/acre)	5-11 = 62 11-21 = 19 > 21 = 4.5		
d. Multi-layered	conifer overstory (>21 inches), understory dense, pole-sized trees (5-20 inches)		
e. Canopy Cover	87% total		
f. Snags (Average stems/acre = Decay Class)	5-11 inches = 12, 28% = Class 1 11-21 inches = 4, 24% = Class 2 > 21 inches = 3, 48% = Class 3-5		
g. Prey	Woodrats		
h. USFS definition of suitable habitat	>21 inches DBH, >70% cc decadence		

**Table I-2. Overall Habitat Suitability Index Values by Seral Stage and Forest Type
Based upon Attributes Denoted by "(*)"**

SPOTTED OWL:

Douglas-fir						Mixed Conifer				
Cover:	1&2	3A	3B/C	4A	4B/C&5C	1&2	3A	3B/C	4A	4B/C&5C
Feeding:	0	L	L	M	H	0	L	M	M	H
Eastside Mixed Conifer						East & Westside True Fir				
Cover:	1&2	3A	3B/C	4A	4B/C&5C	1&2	3A	3B/C	4A	4B/C&5C
Feeding:	0	L	M	L	H	0	L	M	M	H
Ponderosa Pine										
Cover:	1&2	3A	3B/C	4A	4B/C&5C					
Feeding:	0	L	L	/	/					

Note: Habitat Suitability Index Values were assigned primarily according to local documentation of habitat use. The habitat attributes and corresponding habitat capability values in this model are applicable to the extreme western portion of the Forest. However, vegetative conditions and associated habitat capability differ across the forest and index values were modified accordingly.

The following is the current definition of suitable nesting and roosting habitat for the forest types that occur on the Forest. It was the basis for the analysis of the proposed land management alternatives.

East- and Westside True Fir

1. Elevation - Up to 7,000 feet
2. Overstory - Primary species: white fir, red fir, incense cedar, ponderosa pine and lodgepole pine (eastside)
3. Overstory Tree Size - Average DBH ≥ 15 inches
4. Understory - Typically little to no understory is present
5. Total Canopy Cover - ≥ 60% (*)
6. Dead and Down
 - A) Snags - ≥ 5 per acre, ≥ 15 inches DBH
 - B) Logs - ≥ 5 per acre, ≥ 15 inches DBH at large end

7. Presence of deformed trees desired (mistletoe, heart rot, etc.)
8. Patch Size **

East- and Westside Mixed Conifer

1. Elevation - less than 6,500 feet
2. Overstory - Primary species: Douglas-fir, ponderosa pine, sugar pine, incense cedar, white fir, red fir.
3. Understory - Same species as in the overstory, plus hardwoods on the westside. Hardwood understory not present on the eastside.
4. Overstory tree size - Average DBH ≥ 18 inches
5. Total canopy cover - ≥ 60% (*) (Understory must be open enough to allow for owl movement [see ISC report description; for example, as in the 11-40 description that allows for a person to walk underneath understory]).
6. Dead and Down
 - A) Snags - Minimum 2 per acre with average DBH ≥ 18 inches
 - B) Logs - Minimum 2 per acre with average DBH diameter at large end ≥ 18 inches
7. Presence of deformed trees desired (mistletoe, heart rot, etc.)

8. Patch Size **

Westside Douglas-fir

1. Elevation - 500 - 5,000 feet
2. Overstory - Douglas-fir
3. Understory - Douglas-fir, white fir, ponderosa pine, incense cedar and hardwoods.
4. Overstory tree size - Average DBH \geq 18 inches
5. Total canopy cover - \geq 60% (*) (Understory must be open enough to allow for owl movement [see ISC report description; for example, as in the 11-40 description that allows for an average person to walk underneath understory])
6. Dead and Down A) Snags - Minimum 2 per acre with average DBH \geq 18 inches
 B) Logs - Minimum 2 per acre with average diameter large end average \geq 18 inches
7. Presence of deformed trees desired (mistle-toe, heart rot, etc.)
8. Patch Size **

Ponderosa Pine

1. Elevation - less than 6,000 feet
2. Overstory - ponderosa pine
3. Understory - ponderosa pine, Douglas-fir, incense cedar, hardwoods (westside of the forest)
4. Overstory Tree Size - Average DBH \geq 18 inches
5. Total Canopy Cover - \geq 60% (*)
6. Dead and Down A) Snags - Minimum 2 per acre with average DBH \geq 18 inches.

B) Logs - Minimum 2 per acre with diameter at large end \geq 18 inches.

7. Presence of deformed trees desired (mistle-toe, heart rot, etc.)
8. Patch Size **

* Canopy closure includes all overstory **and** understory cover, regardless of species. All canopy above about 7 to 10 feet will contribute to suitable spotted owl habitat. Some of these components (such as hardwoods) may not be included in the timber typing systems, but do contribute to the total canopy, and are a common feature in owl habitat on the westside of the Forest.

At the lower percentages of canopy cover, other attributes begin to play a larger role. These attributes may include the presence of hardwoods, adjacency to water, other stands of suitable habitat and characteristics of stand (for example, presence of down woody debris, deformed trees, etc.).

** In order of fully evaluate the suitability of patches of habitat, wildlife biologists will need to evaluate factors, such as size of the stand and proximity to adjacent stands of suitable habitat. The closer an adjacent block of habitat, the smaller the patch size may be to be considered as suitable. The greater the distance to adjacent blocks, the larger the patch must be in order to be effective for nesting or roosting. Aspect, elevation and type of habitat available for connectivity are also factors to be considered when making determinations of suitable habitat. No minimum size standard is established on the Forest.

Table I-3. Northern Goshawk Habitat Capability Model (*Accipiter gentilis*)

Species status - sensitive

Season: Year Round Habitat Variable:	High Capability (Optimum)	Moderate Capability (Sub-optimum)	Low Capability (Marginal)
1. Vegetation Type: *	Douglas-fir, east- and westside mixed conifer, east- and westside true fir, ponderosa pine and lodgepole pine.		
2. Seral Stage: * a. Nest/Roost b. Forage	4B,4C (5)*** 1,3A,4A,5A (5)	3B*,3C*,4A** (5) 3B,4B,4C,5B,5C (5)	3A (5) 2,3C (5)
3. Nest Stand Structure:	single-layered (3,8)	single-layered (3,8)	multi-layered (3,8)
4. Area Requirements: * a. Nest stand b. Home range	200-300 acres (1,2,3,8) 8,000 acres (2)	150-200 acres (1,2,3,8) 6,250-8,000 acres (2)	50 acres (1,2,3,8) 1,250-6,250 acres (2)
5. Spacial Distribution Territories:	> 1.0 mile (2)	1.0 - 3.5 miles (2)	> 3.5 miles (2)
6. Distance from Nest to Riparian Area:	< 0.25 miles (3)	0.25-1 miles (3)	1-3 miles (3)
7. Special Habitat Components:	Provide small snags and downed logs upslope and within 250 feet of known nest sites to serve as prey plucking sites. (2)		
8. Disturbance:	Establish disturbance zones out to at least 1/3 mile and eliminate human entry and loud noise-generating activities to reduce the potential for abandonment or nest failure from March 1 to August 31. The size of disturbance zones will vary depending on site-specific conditions such as topography, extent and location of disturbance sources, etc.		
9. Characteristics of Nest Sites:			
a. Canopy Closure *	70% or greater (3,8)	40-70% (3,8)	0-40% (3,8)
b. Aspect	North to East (3)	South to Southeast (3)	Southeast to Northwest (3)
c. Percent Slope	0-40% (2,3)	40-60% (2,3)	>60% (2,3)
d. Openings in Canopy	2 openings ≥ 0.1 ac	1 opening ≥ 0.1 ac	No openings
10. Spacial Distribution of Alternate Nest Sites Within a Territory:	>600 M (8)	600-2,800 M (8)	>2,800 M (8)
11. Characteristics of Nest Trees:			
DBH	27-36" (live tree) (3)	21-27" (live tree) (3)	<21" (live tree) (3)
12. Snag Density:	>4/acre 27-36" DBH	2-4/acre 21-27" DBH	<2/acre <21" DBH
13. Dead and Down: (hard logs)	4+ logs ≥ 27" DBH 10' long/acre within 1/4 mile	3-4 logs ≥ 20" DBH 10' long/acre within 1/4-1 mile	3 logs >10" DBH 10' long/acre within 1-3 mile
* Seral stages 3B and 3C were considered moderate, not high, due to the diameter class, not canopy closure. ** Seral stage 4A was considered moderate, not low, due to the contribution of the understory. *** Refer to the Literature Cited Section at the end of this model description for the references noted inside the paragraphs.			

Table I-4. Overall Habitat Suitability Index Values by Seral Stage and Forest Type Based upon Attributes Denoted by "(*)"

GOSHAWK:

Douglas-fir						Mixed Conifer				
Cover:	1&2	3A	3B/C	4A	4B/C&5C	1&2	3A	3B/C	4A	4B/C&5C
Feeding:	0	0	L	M	H	0	0	L	M	M
	0	M	L	H	H	0	M	L	H	M
Eastside Mixed Conifer						East- and Westside True Fir				
Cover:	1&2	3A	3B/C	4A	4B/C&5C	1&2	3A	3B/C	4A	4B/C&5C
Feeding:	0	0	L	M	H	0	0	L	M	H
	0	M	L	H	H	0	M	L	H	H
Ponderosa Pine										
Cover:	1&2	3A	3B/C	4A	4B/C&5C					
Feeding:	0	L	L	/	/					
	L	M	M	/	/					

Literature Cited for the Northern Goshawk Capability Model

- (1) Bloom, P. H., Stewart, G. R., and B. J. Walton. 1986. The status of northern goshawk in California, 1981-1983. Calif. Dept. Fish and Game. Admin Rept. 85-1. Sacramento, Calif. 26 pp.
- (2) Fowler, C. 1988. Habitat capability model: Northern goshawk. USDA Forest Service, Tahoe National Forest. Nevada City, Calif. 21 pp.
- (3) Hall, P. A. 1984. Characterization of nesting habitat of goshawks (*Accipiter gentilis*) in northwestern California. M. S. Thesis. Humboldt State Univ., Arcata, Calif. 70 pp.
- (4) Kings River Conservation District. 1986. Habitat suitability index model: Northern goshawk (*Accipiter gentilis*). Draft. Res. Rept. No. 85-016. 29 pp.
- (5) Marcot, B. G. 1979. California wildlife habitat relationships program (northcoast/cascade zone). Volume II. Bird Narratives. USDA Forest Service, Six Rivers National Forest, Eureka, Calif.
- (6) USDA Forest Service. 1984. Final Environmental Impact Statement for the Pacific Southwest Regional Guide. Pacific Southwest Region 5, San Francisco, Calif.
- (7) -----, 1986. Proposed land and resource management plan: Shasta-Trinity National Forests. USDA Forest Service, Shasta-Trinity National Forest, Redding, Calif.
- (8) Woodbridge, B. 1988. Personal communication.

Table I-5. Habitat Parameters for Fisher (*Martes pennanti*)

Season: Year round Habitat Parameter: @	High Capability	Moderate Capability	Low Capability
1. Home Range: *	6,000 acres with 8 mile linear limit	9,800 acres > 8 miles but actual limit undefined	11,300 acres > 8 miles but actual limit undefined
2. Seral Stage: * a. Denning/Resting b. Foraging	5 ("old growth"), 4 (mature) 5,4,3 (midsuccession)	5,4 5,4,3	5,4 5,4,3
3. Minimum Stand Size:	>120 ac adjacent to dense canopy >310 ac adjacent to moderate canopy >500 ac adjacent to open canopy	80-119 ac adjacent to dense canopy 120-199 ac adjacent to moderate canopy 200-499 ac adjacent to open canopy	60-79 ac adjacent to dense canopy 80-119 ac adjacent to moderate canopy 120-199 ac adjacent to open canopy
4. Denning/Resting Canopy Closure: *	>80%	61-80%	40-60%
5. Home Range Stand Structure: *	70-80% conifer, large tree, dense canopy	60-70% conifer, large tree, dense canopy	50-60% conifer, large tree, dense canopy
(See ** for definition of tree sizes and canopy cover)	<p>If Unavailable: 50-60% large tree, dense canopy, 20-30% large tree, moderate canopy</p> <p>PLUS</p> <p>25-30% mixcon/hardwood, large tree, moderate canopy</p> <p>If Unavailable: 15-20% large tree, moderate or pole-med tree, dense 10-15% pole-med, dense or pole-med tree, mod.</p> <p>PLUS</p> <p>≤ 5% hardwood/other HW=lg tree, open Other=pole-lg tree, ≥ open canopy</p>	<p>If Unavailable: 40-50% large tree, dense canopy, 20-30% large tree, moderate canopy</p> <p>PLUS</p> <p>25-30% mixcon/hardwood, large tree, moderate canopy</p> <p>If Unavailable: 10-15% large tree, moderate or pole-med tree, dense 10-15% pole-med, dense or pole-med tree, mod.</p> <p>PLUS</p> <p>5-10% hardwood/other HW=lg tree, open Other=pole-lg tree, ≥ open canopy</p>	<p>If Unavailable: 30-40% large tree, dense canopy, 20-30% large tree, moderate canopy</p> <p>PLUS</p> <p>30-40% mixcon/hardwood, large tree, moderate canopy</p> <p>If Unavailable: 15-20% large tree, moderate or pole-med tree, dense 15-20% pole-med, dense or pole-med tree, mod.</p> <p>PLUS</p> <p>10-20% hardwood/other HW=lg tree, open Other=pole-lg tree, ≥ open canopy</p>
<p>Large trees, multi-layered= >50 ft tall, >24" dbh, >1 layer Large trees = >50 ft tall, >24" dbh Pole-Medium trees = 20-50 ft tall, 6-24" dbh lg=large, mod=moderate, med=medium, HW=hardwood, ac=acre Canopy Classes: Dense= ≥70% CC, Moderate= 40-69% CC Open= <40% CC, Unsuitable= <30% CC</p>			
6. Riparian/Wet Meadow Proximity to Denning Resting Habitat:	<1/4-1/2 mile	1/2-1 mile	1-2 miles
7. Vertical Diversity Denning, Resting, Foraging Areas:	3-4 layers + shrubs	2-3 layers + shrubs	2 layers + shrubs
8. Openings without Cover:	<1 acre each	1-2 acres each	2-3 acres each

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9. Minimum Snag Densities: (4-5C stands) (size) a. Denning/Resting (foraging use) b. Other Snags:	≥ 2/acre >44" dbh 4-5/acre >20" dbh	1-2/acre ≥ 30-43" dbh 2-3/acre >20" dbh	0.5-1/acre ≥ 24-29" dbh 1/2-1/acre >15" dbh
10. a. Live Tree Snag: (for dens) b. Replacements: (foraging)	>6/ac >44" dbh 12-15/ac >20" dbh	3-6/ac 30-43" dbh 9-18/ac >20" dbh	1.5-3/ac 24-29" dbh 4.5-9/ac >15" dbh
11. Downed logs: (hunting use)	>4/acre 30"x15'	2-3/acre >20"x15'	1-2/acre >20"x15'
12. Open Road Density:	0-<1/2mi/mi ²	1/2-2mi/mi ²	2-3 mi/mi ²
13. Travel Corridor Width: *	≥ 600 ft. within mature stands ≥ 1,200 ft. adjacent to clearcuts	300-599 ft. within mature stands 600-1,199 ft. adjacent to clearcuts	100-299 ft. within mature stands 300-599 ft. adjacent to clearcuts
14. Travel Corridor Canopy Closure:	>60%	50-60%	40-50%
15. Habitat Spacing Distance: *	≤ 3 miles	3-8 miles	>8-12 miles
<p>@ A full list of the assumptions and references to the Fisher Habitat Capability Model are available at the Forest Supervisor's Office.</p> <p>* Attributes used to base overall habitat suitability index values (refer to Table I-7).</p>			

Table I-6. Habitat Parameters for Marten (*Martes americana*)

Season: Year round Habitat Parameter: @	High Capability	Moderate Capability	Low Capability
1. Home Range: *	1,400 acres	2,100 acres	2,500 acres
2. Seral Stage: * a. Denning/Resting b. Foraging	5 ("old growth"), 4 (mature) 5,4,3 (midsuccession)	5,4 5,4,3	5,4 4,3
3. Minimum Stand Size:	>120 ac adjacent to dense canopy >310 ac adjacent to moderate canopy >500 ac adjacent to open canopy	80-119 ac adjacent to dense canopy 120-199 ac adjacent to moderate canopy 200-499 ac adjacent to open canopy	60-79 ac adjacent to dense canopy 80-119 ac adjacent to moderate canopy 120-199 ac adjacent to open canopy
4. Denning/Resting Canopy Closure: *	>70%	41-70%	30-40%
5. a. Stand Structure	50% large tree, dense canopy	35% large tree, dense canopy	25% large tree, dense canopy
(See * for definition of tree sizes and canopy cover)	If Unavailable: 35% ≥ lg tree, dense canopy 15% ≥ lg tree, mod canopy PLUS 30% ≥ lg tree, mod canopy If Unavailable: 15% ≥ pole-lg tree, mod CC 15% ≥ pole-med tree, mod-dense PLUS 20% ≥ lg tree, open canopy	If Unavailable: 20% ≥ lg tree, dense canopy 15% ≥ lg tree, mod canopy PLUS 45% ≥ lg tree, mod canopy If Unavailable: 25% ≥ lg tree, mod canopy & 20% ≥ pole-med tree, mod-dense PLUS 20% ≥ lg tree, open canopy	If Unavailable: 15% ≥ lg tree, dense 10% ≥ lg tree, mod canopy PLUS 55% ≥ lg tree, mod canopy If Unavailable: 30% ≥ lg tree, mod canopy 25% ≥ pole-med tree, mod-dense PLUS 20% ≥ lg tree, open canopy
b. Basal Area:	>350 ft	176-350 ft	75-176 ft
Large trees, multi-layered=>50 ft tall, >24" dbh, >1 layer Large trees = >50 ft tall, >24" dbh Pole-Medium trees = 20-50 ft tall, 6-24" dbh lg=large, mod=moderate, med=medium, ac=acre Canopy Classes: Dense= ≥70% CC, Moderate= 40-69% CC Open= <40% CC, Unsuitable= <30% CC			
6. Riparian/Wet Meadow Proximity to Closed Canopy Stands:	<1/4 mile	1/4-1/2 mile	1/2-1 mile
7. Vertical Diversity:	No pertinent information available.		
8. Openings:	<1 acre each	1-2 acres each	2-3 acres each
9. Minimum Snag Densities: a. Resting/Denning b. Foraging	≥ 3/acre (>24"dbh) >3/acre (>15"dbh)	2-3/acre (>24"dbh) 3/acre (>15"dbh)	1-2/acre (20-23"dbh) 2/acre (>15" dbh)
10. a. Live Tree Snag: (dens) b. Replacements: (forage)	>9/ac (>24" dbh) >9/ac (>15" dbh)	6-9/ac (>24" dbh) 9/ac (>15" dbh)	3-6/ac (>24") 6/ac (>15" dbh)
11. Dead and Downed logs:	≥20/ac (≥15" x 15')	10-19/ac (≥15" x 15')	5-9/ac (≥15" x 15')

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12. Open Road Densities Paved:	<1 mi/mi ²	1-2 mi/mi ²	2-3 mi/mi ²
13. Travel Corridor: a. Canopy Closure: b. Width *:	>60% >300 ft within mature stands >600 ft adjacent to open/no canopy	50-60% 150-299 ft within mature stands 300-599 ft adjacent to open/no canopy	40-50% 100-149 ft within mature stands 200-299 ft adjacent to open/no canopy
14. Habitat Spacing: *	≤ 2 miles	>2-3 miles	>3-6 miles
<p>@ A full list of the assumptions and references to the Marten Habitat Capability Model are available at the Forest Supervisor's Office.</p> <p>* Attributes used to base overall habitat suitability index values (refer to Table I-7).</p>			

**Table I-7. Overall Habitat Suitability Index Values by Seral Stage and Forest Type
Based upon Attributes Denoted by "(*)"**

FISHER:

Douglas-fir						Mixed Conifer				
Cover:	1&2 0	3A L	3B/C M	4A M	4B/C&5C H	1&2 0	3A L	3B/C M	4A M	4B/C&5C H
Feeding:	L	L	M	M	H	L	L	M	M	H
Westside True Fir										
Cover:	1&2 0	3A L	3B/C L	4A L	4B/C&5C L					
Feeding:	L	L	L	L	L					

MARTEN:

Douglas-fir						Mixed Conifer				
Cover:	1&2 0	3A 0	3B/C L	4A M	4B/C&5C H	1&2 0	3A 0	3B/C L	4A M	4B/C&5C M
Feeding:	0	M	L	H	H	0	M	L	H	M
Eastside Mixed Conifer						East & Westside True Fir				
Cover:	1&2 0	3A 0	3B/C L	4A M	4B/C&5C H	1&2 0	3A 0	3B/C L	4A M	4B/C&5C H
Feeding:	0	M	L	H	H	0	M	L	H	H
Ponderosa Pine										
Cover:	1&2 0	3A L	3B/C L	4A /	4B/C&5C /					
Feeding:	L	M	M	/	/					

Table I-8. Black-tailed Deer Habitat Capability Model (*Odocoileus hemionus columbianus*)
Species status - Harvest

Season: Year Round	High Capability (Preferred)	Moderate Capability (Required)*	Low Capability (Marginal)
Habitat Variable:			
1. Vegetation Type:	Douglas-fir, east- and westside mixed conifer, east- and westside true fir, ponderosa pine.		
a. Cover *	2BC, 3BC, 4BC, 5	3A, 4A	1, 2
b. Forage *	1, 2, 3A	3B, 4A	3BC, 4BC
2. Riparian Minimum Width: (Key habitat for fawning/thermal cover)	300 ft.	100 ft.	<100 ft.
3. Forage Area Distance (center) to cover with young:	<300 yds (3)** <150 yds (2,4)	300-500 yds (3) 150-250 yds(2,4)	>500 yds.(3) >250 yds (2,4)
4. Forage Patch Size:			
a. Winter	>160 ac. (2)	100-160 ac.(2)	<100 ac.(2)
b. Summer	1-4 ac.(1,2)	4-10 ac.(1,2)	.10 ac.(1,2)
5. Cover Stand Size: (1,2,4)	20-60 ac.	60-100 ac.	<20 ac >100 ac.
6. Cover Canopy Density: *	60-80% (4,5)	40-60% 80-100% (4,5)	<40% (4,5)
7. Forage Cover Density: (Herb, Shrub)	20-40% (4)	10-20% 40-60% (4)	<10% >60% (4)
8. Forage, Hardwood Basal Area Per Acre: * (6)	25- +35 sq. ft.	15-25 sq. ft.	< 15 sq. ft.
9. Road Density: *	<1.5 mi./sec (4,5)	1.5-3.0 mi./sec (4,5)	>3.0 mi./sec (4,5)
10. Distance to Water:	<0.5 mi. (1,4)	0.5-1.0 mi.(1,4)	>1.0 mi. (1,4)
11. Slope:	0-15% (1,4)	16-60% (1,4)	61-100% (1,4)
* Values of moderate or high capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.			
** Refer to the Literature Cited Section at the end of this model description for the references noted inside the paragraphs.			

Table I-9. Overall Habitat Suitability Index Values by Seral Stage and Forest Type Based upon Attributes Denoted by "(*)"

BLACK-TAILED DEER:

Douglas-fir						Mixed Conifer				
Cover:	1&2	3A	3B/C	4A	4B/C&5C	1&2	3A	3B/C	4A	4B/C&5C
Feeding:	M	M	M	M	M	L	L	M	L	H
	H	M	M	M	M	H	M	M	M	L
Eastside Mixed Conifer						East- and Westside True Fir				
Cover:	1&2	3A	3B/C	4A	4B/C&5C	1&2	3A	3B/C	4A	4B/C&5C
Feeding:	L	L	M	L	M	O	L	M	L	H
	H	M	M	M	L	H	M	L	L	L
Ponderosa Pine										
Cover:	1&2	3A	3B/C	4A	4B/C&5C					
Feeding:	L	L	M	/	/					
	M	M	M	/	/					

Literature Cited for Black-tailed Deer Habitat Capability Model

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- (2) Marcot, B.G. 1979. California Wildlife Habitat Relationships Program: North Coast - Cascades Zones. Vol. III,IV, mammal narrative and species/habitat matrix. USDA Forest Service, Pacific Southwest Region. San Francisco, Calif. 540 pp.
- (3) Shimamoto, K. and D. Airola. 1981. Fish and wildlife capability models and special habitat criteria for the northeast zone National Forest. Pacific Southwest Region, USDA Forest Service. San Francisco, Calif. 260 pp.
- (4) USDA Forest Service. 1982. Deer habitats in California: deer ecology and habitat relationships models for inventory, planning and management. Salwasser, H. et al, editors. USDA Forest Service, Pacific Northwest Region. San Francisco, Calif. 40 pp.
- (5) _____, 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. Brown, E. R., editor. USDA Forest Service, Pacific Northwest Region. San Francisco, Calif. 332 pp.
- (6) California Dept. Fish and Game, 1989. Interim Wildlife/Hardwood Guidelines. Unpublished manuscript. 6 pp.

Table I-10. Pronghorn Habitat Capability Model

Habitat Variable:	High Capability	Medium Capability
1. Vegetation Types: (2)	Low sagebrush, big sagebrush, bitterbrush, perennial grass, wet meadow, annual grassland	Western juniper
2. Shrub Age Class: a. Summer b. Winter	Young, Mature Mature	Seedling Young, Decadent
3. Height of Dominant Vegetation: (1,4)	10-20 inches	5-10 inches or 20-30 inches
4. Shrub Canopy Closure: (1,3,4) a. Summer b. Winter	10-30% 20-50%	<10% or 30-50% 50-70%
5. Tree Canopy Closure: (3,4)	0-10%	10-20%
6. Percent of Forbs in Ground Cover: (1,4)	10-30%	7-10% or 30-50%
7. Average Distance between Free Water: (1,3,4)	<2 miles	2-3.5 miles
8. Road Density: (3,4)	<2 mi/mi ²	2-4 mi/mi ²

Literature for Pronghorn Habitat Capability Model:

(1) Kindschy, R. R.; C. Sundstrom, and J. Yoakum. 1978. Range/wildlife inter-relationships - pronghorn antelope. *In*: Barrett, M. W. (ed)., Proc. of the Eight Pronghorn Antelope Workshop. 8:216-262.

(2) Laudenslayer, Jr. W. F. California wildlife habitat relationships program: Northeast Interior Zone. Vol. 1 - Species/habitat matrix. USDA Forest Service. Region 5.

(3) Salwasser, H. J. Professional judgement. Regional Wildlife Ecologist. Pacific Southwest Region.

(4) Salwasser, H. 1980. Pronghorn antelope population and habitat management in the northwestern great basin environments. Interstate Antelope Conference Guidelines. 63p.

Table I-11. Mule Deer Habitat Capability Model (*Odocoileus hemionus*)

Habitat Variable:	High Capability (Preferred)	Medium Capability (Required)
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COVER STANDS

1. Vegetation Types and Successional Stages:	Ponderosa pine (2,3B&C,4B&C,5), mixed conifer (2,3B&C,4B&C,5), red fir (2,3B&C,4B&C,5), western juniper, riparian deciduous, mountain mahogany, aspen	Lodgepole pine (2,3A,4A), ponderosa pine (2,3A,4A), mixed conifer (2,3A,4A), white fir (2,3A,4A), red fir (2,3A,4A), montane shrubs, bitterbrush, big sagebrush
2. Stand Size:	20-60 acres	10-20 acres or 60-120 acres
3. Canopy Closure: a. Shrubs b. Trees	50-85% >40%	30-50% or 85-90% 20-40%
4. Shrub Age Class:	Mature	Decadent

FORAGE STANDS

1. Vegetation Types and Successional Stages:	Riparian deciduous, montane shrubs, mountain mahogany, aspen, bitterbrush, wet meadow, perennial & annual grass/forbs, seedling/sapling stage of all conifers	Big sagebrush, low sagebrush, ponderosa pine (2,3A,4A), wetlands, red fir, mixed conifer (2,3A,4A), western juniper
2. Distance to Cover:	< 400 yds	400-550 yds
3. Canopy Closure: a. Shrubs b. Trees	10-40% <20%	<10% or 40-80% 20-40%
4. Shrub Age Class:	Young	Mature or Seedling
5. Proportion of Area in Forage Stands:	50-80%	30-50% or 80-90%
6. Livestock Utilization:	Moderate to Light	Light to no grazing
7. Roads:	<2.5 mi/mi ²	2.5-6 mi/mi ²
8. Distance Between Water:	<2 miles	2-3 miles

Table I-12. Black Bear Habitat Capability Model (*Ursus americanus*)

Season: Spring Territory: March-June Habitat Variable:	High Capability (Preferred)	Moderate Capability (Required)*	Low Capability (Marginal)
1. Vegetation Type: *	Douglas-fir, east- and westside mixed conifer, east- and westside true fir, ponderosa pine, lodgepole pine.		
2. Road Density: * (Open, paved)	<0.5 mi/section (3,4)***	0.5-2 mi/section (3,4)	>2 mi/section (3,4)
3. Riparian:	<0.25 mi. to open water (2)	0.25-0.5 mi. to open water (2)	0.5-2 mi. to open water (2)
4. Distance from escape cover:	<100 yards (3,4)	100-150 yards (3,4)	>150 yards(3,4)
5. Disturbance:	Residents, campgrounds and roads cause a variety of disturbances. Roads allow poacher to access bear habitat. Logging operations should avoid wetland or low elevation areas during spring. High elevation sites should be minimized in late summer.		
6. Home Range: (Sow with cubs)	0.5-1.5 sq.mi.(6)	1.5-2 sq.mi.(6)	2-5 sq.mi.(6)
7. Dead and Down Woody Material: (various stages of decay) (7)	10-15/acre $\geq 20"$	5-10/acre $\geq 20"$	<5/acre $\geq 20"$
8. Oaks: **	>21 sq.ft./ac >50% crown cover(4)	10-20 sq.ft./ac 30-50% crown cover (4)	<9 sq.ft./ac <30% crown cover (4)
<p>* Values of moderate or high habitat capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.</p> <p>** One-half of the oaks will be over 14 inches DBH and the remainder will be in the smaller size class, serving as replacement for the larger size classes.</p> <p>*** Refer to the Literature Cited Section at the end of this model description for the references noted inside the paragraphs.</p>			

Table I-13. Black Bear Habitat Capability Model (*Ursus americanus*)

Season: Winter (Jan-Feb) Habitat Variable:	High Capability (Preferred)	Moderate Capability (Required)*	Low Capability (Marginal)
1. Vegetation Type: (2,3) **	Same.		
2. Road Density: *	<0.5 mi./section (3,4)	0.5-1.5 mi. (3,4)	>1.5 mi. (3,4)
3. Den Sites:	Hollows in large trees, stumps and large downed logs (2,3)	Caves (2,3)	Holes dug in the ground (2,3)
<p>* Values of moderate or high habitat capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.</p> <p>** Refer to the Literature Cited Section at the end of this model description for the references noted inside the paragraphs.</p>			

**Table I-14. Territory Requirements for Black Bear
Year-Round Components That Must Exist in Each Territory**

	High	Medium	Low
Adult Males: (3,4)	1-4 sq.mi.	4-10 sq.mi.	>10 sq.mi.
Sows with Cubs:	1-2 sq.mi.	4-6 sq.mi.	>6 sq.mi.
Sows without Cubs:	1-4 sq.mi.	2-5 sq.mi.	>5 sq.mi.
Sub-adults 4 years old: (3,4)	1-8 sq.mi.	8-10 sq.mi.	>10 sq.mi.

Table I-15. Overall Habitat Suitability Index Values by Seral Stage and Forest Type Based upon Attributes Denoted by "(*)"

BLACK BEAR:

Douglas-fir						Mixed Conifer				
Cover:	1&2 L	3A L	3B/C M	4A M	4B/C&5C M	1&2 L	3A M	3B/C M	4A M	4B/C&5C M
Feeding:	M	M	H	H	M	M	M	M	M	M
Eastside Mixed Conifer						East- and Westside True Fir				
Cover:	1&2 L	3A L	3B/C L	4A M	4B/C&5C M	1&2 0	3A 0	3B/C L	4A M	4B/C&5C H
Feeding:	M	M	L	L	L	0	M	L	H	H
Ponderosa Pine										
Cover:	1&2 0	3A L	3B/C L	4A /	4B/C&5C /					
Feeding:	L	M	M	/	/					

Literature Cited for Black Bear Habitat Capability Model:

- (1) Brown, E. R. (Tech. Ed.). 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. USDA Forest Service Publication No. R6-F&WL-192-1985.
- (2) Jacobson, S. 1986. Black bear habitat capability model. USDA Forest Service, Shasta-Trinity National Forests. Redding, Calif. 20 pp.
- (3) Marcot, B.G. 1979. California wildlife relationships program (northcoast/cascade zone). Vol. III, IV, Mammal Narratives/Habitat Matrix. USDA Forest Service, Pacific Southwest Region. San Francisco, Calif.
- (4) Miller, K. 1984. Draft habitat suitability index model: black bear (*Ursus americanus*). USFWS Div. of Ecological Services. Sacramento, Calif. 10 pp.
- (5) Rogers, L. & A. W. Allen. 1987. Habitat suitability index models: black bear, upper great lakes region. USDI Fish and Wildlife Service. Fort Collins, Colo. 54 pp.
- (6) Shimamoto, K., & D. Airola. 1981. Fish and wildlife habitat capability models and special habitat criteria for the northeast zone National Forests. USDA Forest Service. 260 pp.
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**Table I-16. Riparian Habitat Capability Model
(Rivers, Streams)**

Management Indicator Species: Common merganser, Dipper, Winter wren, Yellow-breasted chat, Tailed frog, Ruffed grouse. *

Season: Year Round	High Capability (Preferred)	Moderate Capability (Required)**	Low Capability (Marginal)
Habitat Variable:			
1. Vegetation Type: (2,3)	Riparian Deciduous		
2. Seral Stages: (2)	All		
3. Riparian Management Zone (RMZ): ** (Distance horiz. from high water)	>200 ft.	100-200 ft. NFMA direction	< 100 ft.
4. Water Temperature: (5)	6.5-15 degrees C	15-25 degrees C	> 25 degrees C
5. Dead and Down: (1,2,7)	log class 1,2 (2/ac.) log class 3,4,5 (5/ac.) > 17" & 20 ft	log class 1,2 (<2/ac.) log class 3,4,5 (<5/ac.) <17" & < 20 ft.	
6. Snags: (1,4,5,7)	>4/ac. >25" DBH	1.5-4/ac. 15-25" DBH	<1.5/ac. <15" DBH
7. Snag Height: (1,3,4,5,7)	>20 ft.	10-20 ft.	<10 ft.
8. Snag Recruitment Potential:	>6/ac. >24" DBH	2.5-6/ac. >24" DBH	<2.5/ac >24" DBH
9. RMZ Grass and Forb Production: (4) Under season-long grazing systems, % of the natural site potential that is <i>not</i> utilized: Under early or late season grazing systems, % of the natural site potential that is <i>not</i> utilized:	>80% >25%	50-80% 15-25%	<50% <15%
10. Shrub and Cover Production: (4) Maintain % of the natural site potential for cover and production: (Maintian complexity along edges)	>80%	50-80%	<50%
11. RMZ Tree Cover: ** (4) Maintain % of the natural site potential: (For sites that potentially produce <20 trees/acre, 100% of the potential is the minimum).	>80%	50-80%	<50%
12. Special Habitat Component: (2,3,6)	Some standing pools. Banks with some talus.		
13. Special Restrictions: (1,7)	Restrict road construction in RMZ. Special caution with prescription burning on adjacent managed lands.		

**Table I-16. Riparian Habitat Capability Model (Continued)
(Rivers, Streams)**

Management Indicator Species: Common merganser, **Dipper**, Winter wren, Yellow-breasted chat, **Tailed frog**, Ruffed grouse. *

Season: Year Round Habitat Variable:	High Capability (Preferred)	Moderate Capability (Required)**	Low Capability (Marginal)
14. Seasonal Restrictions: (2,3)	Restrict disturbance during breeding season February 1 to September 15		
15. Territory/Home Range: (2) (River length)	> 8 mi.	6-8 mi.	<6 mi.
* Bolded species are Klamath National Forest management indicator species. ** Values of moderate or high capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.			

**Table I-17. Riparian Habitat Capability Model
(Marsh, Ponds, Lakes)**

Management Indicator Species: Red-legged frog, Western pond turtle, Wood duck.*

Season: Year Round	High Capability (Preferred)	Moderate Capability (Required)**	Low Capability (Marginal)
Habitat Variable:			
1. Vegetation Type: (2)	Riparian Deciduous (especially oaks)		
2. Seral Stages: (2)	All		
3. Upland Territory Size: (3,5)	>500 ac.	200-500 ac.	<200 ac.
4. Dead and Down: (1)	log class 1,2 (hard) >2/ac. log class 3,4,5 (soft) >5/ac.	log class 1,2 (hard) 1-2/ac. log class 3,4,5 (soft) 3-5/ac.	log class 1,2 (hard) <1/ac. log class 3,4,5 (soft) <3/ac.
5. Snags: (1,5,7)	>4/ac. >25" DBH >50 ft. < 183 m. from water	1.5-4/ac. 16-24" DBH 20-50 ft. 183-350 m. from water	<1.5/ac. <16" DBH <20 ft. >350 m. from water
6. Cover:Water Ratio (5)	50:50 to 75:25	25:75 to 50:50	<25:75
7. Canopy Closure: ** (2)	100-70%	70-50%	<50%
8. Special Habitat Components: (2,3,5)	Habitat occupancy and reproductive success for wood duck can be increased with the placement of artificial nest boxes. Numerous loafing sites and/or partially submerged logs. Emergent vegetation (cattails, bullrush, sedges, etc.) covering at least 50% of the water body.		
* Bolded species are Klamath National Forest management indicator species. ** Values of moderate or high capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.			

Literature Cited for the Riparian Habitat Capability Model:

- (1) Brown, E. Reade (ed.). 1985. Management of fish and wildlife habitats in forests of Western Oregon and Washington. Parts 1 & 2 - Chapter Narratives & Appendices. USDA Forest Service, Pacific Northwest Region, Portland, Oregon. 634 pp.
- (2) Marcot, B.G. (ed.). 1979. California wildlife habitat relationships program: North Coast Cascades Zone. Vols. I, II, IV - Herp/Bird narratives, species/habitat matrix. USDA Forest Service. Six Rivers National Forest.
- (3) Nussbaum, R.A., E.D. Brodie, Jr. and R.M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. Moscow, Idaho. The University Press of Idaho. 332 pp.
- (4) Shimamoto, K., Airola, D. (ed.). 1981. Fish and wildlife habitat capability models and special habitat criteria for the northeast zone National Forests. USDA Forest Service, Region 5, Modoc National Forest. 260 pp.
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(6) Stebbins, R.C. 1985. Western reptiles and amphibians. Boston, Massachusetts. Houghton Mifflin Company. 336 pp.

(7) Thomas, J.W. (ed.). 1979. Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington. USDA Forest Service, Agriculture Handbook No. 553, Pacific Northwest Region. Portland, Oregon. 512 pp.

Table I-18. Cavity Nesting and Decadence Wildlife Assemblage (Snags)

Management Indicator Species: Douglas squirrel, Brown creeper, **Red-breasted sapsucker**, **White-headed woodpecker**, **Hairy woodpecker**, **Downy woodpecker**, Screech owl, Flammulated owl, Western bluebird, **Vaux's swift** *

Season: Year Round	High Capability (Preferred)	Moderate Capability (Required)**	Low Capability (Marginal)
Habitat Variable:			
1. Vegetation Type: **	Douglas-fir, east- and westside mixed conifer, east- and westside true fir, ponderosa pine, lodgepole pine.		
2. Snag Density: (5,6)	≥5/acre	2.8-5.45/acre	≤2.80/acre
3. Future (cull) Replacement Densities: (18-28" DBH) (2)	>5.76/acre	2.31-5.76/acre	<2.31/acre
4. Snag Characteristics: (5) a. Height b. DBH	>31 feet >20 inches	6-31 feet 10-20 inches	<6 feet <10 inches
5. Dispersion and spatial distribution: (snags >9"DBH) (3)	One group per 5 acres or less with 15 snags	One group per 5-15 acres, with 5-15 snags	Even dispersion
6. Hard:Soft Ratio: (3)	>3:1	2:1 - 3:1	<2:1
7. Snag Location: (3)	Edges of meadows, brushfields, and riparian areas	Throughout wooded stands	Rocky, open slopes, barren areas
* Bolded species are Klamath National Forest management indicator species. ** Values of moderate or high capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.			

Literature Cited for the Cavity Nesting and Decadence Wildlife Assemblage:

(Note: The numbered references are cited within the various assemblages. The unnumbered references below them provide background information relating to these assemblages.)

1. USDA Forest Service. 1979. California Wildlife/Habitat Relationships Program

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Bauer, R. 1967. Blue grouse habitat management plan. Mendocino National Forest. 18pp.

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Table I-19. Hardwood Wildlife Assemblage**Management Indicator Species: Western gray squirrel, Acorn woodpecker, Scrub jay, Lazuli bunting.**

*

Season: Year Round	High Capability (Preferred)	Moderate Capability (Required)**	Low Capability (Marginal)
Habitat Variable:			
1. Vegetation Type: ** (12) ***	Oregon oak, mixed conifer, Douglas-fir		
2. Seral Stages:	All		
3. Fire Occurance: (9)	low intensity < every 5 years	low intensity < every 10 years	low intensity > every 10 years
4. Age: (2)	80-200	30-80	<30, >200
5. Snags: (13) a. Density b. DBH c. Height	>0.7/ac >17" >30'	0.7-0.19/ac 15-17" 20-30'	<0.19/ac <15" <20'
6. Snag Dispersion: (6)	One group per 5 acres or less with 15 snags	Even Dispersion	One group per >5 acres with <15 snags
7. Dead and Down:	Retain natural amounts and distribution of dead and down.		
8. Tree Diameter: (4)	>14" DBH	<14" DBH	
9. Oak Stand Size: (1,11)	>5 ac	0.5-5 ac	<0.5 ac
10. Average Basal Area: (5) Other oak areas	>30 sq.ft./acre [>28 stems/acre 14" DBH; or >13 stems/acre >20" DBH]	10-30 sq.ft./acre [10-28 stems/acre 14" DBH; or 5-13 stems/acre >20" DBH]	<10 sq.ft./acre <10 stems/acre 14" DBH; or <5 stems acre >20" DBH]
11. Crown Cover Proportion in Oaks: (1)	>50	25-50	<25
<p>* Bolded species are Klamath National Forest management indicator species.</p> <p>** Values of moderate or high capability are needed for long-term viability. Values of low habitat capability do not represent acceptable reproductive habitat.</p> <p>*** Refer to the Literature Cited Section at the end of this model description for the references noted inside the paragraphs.</p>			

Literature Cited for the Hardwood Wildlife Assemblages:

(Note: The numbered references are cited within the various assemblages. The unnumbered references below them provide background information relating to these assemblages.)

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Appendix I - Wildlife Habitat Capability Models

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Table I-20. Elk Habitat Effectiveness Model (*Cervus elaphus roosevelt*)
Species Status - Harvest

Habitat effectiveness for elk is calculated via the following equation: $HE_{SRCF} = (HE_S \times HE_R \times HE_V \times HE_F)^{1/N}$		
where:	$HE_{SRCF} =$ $HE_S =$ $HE_R =$ $HE_C =$ $HE_F =$ $^{1/N} =$	habitat effectiveness index considering the interaction of HE_S , HE_R , HE_C , and HE_F where: habitat effectiveness index derived from sizing and spacing of forage and cover areas. habitat effectiveness index derived from the density of roads open to vehicular traffic. habitat effectiveness index derived from the quality of cover. habitat effectiveness index derived from the quality of forage, and Nth root of the product taken to obtain the geometric mean where N = the number of habitat variables.

Literature Cited for the Elk Habitat Effectiveness Model:

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