Appendix A

Alternative Maps

Figure 1. Payette National Forest - Alternative 1b, 2, 5, and 7

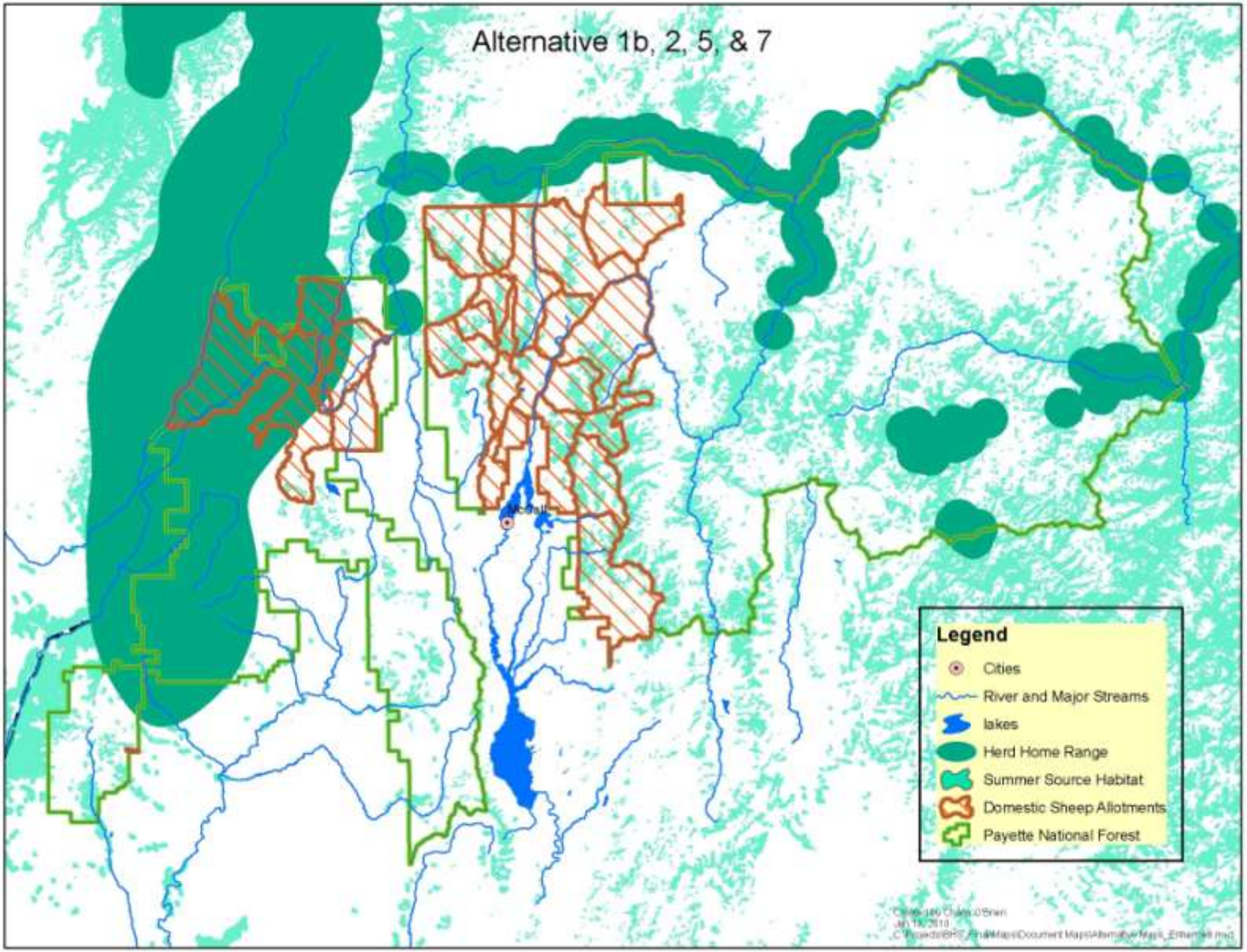


Figure 2. Payette National Forest - Alternatives 3, 4 and 6

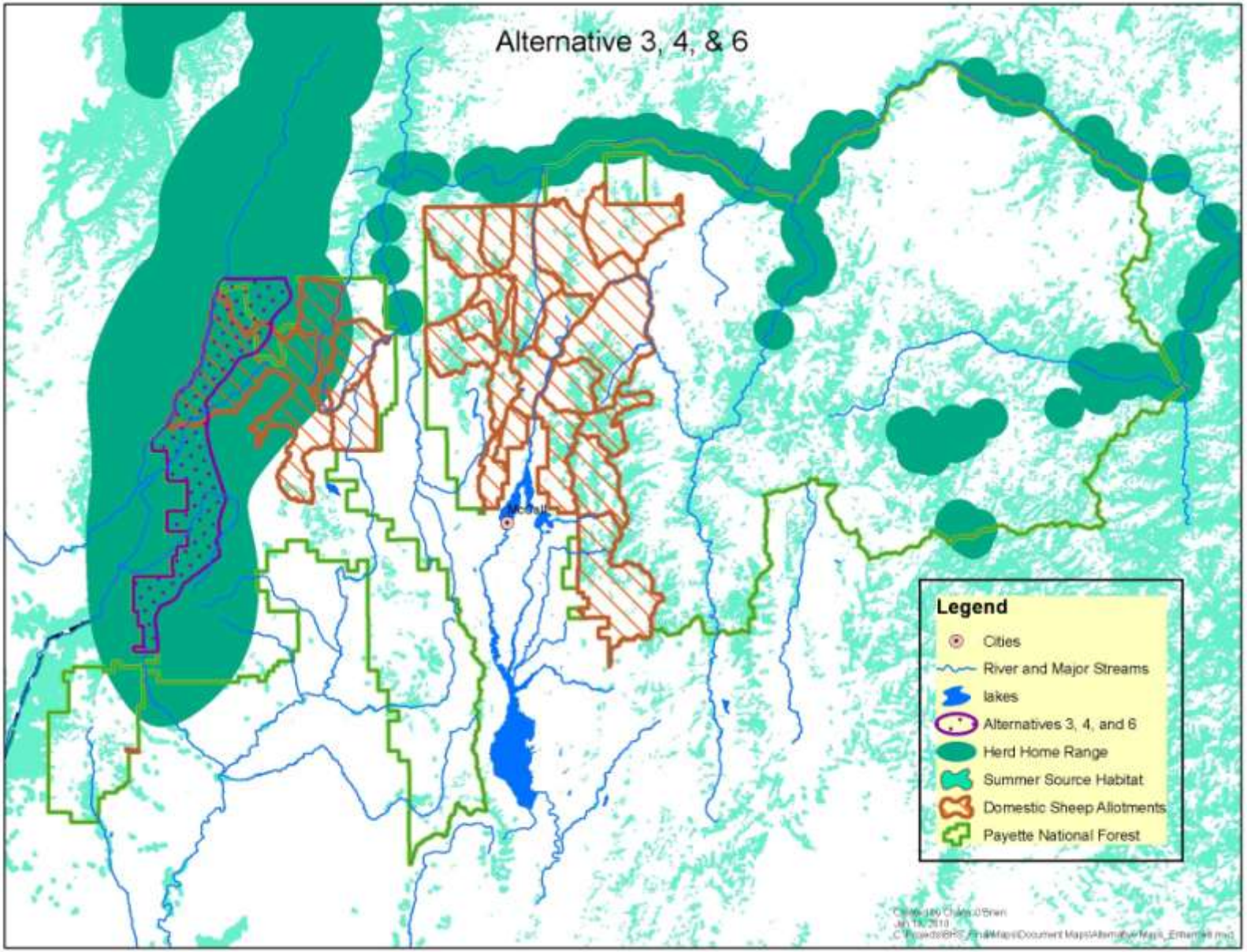


Figure 3. Payette National Forest - Alternative 7E

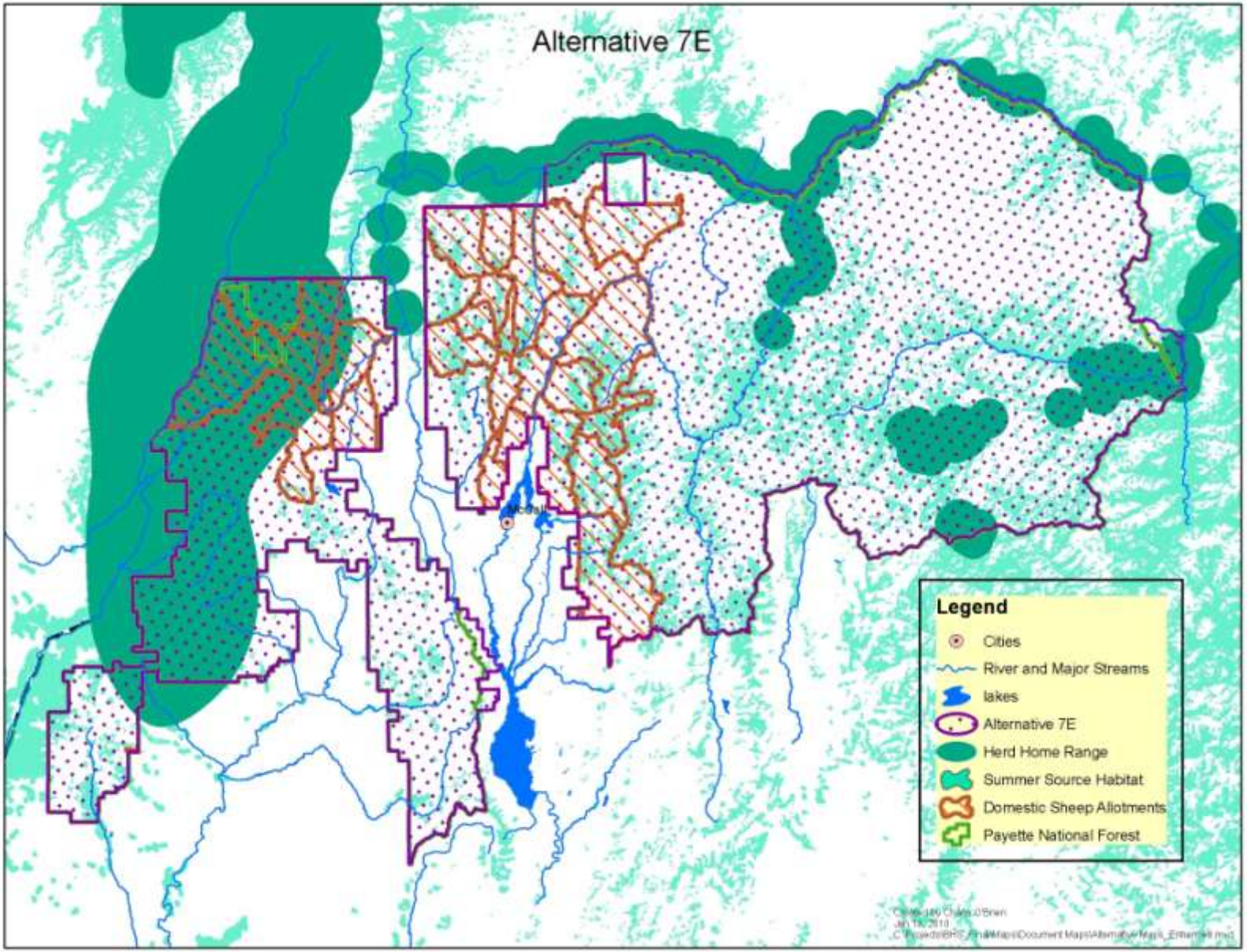


Figure 4. Payette National Forest - Alternative 7G

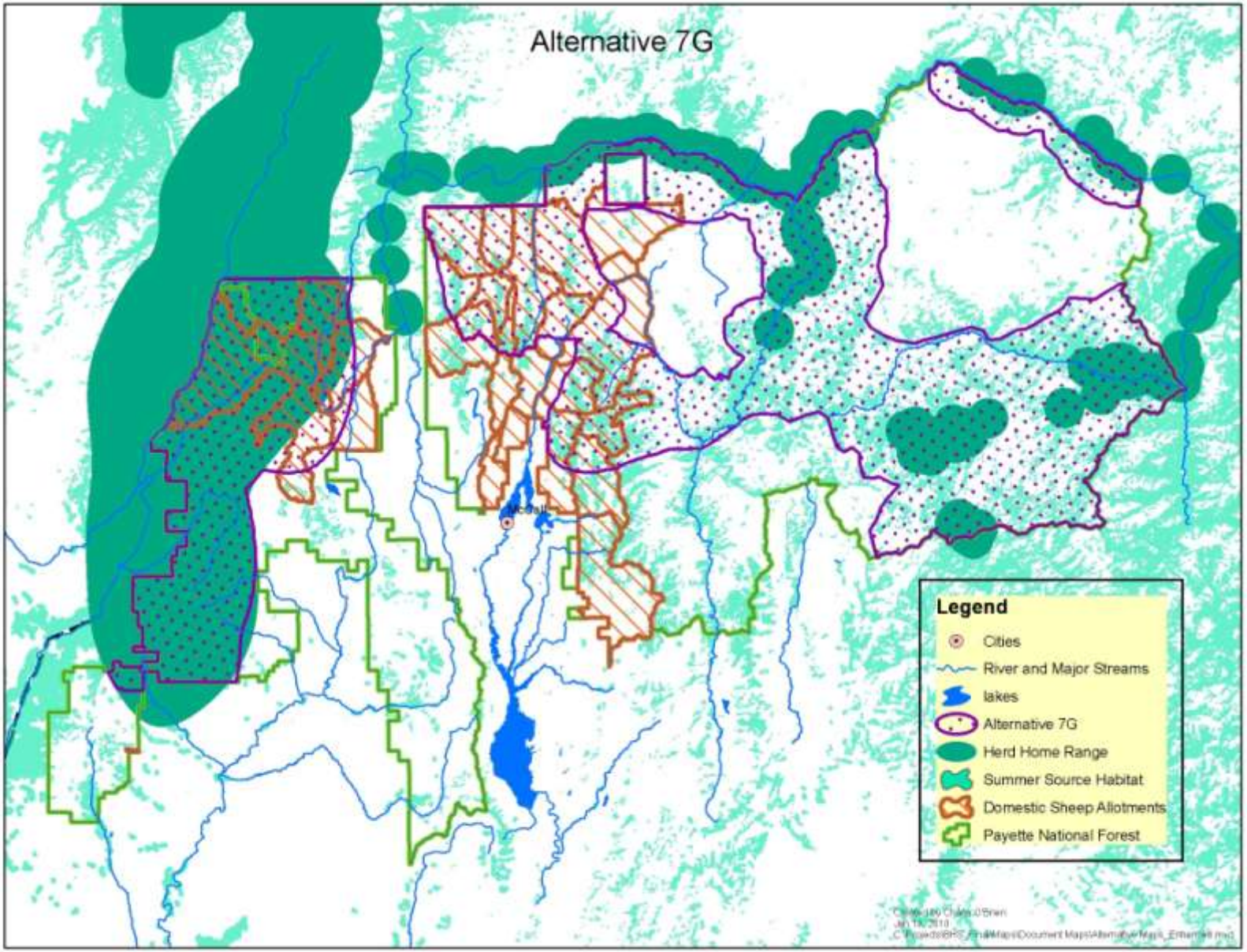


Figure 5. Payette National Forest - Alternative 7L

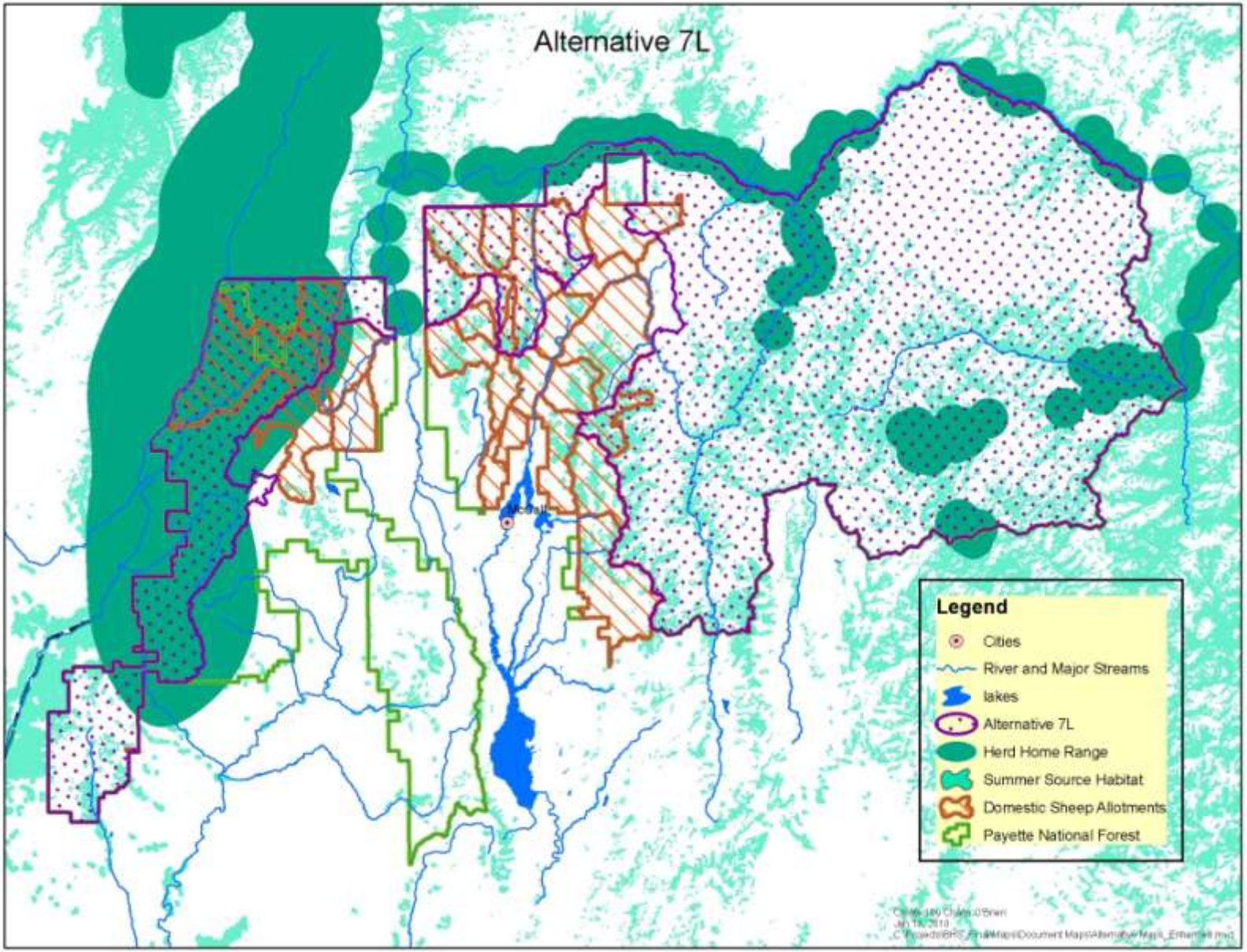


Figure 6. Payette National Forest - Alternative 7M

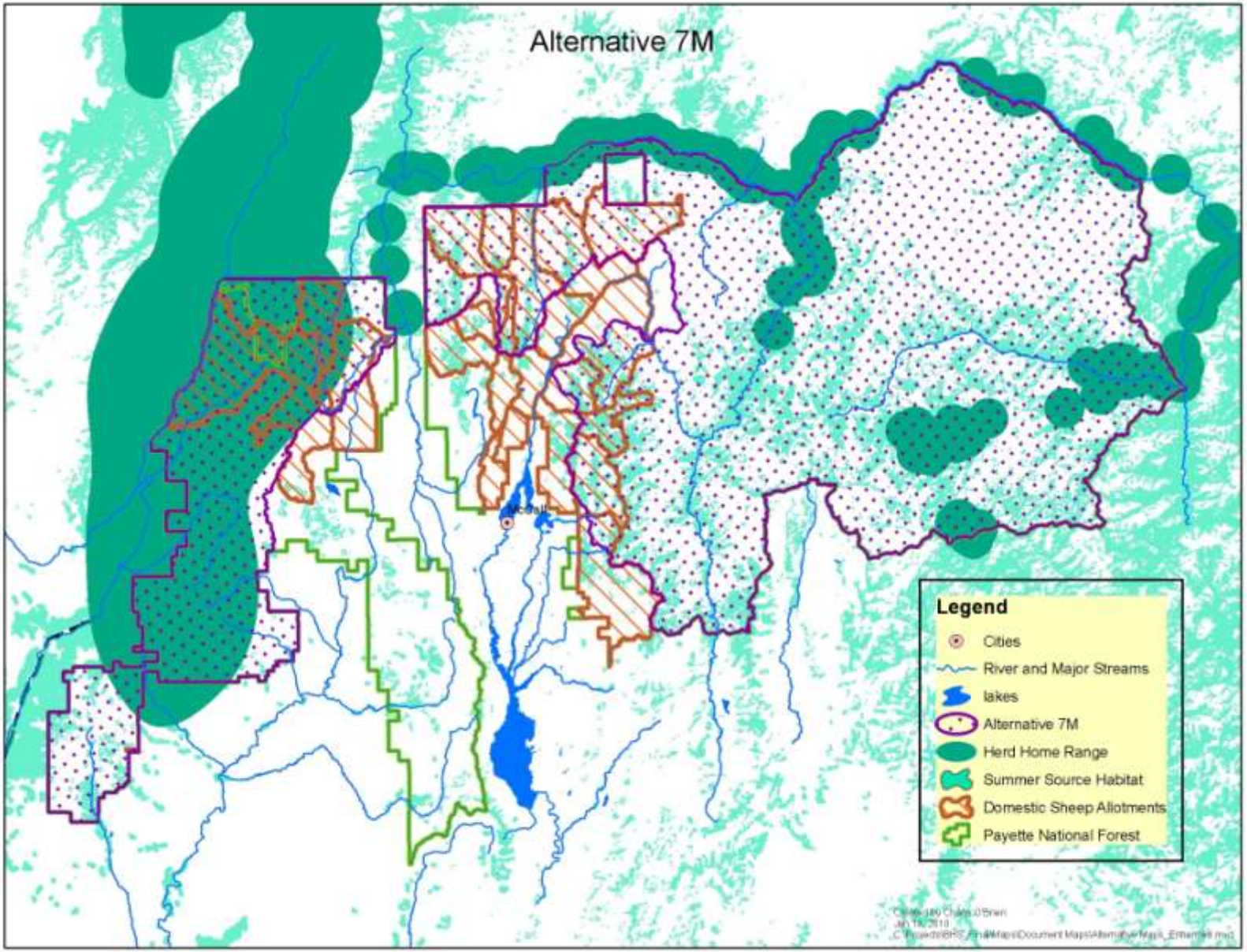


Figure 7. Payette National Forest - Alternative 7N

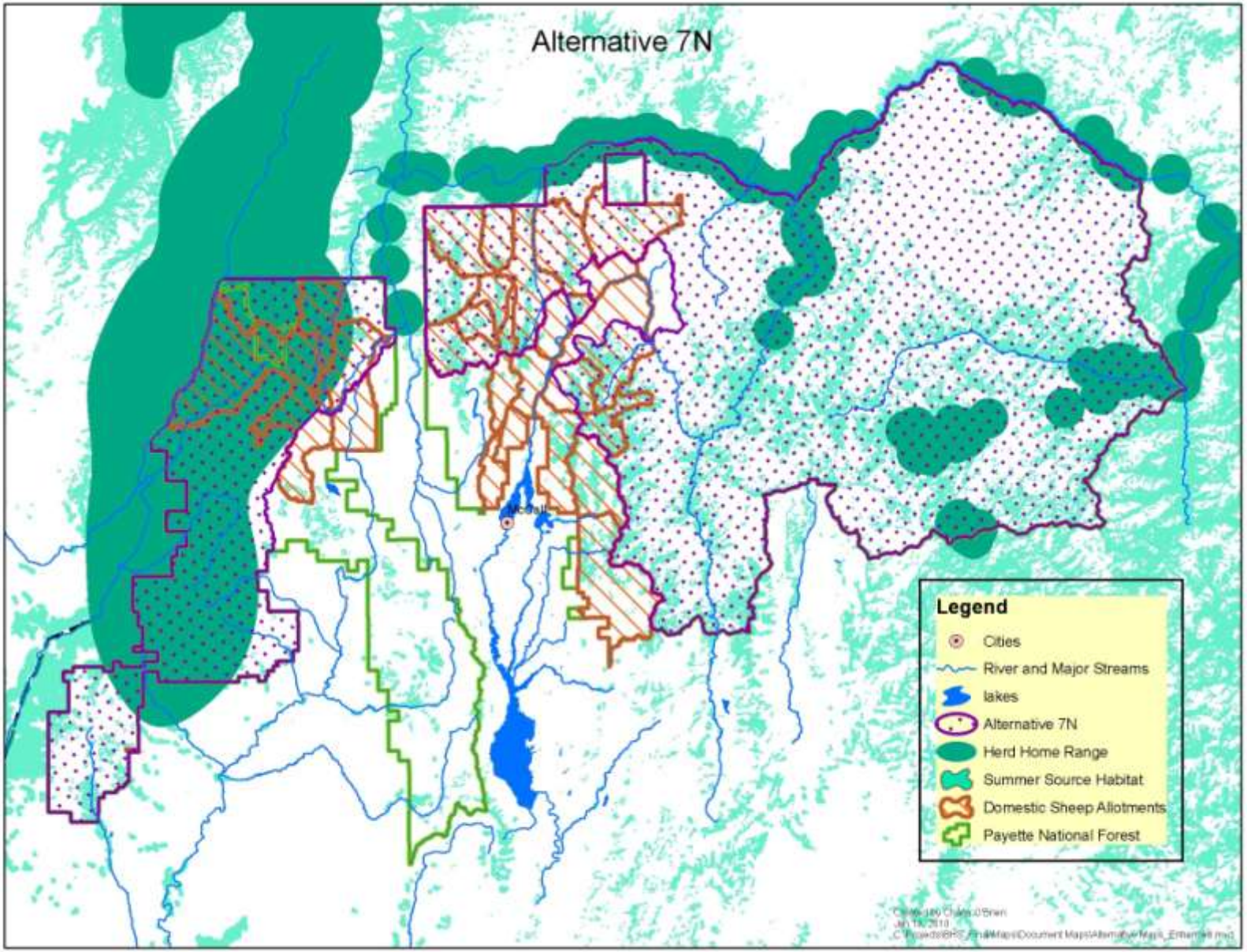


Figure 8. Payette National Forest - Alternative 7O

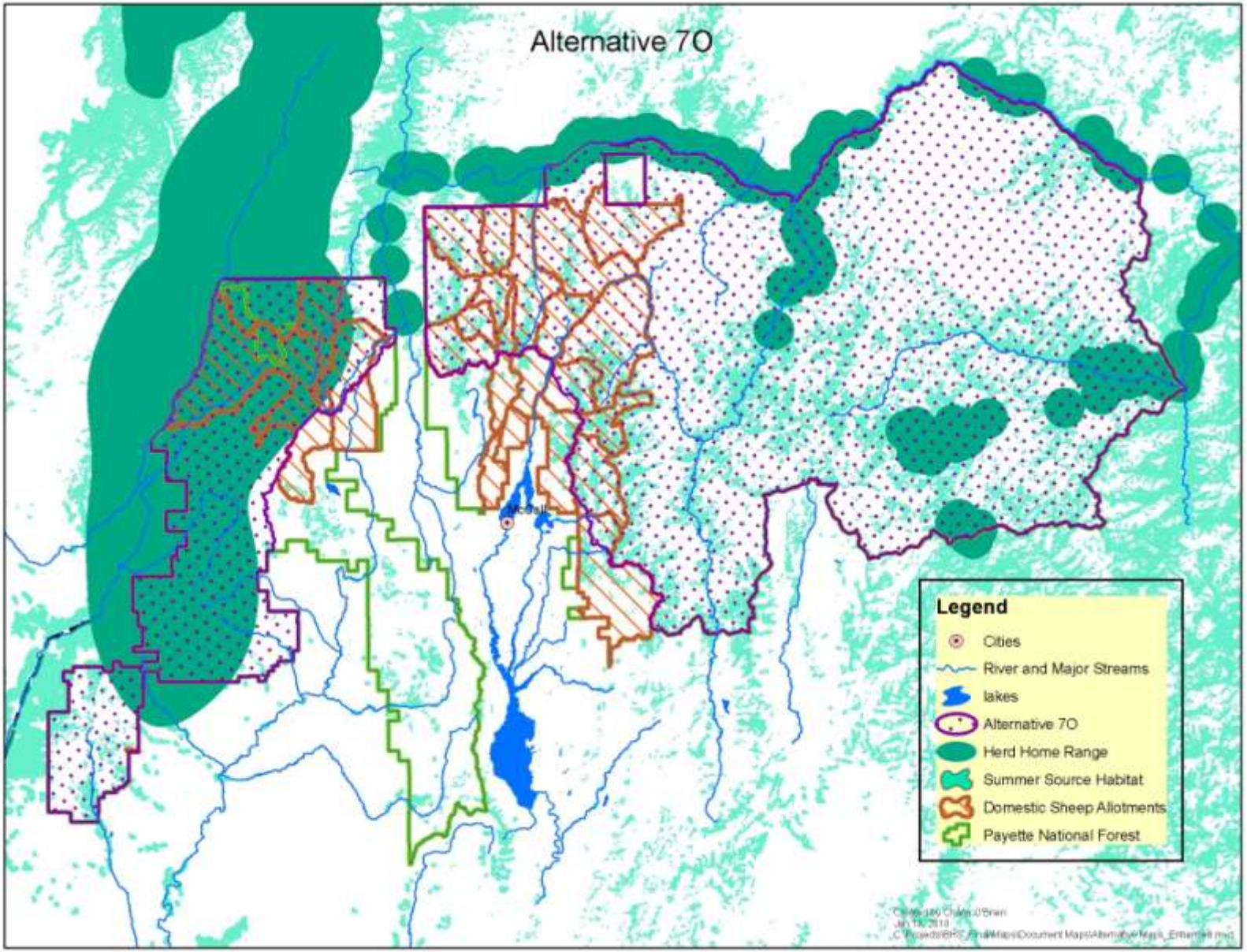
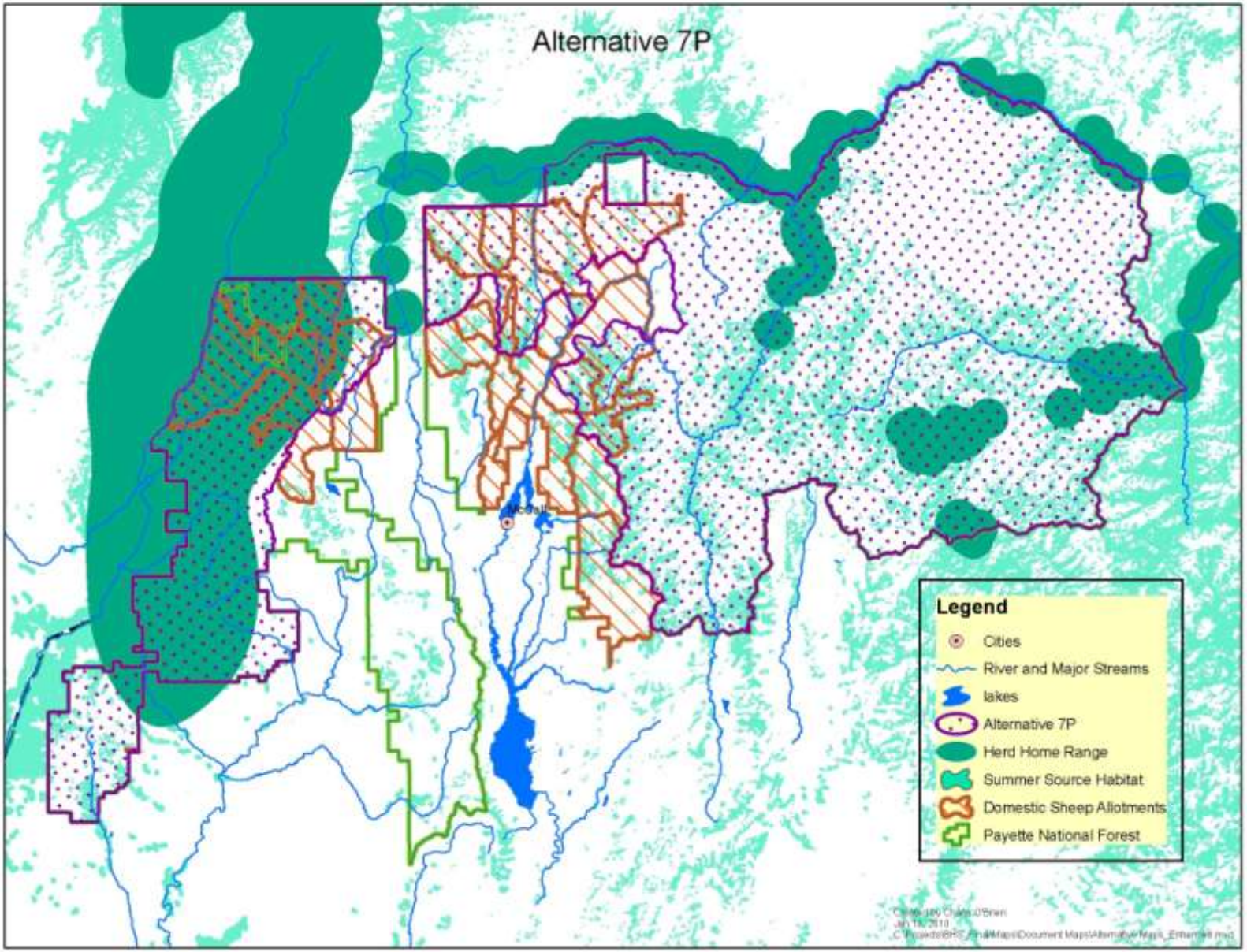


Figure 9. Payette National Forest - Alternative 7P



Appendix B

Modeling and Analysis Technical Report

Bighorn Sheep
Supplemental Environmental Impact Statement Analysis: Modeling and Analysis Technical Report

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1.0 Introduction

In response to a Payette National Forest Land and Resource Management Plan (Forest Plan) (USDA Forest Service 2003a) appeal remand by the Washington Office of the U.S. Forest Service in 2005, the Payette National Forest completed a Draft Supplemental Environmental Impact Statement (Drat SEIS).

In 2003, the Payette National Forest completed the Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement (FEIS) to implement the Forest Plan. The Intermountain Region Forester received five appeals of the decision to implement Alternative 7 as described in the Record of Decision, with appellants contending that the Regional Forester violated the National Forest Management Act and the Hells Canyon National Recreation Area Act on the Payette National Forest by allowing grazing of domestic sheep within or near the range of bighorn sheep (*Ovis canadensis*), thus threatening the viability of bighorn sheep through disease transmission.

On March 9, 2005, the Chief of the Forest Service concurred that the effects analyses and discussion of cumulative effects pertaining to bighorn sheep presented in the FEIS did not adequately address viability and reversed the Intermountain Regional Forester's 2003 decision to approve revised management direction for the Hells Canyon Management Area as it pertains to bighorn sheep and its habitat. The Regional Forester was instructed to do an analysis of bighorn sheep viability in the Payette National Forest commensurate with the concerns and questions discussed in the appeal review and amend the Forest Plan accordingly to ensure bighorn sheep viability. The analysis was to be thorough enough to determine compliance with applicable law and regulation, specifically the Hells Canyon National Recreation Area Act.

In April, the Payette National Forest convened an Interdisciplinary Team (IDT) to develop a supplemental environmental impact statement to the 2003 FEIS (USDA Forest Service 2003b) and to supplement the Forest Plan (USDA Forest Service 2003a). In August 2007, the Payette National Forest received requests from the State of Idaho, State of Oregon, State of Washington, Nez Perce Tribe, Shoshone-Bannock Tribe, Shoshone-Paiute Tribe, and Confederated Tribes of the Umatilla Indian Reservation to be involved in the Draft SEIS process. The process was revised to include their cooperators. As a result of this consultation between the Payette National Forest and cooperators, the Draft SEIS was published in 2008 (USDA Forest Service 2008).

Since the Draft SEIS was published, the Payette National Forest has developed a new method of analyzing the effects of the alternatives. Some of those differences between the analysis used for the Draft and Final SEIS are the result of improvements and/or adjustments to the techniques used in the Draft SEIS or better and more appropriate uses of models, while others are completely new methods or models developed specifically for the Final SEIS. These improvements were based on field reviews conducted by the IDT, monitoring of bighorn sheep populations, discussions with scientists, and feedback on the Draft SEIS. These changes are as follows:

1. An improved source habitat model and an accurate spatial depiction of bighorn sheep
2. A more useful population model of individual bighorn sheep in the Hells Canyon and Salmon River Mountain areas

3. A scientifically relevant analysis of telemetry points and temporal variability information
4. A new quantitative risk analysis model that utilizes the bighorn sheep database to determine the contact risk between bighorn sheep and domestic sheep (this new quantitative model replaces the Draft SEIS risk model)
5. A disease model to assist with cumulative effects analyses and determine bighorn sheep population persistence
6. An improved economic analysis explaining the benefits that a bighorn sheep population has on the Forest landscape

This document details each of the models used in the analysis for the Final SEIS.

2.0 Source Habitat Model

The source habitat model for bighorn sheep used in the Draft SEIS was originally designed by the Hells Canyon Initiative (HCI) (Table 2-1). The HCI is managed by the Hells Canyon Bighorn Sheep Restoration Committee, a State, Federal, and private partnership to restore Rocky Mountain bighorn sheep in the Hells Canyon Complex of Oregon, Idaho, and Washington. Source habitat is defined as those characteristics of macrovegetation that contribute to stationary or positive population growth, which is distinguished from habitats associated with species occurrence since such habitats may or may not contribute to long-term population persistence (Wisdom et al. 2000). The original suitable habitat model was primarily a two-component model that consisted of escape terrain and horizontal visibility. The water sources component was not used in the Payette NF version of this model because the criteria used in the HCI model (>3.2 kilometers [km] from a water source) encompassed every portion of the Forest. The Forest model also did not include the lambing range.

Table 2-1. Hells Canyon Initiative bighorn sheep habitat model

Habitat Component	Criteria	Source
Escape terrain		
Slope	31° ≤ slope ≤ 85°	Gudorf and Sweanor 1996; Smith et al. 1991
Buffer	300 meters (m) or land areas ≤ 1,000 m wide bounded on ≥2 sides by escape terrain (500 m)	Smith et al. 1991; Gudorf and Sweanor 1996
Minimum area	1.6 hectares (ha)	Gudorf and Sweanor 1996
Horizontal visibility	Grassland, rock, open shrub, or forest cover <40%, from satellite imagery	Schirokauer 1996
Water sources	≤3.2 km	Smith et al. 1991; Gudorf and Sweanor 1996
Summer range	Suitable habitat within 300 m of escape terrain	Smith et al. 1991; Gudorf and Sweanor 1996; Schirokauer 1996
Winter range	Suitable habitat all aspects below 4,800 feet; aspect 135°–225°above 4,800 feet	Smith et al. 1991; Gudorf and Sweanor 1996; Coggins pers. comm.
Lambing range	Escape terrain 45°–315° ≤ 1 km from water ≥2 contiguous ha	Gudorf and Sweanor 1996

Source: Hells Canyon Bighorn Sheep Restoration Committee 1997

The original source habitat model used for the Draft SEIS needed two modifications for the current modeling process. The first issue was that the geographic range of the model only covered the Hells Canyon Complex and not the entire Forest. The second issue concerned the vegetation layer used in the horizontal visibility component of the original model. The HCI model utilized the National Land Cover Dataset, which was too broad and contained no canopy cover information, resulting in an insufficient level of detail for the vegetation data. To solve the problems of scale and detail, Payette NF modelers used a different vegetation dataset for horizontal visibility and included low canopy cover forested cover types. Using forested types is supported by the HCI's cited literature but was not used by the HCI because of limitations of the National Land Cover Dataset.

The escape terrain component was found to be sufficient and was used exactly as it was in the HCI model for the Draft SEIS. However, field reviewers found that the escape terrain portion of the model was overmapping in areas that met the steepness criterion but lacked the ruggedness to make the area source habitat. To correct this problem Payette NF modelers used a ruggedness ArcGIS script (Sappington et al. 2007) to create a ruggedness surface that was then overlaid with the telemetry and observation data. From this overlay, modelers created a histogram of ruggedness to determine the ruggedness cutoff point for source habitat, which was 310 or less out of a range of 0 to 3455. Adding this new criterion changed of overall amount of mapped source habitat by 2% and reduced the correlation between the source habitat and telemetry data from 92% to 90%.

The winter version of the source habitat model was also modified from the Draft to the Final SEIS. The original HCI model and the version used in the Draft SEIS restricted the habitat to southern aspects above 1,463 meters (4,800 feet). However, field reviewers found that most of the areas above 1,463 meters (4,800 feet) are covered by snow and therefore not suitable habitat. To overcome this problem, Payette NF modelers used persistent snow data (**Copeland et al. The bioclimatic envelope of the wolverine (*Gulo gulo* spp.): do climatic constraints limit its geographic distribution? *In review.*** Canadian J. Zoology***)*** and removed from winter source habitat areas above 1,463 meters (4,800 feet) that were snow covered 2 or more years out of the last 7. This change in mapping dropped the amount of mapped winter source habitat by 18%; however, it only dropped the correlation between winter source habitat and winter telemetry points from 82% to 80%.
The horizontal visibility component used the vegetation dataset from the LANDFIRE project (The National Map LANDFIRE 2006), an interagency effort to map vegetation and fuels data in a consistent fashion and at a scale useful at an incident level nationally. The nonforest vegetation cover types from the HCI model were crosswalked into the LANDFIRE nonforested cover types by the Payette NF staff. The documentation created by the HCI stated that forested cover types of less than 40% canopy cover can be used in the model; however, in the actual model they were not used because canopy cover was not included in the original National Land Cover Dataset. Forested cover types for canopy cover ≤30% were added to the model from LANDFIRE. The 30% canopy cover for forest cover type was chosen based on review by Payette NF staff using the 2004 National Agricultural Imagery Program (NAIP) 1-m full-color photographs. The LANDFIRE data at 40% canopy cover in forested types tended to map canopy covers that appeared denser than 40% cover, particularly on the east side of the Forest. This discrepancy would have overestimated the amount of source habitat available to bighorn sheep on the eastern portion of the Forest and may have contributed to some undermapping of source habitat on the western side of the Forest where the canopy covers better matched the image from the photographs. However, it appeared to be less of an error to underestimate

the habitat in the western part of the Forest when compared to the amount that would have been overmapped in the east. This choice of using a 30% canopy cover was also confirmed during a season of field reviews of the habitat data.

Modelers also decided to filter the habitat model to a minimum mapping size of 2.0 hectares (5 acres). The original HCI model only filtered the escape terrain component to approximately 1.6 hectares (4 acres). The overall 2.0 hectare (5 acre) minimum mapping area filter did a better job of habitat mapping because of the nature of the LANDFIRE vegetation data. The final product and the forest cover type/canopy cover choices were verified with NAIP photography and on-the-ground field reviews at several locations throughout a field season.

The source habitat model used for the Final SEIS was compared with over 54,000 telemetry and observation points, mainly from Hells Canyon and the Salmon River canyon; 90% of all known bighorn sheep telemetry points fell within the modeled summer source habitat and 80% fell within the winter source habitat. A final review of all source habitat model components and outcomes was completed by the IDT and accepted as adequate to fulfill the needs of this analysis. One manual change was made to the habitat in the Lost Valley area where it was determined to be over mapping and leading to an error in the risk of contact analysis. This manual change was also accepted by the IDT. Detailed information on each input and function is found in Table 2-2, which shows summer source habitat for bighorn sheep in Hells Canyon and the Forest. Table 2-3 shows winter source habitat for bighorn sheep in Hells Canyon and the Forest. Table 2-4 describes the LANDFIRE cover types.

Table 2-2. Summer habitat model

Name	Explanation[a]
CON selection of non-forest cover types	This command creates the non-forested input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data is Existing Vegetation Type downloaded from LANDFIRE on May 2, 2007. The map algebra command is "con (F:\Bighorn\Landfire\33677953\33677953 in {12, 31, 2001, 2006, 2079, 2080, 2081, 2106, 2123, 2124, 2125, 2126, 2127, 2134, 2135, 2139, 2140, 2142, 2143, 2144, 2145, 2153, 2169, 2181, 2182, 2183, 2220, 2062, 2065, 2144, 2070, 2017, 2115, 2165},1)".
CON selection of forest cover types and canopy covers	This command creates the forested input for the horizontal visibility portion of the Bighorn Sheep Summer Source Habitat model. The input data are Existing Vegetation Type and Existing Vegetation Cover downloaded from LANDFIRE on May 2, 2007. The map algebra command is "con ((F:\Bighorn\Landfire\33677953\33677953 in {2008, 2009, 2011, 2012, 2016, 2018, 2019, 2020, 2035, 2036, 2037, 2038, 2039, 2041, 2042, 2045, 2046, 2047, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2060, 2061, 2063, 2154, 2156, 2157, 2158, 2161, 2166, 2167, 2173, 2174, 2178, 2200, 2203, 2205, 2206, 2208, 2227, 2228, 2232} and F:\Bighorn\Landfire\30745420\30745420 in {101, 102}), 1)". The canopy covers from LANDFIRE are as follows: 101, Tree Cover ≥10 and <20%; 102, Tree Cover ≥20 and <30%.
MERGE of forested and non-forest selections	This command merges the forested and non-forest components of the horizontal visibility component of the Bighorn Sheep Summer Source Habitat model. The map algebra for this command is "merge (non-forest, forest)".
Project Raster from Albers to Universal Transverse Mercator (UTM)	This command changes the projection of the combined forested and non-forested vegetation components. The LANDFIRE projection was Albers NAD83, which was projected to the local projection of UTM Zone 11 NAD83.

Name	Explanation[a]
Region Group for minimum mapping size	This Region Group command is the first step in filtering for a minimum mapping unit. This command takes the input and groups the cells based on if they touch and then gives all the touching cells the total count for that group.
CON selection of minimum mapping size of 5 acres	This command selects from the grouped input groups of cell 5 acres or larger. The map algebra for this command is "con (F:\Bighorn\Landfire\hor_vis_rg.count ≥23,1)".
"Slope ≥31 and ≤85 degrees" CON	This CON function selects slopes from the slope grid derived from the National Elevation Dataset elevation grid. The slopes selected are equal to or greater than 31° and less than or equal to 85° and roughness index of ≤310. This selection is as follows "C:\Projects\BHS_Final\Data\Elevations\deg_slp ≥31 AND C:\Projects\BHS_Final\Data\Elevations\deg_slp ≤85" and C:\Projects\BHS_Final\Data\Elevations\ruf_10000 ≤310.
Region Group	This command takes the input and groups the cells based on if they touch and then gives all the touching cells the total count for that group.
CON & ZONALAREA (Single Output Map Algebra)	This command selects from the grouped input groups of cell 16000 or larger. The map algebra for this command is "con (zonalarea (slpgp) ≥16000, 1)".
CON & EUCDISTANCE LE 300 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells ≤300 m. The map algebra for this command is "con (eucdistance (escslp) ≤300, 1)".
CON & EUCDISTANCE GT 500 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells greater than 500 m. The map algebra for this command is "con (eucdistance (escslp) > 500, 1)".
CON & EUCDISTANCE GE 500 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells ≥500 m. The map algebra for this command is "con (eucdistance (gt500) ≥500, 1)".
CON & ISNULL (Single Output Map Algebra)	This CON function erases the "buff300" from "wi500" to create the final output for the escape terrain component. The map algebra for this function is "con (isnull (buff300), con (wi500 == 1, 1), 1)".
CON combines the two model components	This CON command combines the two model components so that on the cell and overlap from the two inputs appear in the final output.

[a] See Table 2-4 for descriptions of the LANDFIRE cover types

Table 2-3. Winter habitat model

Name	Explanation[a]
CON selection of non-forest cover types	This command creates the non-forested input for the horizontal visibility portion of the Bighorn Sheep Winter Source Habitat model. The input data is Existing Vegetation Type downloaded from LANDFIRE on May 2, 2007. The map algebra command is "con (F:\Bighorn\Landfire\33677953\33677953 in {12, 31, 2001, 2006, 2079, 2080, 2081, 2106, 2123, 2124, 2125, 2126, 2127, 2134, 2135, 2139, 2140, 2142, 2143, 2144, 2145, 2153, 2169, 2181, 2182, 2183, 2220, 2062, 2065, 2144, 2070, 2017, 2115, 2165},1)".
CON selection of forest cover types and canopy covers	This command creates the forested input for the horizontal visibility portion of the Bighorn Sheep Winter Source Habitat model. The input data are Existing Vegetation Type and Existing Vegetation Cover downloaded from LANDFIRE on May 2, 2007. The map algebra command is "con ((F:\Bighorn\Landfire\33677953\33677953 in {2008, 2009, 2011, 2012, 2016, 2018, 2019, 2020, 2035, 2036, 2037, 2038, 2039, 2041, 2042, 2045, 2046, 2047, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2060, 2061, 2063, 2154, 2156, 2157, 2158, 2161, 2166, 2167, 2173, 2174, 2178, 2200, 2203, 2205, 2206, 2208, 2227, 2228, 2232} and F:\Bighorn\Landfire\30745420\30745420 in {101, 102}), 1)". The canopy covers from LANDFIRE are as follows: 101, Tree Cover ≥10 and <20%; 102, Tree Cover ≥20 and <30%.
MERGE of forested and non-forest selections	This command merges the forested and non-forest components of the horizontal visibility component of the Bighorn Sheep Winter Source Habitat model. The map algebra for this command is "merge (non-forest, forest)".
Project Raster from Albers to Universal Transverse Mercator (UTM)	This command changes the projection of the combined forested and non-forested vegetation components. The LANDFIRE projection was Albers NAD83, which was projected to the local projection of UTM Zone 11 NAD83.
Region Group for minimum mapping size	This Region Group command is the first step in filtering for a minimum mapping unit. This command takes the input and groups the cells based on if they touch and then gives all the touching cells the total count for that group.
CON selection of minimum mapping size of 5 acres	This command selects from the grouped input groups of cell 5 acres or larger. The map algebra for this command is "con (F:\Bighorn\Landfire\hor_vis_rg.count ≥23,1)".
"Slope ≥31 and ≤85 degrees" CON	This CON function selects slopes from the slope grid derived from the National Elevation Dataset elevation grid. The slopes selected are equal to or greater than 31° and ≤85° and roughness index of ≤310. This selection is as follows "C:\Projects\BHS_Final\Data\Elevations\deg_slp ≥31 AND C:\Projects\BHS_Final\Data\Elevations\deg_slp ≤85" and C:\Projects\BHS_Final\Data\Elevations\ruf_10000 ≤310.
Region Group	This command takes the input and groups the cells based on if they touch and then gives all the touching cells the total count for that group.
CON & ZONALAREA (Single Output Map Algebra)	This command selects from the grouped input groups of cell 16000 or larger. The map algebra for this command is "con (zonalarea (slpgp) ≥16000, 1)".
CON & EUCDISTANCE LE 300 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells ≤300 m. The map algebra for this command is "con (eucdistance (escslp) ≤300, 1)".
CON & EUCDISTANCE GT 500 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells greater than 500 m. The map algebra for this command is "con (eucdistance (escslp) > 500, 1)".

Name	Explanation[a]
CON & EUCDISTANCE GE 500 (Single Output Map Algebra)	This CON function calculates the straight line distance from the input then selects all cells ≥500 m. The map algebra for this command is "con (eucdistance (gt500) ≥500, 1)".
CON & ISNULL (Single Output Map Algebra)	This CON function erases the "buff300" from "wi500" to create the final output for the escape terrain component. The map algebra for this function is "con (isnull (buff300), con (wi500 == 1, 1), 1)".
CON combines the two model components	This CON command combines the two model components so that on the cell and overlap from the two inputs appear in the final output.
Southern Aspects above 4,800 feet excluded	The Map Algebra expression creates a grid that masks out area above 4,800 feet that are not on southern aspect. "con ((c:\Projects\BHS_Final\Data\Elevation\large_elev le 1463.04) OR ((c:\Projects\BHS_Final\Data\Elevation\large_elev gt 1463.04) and (c:\Projects\BHS_Final\Data\Elevation\large_asp ge 135 and c:\Projects\BHS_Final\Data\Elevation\large_asp le 225)), 1)"
Perennial Snow Areas excluded	The Map Algebra expression masks out, of the southern aspect mask, areas that are covered by persistent snow. "con((win_area1 eq 1) and (pere_snow le 1),1)"
Merge winter exclusions with the escape terrain and horizontal visibility	This CON command combines the winter exclusions with the escape terrain and horizontal visibility components so that only the areas that overlap between components are the only areas in the final output.

[a] See Table 2-4 for descriptions of the LANDFIRE cover types

Table 2-4. LANDFIRE cover types

No.	Type of Vegetation
12	Snow/Ice
31	Barren
2001	Inter-Mountain Basins Sparsely Vegetated Systems
2006	Rocky Mountain Alpine/Montane Sparsely Vegetated Systems
2008	North Pacific Oak Woodland
2009	Northwestern Great Plains Aspen Forest and Parkland
2011	Rocky Mountain Aspen Forest and Woodland
2012	Rocky Mountain Bigtooth Maple Ravine Woodland
2016	Colorado Plateau Pinyon-Juniper Woodland
2017	Columbia Plateau Western Juniper Woodland and Savanna
2018	East Cascades Mesic Montane Mixed-Conifer Forest and Woodland
2019	Great Basin Pinyon-Juniper Woodland
2020	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland
2035	North Pacific Dry Douglas-fir Forest and Woodland
2036	North Pacific Hypermaritime Sitka Spruce Forest
2037	North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest
2038	North Pacific Maritime Mesic Subalpine Parkland
2039	North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
2041	North Pacific Mountain Hemlock Forest
2042	North Pacific Mesic Western Hemlock-Silver Fir Forest
2045	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest

No.	Type of Vegetation
2046	Northern Rocky Mountain Subalpine Woodland and Parkland
2047	Northern Rocky Mountain Mesic Montane Mixed Conifer Forest
2049	Rocky Mountain Foothill Limber Pine-Juniper Woodland
2050	Rocky Mountain Lodgepole Pine Forest
2051	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Wood
2052	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland
2053	Northern Rocky Mountain Ponderosa Pine Woodland and Savanna
2054	Southern Rocky Mountain Ponderosa Pine Woodland
2055	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
2056	Rocky Mountain Subalpine Wet-Mesic Spruce-Fir Forest and Woodland
2057	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
2060	East Cascades Oak-Ponderosa Pine Forest and Woodland
2061	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
2062	Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland
2063	North Pacific Broadleaf Landslide Forest and Shrubland
2065	Columbia Plateau Scabland Shrubland
2070	Rocky Mountain Alpine Dwarf-Shrubland
2079	Great Basin Xeric Mixed Sagebrush Shrubland
2080	Inter-Mountain Basins Big Sagebrush Shrubland
2081	Inter-Mountain Basins Mixed Salt Desert Scrub
2106	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
2115	Inter-Mountain Basins Juniper Savanna
2123	Columbia Plateau Steppe and Grassland
2124	Columbia Plateau Low Sagebrush Steppe
2125	Inter-Mountain Basins Big Sagebrush Steppe
2126	Inter-Mountain Basins Montane Sagebrush Steppe
2127	Inter-Mountain Basins Semi-Desert Shrub-Steppe
2134	Columbia Basin Foothill and Canyon Dry Grassland
2135	Inter-Mountain Basins Semi-Desert Grassland
2139	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland
2140	Northern Rocky Mountain Subalpine-Upper Montane Grassland
2142	Columbia Basin Palouse Prairie
2143	Rocky Mountain Alpine Fell-Field
2144	Rocky Mountain Dry Turf
2145	Rocky Mountain Subalpine-Montane Mesic Meadow
2153	Inter-Mountain Basins Greasewood Flat
2154	Inter-Mountain Basins Montane Riparian Systems
2156	North Pacific Lowland Riparian Forest and Shrubland
2157	North Pacific Swamp Systems
2158	North Pacific Montane Riparian Woodland and Shrubland
2161	Northern Rocky Mountain Conifer Swamp
2165	Northern Rocky Mountain Foothill Conifer Wooded Steppe

No.	Type of Vegetation
2166	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland
2167	Rocky Mountain Poor-Site Lodgepole Pine Forest
2169	Northern Rocky Mountain Subalpine Deciduous Shrubland
2173	North Pacific Wooded Lava Volcanic Flowage
2174	North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest
2178	North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
2181	Introduced Upland Vegetation—Annual Grassland
2182	Introduced Upland Vegetation—Perennial Grassland and Forbland
2183	Introduced Upland Vegetation—Annual and Biennial Forbland
2200	Pseudotsuga menziesii-Quercus garryana Woodland Alliance
2203	Juniperus occidentalis Woodland Alliance
2205	Tsuga mertensiana-Abies amabilis Woodland Alliance
2206	Pseudotsuga menziesii Giant Forest Alliance
2208	Abies concolor Forest Alliance
2220	Artemisia tridentata ssp. vaseyana Shrubland Alliance
2227	Pseudotsuga menziesii Forest Alliance
2228	Larix occidentalis Forest Alliance
2232	Abies grandis Forest Alliance

3.0 Bighorn Sheep Herd Home Range Modeling

Home range modeling was conducted as part of the major bighorn sheep herd analysis for the Hells Canyon Complex and the Main and South Fork Salmon Rivers. The herd home range modeling made it possible to analyze the impacts of domestic sheep grazing on the Forest to the broader bighorn sheep metapopulations. The analysis showed the extent of the interchange between the different herds throughout the Hells Canyon Complex and the Main and South Fork Salmon Rivers. This type of modeling also allowed the IDT to determine the core areas of bighorn sheep habitat usage.

The tools and processes used to complete this analysis are common to home range analysis used for many species. The analysis consisted of a fixed kernel home range model created with the observations and telemetry data collected by the HCI from 1997 through 2008. Francis Cassirer (Idaho Department of Fish and Game [IDFG]), who is the HCI project leader responsible for the telemetry database management, used the telemetry data to divide the bighorn sheep population into herds. The herd assignments were based on transplant locations and breeding groups of ewes that shared the same range. A population is based on the entirety of the breeding individuals independent of shared range. Identified herds are the Asotin, Big Canyon, Black Butte, Imnaha, Lostine, Upper Hells Canyon, Main Salmon/South Fork, Mountain View, Muir Creek, Myers Creek, Redbird, Sheep Mountain, and Wenaha (Figures 3-1 through 3-13). The McGraw herd that was modeled in the draft has been renamed to Upper Hells Canyon. The Upper Hells Canyon currently has an estimated population of 45 individuals however there is little telemetry or observation data for these animals. The IDT decided to used the herd home range of the McGraw Sheep and attach the current population from Upper Hells Canyon. Several small herds had too few points to accurately create a herd home range or telemetry from transplants that failed to form a herd, so no home range modeling was conducted on them. These small herds are called 05IMREL, Lower Hells Canyon, Saddle Creek, Quartz Creek, Minam and Sheep Creek.

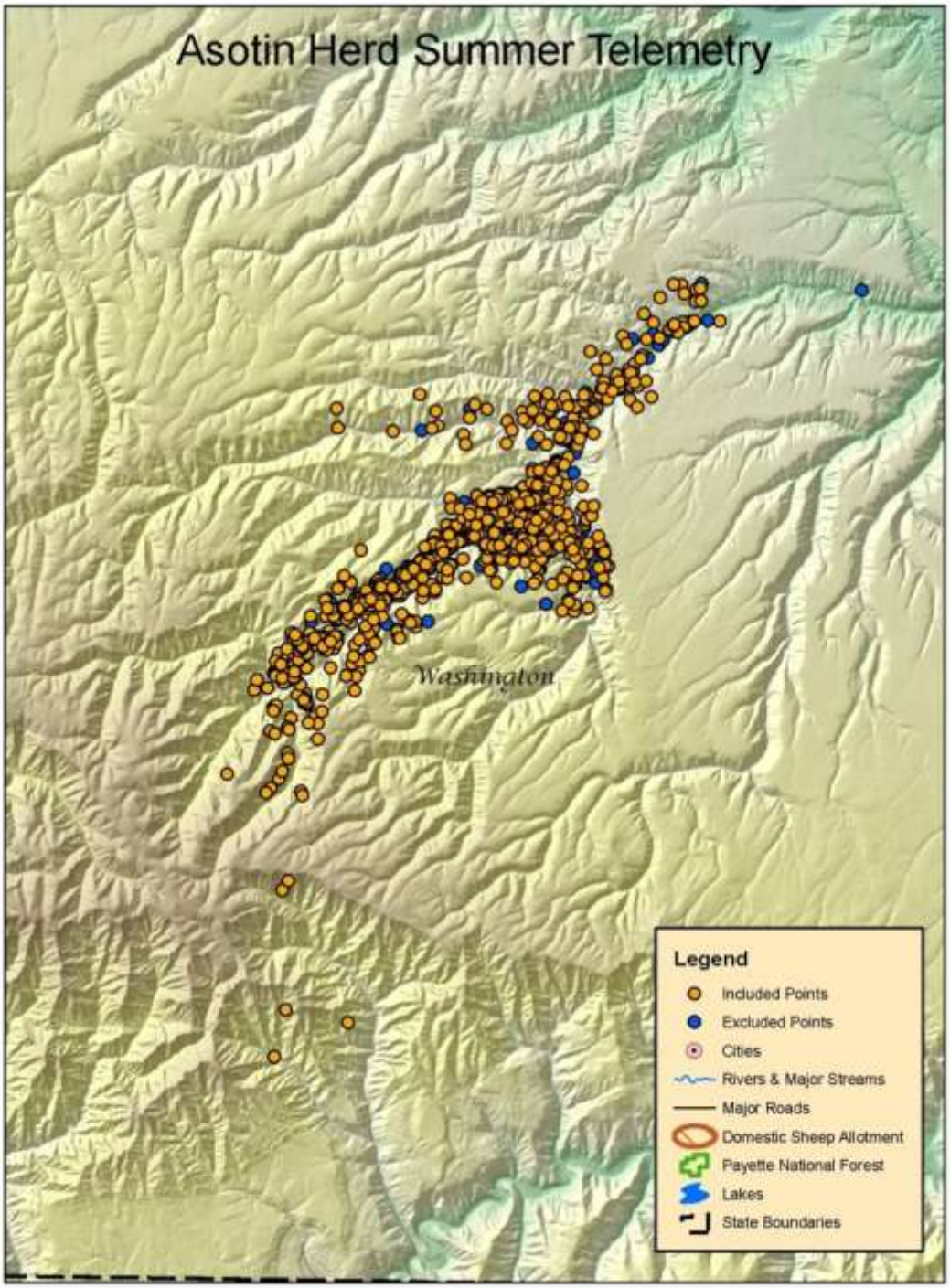


Figure 3-1. Asotin herd telemetry points

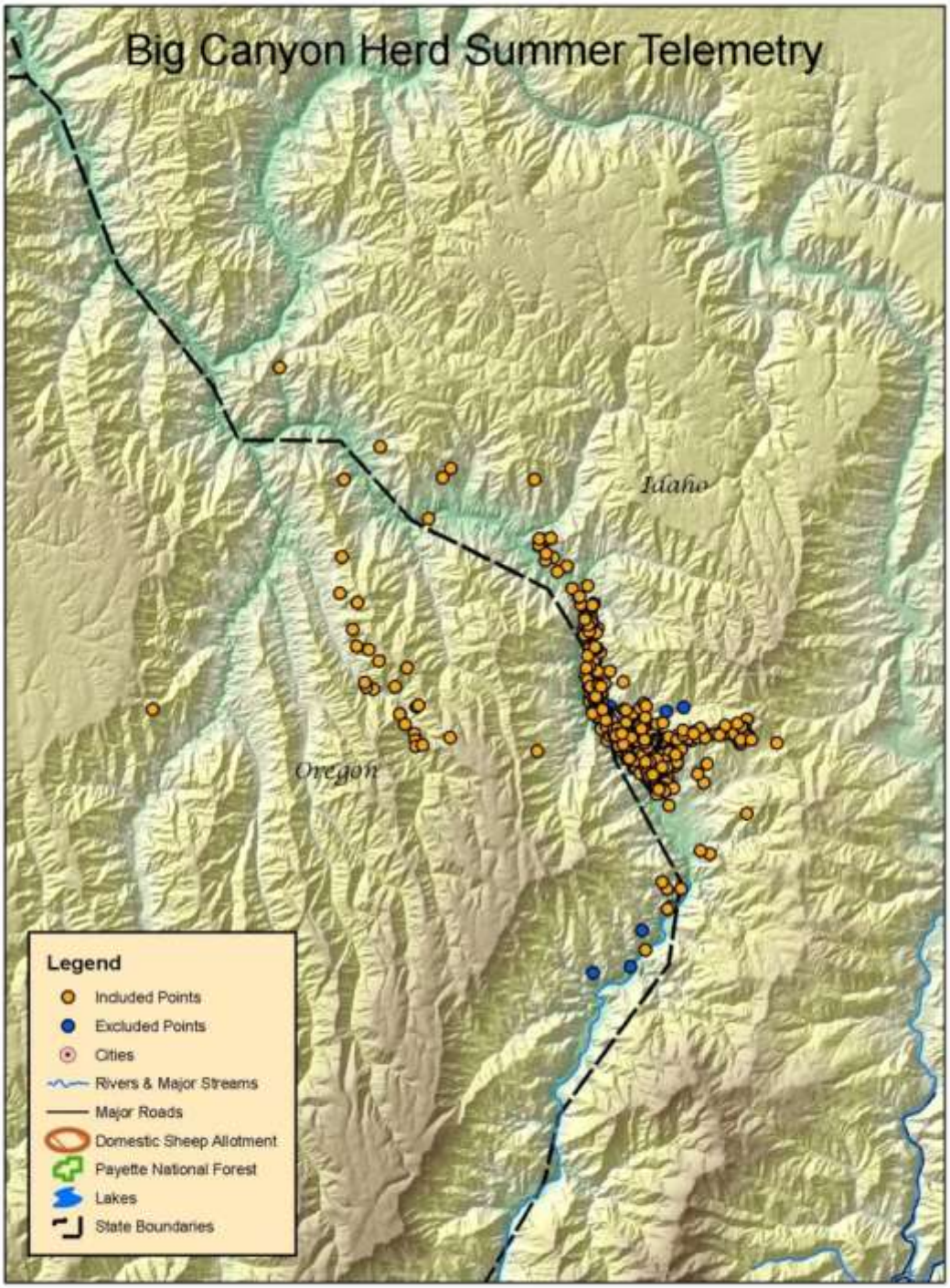


Figure 3-2. Big Canyon herd telemetry points

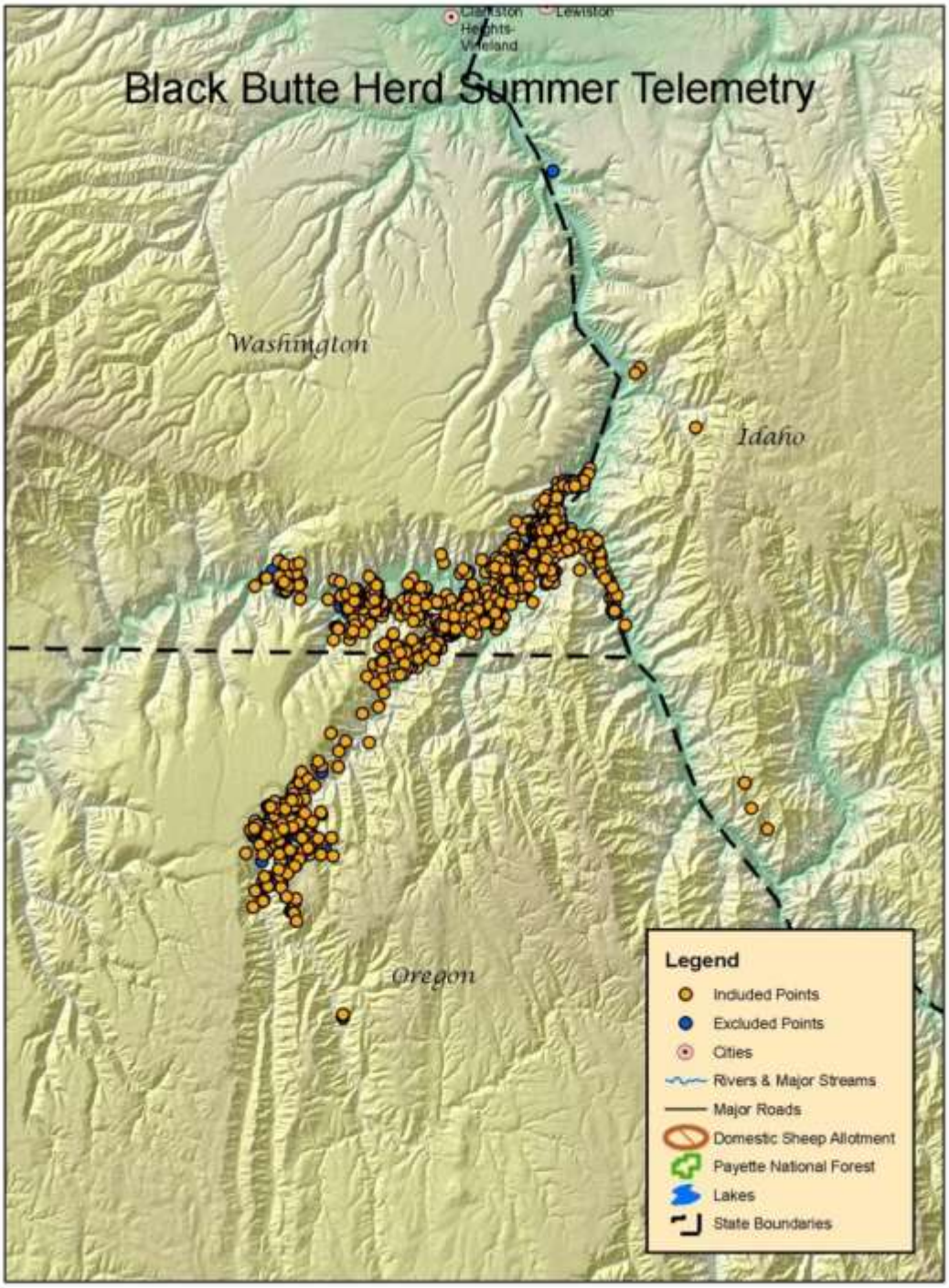


Figure 3-3. Black Butte herd telemetry points

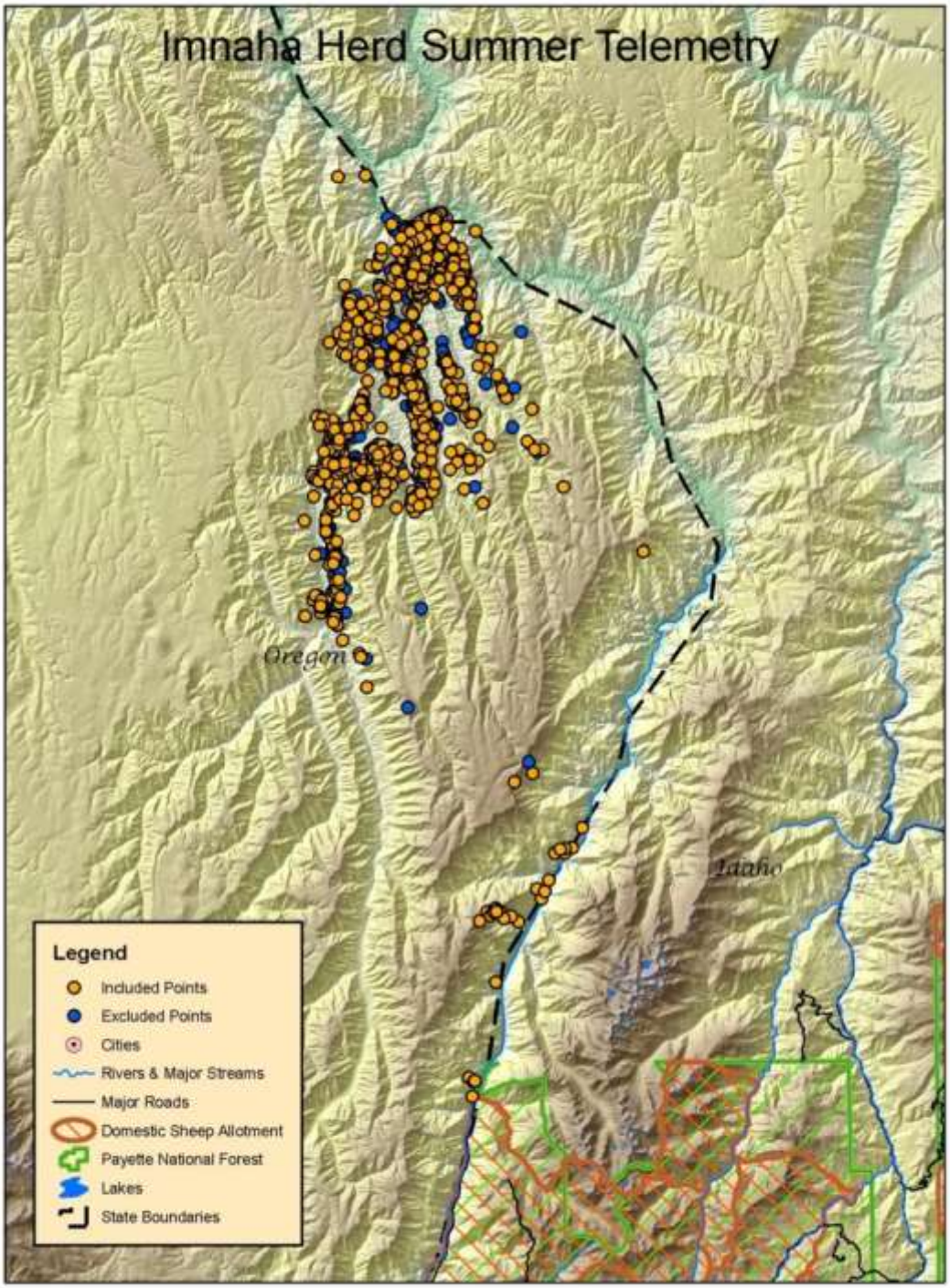


Figure 3-4. Imnaha herd telemetry points

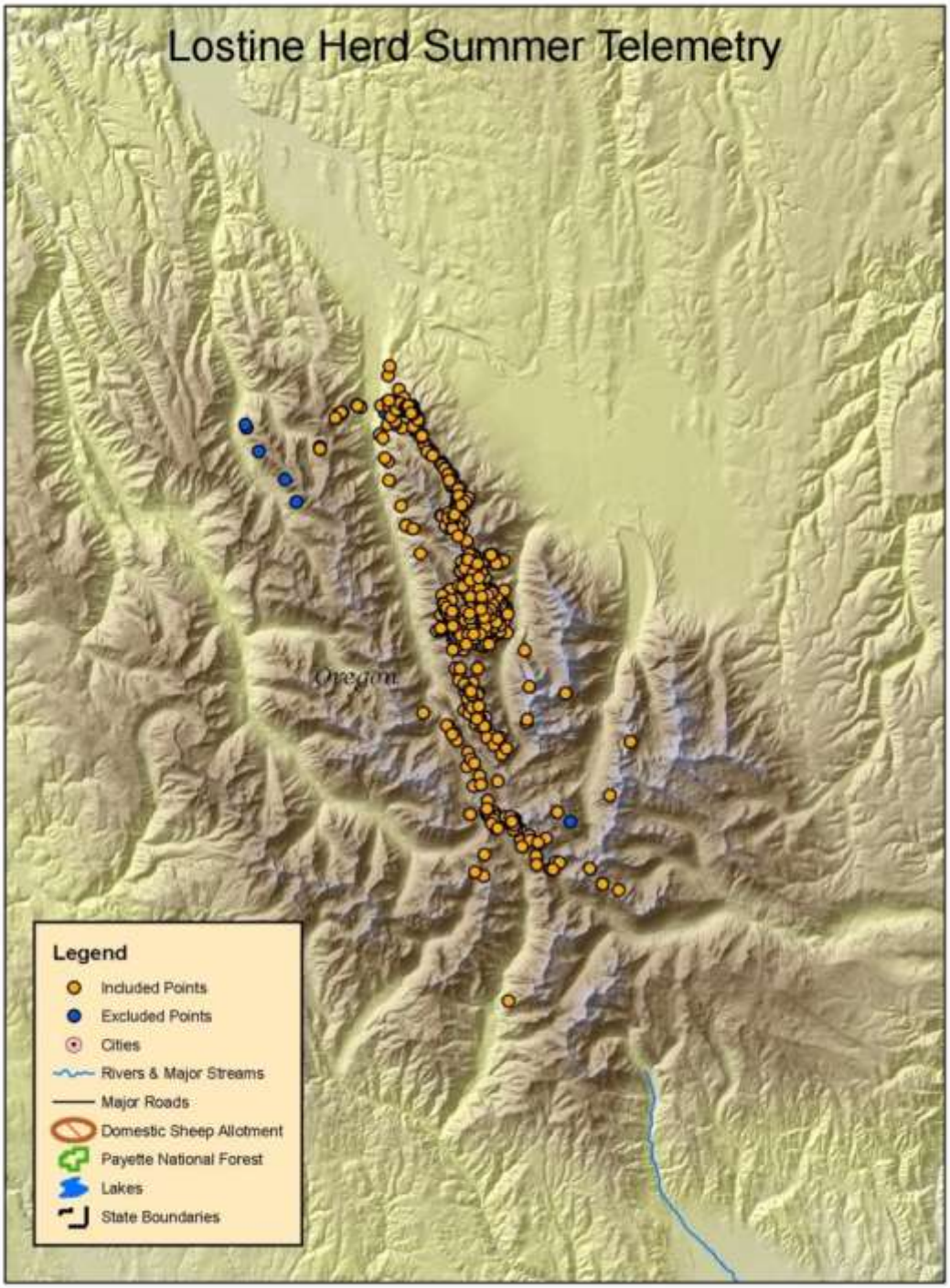


Figure 3-5. Lostine herd telemetry points

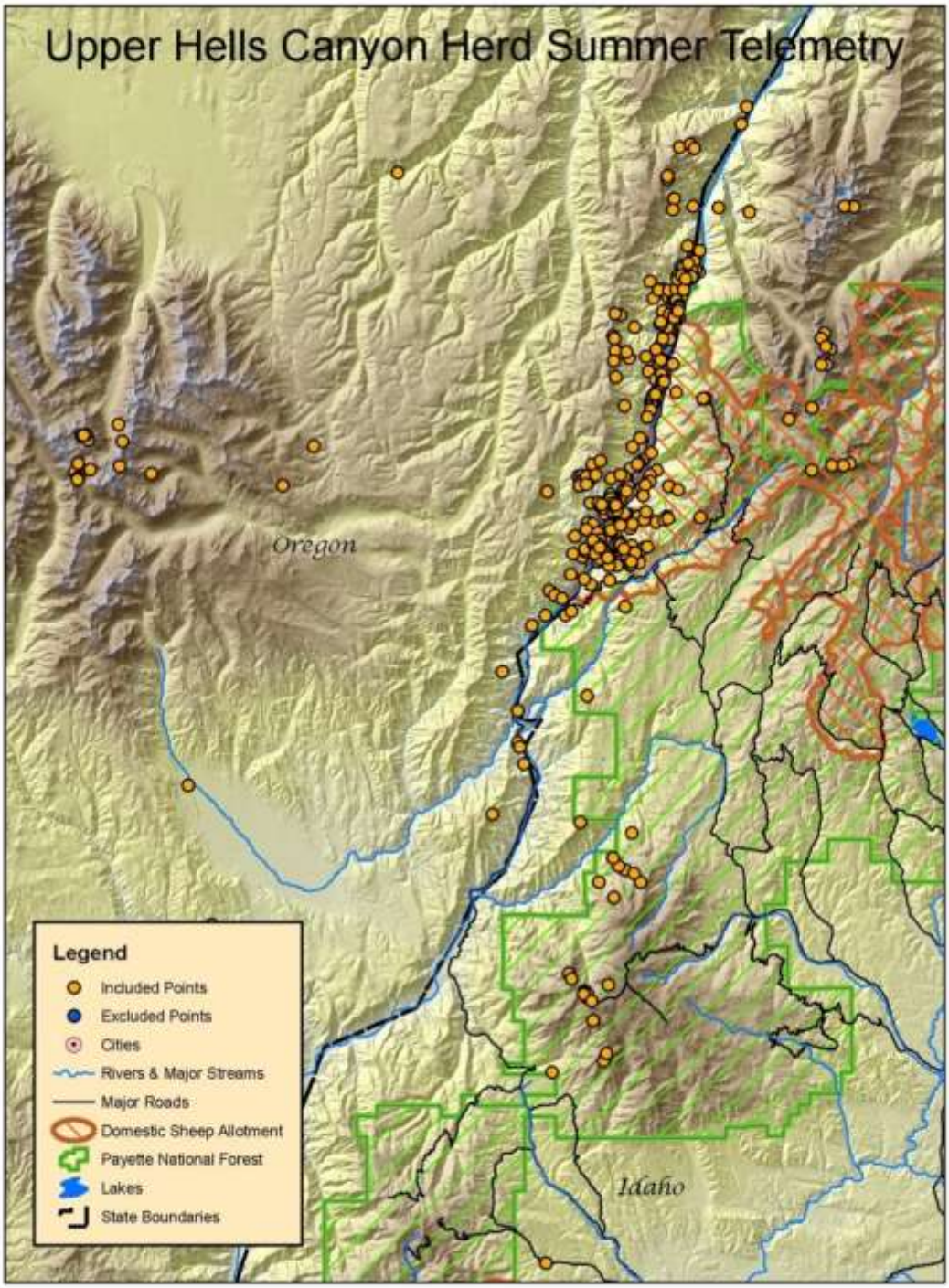


Figure 3-6. Upper Hells Canyon herd telemetry points

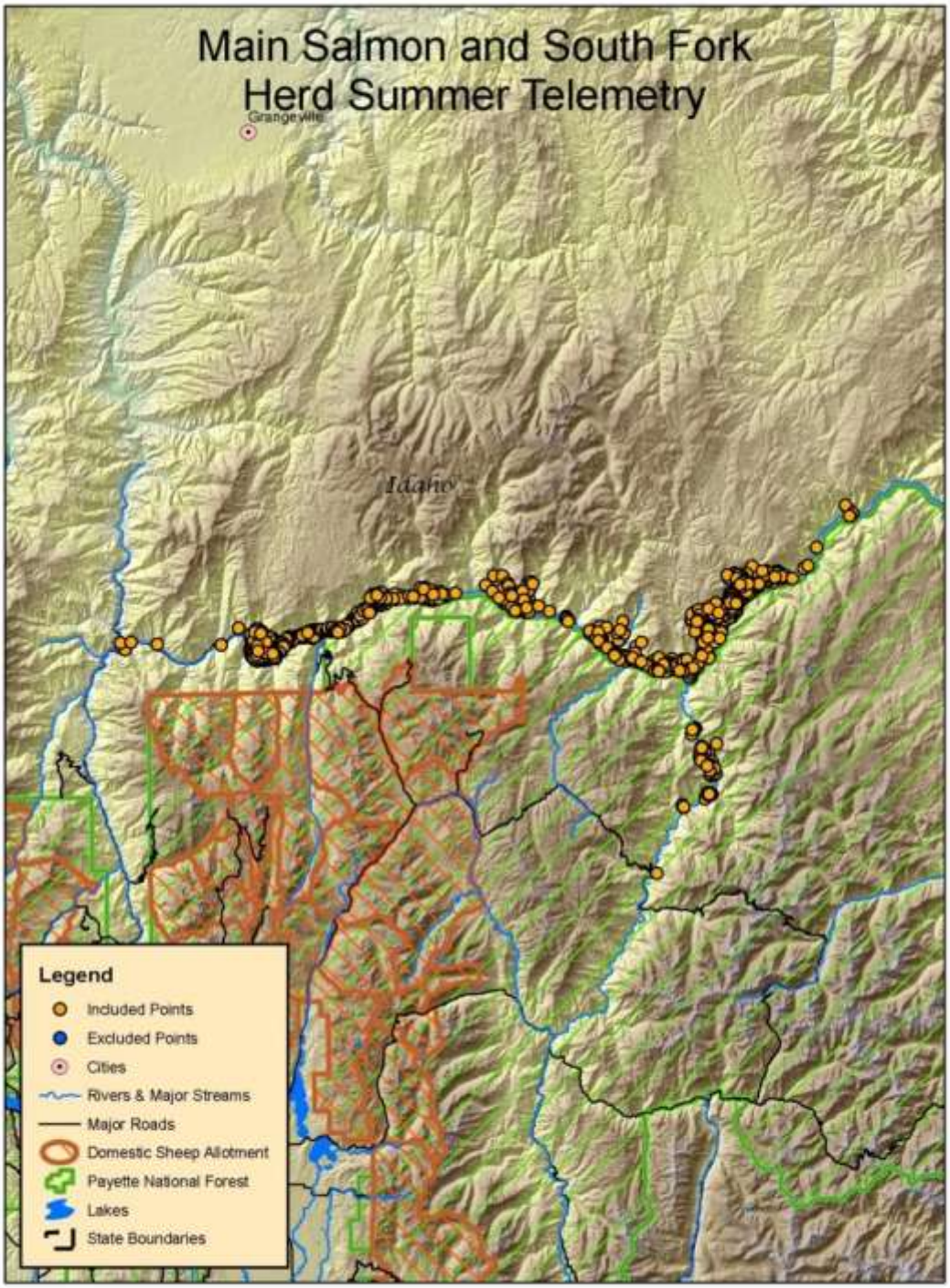


Figure 3-7. Main Salmon/South Fork herd telemetry points

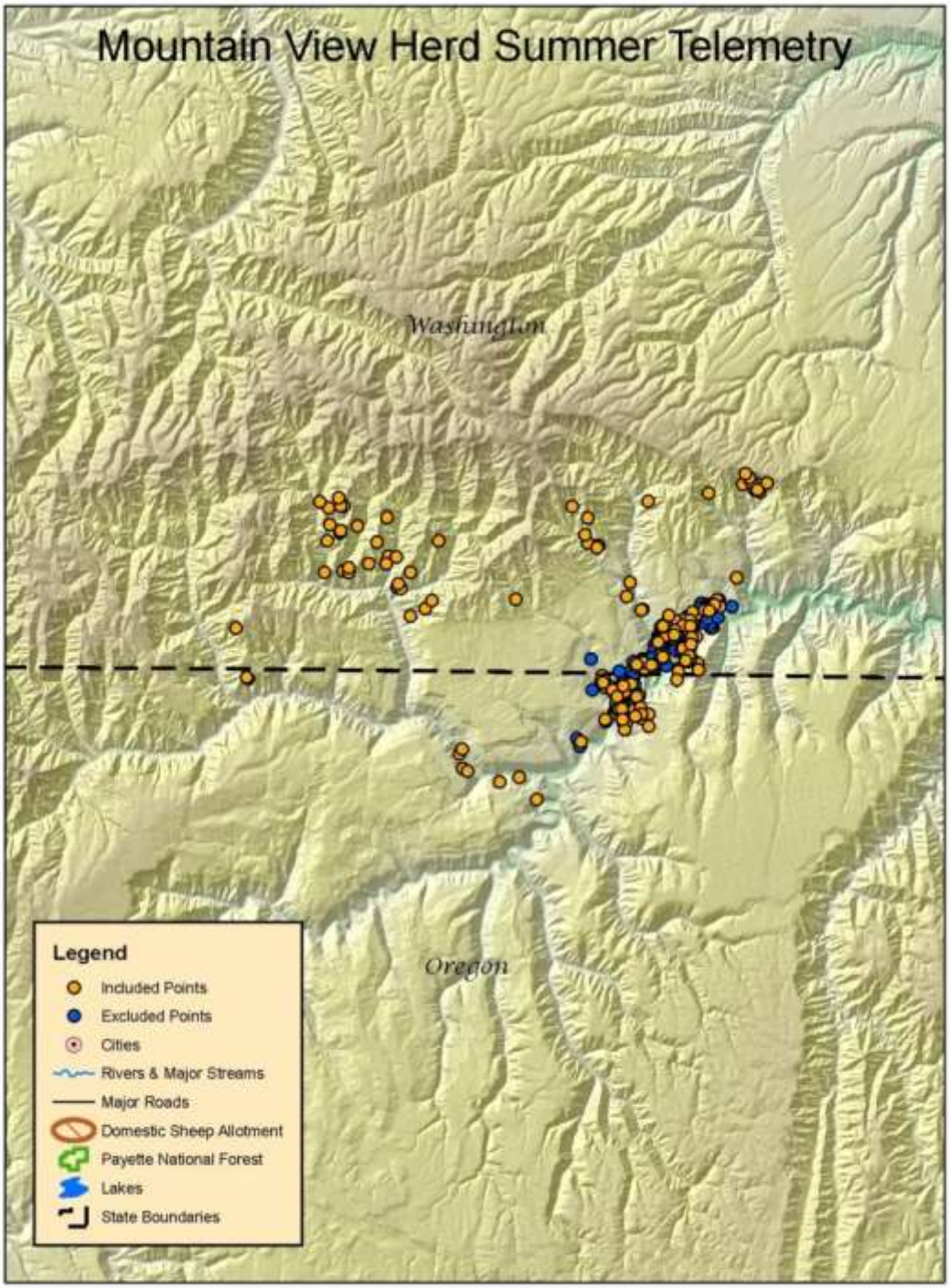


Figure 3-8. Mountain View herd telemetry points

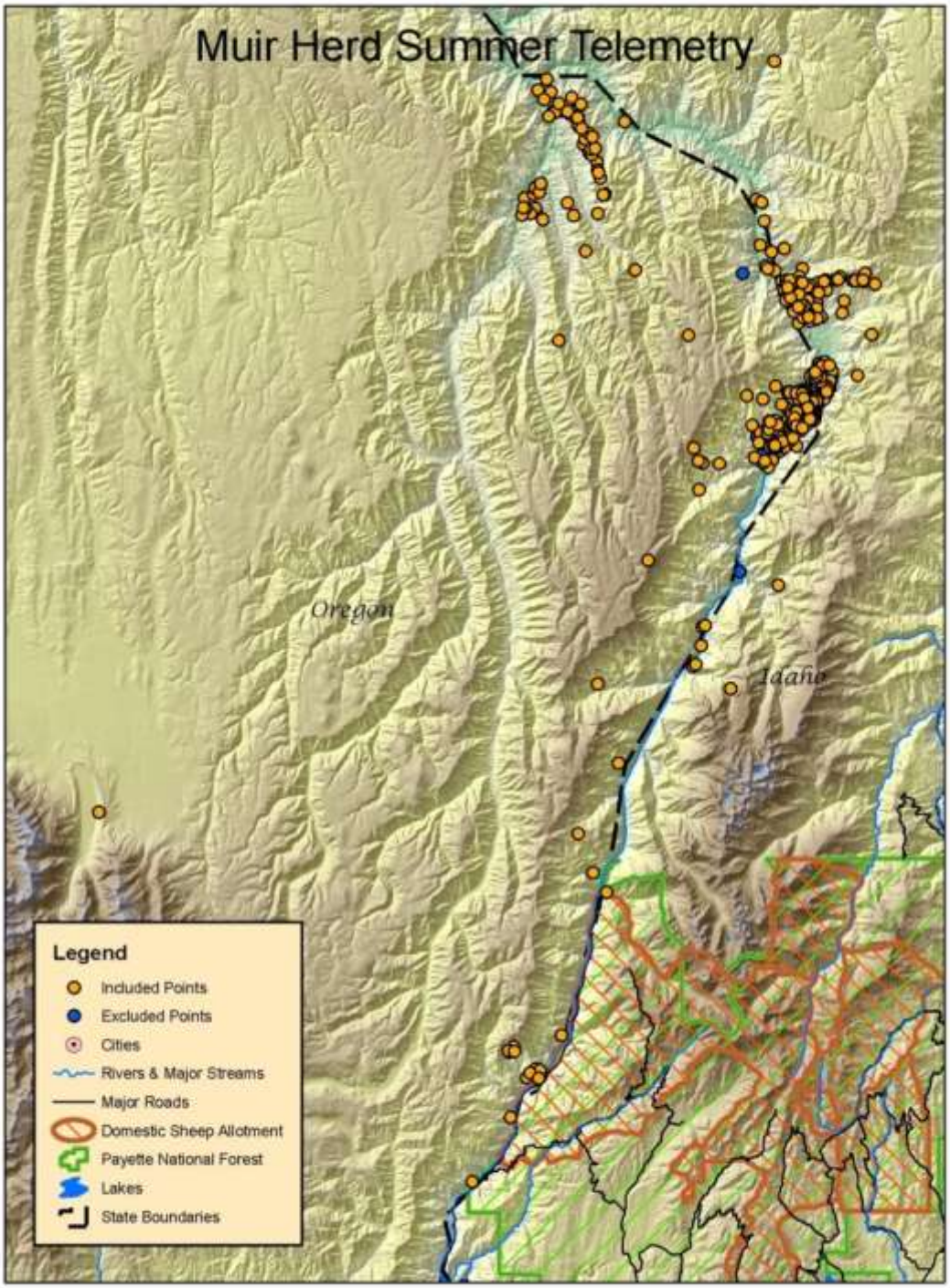


Figure 3-9. Muir herd telemetry points

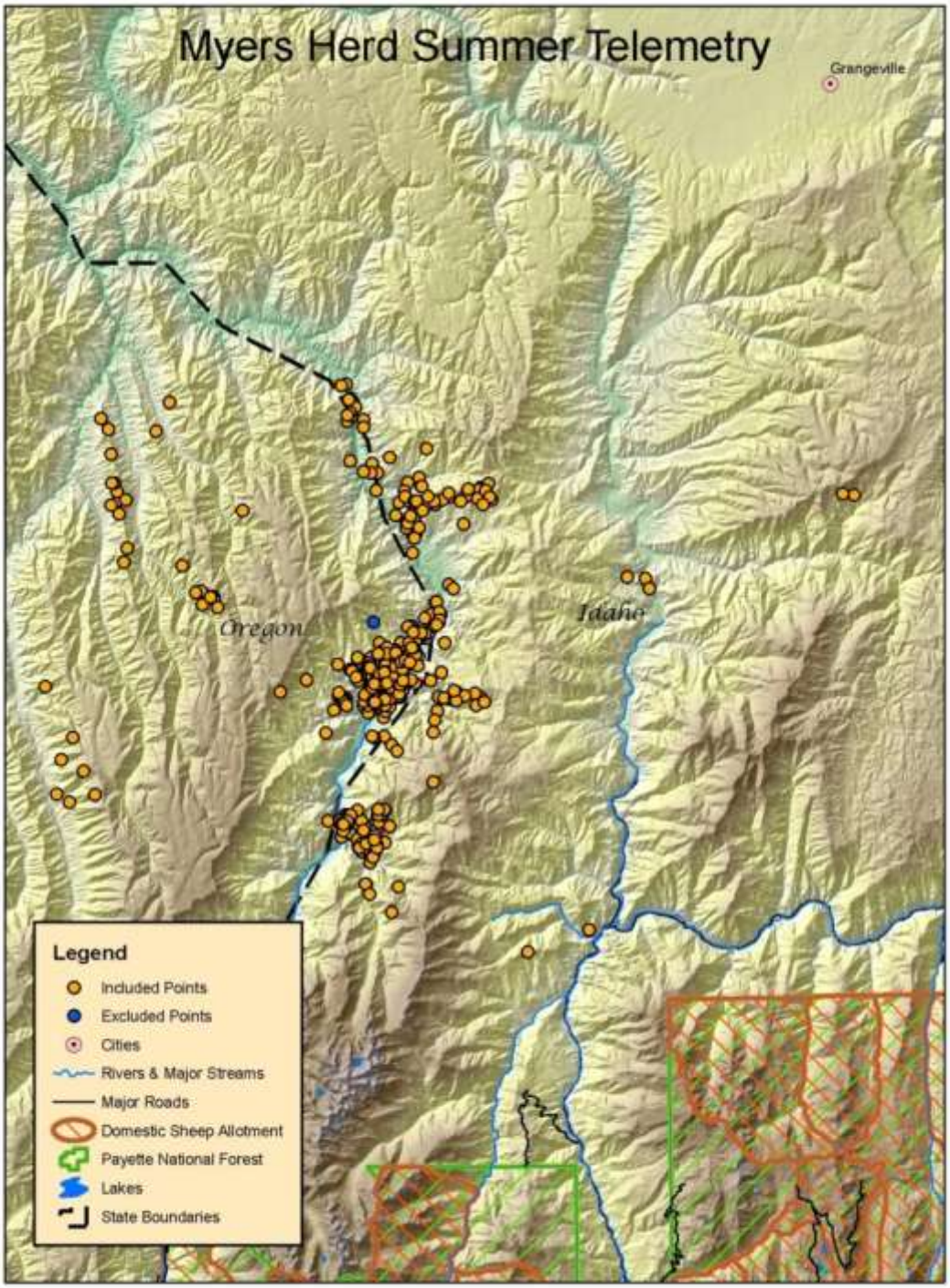


Figure 3-10. Myers herd telemetry points

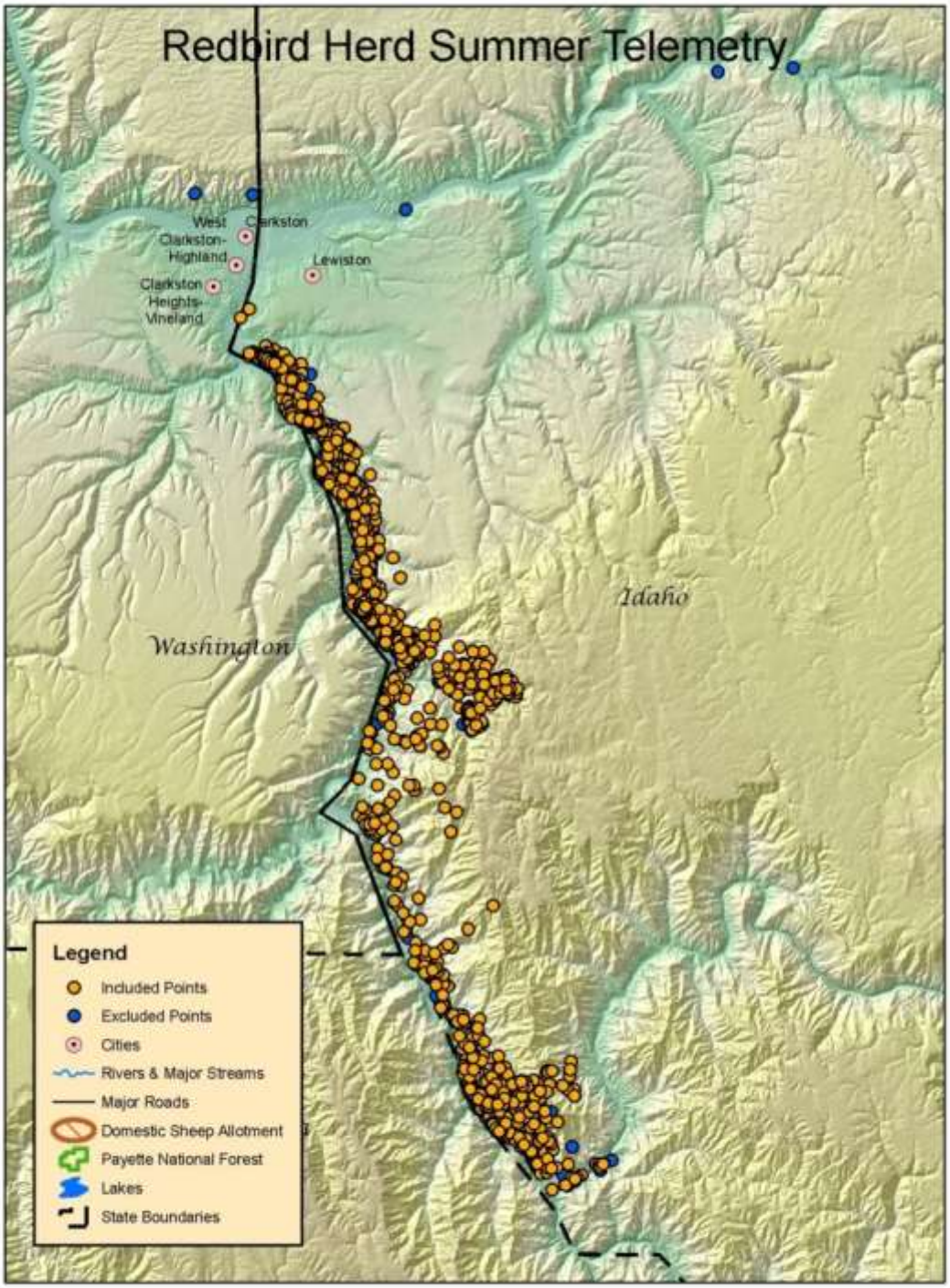


Figure 3-11. Redbird herd telemetry points

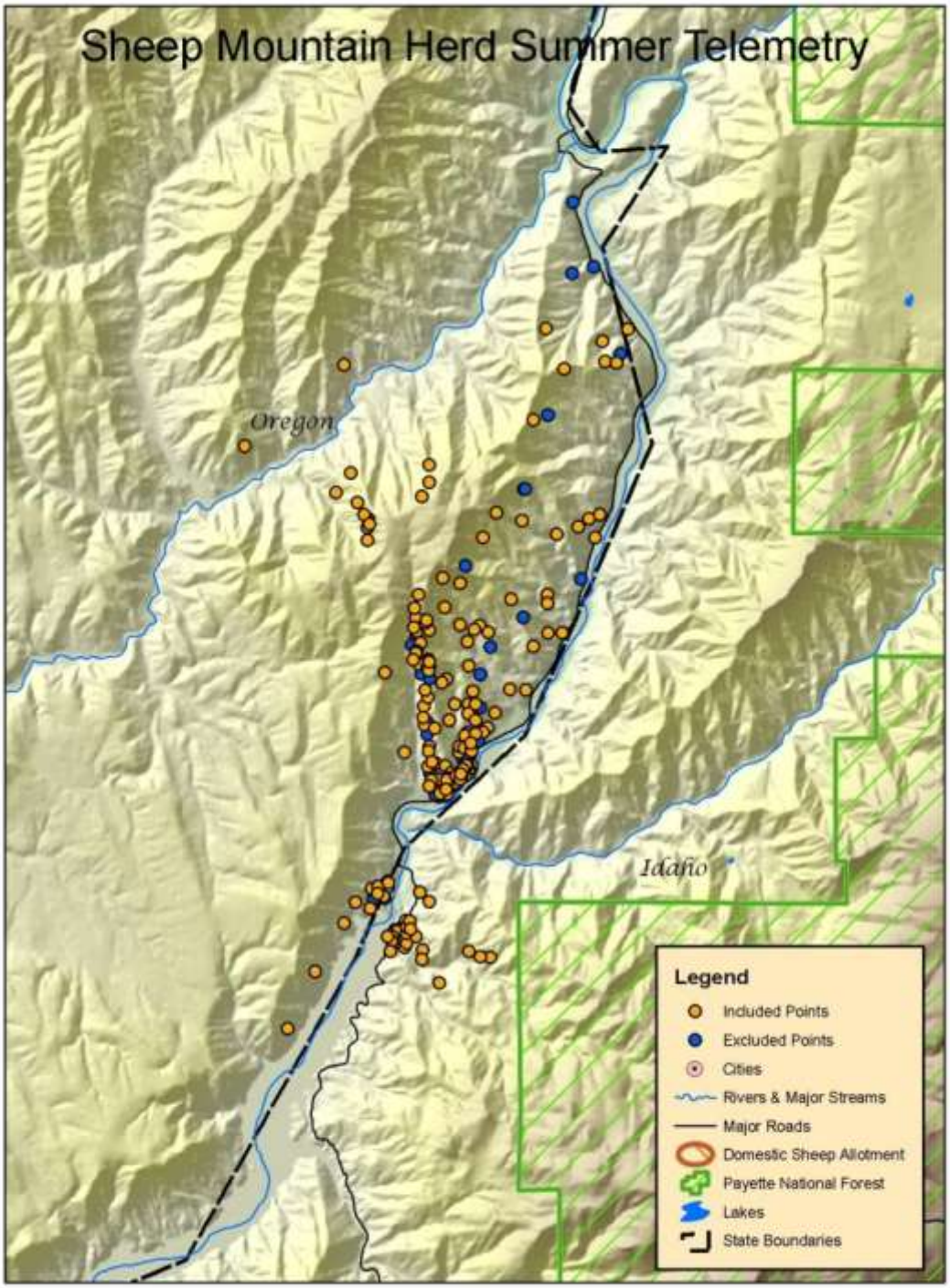


Figure 3-12. Sheep Mountain herd telemetry points

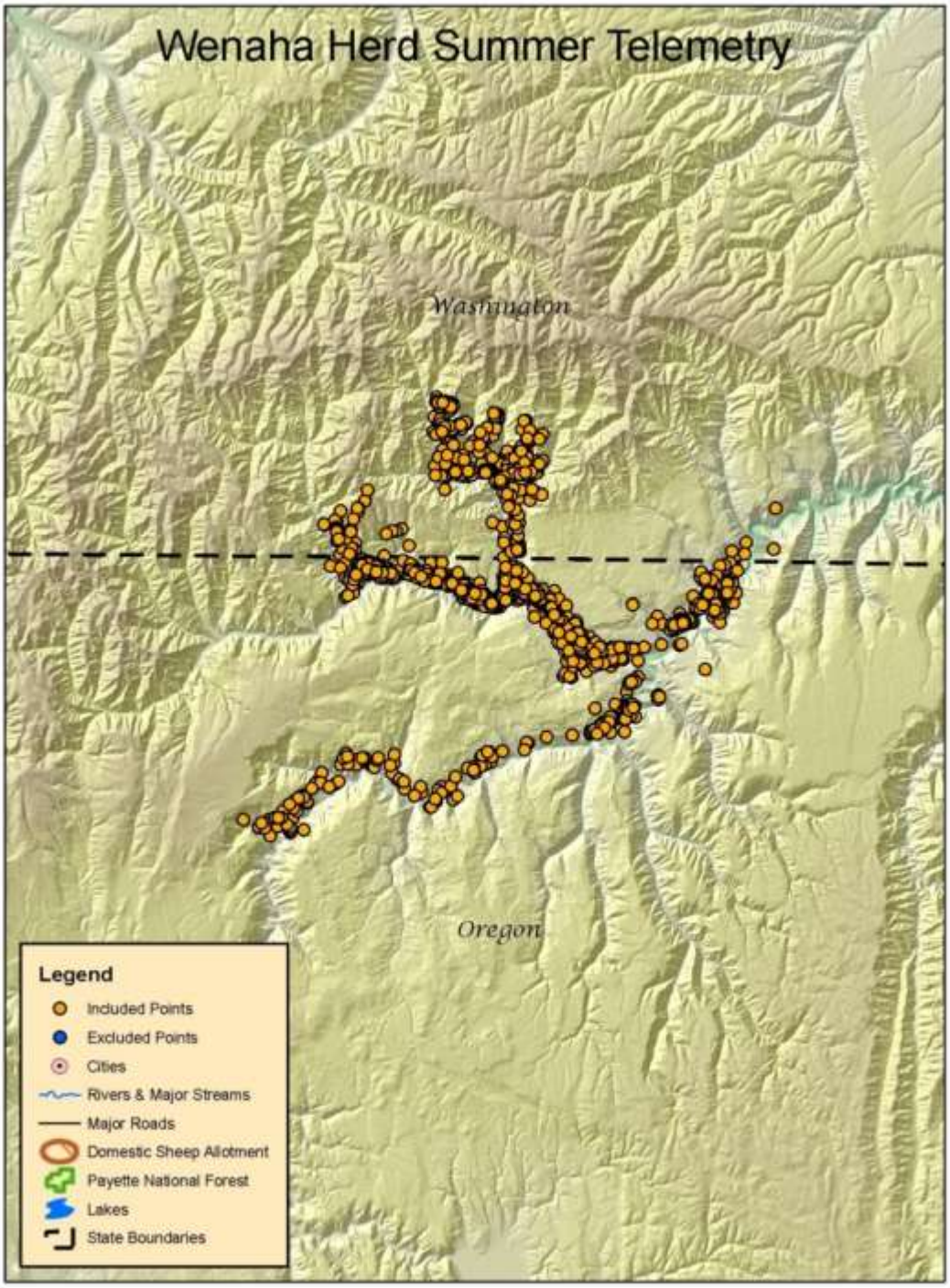


Figure 3-13. Wenaha herd telemetry points

The home range modeling was completed with Home Range Extension version 1.1 for ArcGIS (Rodgers et al. 2007). The home range analysis utilizes a fixed kernel analysis with a band width of the calculated h_{ref} value with volume contours starting at 50% to 90% in 10% increments and 5% increment between 90% and 95% (Figures 3-14 through 3-26). Points beyond 95% were considered forays and analyzed separately in the foray model.

This process of home range analysis was done for each identifiable individual within a herd, which had more than 20 telemetry points. All other telemetry and observation points for a herd that did not meet these criteria were excluded from the home range analysis and used to verify the accuracy of the final herd home range volume contours. One of the byproducts of the process is a surface raster from which the volume contours were created. In order to create an overall herd home range the raster surfaces from the individuals were added together, and then volume contours were created from the merged herd surface. The volume contours were created from the combined raster surface with Hawth's Analysis Tools version 3.27 Extension for ArcGIS (Hawthorne Beyer 2002–2006). This process is similar to more traditional home range analysis that is conducted on individuals; the band width is determined for each individual, and then the results aggregated together for a group.

The Home Range Extension uses a standard bivariate normal probability density function to estimate the utilization distribution; h_{ref} is calculated as the square root of the mean variance in x (var x) and y (var y) coordinates divided by the sixth root of the number of points (Worton 1995).

$$href = n^{\frac{-1}{6}}\sqrt{\frac{\text{var } x + \text{var } y}{2}}$$

This process does not follow the same process used in the Clifford et al. (2007) work that was referenced in the draft analysis for several reasons. The Home Range Extension uses a Gaussian kernel, which never reaches 0 and mathematically cannot calculate a 100% volume contour. When a user puts 100% into the software, the software limits that 100% to an internal value, such as 99.9999%. The Home Range Extension version used in the Draft SEIS was 0.99, and it had a different internal limit than version 1.1, which was used for the analysis in the Final SEIS. Because of these problems, the analysis was split into two parts. The first part is the herd home range that defines the core areas of habitat usage. The analysis for the Draft SEIS used the 50% to 90% volume contours to define this area of core habitat usage. The second part is an analysis for the foray behaviors that bighorn sheep exhibit, especially young rams. The analysis for the Draft SEIS used the 90–100% volume contour areas to analyze these foray behaviors. The herd home range and the forays are two very different types of habitat usage behaviors and needed to be handled by two analyses. While this process differs from the analysis in Clifford et al. (2007), it does allow calculation of the annual rates of contact between bighorn sheep populations and domestic sheep allotments.

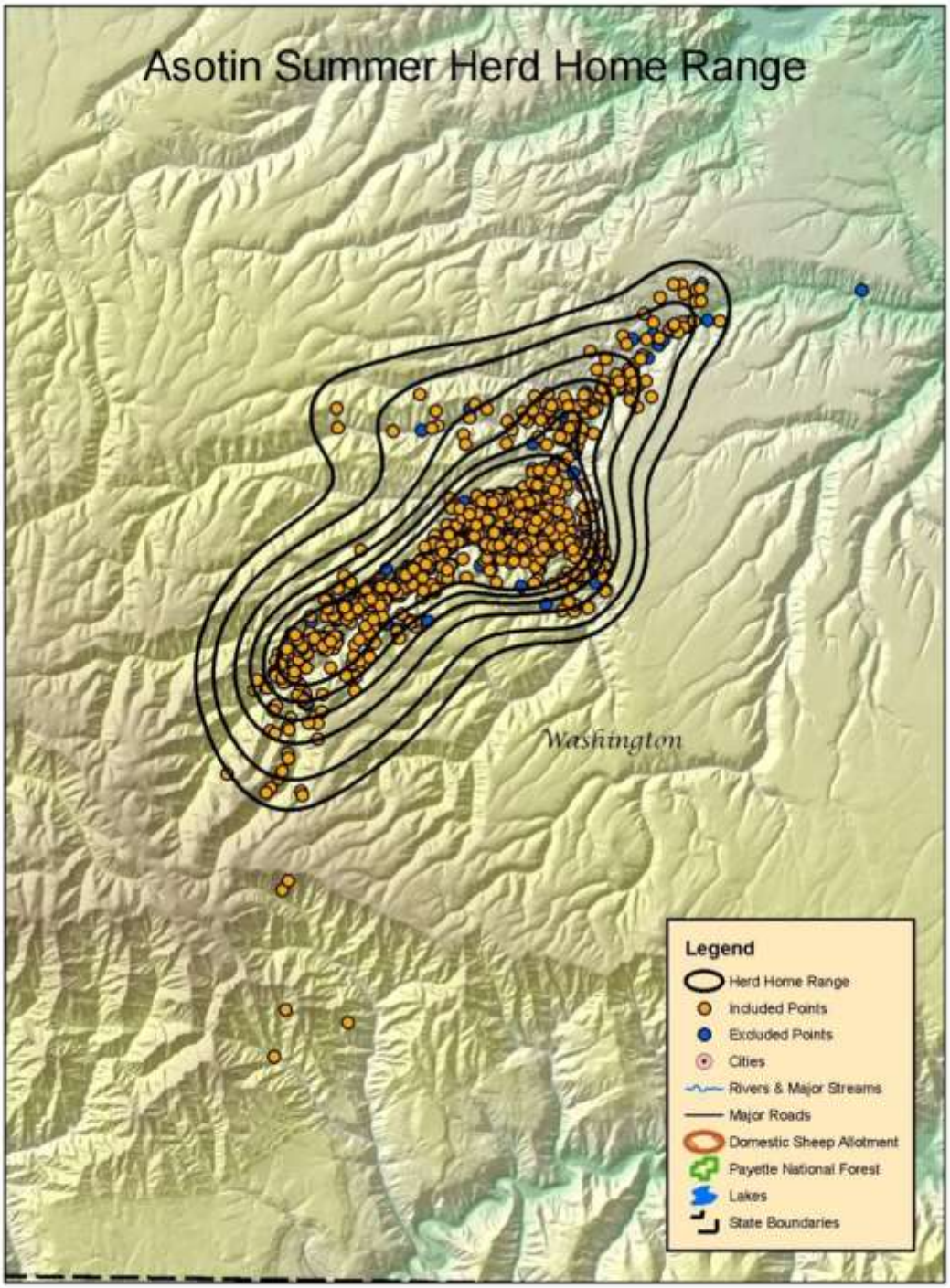


Figure 3-14. Asotin home range

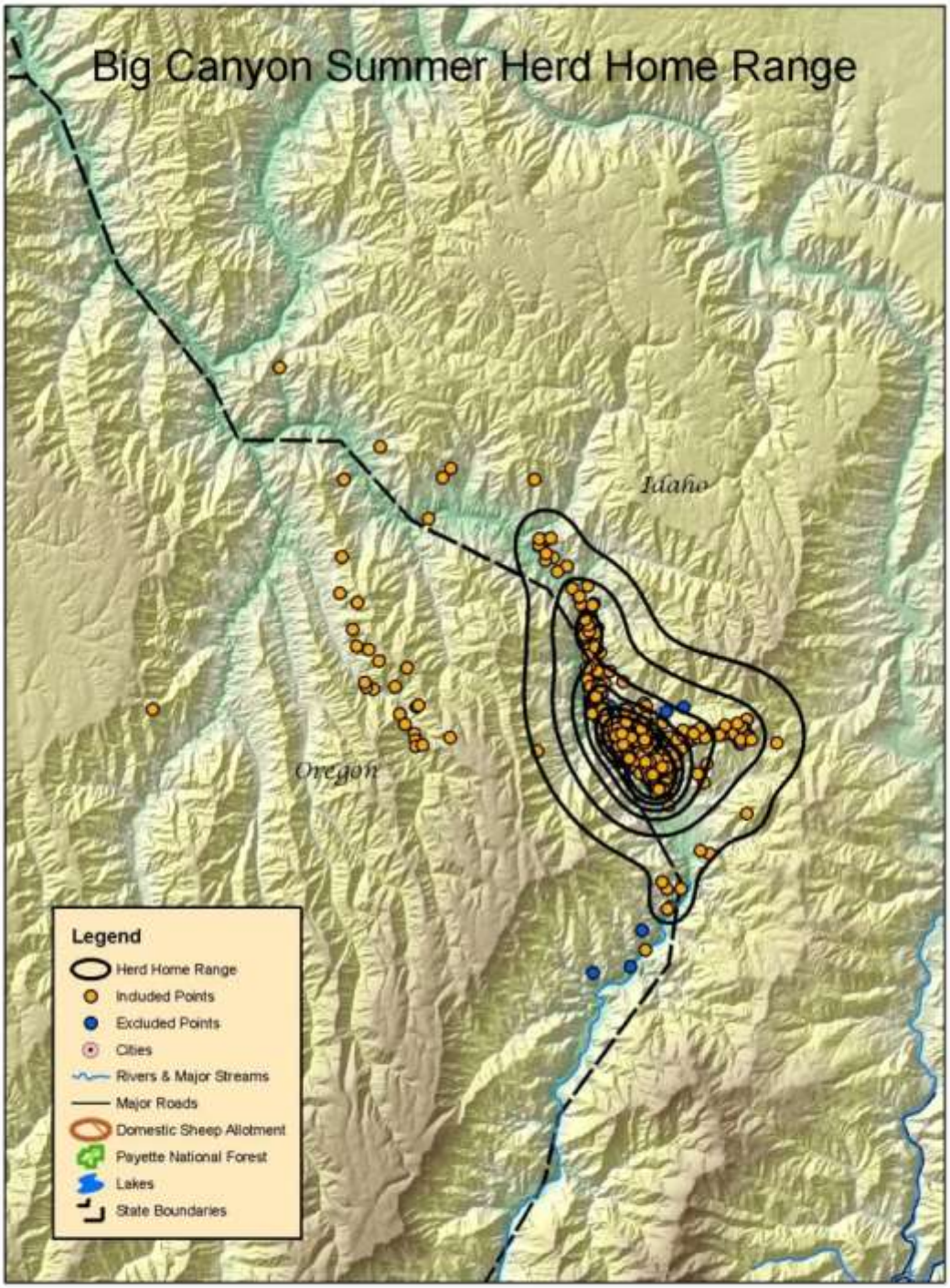


Figure 3-15. Big Canyon herd home ranges

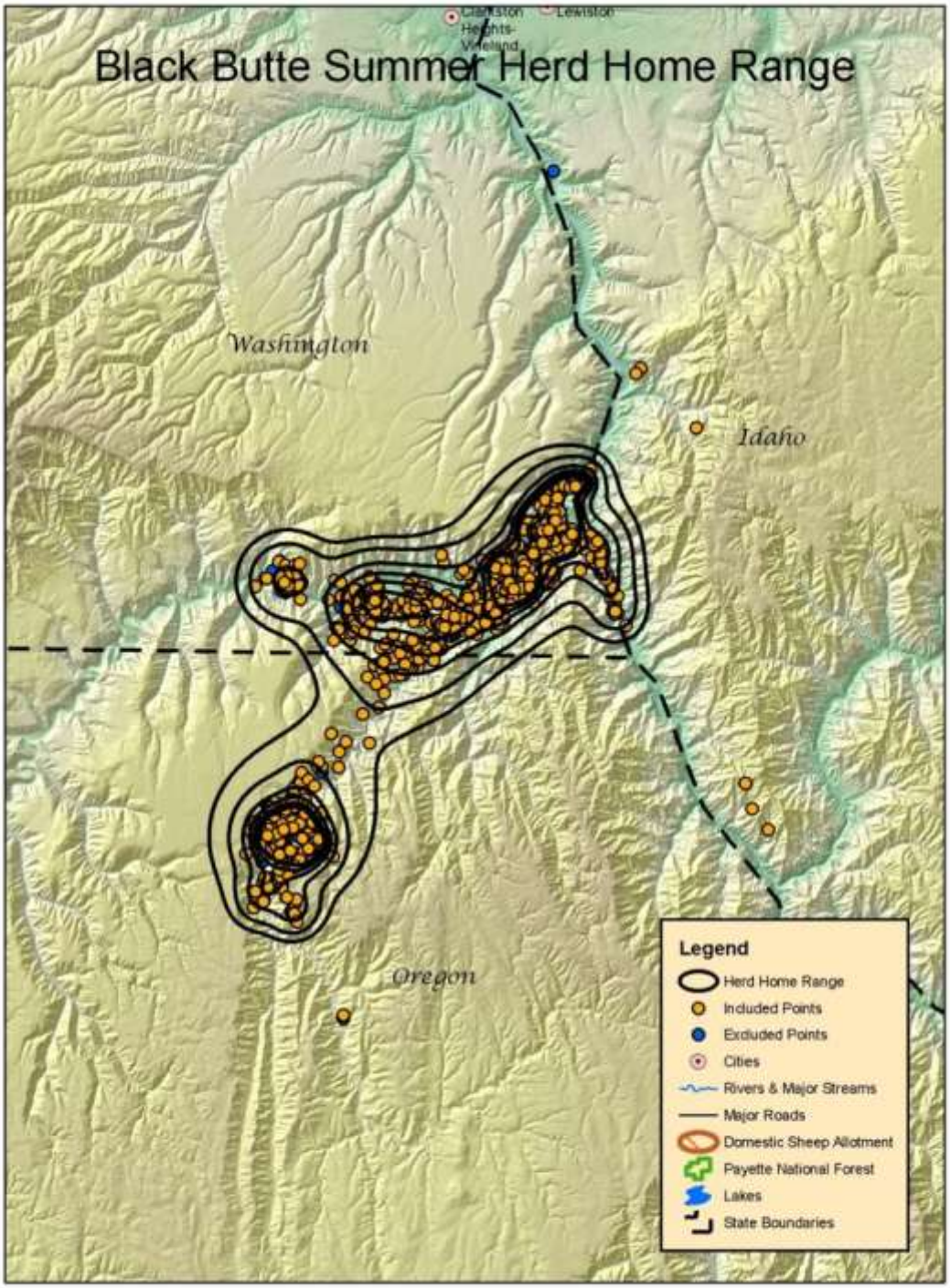


Figure 3-16. Black Butte herd home range

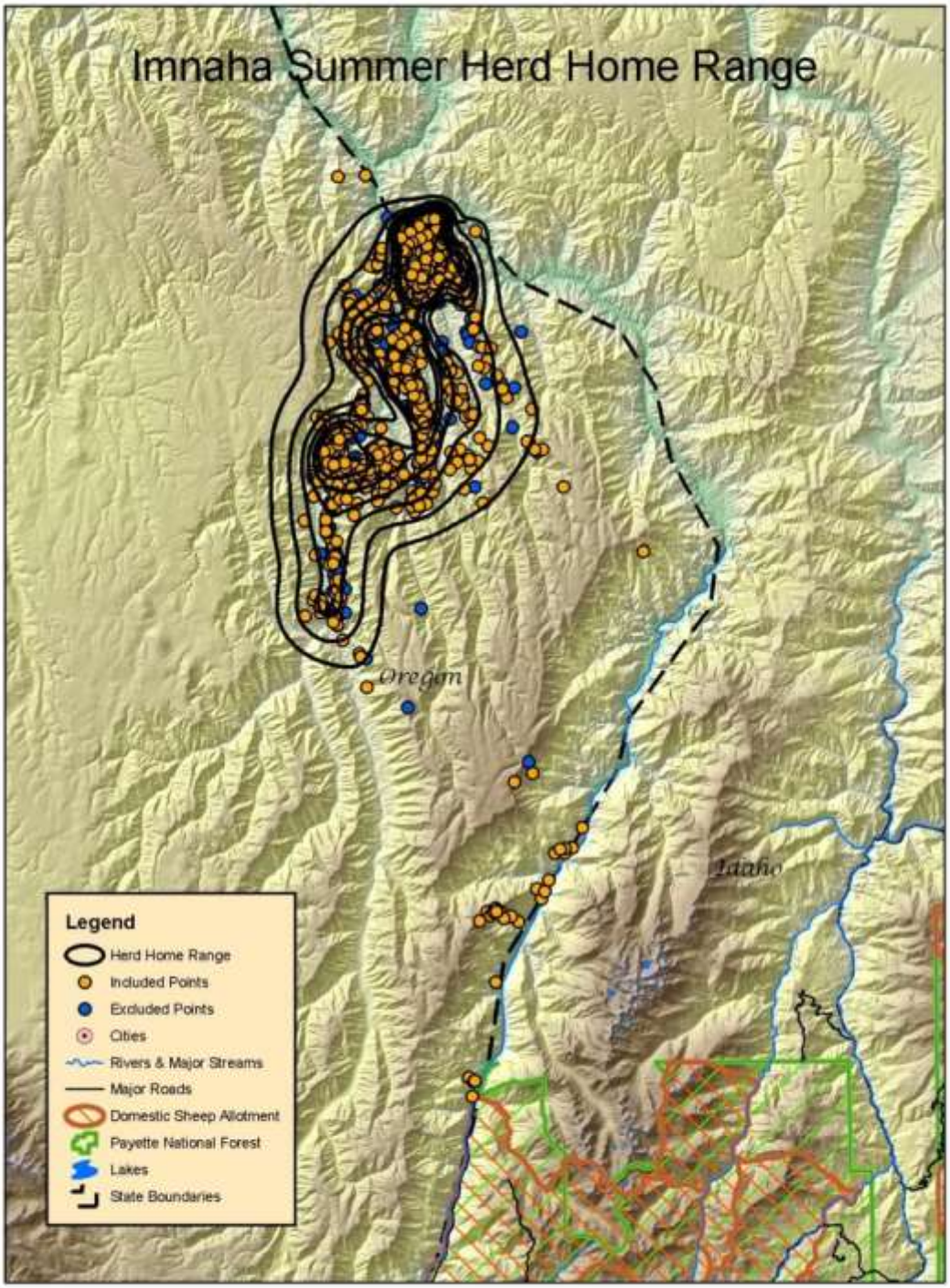


Figure 3-17. Imnaha herd home range

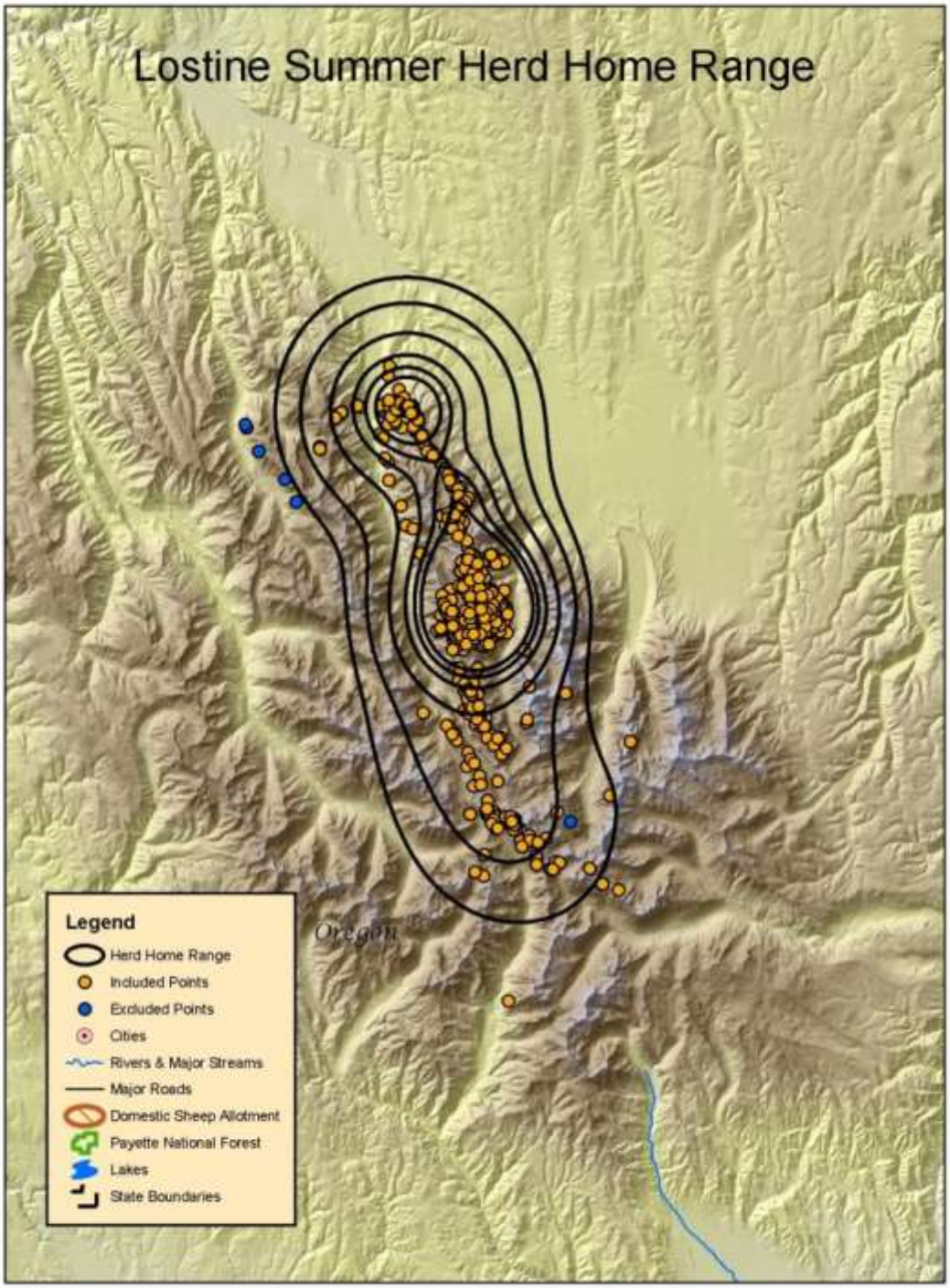


Figure 3-18. Lostine herd home range

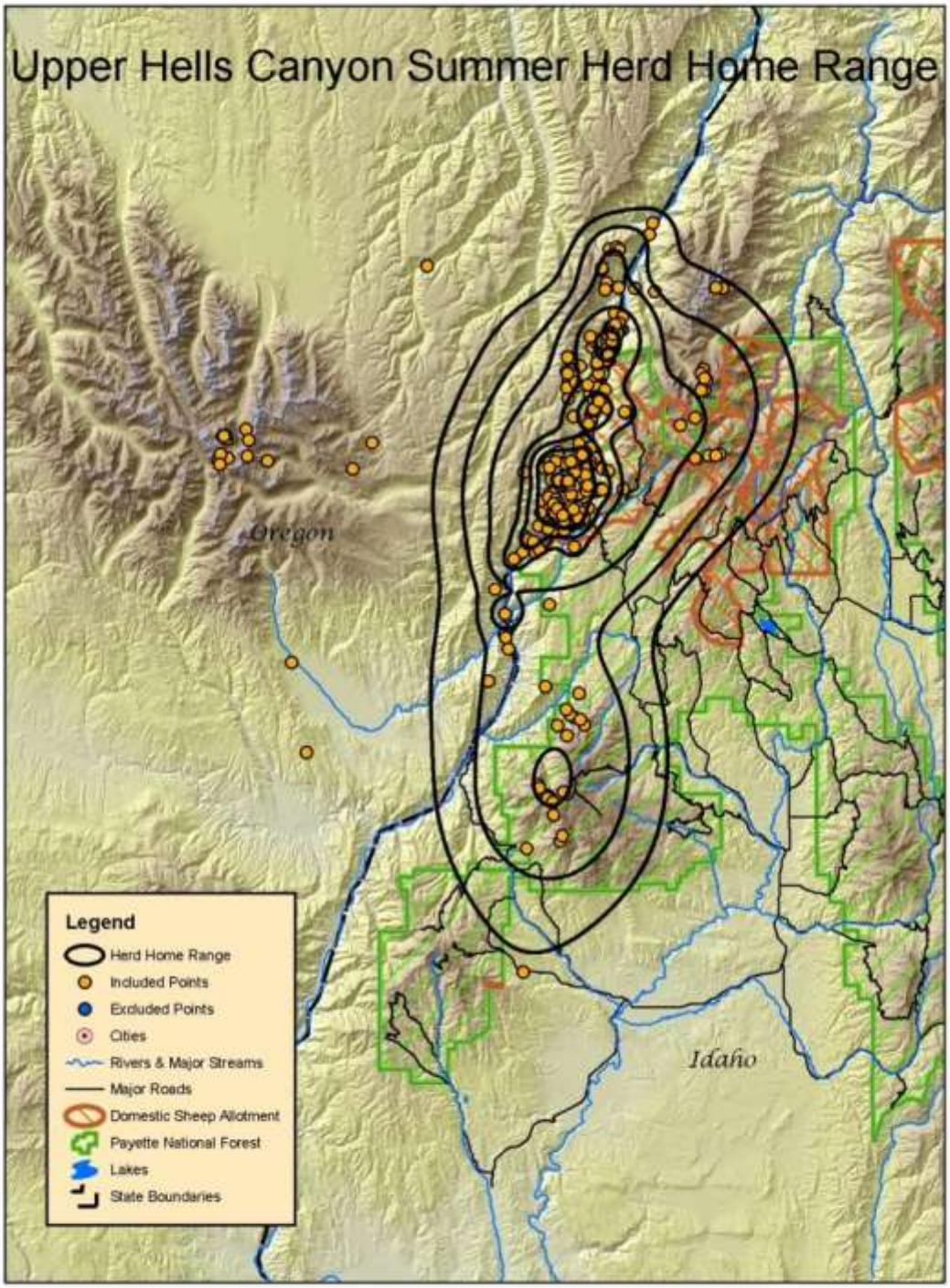


Figure 3-19. Upper Hells Canyon herd home range

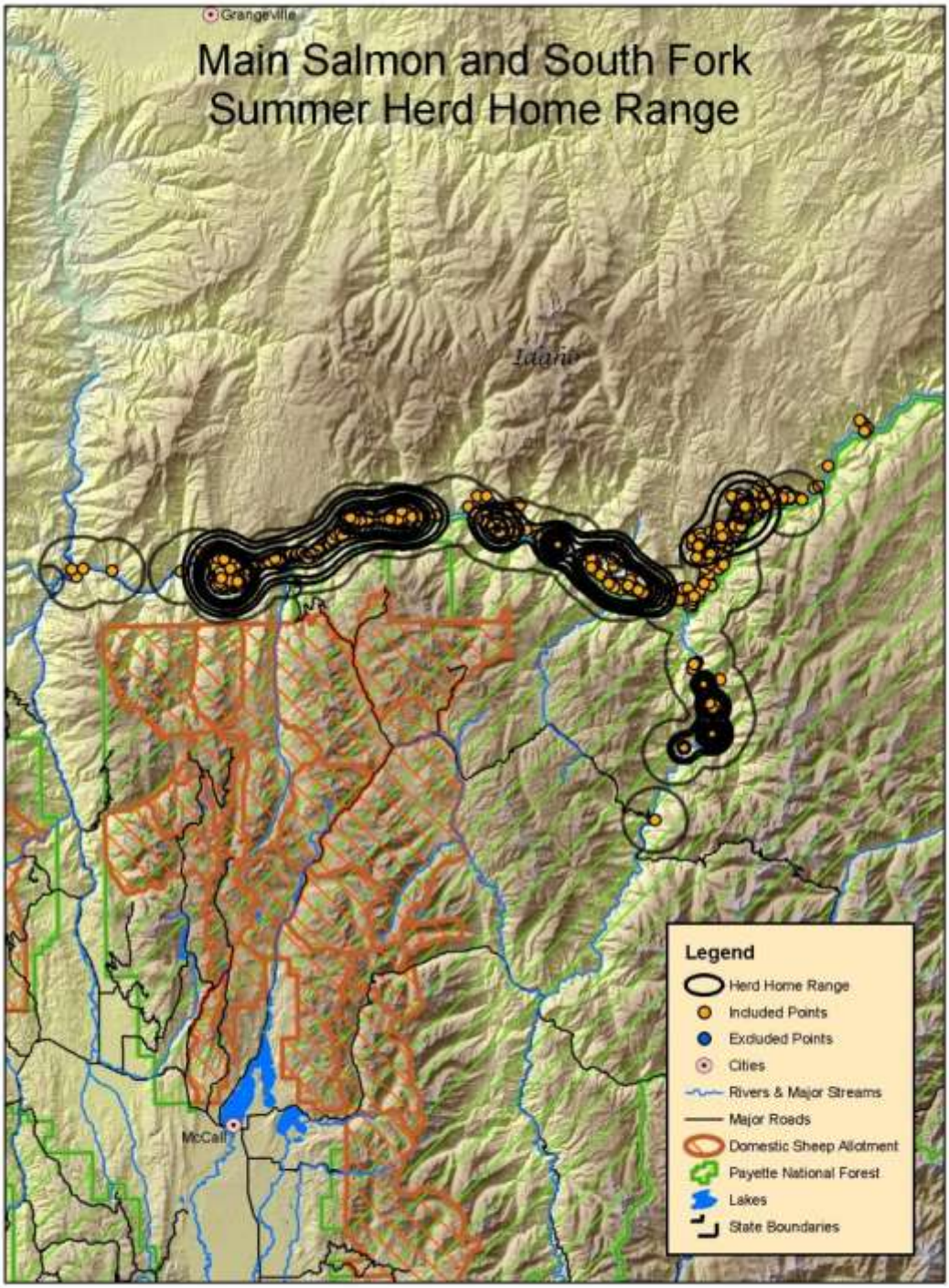


Figure 3-20. Main Salmon/South Fork herd home range

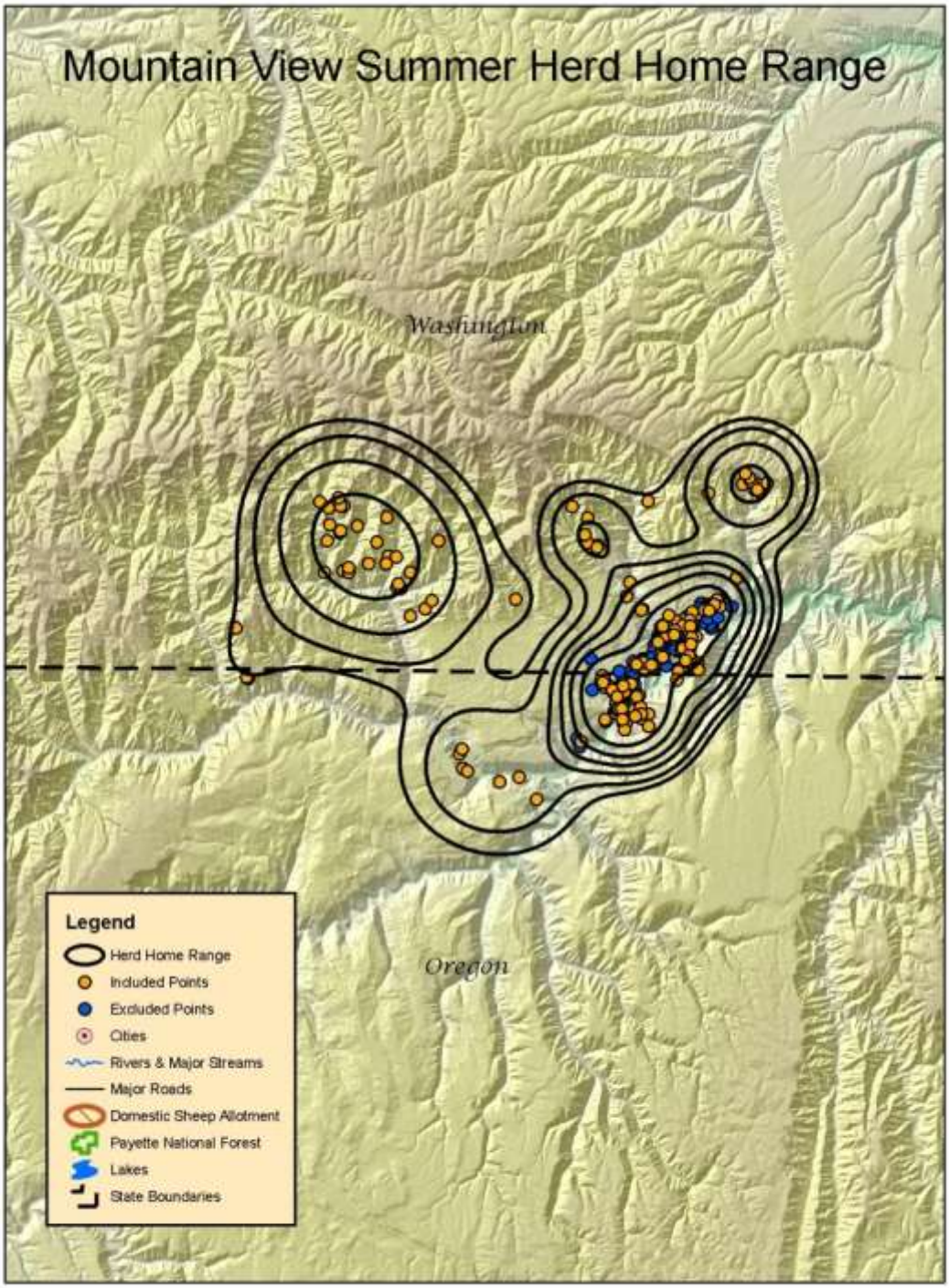


Figure 3-21. Mountain View herd home range

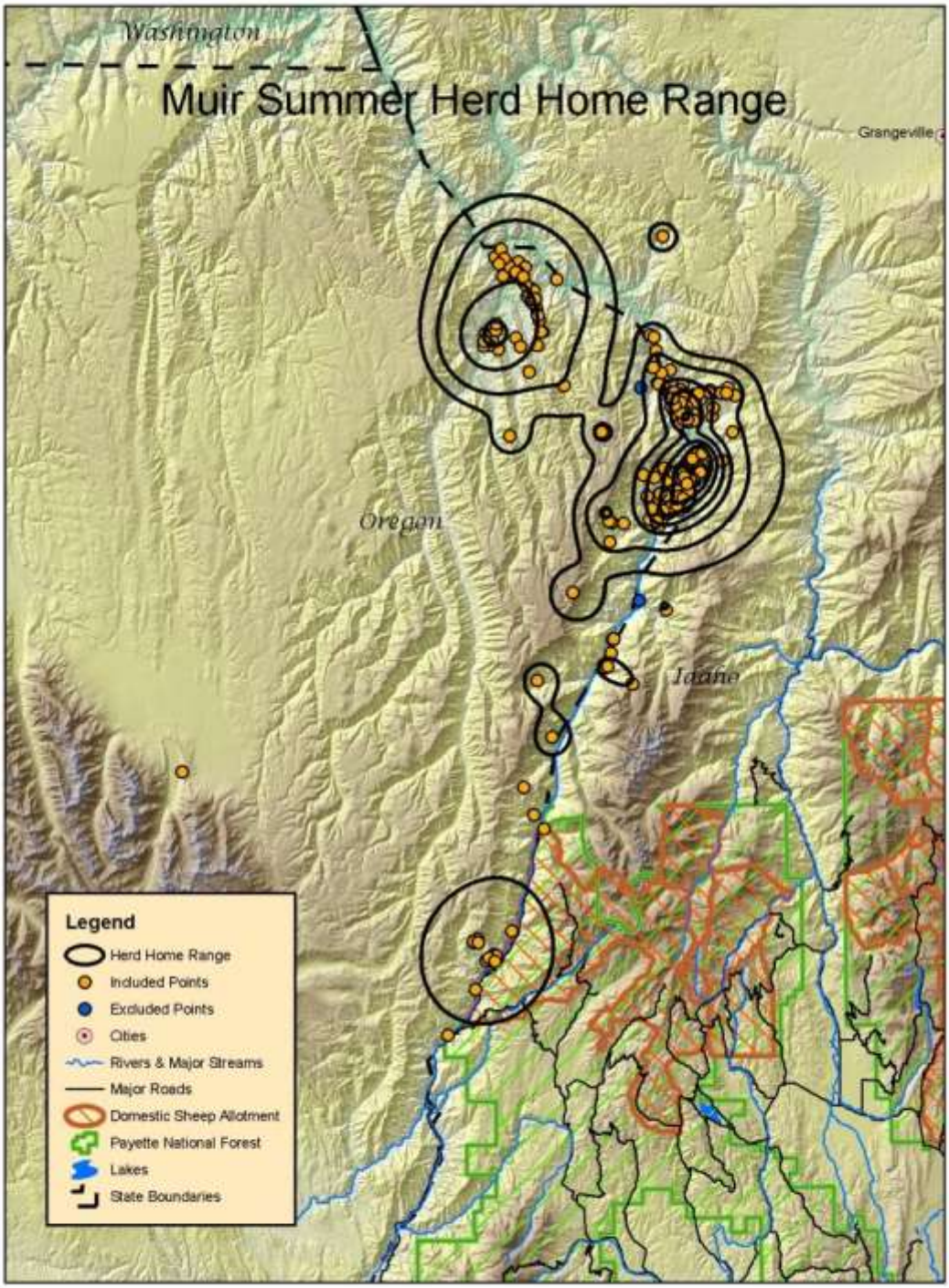


Figure 3-22. Muir herd home range

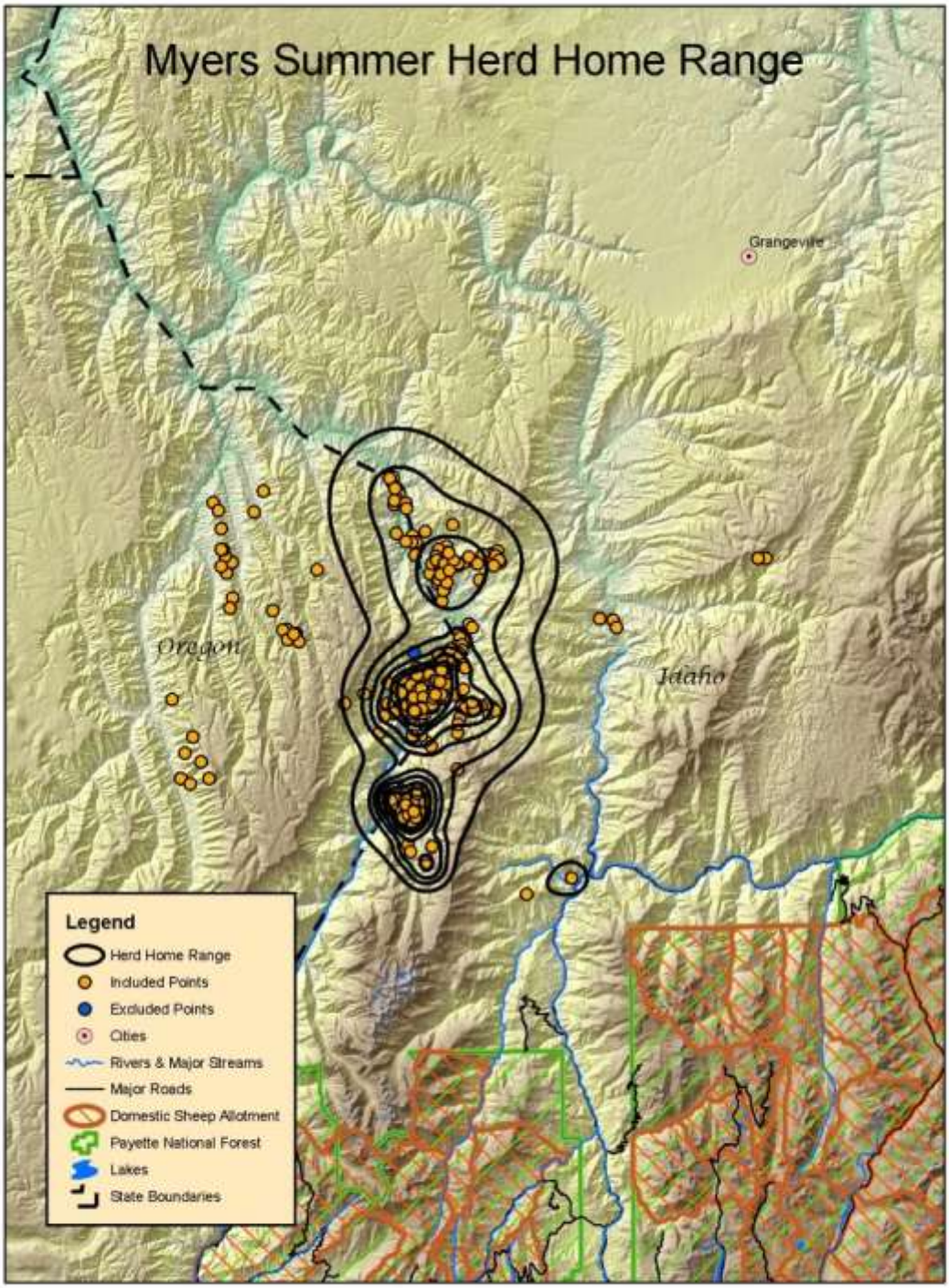


Figure 3-23. Myers herd home range

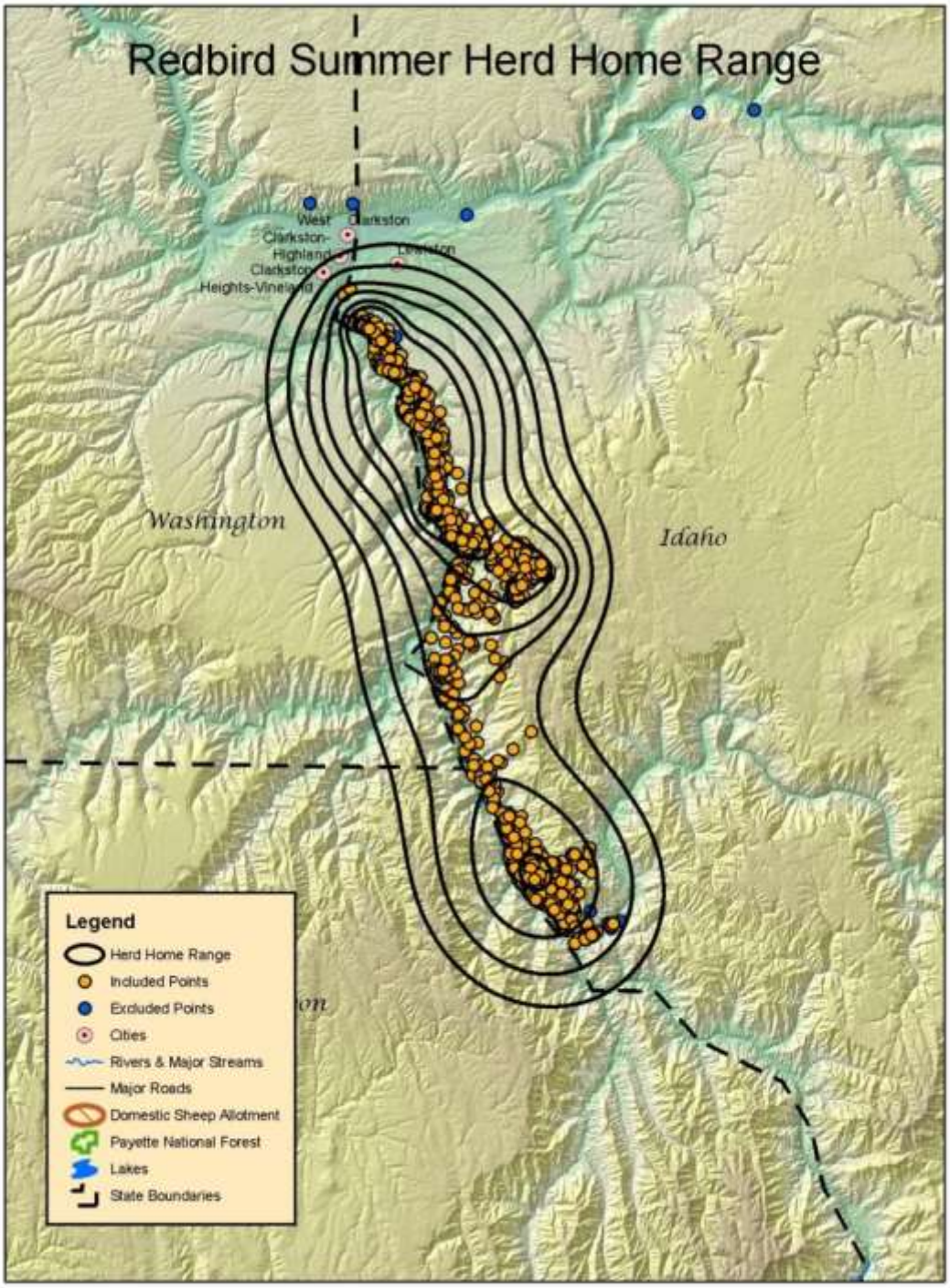


Figure 3-24. Redbird herd home range

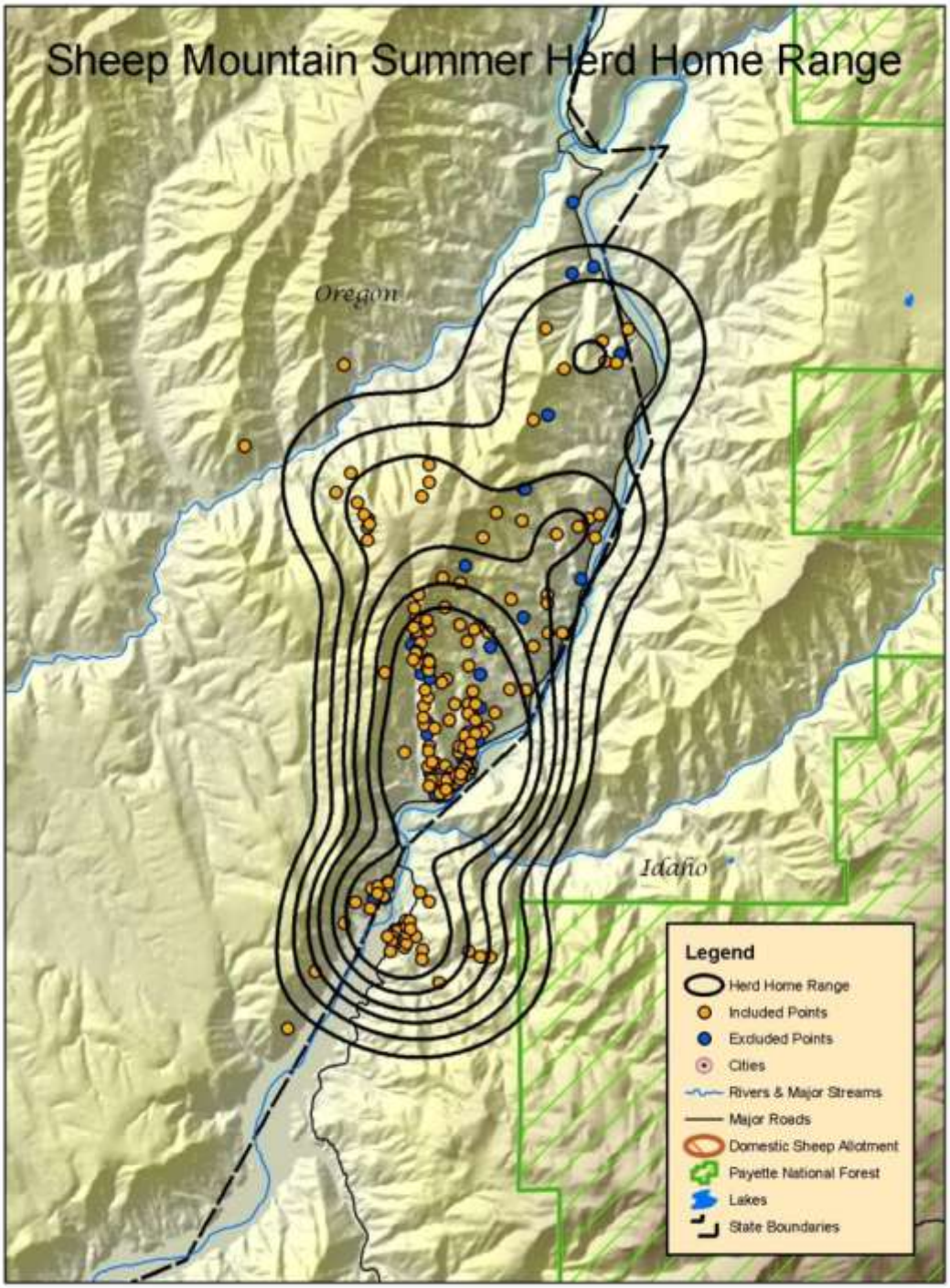


Figure 3-25. Sheep Mountain herd home range

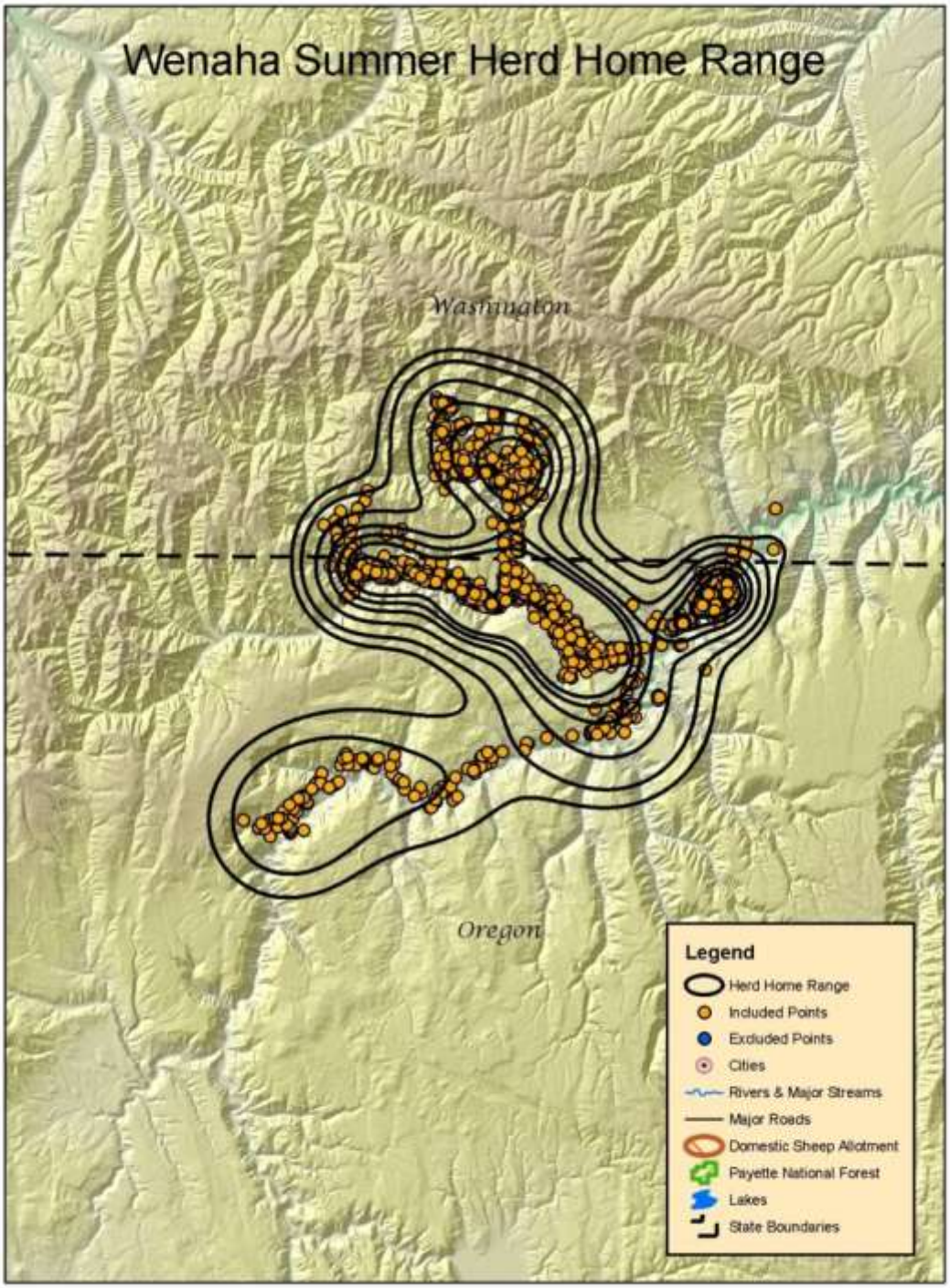


Figure 3-26. Wenaha and Mountain View herd home range

4.0 Foray Model

Like bighorn sheep elsewhere, Hells Canyon and Salmon River bighorn sheep—particularly rams—make occasional long-distance movements beyond their core herd home ranges. Singer et al. (2001) called these movements "forays" and defined them as any short-term movement of a radiocollared animal away from and back to its herd's home range. This life history trait can put bighorn sheep at risk of contact with domestic sheep, particularly when suitable habitats are well connected and overlap with domestic sheep use areas (Gross et al. 2000; Singer et al. 2000). The risk of contact between dispersing bighorn sheep and domestic sheep is related to the number of bighorn sheep in a herd, the proximity of domestic sheep use areas (allotments) to core bighorn sheep herd home ranges, the distribution of bighorn sheep source habitats across the landscape, and the frequency and distance of bighorn sheep forays outside of core herd home ranges.

The sequence of events by which a disease outbreak could result from contact of a bighorn sheep with a domestic sheep in an active allotment can be broken down into a number of steps. First, to reach an occupied allotment, a bighorn sheep must 1) leave the core herd home range; 2) travel far enough to reach the allotment; and 3) intersect the allotment (i.e., rather than some other area at the same distance from the core herd home range). For disease transmission to occur, the bighorn sheep must 4) come into contact with domestic sheep in the allotment and 5) contract the disease from the domestic sheep. Finally, for an outbreak to affect the animal's home herd, the infected bighorn sheep must 6) make its way back to the core herd home range and 7) transmit the disease to other members of the herd.

The foray model covers steps 1–3 above and is used to estimate the per-season (summer or winter) probability that an individual ram or ewe will go on a foray that intersects a given allotment. Separate models were constructed for rams and ewes due to the distinct movement patterns exhibited by the two sexes. All estimates of movement behavior were formed by analyzing the same large telemetry dataset on bighorn sheep movements in Hells Canyon that was used to determine the core home range of each herd. The estimates of the foray behaviors started with the Imnaha herd because that herd was established from bighorn sheep from the Salmon River. The telemetry collars were not placed on the sheep in the Imnaha herd until 15 years after the animals were translocated so all of the telemetry collected for the herd is of established behaviors and not post release movements. The dataset consisted of approximately 52,000 point locations from more than 400 animals in 13 herds collected between 1997 and 2008. In the Salmon River system, there is only a single year of telemetry data for 30 individuals in one herd—the Main Salmon/South Fork herd. These data are useful in estimating the herd's core home range, but they are not sufficient to characterize the foray behavior of animals in that herd. As a result, modelers used the much more extensive data collected in the Hells Canyon herds to estimate the likely movement patterns of bighorn sheep in herds throughout the Forest.

The path taken by a bighorn sheep traveling outside its core herd home range might intersect any part of an allotment. The analysis began by calculating the probability of intersection in each of 35 "rings" or annuli of 1-km width located between 1 and 35 km from the core herd home range boundary. That probability was broken down into three parts, as follows in Equation 1:

$$\begin{aligned} P(\text{Intersect allotment}_{\text{Ring_k}}) = {} & P(\text{Foray}) \times \\ & P(\text{Animal reaches ring}_{\text{k}} \mid \text{Foray}) \times \\ & P(\text{Intersect allotment} \mid \text{Animal reaches ring}_{\text{k}}) \end{aligned}$$

Probability of a Foray Movement—*P*(Foray)

Most bighorn sheep, in most years, never move beyond the core herd home range. Table 4-1 summarizes the frequency of foray movements by rams and ewes in summer (May–October) and winter (November–April). Modelers separately calculated the probability of bighorn sheep–domestic sheep contact in summer and winter, both because characteristic movement patterns differ between the seasons (e.g., the rut occurs in November/December and produces relatively frequent and long-distance exploratory forays by rams) and because the allotments are only permitted to domestic sheep during the spring and summer seasons.

For the foray model, the key values in Table 4-1 are the proportion of animal-years with at least one foray. (Animal-years refer to observations with a unique combination of both animal identification and year: If a single ram was observed in 4 different years and left the core herd home range during 1 of those years, it would be said to have made a foray in 1 of 4 animal-years.) In any one summer, 14.1% of rams and 1.5% of ewes typically leave the core herd home range at least once. Alternatively, a given ram has a 14.1% probability and a ewe has a 1.5% probability of making a foray. This percentage is the per-season probability of a foray, termed *P*(Foray) and used above in Equation 1.

Table 4-1. Summary of telemetry observations made outside of the core herd home ranges

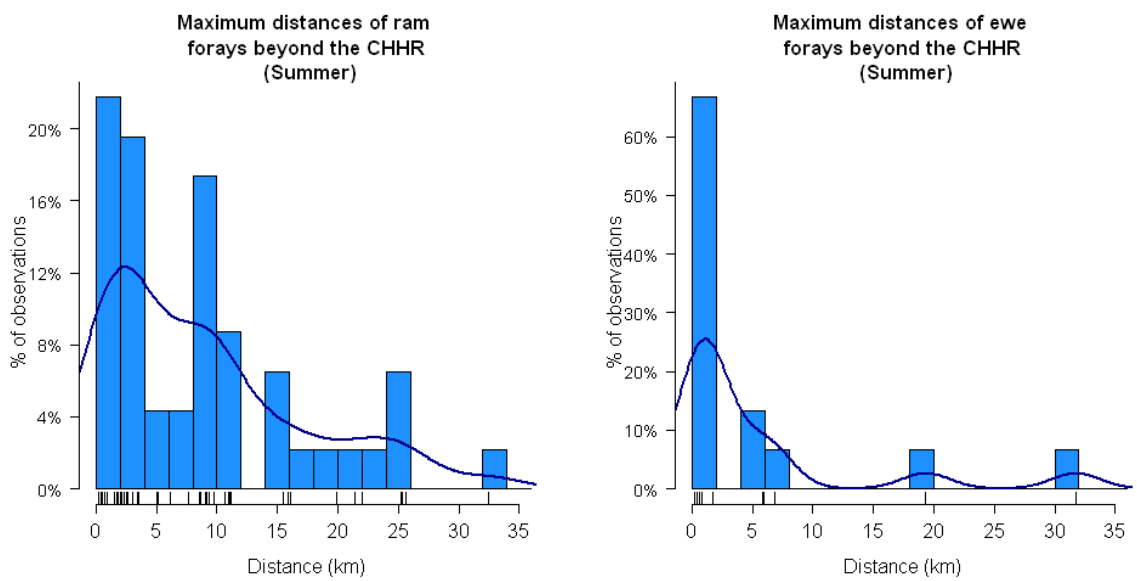
	Ewes		Rams	
Summer—May to October	**Percent (%)**	**Number**	**Percent (%)**	**Number**
Animals located beyond CHHR[a] at least once during period of observation	**6.50**	(14/215)	**28.80**	(30/104)
Animal-years with at least one foray	**1.50**	(15/985)	**14.10**	(44/311)
Telemetry points outside of CHHR	**0.20**	(29/17258)	**4.40**	(160/3674)
Winter—November to April				
Animals located beyond CHHR at least once during period of observation	**12.9**	(28/217)	**34.9**	(38/109)
Animal-years with at least one foray	**5.6**	(60/1062)	**17.8**	(68/380)
Telemetry points outside of CHHR	**0.8**	(109/12941)	**3.7**	(156/4200)

[a] CHHR = core herd home range

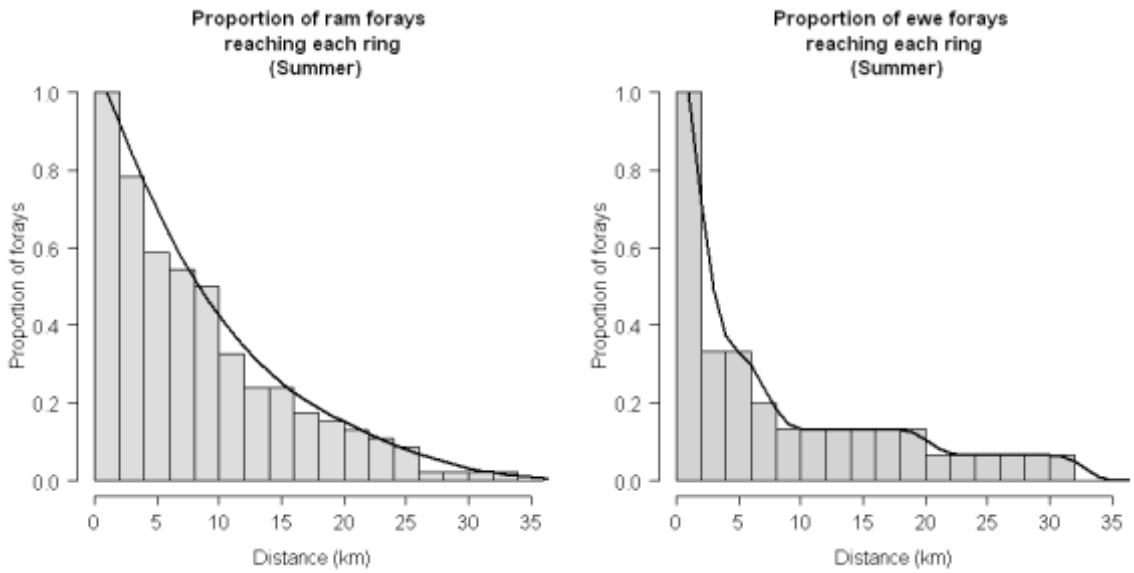
Distance from Core Herd Home Range Travelled on Typical Forays—*P*(Animal reaches ring$_k$ | Foray)

Many animals—particularly ewes—may not travel far, even if they are observed outside of the core herd home range. The probability that a bighorn sheep on a foray will reach an allotment drops off with distance. To characterize that decreasing probability, modelers first extracted from each foray the maximum distance from the core herd home range at which a ram or ewe was observed (Figures 4-1a and 4-1b). One bighorn sheep (a ram) was observed during the summer nearly 35 km from its core herd home range, so the distributions extend out to that distance.

An animal located 25 km from the core herd home range has crossed each ring between itself and the core herd home range. Likewise, 100% of the animals that make a foray intersect at least the first ring around the core herd home range. More generally, the proportion of animals whose forays intersect each ring is equal to the proportion known to have reached it or one of the rings beyond it. That distribution is shown in Figure 4-2a, along with a smooth curve fitted to it. The figure shows that fully half of the rams who leave the core herd home range travel at least 10 km from it; nearly a quarter get to 16 km, but just one ram has been observed (in summer) more than 26 km away. Modelers used the distribution in Figure 4-2a to calculate the probability that an animal will reach any given ring surrounding its core herd home range, *P*(Animal reaches ring$_k$ | Foray) in Equation 1.



Figures 4-1a and 4-1b. Maximum distances of ram and ewe summer forays beyond the core herd home range.



Figures 4-2a and 4-2b. Proportion of ram and ewe summer forays that reach each ring.

Figures 4-1a and 4-1b display the observed maximum distances of ram and ewe forays outside of core herd home ranges (95% isopleth) and Figures 4-2a and 4-2b display the proportion of rams and ewes with forays reaching each of the rings between 0 and 35 km from core herd home range areas.

Habitat Selection within a Ring—*P*(Intersect allotment | Animal reaches ring$_k$)

Given that an animal has reached a ring, the probability that it will be in an allotment is proportional to 1) the size of the allotment relative to the ring and 2) the quality of the habitat in the allotment relative to that in the ring. Calculating the size of the allotment relative to the ring is simple, but determining the quality of the habitat in the allotment relative to that in the ring requires knowing the habitat preference of bighorn sheep. Modelers represented that preference by calculating a resource selection function, defined as a function that is proportional to the probability of its use by an organism (Manley et al. 1993; Boyce et al. 2002).

Modelers constructed the resource selection function using a use/availability approach and expressed the relative preference for connectivity areas and non-habitat relative to the preference for source habitat using Equation 2:

$$\text{Pref}_h = \frac{\text{Use}_h / \text{Area}_h}{\text{Use}_{\text{source_hab}} / \text{Area}_{\text{source_hab}}}$$

Where:

Use_h = the number of telemetry points found in habitat type h;
$Area_h$ = the area of habitat type h available to the bighorn sheep; and
h = one of source habitat, connective area, or non-habitat.

Modelers calculated habitat preferences exhibited in three different areas: within the core herd home range, in the rings between 1 and 10 km from the core herd home range, and in the rings between 11 and 35 km from the core herd home range (Figure 4-3).

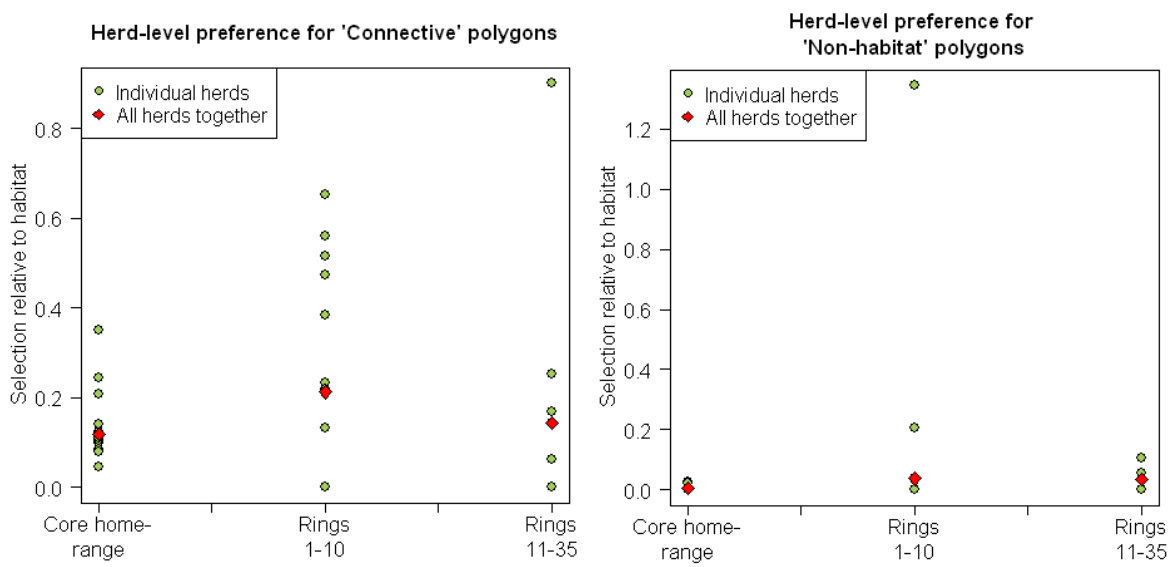


Figure 4-3. Observed herd-level preferences for connectivity area and non-habitat, relative to source habitat.

Next, modelers used the preferences and the distribution of habitat within each ring surrounding a core herd home range to calculate the probability that a bighorn sheep that reaches a ring will intersect the ring in an allotment using the Equation 3:

$$P(\text{Intersect allotment}_{\text{Ring_k}} \mid \text{Animal reaches ring k}) = \frac{\sum_h (\text{Area}_h \text{ in allotments w/in ring k}) \times (\text{Pref}_h)}{\sum_h (\text{Area}_h \text{ in ring k}) \times (\text{Pref}_h)}$$

Equation 3 implies that in a ring of homogeneous habitat, the probability of intersecting an allotment is simply proportional to the allotment's size. If, on the other hand, the habitat composition of the allotment is less (or more) favorable to bighorns than the composition of the ring as a whole, bighorns will be correspondingly less (or more) likely to intersect the allotment.

Finally, modelers used Equation 3 to complete the calculation of Equation 1 for each of the 35 rings surrounding the core herd home range. Equation 1 expresses the annual probability that a bighorn sheep will go on a foray, reach a ring at a given distance from the core herd home range, and intersect that ring within an active allotment.

Going from the probability of intersection in individual rings to the overall probability of intersection is complicated by the fact that ring-level probabilities are not independent (i.e., a bighorn whose foray intersects a large allotment in ring 17 is also likely to have intersected parts of the allotment lying in rings 16 or 15 on the same foray). As a result, the ring level probabilities cannot simply be added together to determine the overall risk. Although the approach is somewhat conservative (underestimating the probability of intersection), the modelers took the overall probability of intersection with an allotment to be the maximum value found for any one of the rings as shown in Equation 4:

$$P(\text{Intersect allotment}) = \max_k P(\text{Intersect allotment}_{\text{Ring_k}})$$

Probability of Effective Contact between Bighorn Sheep and Domestic Sheep within an Allotment

Given that a bighorn reaches an occupied allotment, what is the probability that it will contact and contract disease from the domestic sheep in that allotment? For a similar model, applied to populations of endangered Sierra Nevada bighorn sheep (Clifford et al. 2009), researchers assumed that cohabitation with domestic sheep was equivalent to contact, citing the attraction of bighorn sheep (particularly rams) to domestic sheep, and past observations of stray domestic sheep associating with bighorn sheep.

Because there is so much uncertainty surrounding this parameter, and essentially no research that would allow its estimation, the disease model was run with a range of probabilities of effective contact given cohabitation. The values used were 25%, 50%, 75%, and 100%.

5.0 Disease Model

At the request of the Forest Service, modelers at the University of California at Davis developed a simulation model to predict the population numbers of bighorn sheep in herds within the Forest over a period of 200 years. The model used information based on expert opinion, scientific literature, and unpublished data. The model was constructed using a commercially available spreadsheet (Excel) and was probabilistic (stochastic), using a commercially available spreadsheet add-in (@RISK). Outputs generated by the model include distributions for annual population numbers for each of the 15 bighorn sheep herds, the number of times a herd would become extirpated, and effects of each of the management scenarios examined. Input specifications, model construction, simulation results, and instructions on how to run the model are contained in this report.

5.1 Inputs

This bighorn sheep disease model simulated 15 herds (Asotin, Big Canyon, Big Creek, Black Butte, Imnaha, Lostine, Main Salmon/South Fork, Upper Hells Canyon, Mountain View, Muir Creek, Myers Creek, Red Bird, Sheep Mountain, Upper Main Salmon, and Wenaha) and 2 areas of concern. Herd populations could be extended or contracted by copying equations across the spreadsheet or by setting initial herd populations to 0, respectively.

The model consists of the following set of demographic and epidemiologic inputs. The demographic inputs consist of initial herd populations, interim herd level (IHL) estimates, nonviable herd numbers (NVNs), and population growth rates without disease. Epidemiologic inputs consist of a herd-to-herd contact (potential disease transmission) matrix, initial herd infection status, outbreak probability after the initial year, bighorn sheep-to-bighorn sheep transmission, domestic sheep-to-bighorn sheep transmission, combined bighorn sheep- or domestic sheep-to-bighorn sheep transmission, disease outbreak impact, extended infectious duration, extended adverse effect duration, and extended adverse effect impact.

5.1.1 Demographic Inputs

The following demographic parameters were used to simulate herd size and herd growth rates in the absence of disease.

Initial herd populations—The current population estimates of the 15 herds and 2 areas of concern were based on observations made by the IDFG, the Oregon Department of Fish and Wildlife, the Washington Department of Fish and Wildlife, and the Salmon River Bighorn Sheep Project (administered by the Nez Perce Tribe). Herd sizes ranged from 10 (Myers Creek) to 186 (Big Creek), while the 2 areas of concern had fewer individuals. A total of 1,033 bighorn sheep was estimated in all 15 herds.

In the model, the estimates appear below the herd-to-herd transmission matrix. Figure 5-1 provides a screenshot of some demographic inputs for herds 1–4 (Asotin, Big Canyon, Big Creek and Black Butte).

	BC	BD	BE	BF	BG	BH	BI
22	Current population			84	20	186	47
23	Interim herd levels (IHL)			172	96	479	461
24	Nonviable nos. all herds			30			
25	Initial herd infection status			0	0	0	0

Figure 5-1. Individual herd population-level and infection parameters

Interim Herd Level (IHL)—The IHL was used as a proxy for carrying capacity. The model limited population growth once the herd sized approached the IHL and populations were not allowed to exceed the IHL. IHLs were determined using population numbers reported from the 1980s. The IHLs ranged from 34 (Myers Creek) to 975 (Upper Main Salmon) for a total of 4,703; appear below the herd-to-herd transmission matrix in the spreadsheet; and are shown for 4 herds in Figure 5-1.

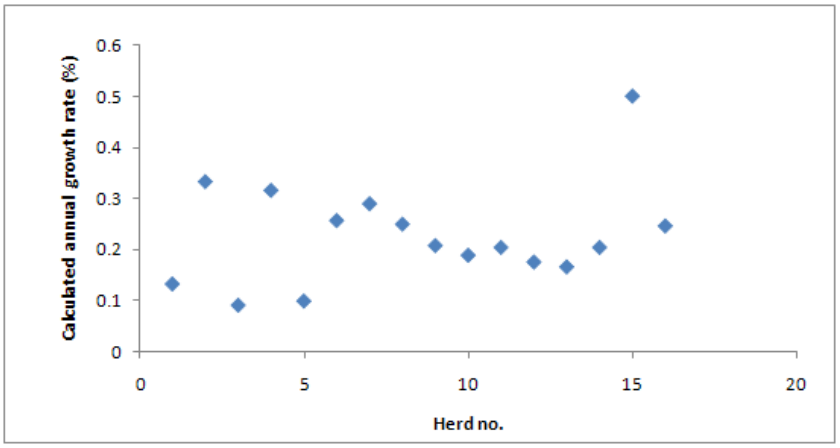
Nonviable Herd Numbers (NVN)—Modelers believed that a minimum population size exists—referred to here as the NVN—at or below which a population would not continue to grow at a disease-free rate and would in fact decline. Based on expert opinion of the IDT and Cooperating Agency experts, the model uses an NVN of 30 for all herds, with the exception of the combined herds of Big Canyon, Muir Creek, and Myers Creek (herds 2, 12, and 13), which by the nature of their overlap were considered to be a single herd and have an NVN of 30 for the combined herds. Although a single value of 30 was used, the model permits using individual NVNs for each of these herds. The cell referring to this value appears above the individual herd population models in row 43 of the spreadsheet (Figure 5-2).

	BH	BI
39	r_1 2nd par	-0.034
40	r_1 2nd par	0.248
41	r1_3rd par	4.9269
42	K_1	172
43	NV no. 1	30

Figure 5-2. Input parameters for growth rate equation and population constraints

Population Growth Rates—This rate is calculated for each herd individually, with the exception of the three herds that were combined as noted above.

Data used to fit the growth rate equation were taken from the McCarty and Miller 1998 data of 16 translocated populations of Rocky Mountain bighorn sheep in Colorado (Figure 5-3).



Source: McCarty and Miller (1998).

Figure 5-3. Calculated growth rate data model input

As an example of a population growth rate calculation, the population growth equation for the Asotin herd (herd 1, which appears in cell BL63) is given by the following equation:

=IF(BJ63<BI$43,BJ$49*BJ63,IF(BI63=0,RiskLoglogistic(r_1,BI$40,BI$41)*BJ63*((K_1-BJ63)/K_1),IF(AND(BI63>0,BI62=0),BK63,RiskUniform(CA35,CB35)*BJ63)))

This equation is rather complex and can be interpreted as follows. If the current population (BL63) is less than the NVN (shown for this herd in cell BJ49), it will decline annually at a proportion equal to the value in BJ49 (currently set at −0.25, i.e., 25%). On the other hand, if the population remains at or above the NVN, and there is not a disease outbreak (BI63 = 0), then the herd will have a growth rate estimated from the data presented by McCarty and Miller (1998) (Figure 5-3).

The statistical distribution and its parameters that best fits these data were identified using @RISK (see section 5.2). The equation was found to be best described by a loglogistic distribution ($P > 0.99$) with its 3 distribution parameters (−0.034, 0.248, and 4.9269) in cells BI39:BI41 (Figures 5-2 and 5-4). The 3 parameters (□□□) represent the location, scale, and shape of the distribution. In the figure, it can be seen that without disease or herd size constraints, a bighorn sheep herd will grow at the rate of 0–60% per year, with rates typically (85% of the time) between 10% and 35% and a 10% chance that the growth rate will be <10% or >42%.

The growth rate is limited by the IHL by the following equation:

$$dN/dt = N*r*(K-N)/K$$

Where:

N = total population size,
r = the unconstrained population growth rate, and
K = IHL.

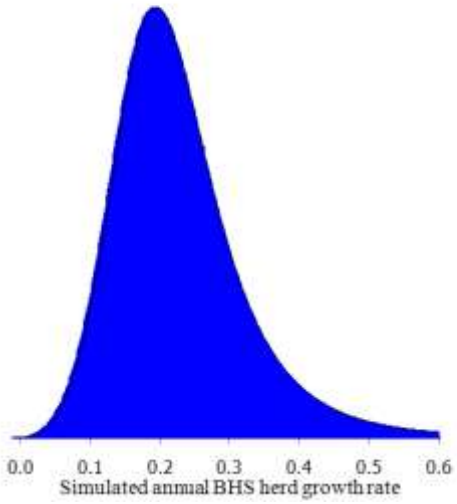


Figure 5-4. Probability density function (pdf) of growth rate without disease input

If, on the other hand, a disease outbreak occurs in the current but not previous year (identified in cells BI63 and BI62, respectively), the growth (actually a decline) is calculated as the product of the probability of an outbreak (0 = no and 1 = yes) multiplied by the disease impact, which in the figure is shown as −54.6. Since no outbreak occurred, a simulated growth will take place in the Asotin herd (herd 1), which will increase from 84 in year 1 (the beginning of the simulation) to 91.4 in year 2.

5.1.2 Epidemiologic Inputs

The following epidemiologic inputs were used to simulate the adverse effects of disease in bighorn sheep study populations.

Herd-to-herd Contact Probability Matrix—This matrix represents the probability of animal contacts among bighorn sheep residing in different herds. Figure 5-5 illustrates how the matrix appears in the model. Values in the matrix represent the annual probability of an individual animal in a given herd ("FROM" column), making adequate contact that could result in disease transmission with at least one individual in another herd (TO), named in column BE. Probability values are calculated on an individual animal basis. For example, there is a 0.49% chance per year (cell BF7) that a bighorn sheep from the Asotin herd (herd 1) will have an adequate contact with at least one animal from the Black Butte herd (herd 4). If this contact occurred and the Asotin herd was infected and the Black Butte herd was susceptible, it is assumed that transmission of the pathogen would be sufficient to cause disease in bighorn sheep in the Black Butte herd. The estimates of contact probabilities in the matrix were obtained from the foray and risk analyses (section 4), which were based on observations of bighorn sheep movements in herds in Hells Canyon and on the Salmon River.

	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW
1		Probability of		FROM																	
2				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
3		interherd contact		Asotin	Big_Canyon	Big_Creek	Black_Bu	Imnaha	Lick_Cree	Little_Sa	Lostine	Main_Salmc	McGraw	Mountain_\	Muir	Myers	Quartz	Red_Bird	Sheep_Mou	Upper_M	Wenaha
4		1	Asotin	0.0000	0.0000	0.0000	0.0055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0233	0.0000	0.0000	0.0000	0.0187	0.0000	0.0000	0.0070
5		2	Big Canyon	0.0000	0.0000	0.0000	0.0000	0.0199	0.0000	0.0005	0.0000	0.0018	0.0008	0.0000	0.9990	0.9999	0.9990	0.0060	0.0000	0.0000	0.0000
6	TO	3	Big Creek	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9999	0.0000
7		4	Black Butte	0.0049	0.0000	0.0000	0.0000	0.0022	0.0000	0.0000	0.0000	0.0000	0.0000	0.0180	0.0039	0.0000	0.0001	0.9999	0.0000	0.0000	0.0092
8		5	Imnaha	0.0000	0.0198	0.0000	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0024	0.0000	0.9990	0.0238	0.0322	0.9999	0.0000	0.0000	0.0000
9		6	Lick Creek	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10		7	Little Salmc	0.0000	0.0005	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0247	0.0152	0.0000	0.0093	0.0151	0.0224	0.0000	0.0000	0.0000	0.0000
11		8	Lostine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0018	0.0000	0.0002	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000
12		9	Main Salmc	0.0000	0.0014	0.0010	0.0000	0.0000	0.0002	0.0103	0.0000	0.0000	0.0030	0.0000	0.0074	0.9999	0.0145	0.0000	0.0000	0.9999	0.0000
13		10	McGraw	0.0000	0.0006	0.0000	0.0000	0.0019	0.0000	0.0115	0.0015	0.0026	0.0000	0.0000	0.9990	0.0098	0.9999	0.0000	0.9999	0.0000	0.0000
14		11	Mountain V	0.0126	0.0000	0.0000	0.0266	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0100	0.0000	0.0000	0.9999
15		12	Muir	0.0000	0.9999	0.0000	0.0035	0.9990	0.0000	0.0022	0.0002	0.0027	0.9999	0.0000	0.0000	0.9999	0.9999	0.9999	0.0018	0.0000	0.0000
16		13	Myers	0.0000	0.9999	0.0000	0.0000	0.0178	0.0000	0.0061	0.0000	0.9990	0.0099	0.0000	0.9990	0.0000	0.9999	0.0057	0.0000	0.0000	0.0000
17		14	Quartz	0.0000	0.9999	0.0000	0.0001	0.9999	0.0000	0.0057	0.0015	0.0041	0.9999	0.0000	0.9990	0.9999	0.0000	0.0066	0.0018	0.0000	0.0000
18		15	Red Bird	0.0069	0.0029	0.0000	0.9990	0.9999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0028	0.9990	0.0045	0.0074	0.0000	0.0000	0.0000	0.0004
19		16	Sheep Mou	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.9999	0.0000	0.0140	0.0000	0.0115	0.0000	0.0000	0.0000	0.0000
20		17	Upper Mair	0.0000	0.0000	0.9999	0.0000	0.0000	0.0000	0.0000	0.0000	0.9999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21		18	Wenaha	0.0035	0.0000	0.0000	0.0264	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9990	0.0000	0.0000	0.0000	0.0022	0.0000	0.0000	0.0000

Figure 5-5. Screenshot of bighorn sheep herd-to-herd individual animal contact probability matrix

However, the probability of disease transmission is further modified to account for the fact that not all contacts of a bighorn sheep from a susceptible herd with animals in an infected bighorn sheep herd will result in disease transmission back to the susceptible herd. The following factors may result in the lack of transmission:

1. The susceptible sheep may not contact an infectious sheep
2. If an effective contact is made, the newly infected sheep may not return to its herd of origin due to various factors, including the fact that the bighorn sheep may die prior to returning to its herd.

To account for this lack of transmission, a probability term was included in the model to reflect the <100% transmission probability resulting from the herd-level contact. The input for this transmission reduction term is located in CA29 (see Figure 5-6). In the example shown in the figure, there is a 75% chance of disease transmission if contact were made between a bighorn sheep from a susceptible herd and an infected bighorn sheep herd.

	BZ	CA	CB
29	BHS to BHS effective transmission probability	0.75	
30	scenario no.	1	
31	Domestic to BHS effective transmission probability	0.25	
32	Hell's Canyon total population IHL	10000	
33		min	max
34	Duration of adverse herd infection effect (years)	4	10
35	Extended effect impact	-0.13	0
36	Duration of infectious years	1	4
37	Outbreak impact (prop. dec.)	0.69	

Figure 5-6. Model parameters and sample values for disease spread and control

Initial Herd Infection Status—In year 1, the infection status of each bighorn sheep herd is specified by the user by entering a 0 or 1 in cells BF25:BW25 to indicate the herd is susceptible or infected, respectively. In the example shown in Figure 5-1, herds 1–4 are presumed susceptible at year 1.

In the initial year, the probability of an infection in a given bighorn sheep herd was calculated for the individual herds in row 63 and the column with the heading "Outbrk this yr?" (e.g., BI63 for the Asotin herd) (Figure 5-7).

	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT
60					Asotin							Big Canyon			
61		Prob. Avoiding contact:		Outbrk	Herd 1	Outbrk		year of	Prob. Avoiding contact (Q)			Herd 2	proportion		
62	Time	w/BHS	w/Domesti	this yr?	Asotin	impact	growth	extirpati	BHS	Domestic	prob.	Big Canyo	impact	growth	extirpati
63	1			0	84	-33.6	8.8662	1			0	20	-15	1.716	1
64	2	1	1	0	92.8662	-37.146	9.6894	2	1	1	0	21.716	-16.29	4.046	2
65	3	1	1	0	102.556	-70.763	18.067	3	1	1	0	25.762	-19.32	6.432	3
66	4	1	1	0	120.623	-83.23	6.868	4	1	1	0	32.194	-22.21	7.642	4
67	5	1	1	0	127.491	-95.618	10.951	5	1	1	0	39.836	-31.87	6.367	5
68	6	1	1	0	138.442	-55.377	4.907	6	1	1	0	46.203	-30.03	4.677	6
69	7	1	1	0	143.349	-114.68	6.5091	7	1	1	0	50.88	-20.35	3.78	7
70	8	1	1	0	149.858	-97.407	5.4974	8	1	1	0	54.66	-43.73	5.199	8
71	9	1	1	0	155.355	-107.19	2.3476	9	1	1	0	59.859	-19.75	6.646	9
72	10	1	1	0	157.703	-126.16	1.75	10	1	1	0	66.505	-26.6	1.669	10
73	11	1	1	0	159.453	-127.56	3.0262	11	1	1	0	68.174	-27.27	8.774	11
74	12	1	1	0	162.479	-129.98	1.8113	12	1	1	0	76.948	-57.71	3.251	12
75	13	1	1	0	164.29	-65.716	0.8173	13	1	1	0	80.199	-64.16	3.254	13
76	14	1	1	0	165.107	-132.09	0.863	14	0.994501	1	0	83.453	-66.76	2.801	14
77	15	1	1	0	165.97	-54.77	1.0623	15	0.998072	1	0	86.254	-28.46	3.365	15
78	16	0.067025	1	6	167.033	-133.63	-133.6	16	0.998309	1	0	89.618	-35.85	1.488	16
79	17	0.000317	0	5	33.4065	-26.725	-0.584	17	1.7E-193	1	9	91.106	-30.07	-30.07	17
80	18	0.403239	0	4	32.823	-24.617	-1.855	18	0.001867	0	8	61.041	-42.12	-2.434	18
81	19	0.615008	0	3	30.9678	-24.774	-2.952	19	0.898742	0	7	58.607	-46.89	-4.713	19
82	20	1	0	2	28.016	-21.012	-4.483	20	1	0	6	53.894	-37.19	-0.034	20
83	21	1	0	1	23.5335	-18.827	-3.765	21	0.998507	0	5	53.86	-37.16	-6.27	21
84	22	1	0	0	19.7681	-13.64	-3.163	22	0.999104	0	4	47.59	-38.07	-5.951	22
85	23	1	1	0	16.6052	-11.458	-2.657	23	1	0	3	41.639	-31.23	-5.324	23

Figure 5-7. Example outputs for disease transmission risk and herd impact

The equation in cell BI63 (Figure 5-7) is

=IF(BF25=0,0,INT(RiskUniform(CA34,CB34)))

This equation may be interpreted as follows. If the Asotin herd is specified as initially noninfected, then BF25 = 0 and the value of cell BI63 is also 0. On the other hand, if BF25 is another value (e.g., 1), then the duration of the adverse effects of the infection (to be further discussed below) is selected as an integer number of years from a uniform random sample of the time range listed in cells CA34:CB34 (i.e., 4 to 10 years in this example).

Outbreak Probability after the Initial Year—The probability of a disease outbreak in a bighorn sheep herd was based on herd population records and is indicative of an epidemic, which results in a substantial dieoff in the herd. Whenever possible, laboratory records were used to support this assumption. As with the matrix of bighorn sheep herd-to-herd contact probabilities (Figure 5-5), the annual probabilities of contact between a bighorn sheep in a herd and the domestic sheep on each open allotment were estimated by the foray and risk models using bighorn sheep movement data collected in Hells Canyon and on the Salmon River. Finally, adjustment terms were included to account for the fact that not all bighorn sheep contacts with infected bighorn sheep or domestic sheep herds would result in an infection and subsequent disease in the susceptible bighorn sheep herd.

Bighorn Sheep-to-Bighorn Sheep Transmission—Outbreaks occurring in year 1 can be initiated by the user, as discussed in the previous section. If none of the bighorn sheep herds were assumed to be infected in year 1, the only route of infection would come from contact by a bighorn sheep with a neighboring infected domestic sheep herd.

In order to simplify subsequent transmission equations, the probabilities presented in this section are the probabilities of avoiding adequate contacts (q), either with bighorn sheep from a different herd or domestic sheep.

This approach is based on the Reed-Frost equation (Abbey 1952) as follows:

$$P = 1 - q^C$$

Where:

P = the probability of a bighorn sheep from a given susceptible herd becoming infected and is based on the probability of avoiding adequate (sufficient to cause disease transmission if one individual was infectious and the other susceptible) contact with all infectious individuals in a given herd;
q = the probability of avoiding an adequate contact; and
C = the number of infectious individuals.

Modifying the Reed-Frost equation to reflect the infection risk coming from individuals in specific herds, rather than randomly distributed individuals in all bighorn sheep herds, would change the equation as shown:

$$P_{BHS} = 1 - q_1{}^{C_1} q_2{}^{C_2} q_3{}^{C_3} \ldots q_n{}^{C_n}$$

Where:

P_{BHS} = the probability of a susceptible bighorn sheep herd becoming infected by a bighorn sheep from an infected herd;
1, 2, 3, …n = the n bighorn sheep herds that have potential disease transmission contact with the susceptible herd;
q_n = the probability that an individual from the susceptible bighorn sheep herd will not make an adequate (sufficient to cause disease transmission) contact with one of the n herds; and
C_n is the number of infectious bighorn sheep in herd n.

Substituting Q_{BHS} for $q_1{}^{C_1} q_2{}^{C_2} q_3{}^{C_3} \ldots q_n{}^{C_n}$ results in the following formula:

$$P_{BHS} = 1 - Q_{BHS}$$

In this way, instead of calculating the numerable combinations of how a bighorn sheep herd could become infected (e.g., by 1 or more infected bighorn sheep herds), the probability of avoiding infection from the other (15) bighorn sheep herds (Q) is first calculated. That value is then subtracted from 1 to calculate the probability of a bighorn sheep from a susceptible herd becoming infected by adequate contact with an infected bighorn sheep herd (P_{BHS}).

The probability of avoiding an infection is illustrated for the Asotin herd (herd 1), which is assumed to be at risk from infected domestic sheep and infected bighorn sheep in the Black Butte, Mountain View, Red Bird, and Wenaha herds (herds 4, 11, 15, and 18) (see Figure 5-5 for nonzero values in BF4:BF21).

The probability of the Asotin herd avoiding adequate contact with any infected bighorn sheep or domestic sheep herd is 1 through year 15. In other words, the probability of it becoming infected by these herds is 0 through year 15. In year 16, a 6.7% chance exists that the Asotin herd will avoid infection from all other infected bighorn sheep herds (Q_{BHS}), which is a reflection of previous infection occurring in another bighorn sheep herd. In other words, there was a 93.3% (100% minus 6.7%) probability that the Asotin herd would become infected by contact with an infected bighorn sheep herd. Through the first 15 years, none of the bighorn sheep herds that Asotin bighorn sheep animals were in contact with were infected (i.e., the Black Butte, Mountain View, Red Bird, and Wenaha herds [herds 4, 11, 15, and 18]). As indicated by the nonzero value in cell BI78, the Asotin herd became infected in year 16. In addition, as BI78 = 6, the duration of the adverse herd infection will be simulated to last for 6 years (Figure 5-7). (The origin of this duration will be explained below.)

The probability of disease spread from the Black Butte to Asotin herd in year 2 is calculated as follows:

(1-$L63*$BI$4)^($CG63*BI28)

This equation is interpreted as the probability of the Black Butte herd not being infected (i.e., 1-L63) times the probability of an individual animal from the Black Butte herd contacting an animal in the Asotin herd (BI4). The "$" symbol is used to fix relationships such that when the equation is copied down the spreadsheet the row reference will remain fixed (i.e., in this example will remain referring to row 4) and when copied across columns the column reference will remain fixed (i.e., in this example referring to either column L [$L63] or column BI [$BI$4]). This resulting probability of not making a contact sufficient to cause disease transmission is then exponentiated (^) to the number of bighorn sheep in the Black Butte herd (CG63) times the probability that the individual animal will be infectious (BI28) (i.e., the number of infectious sheep in the Black Butte herd). The probabilities of these bighorn sheep being infectious appear in cells BF28:BW28 (not shown) and may be determined independently by entering a desired probability value in the respective cell or collectively, as is currently the case, where all infectious probabilities are specified in cell CA29 (Figure 5-6).

The probability of avoiding adequate contact with an infected bighorn sheep in a given herd depends on the probability of an individual sheep from a given herd contacting a bighorn sheep in the herd of concern—in this example the Asotin herd—as well as the number of animals in the contact herd. Therefore, the probability of the Asotin herd being contacted by at least one infected bighorn sheep in another herd is calculated in year 1 (BG64) as follows:

```
=(1-$C63*$BF$4)^($BJ63*$BF$28)*(1-$F63*$BG$4)^($BQ63*$BG$28)*(1-
$I63*$BH$4)^($BY63*$BH$28)*(1-$L63*$BI$4)^($CG63*$BI$28)*(1-
$O63*$BJ$4)^($CO63*$BJ$28)*(1-$R63*$BK$4)^($CW63*$BK$28)*(1-
$U63*$BL$4)^($DE63*$BL$28)*(1-$X63*$BM$4)^($DM63*$BM$28)*(1-
$AA63*$BN$4)^($DU63*$BN$28)*(1-$AD63*$BO$4)^($EC63*$BO$28)*(1-
$AG63*$BP$4)^($EK63*$BP$28)*(1-$AJ63*$BQ$4)^($ES63*$BQ$28)*(1-
$AM63*$BR$4)^($FA63*$BR$28)*(1-$AP63*$BS$4)^($FI63*$BS$28)*(1-
```

```
$AS63*$BT$4)^($FQ63*$BT$28)*(1-$AV63*$BU$4)^($FY63*$BU$28)*(1-
$AY63*$BV$4)^($GF63*$BV$28)*(1-$BB63*$BW$4)^($GM63*$BW$28)
```

The first term refers to the status of the Asotin herd and is included for ease of copying this formula across to all bighorn sheep herds. Since the probability of a herd contacting itself is 0 (Figure 5-5), the probability of any herd being the source of its own infection is 0, which in this example is the value in cell C63. This complete term is given as follows:

```
(1-$C63*$BF$4)^($BJ63*$BF$28)
```

The other terms in the equation refer to the other 14 bighorn sheep herds being considered in this model. In this example, it can be seen from Figure 5-5 that there is a risk of the Asotin herd being infected if there is contact between a sheep in the Asotin herd and an infected sheep in the Black Butte herd (herd 4), which has an individual animal contact probability of 0.0055, or approximately 0.6% per year.

For example, assuming scenario Alt_7G was selected, there are 8 herds that have a nonzero probability that a bighorn sheep in that herd will contact a domestic sheep allotment herd. For the Lick Creek bighorn sheep herd, this probability is 0.0154 per animal per year (cell CG6). Assuming there were 2 bighorn sheep in the herd, the probability of bighorn sheep in the Lick Creek herd avoiding a contact with domestic sheep that would result in disease transmission is calculated as follows:

```
= (1-0.0154)^(2*0.25) = 0.9923
```

Alternatively, the probability of disease transmission from a domestic sheep allotment herd to the 2 bighorn sheep in Lick Creek is <1% in year 2.

Domestic Sheep-to-Bighorn Sheep Transmission—The probability of a bighorn sheep herd becoming infected by contact with an infected domestic sheep herd is calculated similarly to the probability of a bighorn sheep to bighorn sheep herd transmission (see previous discussion for calculation of P_{BHS}). As for bighorn sheep transmission estimates, the probability of transmission from a domestic to bighorn sheep herd is based on bighorn sheep movement data (Figure 5-8) regarding domestic sheep grazing allotments in the Forest.

The following equation was used to calculate the transmission from an infected domestic sheep herd to an individual in a susceptible bighorn sheep herd:

$$P_{BHSn|DS} = 1 - q_n{}^{C_n}$$

Where:

> $BHS_n|DS$ refers to the probability that no adequate contact is being made by any of the bighorn sheep in herd n with all domestic sheep herds.

Also, $q_n = 1 - p_n$, where p_n is the probability of an individual bighorn sheep contacting domestic sheep in a Forest allotment herd.

This relationship is illustrated for the Asotin herd in cell BH64 (Figure 5-7), which calculates the probability of all bighorn sheep in the Asotin herd avoiding adequate contact with domestic sheep in allotment herds:

=IF(BI63=0,(1-BJ$46)^(BJ63*$CA$31),0)

From the equation, if BI63 is 0, meaning the Asotin herd was not infected in the previous year, the herd's probability of infection is calculated as follows:

=(1-BJ$46)^(BJ63*$CA$31)

Where:

BJ$46 = the probability of a bighorn sheep from the Asotin herd making adequate contact with a domestic sheep in a Forest allotment flock;
BJ63 = the population size of the Asotin herd; and
CA31 (Figure 5-6) = the probability that such an adequate contact will result in disease transmission from the domestic sheep to the bighorn sheep and the resulting infected bighorn sheep will return to the Asotin herd and cause infection there.

	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT
3	Vlookup code number		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
4		Herd numbe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
5	Scenario	number	Asotin	Big_Canyon	Big_Creek	Black_Butte	Imnaha	Lick_Cree	Little_Sal	Lostine	Main_Sal	McGraw	Mountain	Muir	Myers	Quartz	Red_Bird	Sheep_M	Upper_Ma	Wenaha	
6	Alt_7G	1	0	0	0	0	0	0.0154	0.00746	0	0.00159	0.00252	0	0.00026	0.00021	0.00056	0	0.00036	0	0	
7	Alt_7H	2	0	0	0	0	0	0.00286	0	0	0	0	0	0	0	0	0	0	0	0	
8	Alt_7J	3	0	0	0	0	0	0.02504	0.00837	0	0.00067	0.00142	0	0.0002	0.00026	0.0005	0	0.00037	0	0	
9	Alt_7K	4	0	0	0	0	0	0.07611	0.0092	0	0.00354	0.00304	0	0.00036	0.00044	0.00071	0	0.0004	0	0	
10	Alt_346	5	0	3.211E-05	0	0	0	0.07611	0.01657	0	0.00618	0.00304	0	0.00135	0.00106	0.00902	0	0.00087	0	0	
11	Alt_Test2	6	0	0	0	0	0	0.02308	0.00838	0	0.00131	0.00142	0	0.00024	0.00027	0.0005	0	0.0004	0	0	
12	Alt_Test3	7	0	0	0	0	2.714E-09	0.02073	0.00837	0	0.0009	0.00142	0	0.0002	0.00026	0.0005	0	0.00037	0	0	
13	Alt_Test4	8	0	0	0	0	2.714E-09	0.02073	0.00178	0	0.00067	0.00142	0	0.0002	5.7E-05	0.0002	0	0.00037	0	0	
14	Alt_5	9	0	3.211E-05	0	0	0	0.03092	0.01642	0	0.0061	0.00188	0	0.0013	0.00106	0.0012	0	0.00087	0	0	
15	Alt_10	10	0	3.211E-05	0	0	0	0.02049	0.01022	0	0.00428	0.00187	0	0.00086	0.00106	0.00075	0	0.00087	0	0	
16	Alt_15	11	0	3.211E-05	0	0	0	0.00885	0.00679	0	0.00208	0.00187	0	0.00071	0.00096	0.00075	0	0.00087	0	0	
17	Alt_20	12	0	3.211E-05	0	0	0	0.00481	0.00142	0	0.00208	0.00138	0	0.00035	0.00069	0.00075	0	0.00087	0	0	
18	Alt_25	13	0	3.211E-05	0	0	0	0.00156	0.00127	0	0.00129	0.00043	0	0.0002	0.00069	0.00052	0	0.00022	0	0	
19	Alt_30	14	0	3.211E-05	0	0	0	0.00023	0.00057	0	0.0003	9.6E-05	0	4.9E-05	0.00037	0.00017	0	0.00015	0	0	
20	Alt No Allotments	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21																					

Figure 5-8. Domestic sheep-to-bighorn sheep individual animal contact probability matrix

These probabilities vary by bighorn sheep herd and the control scenario that is being examined, where the scenario reflects the presence or absence of domestic sheep allotments in the Forest (Figure 5-8). (The current value in CA31 is 0.25, which means 25% of the bighorn sheep contacts with a domestic sheep herd will result in disease transmission (Figure 5-6). This value is readily changeable, and other values have also been examined in a sensitivity analysis.

If, on the other hand, BI63 ≠0, implying the Asotin herd was already infected in the previous year, it is not susceptible and therefore will not become newly infected by contact with an infected domestic sheep herd.

For example, assuming scenario Alt_7G was selected, there are 8 herds that have a nonzero probability that a bighorn sheep in that herd will contact a domestic sheep allotment herd. For the Lick Creek bighorn sheep herd, this probability is 0.0154 per animal per year (cell CG6). Assuming there were 2 bighorn sheep in the herd, the probability of bighorn sheep in the Lick Creek herd avoiding a contact with domestic sheep that would result in disease transmission is calculated as follows:

= (1-0.0154)^(2*0.25) = 0.9923

Alternatively, the probability of disease transmission from a domestic sheep allotment herd to the 2 bighorn sheep in Lick Creek is <1% in year 2.

Combined Bighorn Sheep- or Domestic Sheep-to-Bighorn Sheep Transmission—The transmission information calculated to account for transmission from either an infected bighorn sheep or domestic sheep herd was used to calculate the overall probability of a bighorn sheep herd becoming infected. This probability is illustrated for year 2 in the Asotin herd by the equation in cell BI64 as follows:

=IF(BJ63=0,0,IF(BI63>0,BI63−1,IF(RiskBinomial(1,1−BG64*BH64) = 1,INT (RiskUniform(CA34,CB34)),0)))

This equation is interpreted as follows: If the herd size (BJ63) is 0 then the probability of the herd becoming infected is 0. If the population is not 0, then the infection status in the previous year (BI63) is examined, and if found to be >0, this implies the herd is already infected. If infected in the previous year, the number of additional years of extended infection is reduced by 1 year. (For instance, as shown in Figure 5-7, the Asotin herd was simulated to be infected in year 16 and the extended duration of infection was 6 years. In year 17, this duration is reduced to 5 years, as indicated by BI79 = 5.) If none of the above is true (i.e., the Asotin herd was not an infected herd in the previous year), then the probability of it becoming infected in the current year is calculated from a binomial distribution as follows:

RiskBinomial(1,1-BG64*BH64)

This calculation can take on the value of 0 (noninfected) or 1 (infected), depending on the probability of the Asotin herd not avoiding adequate contact with infected sheep from either a bighorn sheep (BG64) herd or a domestic sheep (BH64) herd in the previous year. If it does not avoid these adequate contacts, the Asotin herd is simulated to become infected and the duration of the infection is drawn from a uniform distribution ranging from 4 to 10 years in this example (CA34:CB34 in Figure 5-6). Finally, if none of the above is true, then the Asotin herd was simulated to have successfully avoided infection and is simulated to be noninfected in the current year.

Disease Outbreak Impact—The impact of a disease outbreak is measured as the product of the herd size and proportion impact. Although an outbreak may not occur, the model keeps track of what the impact would be had there been an outbreak. Data used to estimate this parameter were from 7 suspected pneumonia outbreaks that occurred in Hells Canyon herds from 1995–1998. The mortality proportions in 5 outbreaks reported in 1995–1996 were 0.33, 0.40, 0.65, 0.69, and 0.75. The lowest proportion (0.33) occurred in the smallest herd (30 animals) in the Upper Joseph Creek herd. The largest proportion (0.75) occurred in the largest herd (220 animals) in the Black Butte herd. In 1999, 2 outbreaks involved the Upper Hells Canyon and Sheep Mountain herds, where approximately 80% of the animals died in the first year of the outbreak, followed by subsequent declines and ultimately extirpation. These data were considered as a discrete distribution, with each event assumed to have an equal probability (0.14) of occurring. Note that since the 80% mortality rate was reported twice, it assumed a probability of 0.29 (Table 5-1).

Table 5-1. Input data for cause-specific disease mortality and associated probabilities

Mortality Proportions	Probability of Occurring
0.33	0.142857
0.5	0.142857
0.65	0.142857
0.69	0.142857
0.75	0.142857
0.8	0.285714

Additional review of 48 public records of pneumonia epidemics (Singer et al. 2000) showed a highly variable mortality rate (13–100%) during the epidemic, with a mean (SE) of 69% (4%).

Table 5-2 illustrates results used to simulate population size and growth given the presence or absence of pneumonia in a sample herd. In this example, there was no simulated disease outbreak, as illustrated by "Outbreak this Year" values of 0 for each year. As a result, the population was simulated to increase from 84 to approximately 113 in 3 years, based on the growth listed in the last column. However, the population decrease (negative growth) was also calculated (and presented in the table) in case the herd was simulated to become infected. If in fact the herd were simulated to become infected, the population decrease would be between approximately 34 and 91, depending on the year the infection occurred.

Table 5-2. Outbreak avoidance probability and example herd growth and disease impact

Outbreak This Year	Sample Herd	Outbreak Impact	Growth
0	84	–33.6	10.7
0	94.7	–65.4	9.6
0	104.3	–72.0	8.9
0	113.2	–90.6	8.5

Extended Infectious Duration—Once a simulated herd became infected, modelers assumed there was a variable length of time, generally more than a year, where animals in the herd would remain infectious.

The duration of infectiousness was assumed to range from 1 to 4 years and follows a uniform distribution. The inputs for the duration range are located in CA36:CB36 (Figure 5-9).

	BZ	CA	CB
34	Extended adverse effect duration (Yrs)	4	10
35	Extended adverse effect impact	-0.13	0
36	Extended infectious duration (Yrs)	1	4
37	Outbreak impact (prop. dec.)	0.69	

Figure 5-9. Model parameters and sample values for disease impact

Calculations were performed in a matrix of cells referred to as the "Extended Infectiousness Calculator," which appears in the range of A61:GP262 (Figure 5-10) and is shown for the Main Salmon/South Fork herd (herd 9).

	Y	Z	AA
60			
61	Herd 9	Main_Salmon_Sout	
62	Extended	Infectiousness	Years
63	0	0	0
64	0	0	0
65	0	0	0
66	0	0	0
67	0	0	0
68	0	0	0
69	0	0	0
70	0	0	0
71	0	0	0
72	0	0	0
73	0	0	0
74	0	0	0
75	0	0	0
76	0	0	0
77	0	0	0
78	0	0	0
79	1	2	1
80	2		1
81	3		0
82	4		0
83	5		0
84	6		0
85	0	0	0

	DR	DS	DT	DU	DV	DW	DX	DY
60				Main Salmon South Fork				
61	Prob. Avoiding conta		extension	Herd 9	Outbreak	year of		
62	BHS	Domestic	prob.	Main Saln	impact	growth	extirpation	
63			0	89	-29.37	16.34243	1	
64	1	0.965311	0	105.3424	-79.0068	17.79046	2	
65	1	0.959074	0	123.1329	-40.6339	26.91388	3	
66	1	0.952329	0	150.0468	-60.0187	26.91476	4	
67	1	0.942216	0	176.9615	-122.103	7.394426	5	
68	1	0.93221	0	184.356	-127.206	23.97856	6	
69	1	0.92948	0	208.3345	-156.251	17.83888	7	
70	1	0.920681	0	226.1734	-169.63	18.59319	8	
71	1	0.914189	0	244.7666	-195.813	36.29167	9	
72	1	0.907471	0	281.0583	-224.847	23.9823	10	
73	1	0.8945	0	305.0406	-198.276	19.91381	11	
74	1	0.886031	0	324.9544	-259.963	9.059882	12	
75	1	0.879059	0	334.0142	-267.211	16.58325	13	
76	1	0.875906	0	350.5975	-280.478	5.067328	14	
77	1	0.870163	0	355.6648	-117.369	12.41778	15	
78	1	0.868415	0	368.0826	-294.466	17.76384	16	
79	1	0.864148	6	385.8464	-127.329	-127.329	17	
80	0	0.85808	5	258.5171	-85.3106	-28.3863	18	
81	0	0.902534	4	230.1308	-158.79	-27.8536	19	
82	1	0.912755	3	202.2771	-131.48	-6.56065	20	
83	1	0.922896	2	195.7165	-156.573	-23.265	21	
84	1	0.9253	1	172.4515	-56.909	-8.18364	22	
85	1	0.933879	0	164.2678	-131.414	18.46384	23	

Figure 5-10. Example output for calculation and linkage between extended infectiousness calculation and output

For each herd, a series of three calculations are performed in order to determine whether or not the herd was simulated as being infected ("Extended" column), and if so, what is the duration of infectiousness ("Infectiousness" column)? This information is recorded and kept track of, with a "counter," and used to determine subsequent infections in other bighorn sheep herds ("Years" column).

For the Main Salmon/South Fork herd, this equation is given as follows:

```
=IF(Y64=0,0,IF(Y64=1,ROUND(RiskUniform($CA$36,$CB$36),0),""))
```

This equation is interpreted as follows: If the herd was determined to not be infected, the value in Z64 is 0. On the other hand, if the herd is infected, this cell will take on a value ranging from the minimum and maximum values in cells CA36 and CB36 (1–4, as shown in Figure 5-9). In other words, it was assumed that once infected, a herd would be infectious for 1–4 years, and the probability of the duration would follow a uniform distribution, meaning the probability of being infectious is equal for all 4 years (i.e., 1=2=3=4, or 0.25 [25%]) each.

Within the results presented here, the Main Salmon/South Fork herd was simulated to be infected in year 17 (row 79) as shown above, the duration of an adverse disease-related growth/decline was estimated to be 6 years (Y79:Y84). The duration of infectiousness was predicted to be 2 years (Z79) (Figure 5-10).

In the second and subsequent years of disease introduction into a bighorn sheep herd, the impact was assumed to be uniformly distributed between 0 and −13%. Note that during this time, the herd may be infectious for multiple years, as shown in cells Z79:AA80; however, it is not susceptible. The rationale being that the extended adverse growth period, shown here as 6 years, implies an endemic level of disease in the population, meaning it is currently infected and will not be susceptible until the following year (indicated here as the year corresponding to row 85).

In subsequent cells (e.g. Y64), the following equation was used:

```
=IF(DT64>0,Y63+1,0)
```

The means that the value in cell DT64 specifies whether or not the Main Salmon/South Fork herd (herd 9) is currently infected (1 = yes, 0 = no). Therefore if the herd is infected, the value in Y64 becomes 1 greater than that in the previous "year," which in this example is 0. In this example, cell Y64 would take the value of 1, indicating that the herd is currently infected but was not in the previous year. However, if this were a multiyear infectious situation and the previous year were 1, then the value in Y64 would be 2. If the herd was not simulated to be infected this cell would take the value of 0.

In the adjacent cell (AA64) the equation is

```
=IF(Y64=0,0,IF(Y64<=OFFSET(Y64,-(Y64-1),1,1,1),1,0))
```

Therefore, if the herd is not infected, Y64 = 0 and AA64 will be 0. On the other hand, if the herd is infected, AA64 will take on a value reflecting the number of years it has been infected and compare that with the number of years that it was previously calculated to remain infectious based on the value in B64. To perform this calculation, the "OFFSET" equation in Excel is used, which uses references to determine a cell value. In this case, the offset would use Y64 as the reference cell and based on the value there would move a given number of cells to determine the value. In this case, it will move down Y64 cells and then back up one and use that value. Therefore, if Y64 = 2, then AA64 = 1.

Extended Adverse Effect Duration—Outbreaks of respiratory disease in bighorn sheep typically manifest as an all-ages dieoff, followed by several years of reduced or zero lamb recruitment. In the model, this dieoff was represented as an extended period of depressed population growth in a diseased bighorn sheep herd beyond the initial year of infection (George et al. 2008; Clifford et al. 2009). The duration was assumed to be 4–10 years (CA34:CB34) with a uniform distribution, including the initial year of infection (Figure 5-9).

Extended Adverse Effect Impact—The adverse effect due to disease in a bighorn sheep herd is represented as the depressed population growth rate, which is simulated during the adverse effect duration as described above. In the example shown in Figure 5-9 (CA35:CB35), it is assumed that the population growth rate for a diseased herd ranges from −13% to 0% with a uniform distribution. In other words, in this example, if a given herd were infected in the current year it will have an adverse population growth ranging from a low of −13% to a high of 0% (no change). This adverse impact will vary but will remain within this range for the duration of the adverse effect period, i.e. 4–10 years.

The results of an iteration are presented to illustrate how this information is used in the simulation model. In this example, the bighorn sheep in the Main Salmon/South Fork herd have a simulated pneumonia outbreak in year 17. In addition, it was assumed the duration of the adverse effect on growth would be 6 years (DT79) (Figure 5-10). The subsequent 5 cells (DT80:DT84) count down to 1, reflecting the duration of the negative growth associated with this extended adverse effect. The impact in the first year was estimated to be a population reduction of 127.3 animals (DV79), followed by declines of 28.4, 27.9, 6.6, 23.3, and 8.2 in the subsequent 5 years.

5.2 Stochastic Features of the Model Using @RISK

@RISK is an Excel add-in that permits the model to include components of uncertainty and variability and thereby expands it from a deterministic model to a stochastic (probabilistic) one. As such, multiple runs, or iterations, may be performed to evaluate the range of outcomes that may arise from the selection of various actions. The following section is devoted to understanding @RISK.

To view the @RISK features, click on the @RISK tab (Figure 5-11), which will bring up the @RISK options.

Figure 5-11. @RISK icons used for stochastic simulations

In this menu, one can modify the number of iterations (sometimes referred to as realizations) and number of simulations. In the current example, the number of iterations is 100 and simulations is 1. A simulation may sometimes be referred to as a scenario (i.e., a particular combinations of various inputs).

By clicking on the "pdf" icon, which is just below the "Simulations" option, you will see the following menu of "Simulation Settings" options (Figure 5-12). By selecting the "General" tab and specifying the "Number of Iterations" or "Simulations," the user can permit the model to use "Multiple CPU Support" (i.e., if you have a "dual processor" computer) by selecting "Enabled."

When constructing the model, the user can either select "Random Values (Monte Carlo)," which will give a new value for each new calculation, or "Static Values." If users are interested in seeing the "average" value, they should select the Static Values option, which will show a single value and not change as new calculations are made. (Note: regardless of the option selected, when iterations are performed @RISK will use random values, which will result in stochastic simulations being performed.)

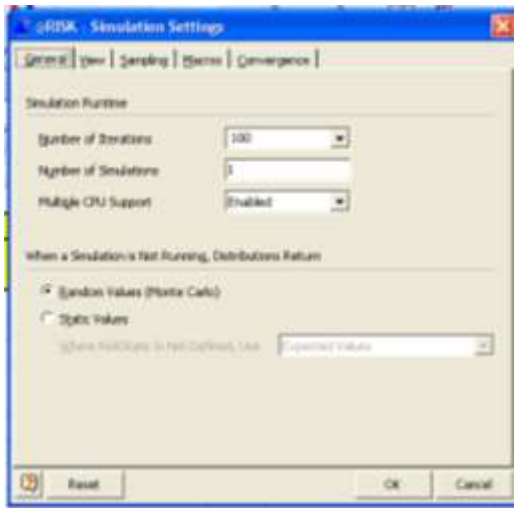


Figure 5-12. @RISK "Simulation Settings" menu, "General" tab settings

The type of random sampling ("Sampling Type") used in the stochastic simulations can be either "Monte Carlo" (MC) (completely random) or "Latin Hypercube" (Figure 5-13), which is essentially a stratified random sampling technique that samples for a portion of the distribution based on its probability of occurring. For example, if the distribution being sampled was uniform (0,1), 10% of the samples would be between 0 and 0.10. If MC sampling was selected, it is unknown what percentage of the samples would be between 0 and 0.10. In practice, select MC if you want complete randomness to be simulated and Latin Hypercube if you want to make sure your iterations are truly representative of the population you are sampling from. If the number of iterations is large (e.g., ≥1,000), the results will be very similar, regardless of sampling type selected.

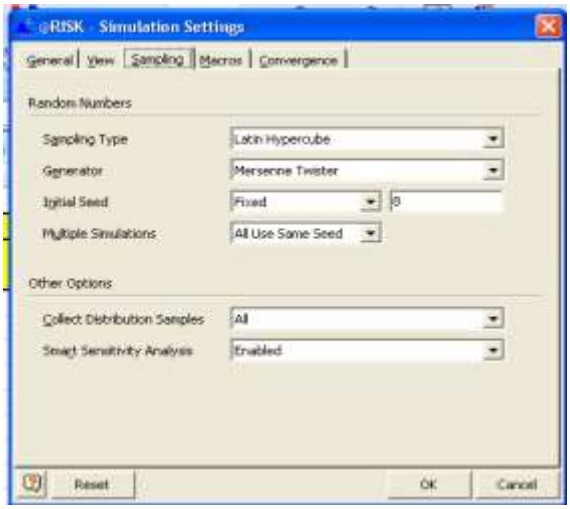


Figure 5-13. @RISK "Simulation Settings" menu, "Sampling" tab settings

5.3 Outputs

Examples of the simulated individual herd populations are presented over a 200-year period (Figures 5-14 through 5-17). Different outbreak results are presented to illustrate different population patterns that may arise from a given set of assumptions and to illustrate the stochastic nature of the model—each time the

model is run, the results are different. These outputs were chosen because they illustrate the range of possible outcomes that might result from a single management scenario.

The model is currently designed to simulate events over a 1,000-year period. This extension may be accomplished by copying down equations from year 200 through 1,000 (i.e., copying A262:GP262 through A1061:GP1061). Similar expansion modifications would need to be made to the figure in order to display results occurring during the 1,000-year period.

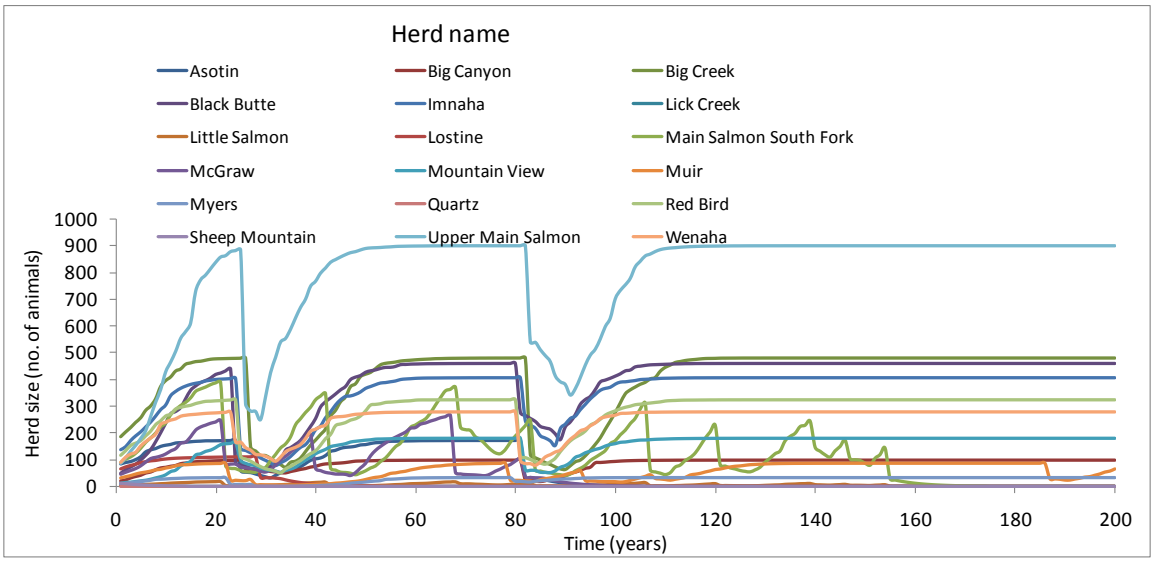


Figure 5-14. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 10 herds surviving

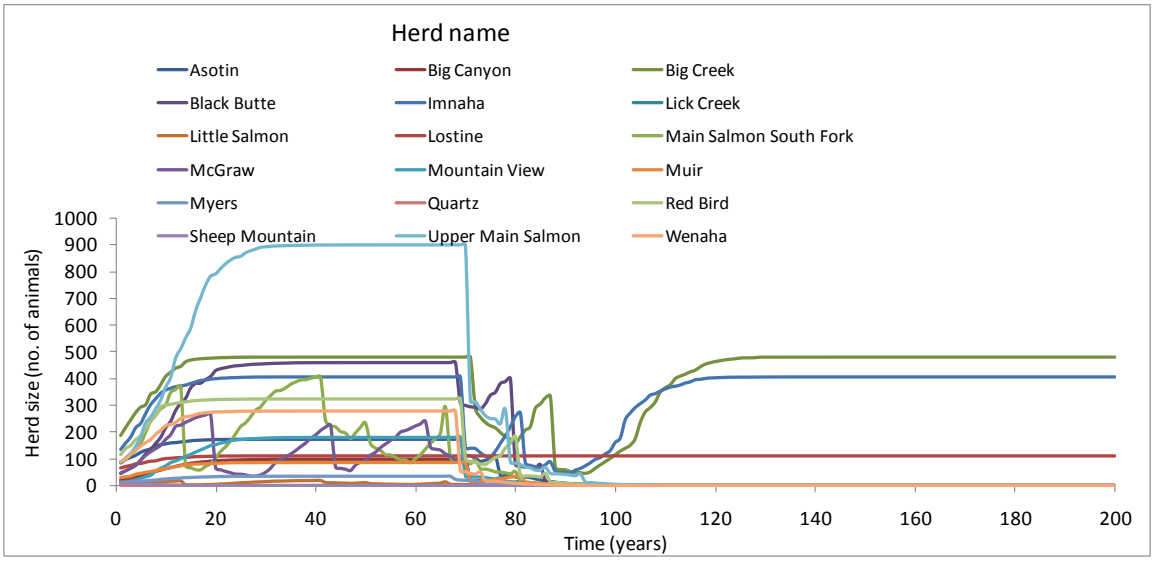


Figure 5-15. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 3 herds surviving

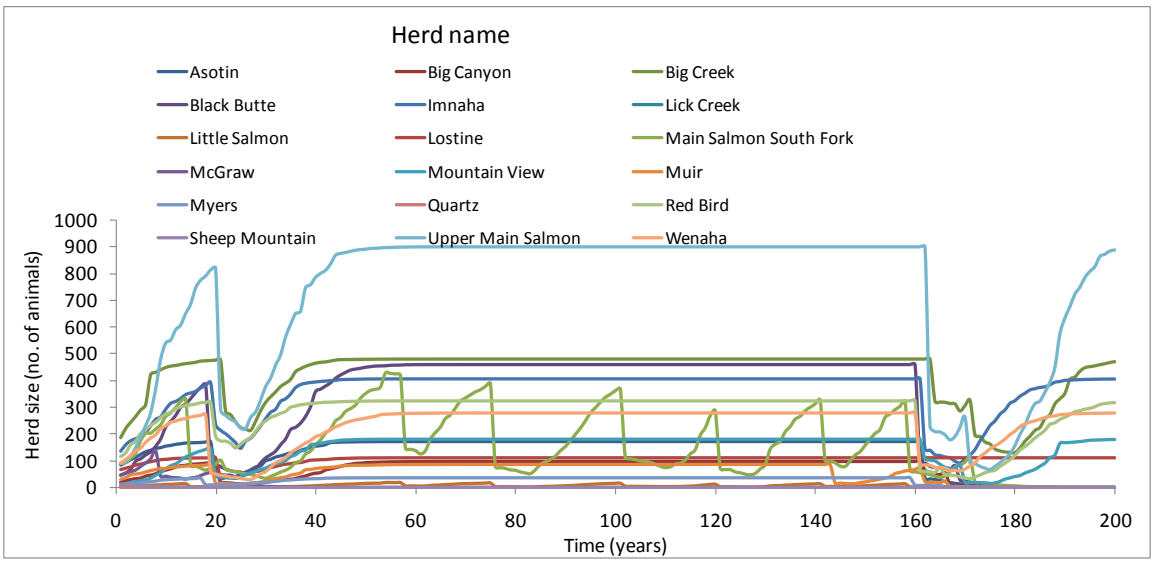


Figure 5-16. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 7 herds surviving

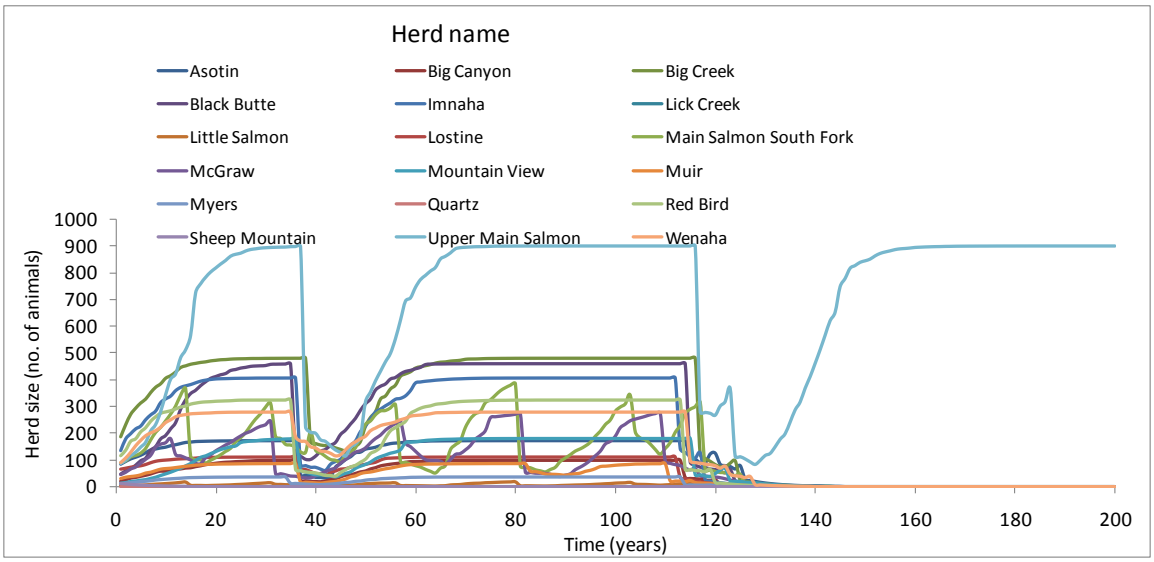


Figure 5-17. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 1 herd surviving

Summary Findings from Simulation Results—Figure 5-18 shows the simulation results of the Asotin herd (cells BG1066:BJ1070). Similar results were obtained for each of the 14 other populations and are reported in the same rows as these but under the columns coinciding with their respective population.

	BG	BH	BI	BJ
1066	Asotin			
1067	outbreaks			2
1068	min pop			0
1069	nonviable			1
1070	extirpation year			106

Figure 5-18. Sample simulation results showing number of outbreaks, minimum population, nonviable status, and extirpation year (if occurred)

Figure 5-18 shows 2 outbreaks occurred in the Asotin herd. In addition, the minimum population was 0 and extirpation occurred in year 106. Note that under the current assumption, once a population is extirpated it is assumed to never recover (i.e., remains at 0 for the rest of the simulated time). If instead the outcome would be reintroduction of a new population, this could be input into the model in the future.

Outputs are recorded in graphs for each herd's extirpation history (Figure 5-19). In this example, results show that of the 100 iterations, each resulted in the population falling to 0 an average of 32 years (SD = 16.3) after the start of the analysis, ranging from 4 to 77 years.

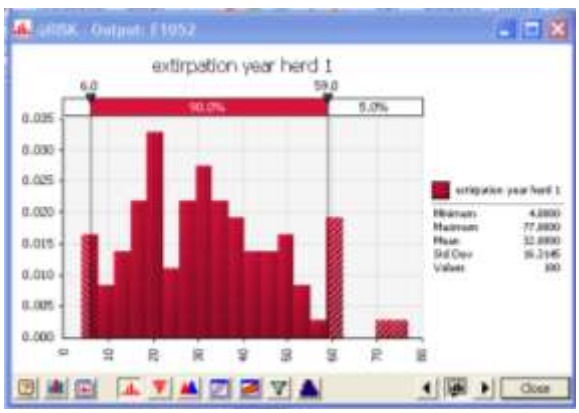


Figure 5-19. Example simulation output distribution of extirpation year for herd 1

5.3 Running the Model

Before opening the bighorn sheep model, it is important to first open @RISK, which will in turn open Excel. Once Excel is opened, then open the model file you wish to work with. Opening the model directly may result in an extensive number of cells having unreadable equations. If you do open the model directly by mistake and you see a large number of cells having "VALUES" or some other improper values, close and do not save the file, then open @RISK.

Hints: When making frequent changes to the model, you may want to avoid frequent recalculations. To do this, go to "Tools/Options" and select the "Calculation" tab, where you can set the "Calculation options" to "Manual" (Figure 5-20). Also, when running the model, do not collect distribution samples (Figure 5-21). This option is available in the "Sampling" tab of the "Simulation Settings" in @RISK.

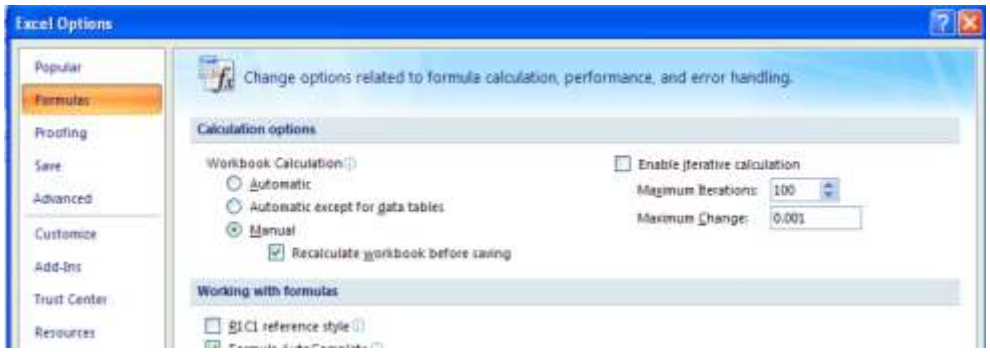


Figure 5-20. Illustration of proper settings to avoid extensive recalculations when modifying the model

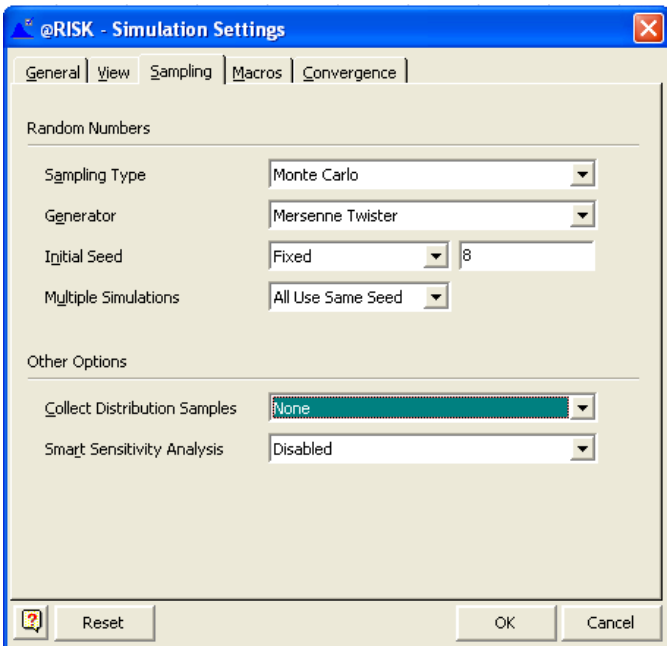


Figure 5-21. Illustration of proper settings to avoid extensive data collection when running the model

Red triangles appear in the upper right-hand corner of some spreadsheet cells. These triangles indicate the cell has a comment, which is meant to help the user better understand the cell. Typically comments are used when a cell has a complicated equation, or there may be documentation specifying a data source that was used to derive the value or equation that appears in the cell. These comments can be viewed individually by moving the cursor over the cell or all together by hitting alt+V and then C, which will enable the view comments feature. If a comment is too large for the box that contains it, you can increase the box size by clicking on the box and dragging one of the corners to the desired size.

Once the user inputs and outputs have been defined, the model may be run by simply clicking the “Start Simulation” icon. The duration of the simulations depends on, among other things, the speed, memory, and number of processors of the computer, in addition to the number of iterations and simulations being examined.

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Appendix C

Occupancy, Risk and the Potential for Contact Report

Occupancy, Risk and the Potential for Contact between Bighorn Sheep and Domestic Sheep on the Payette National Forest

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Introduction

In 2003, the Payette National Forest (Payette NF) released its revised *Payette National Forest Land and Resource Management Plan* (Forest Plan) (USDA Forest Service 2003), which included direction on the management of bighorn sheep (*Ovis canadensis*) in Management Area (MA) #1 (Hells Canyon). The Forest Plan was appealed, in part due to the allegation that it violated the National Forest Management Act and the Hells Canyon National Recreation Area (HCNRA) Act by allowing domestic sheep (*Ovis aires*) grazing "within or near the range of bighorn sheep, thus threatening the viability of bighorn sheep through disease transmission" (USDA Forest Service 2005).

The Forest Plan includes one guideline for MA #1, which states: "Within bighorn habitat emphasis areas, close sheep allotments as they become vacant, or convert them to cattle where appropriate, to eliminate the risk of disease transmission from domestic to wild sheep. Do not convert cattle allotments to sheep allotments within occupied bighorn sheep habitat" (USDA Forest Service 2003).

The Chief of the Forest Service's (Chief's) remand to the Regional Forest states in part: "The Regional Forester is instructed to do an analysis of bighorn sheep viability in the Payette NF commensurate with the concerns and questions discussed above, and amend the SW Idaho Ecogroup Final Environmental Impact Statement (FEIS) accordingly. Changes to the management direction of the Payette NF LRMP for MA #1 (Hells Canyon) and adjacent areas shall be evaluated, and adopted as necessary to ensure bighorn sheep viability. The analysis and evaluation must be extensive enough to support determinations of compliance with applicable law and regulation, specifically the Hells Canyon NRA Act, 36 CFR 219.19, and 36 CFR 292.48" (USDA Forest Service 2005).[1] The Chief's remand for analyzing bighorn sheep viability is linked to the likelihood of contact and disease transmission between domestic and bighorn sheep.

"Occupied" Habitat and the Chief's Remand

The concept of bighorn sheep occupied habitat is referenced in the Chief's remand relative to the potential for contact and disease transmission between domestic sheep and bighorn sheep on five occasions, all in the "Discussion" section of the remand. Emphasis has been added in the following excerpts:

1) The Payette NF LRMP includes a Rangeland Resource 'Guideline' for Hells Canyon MA #1 that reads:

   > "Within bighorn habitat emphasis areas, close sheep allotments as they become vacant, or convert them to cattle where appropriate, to eliminate the risk of disease transmission from domestic to wild sheep. Do not convert cattle allotments to sheep allotments within **occupied** bighorn sheep habitat" (USDA Forest Service 2003 and 2005, p. 12).

[1] For a detailed account of the rationale and remand decision, see *Decision for the Appeal of the Payette National Forest Land and Resource Management Plan* (USDA Forest Service 2005).

This reference cites guidance from Forest Plan Guideline MA #1 (Hells Canyon) and refers to the Forest's use of the term "occupied habitat" in the Forest Plan.

2) "Payette NF LRMP direction pertaining to bighorn sheep in the Hells Canyon MA was described above. It is limited to a coordination objective, and a guideline for closing domestic sheep allotments should they become vacant. 'Guideline' is defined as 'a preferred or advisable course of action generally expected to be carried out' (Payette LRMP, p. GL-17). The Payette LRMP does not contain any direction for protecting or maintaining bighorn sheep or their habitat in the Hells Canyon MA, in particular for the protection of bighorn sheep from the documented current and likely future threat of disease transmission from domestic sheep. By permitting the presence of domestic sheep within **occupied** bighorn sheep range, the Payette NF does not appear to be managing the habitat to maintain viable populations of bighorn sheep" (USDA Forest Service 2005, pp. 13–14).

The focus of this discussion is on Forest Plan direction and the charge that the Forest Plan does not contain direction for protecting bighorn sheep from contact and disease transmission. The specific focus of this section is on MA #1 (Hells Canyon). The inference is that "occupied habitats" in Hells Canyon are needed to support viable populations of bighorn sheep per 36 CFR 219.19. No specific guidance is given for defining "occupied" habitats.

3) "Based on the above analysis, the viability of bighorn sheep populations within the Hells Canyon area, and across the Payette NF, appears to be threatened by allowing continued grazing of domestic sheep in or near **occupied** bighorn sheep habitat. As documented in the FEIS and relevant scientific literature, without immediate removal of domestic sheep from **occupied** bighorn sheep habitat, bighorn sheep within that habitat are likely at risk of extirpation. Bighorn sheep habitat is contiguous between the Payette NF and NFS lands to the north, east and south, and bighorn sheep appear to move between the two identified habitat areas (Hells Canyon and Snake River) within the Payette NF (FEIS Appendix A, letter #53; NOA #0021, Attachment A). Transmission of disease to bighorn sheep on the Payette NF that are part of the Hells Canyon population will place the entire Payette NF population at substantial risk". (USDA Forest Service 2005, p. 14).

In this section, the discussion is expanded from MA #1 to include the remainder of the Payette NF. The impetus is on removing domestic sheep from occupied bighorn sheep habitat, though the attributes for defining occupied habitat are not specified. The emphasis is on the risks of disease transmission from domestic sheep to bighorn sheep, specific to bighorn sheep population viability.

4) "While the Hells Canyon MA is thus not specifically included within the Hells Canyon NRA Act, it is clear that by permitting the presence of domestic sheep within adjacent **occupied** bighorn sheep range, and with the documented movement of bighorn sheep between the NRA and the Payette NF (see discussion above, and the specific citations in NOA #0018, p. 37), the Payette NF is not managing livestock grazing in the Hells Canyon MA in a manner compatible with the protection and maintenance of bighorn sheep or their habitat within the Hells Canyon NRA" (USDA Forest Service 2005, p. 14).

The use of occupied habitat in the above quote is specific to the Hells Canyon NRA and alleges that the Forest Service is not managing grazing in bighorn sheep habitat in a manner compatible with Hells Canyon NRA Act. No effort is made to define occupied habitat.

5) "Another appellant contends that '[t]he Forest Plans propose reviewing only 5% of projects within known **occupied** habitat to determine whether Forest management actions are affecting species habitats. This monitoring effort is insufficient to accurately monitor populations with any statistical certainty' (NOA #0018, p. 11). This is a reference to the first of two monitoring requirements for management indicator species (MIS) (Payette NF LRMP, p. IV-11). However, the monitoring frequency is stated as 'up to 25 percent' so this contention is incorrect. In addition, this item is for monitoring changes to habitat: the second MIS requirement is for monitoring population trends". (USDA Forest Service 2005, p. 26).

This section cites an appellant's contention with Forest Plan monitoring. No specific criteria are used to define occupied habitat.

In summary, the primary focus of the Chief's remand is to provide management direction that will provide habitats that support viable populations of bighorn sheep on the Payette NF per regulatory direction in 36 CFR 219.19. The emphasis on "occupied" habitat is viewed in light of this direction relative to implications of disease transmission between domestic sheep and bighorn sheep. No effort is made in the Chief's remand to provide specific direction that defines occupied habitat.

Habitat Occupancy and Bighorn Sheep

The delineation of occupied habitat is an important concept used by managers and researchers in understanding the distributions of species on landscapes and the implications of natural and anthropogenic perturbations on those species and their habitats. Researchers and managers also have a long history of developing models that infer habitat suitability based on species' habitat requisites and the potential for species to occur in, or occupy, these suitable habitats. Considerable effort has been placed on monitoring species and their habitats to this end. However, there is a great difference between identifying suitable habitat and inferring that such habitat is occupied. Relative to this issue on Forest Service administered lands, guidance from the 1982 planning regulations (36 CFR 219.19) state that "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area."

MacKenzie (2005) summarizes the long-standing issue of presence (occupied habitat) and absence of species on landscapes beginning with the well-known assertion that whereas presence can be confirmed, absence cannot. There have been numerous sampling schemes for the detection/non-detection of species, most of which include modeling efforts that assess the probability of detection or the estimation of occupied habitat patches (e.g., Johnson 1980; Gu and Swihart 2003; Manley et al. 2005; Stanley and Royel 2005; Hirzel et al. 2006; Vaughan and Ormerod 2006; Hockey and Curtis 2008; Long et al. 2009; Nichols et al. 2008). In the absence of specific modeling or sampling, and when data are limiting, Delphi (expert opinion) methodologies have also been used to assess the quantity and quality of habitats and even species occupancy (e.g., Johnson and Gillingham 2004; Seone et al. 2005).

Documenting bighorn sheep occupied habitat on the Payette NF has several challenges, and the availability of suitable habitat does not infer occupied habitat for a number of reasons. Substantial declines of bighorn sheep populations, contractions in the species geographical distribution, translocations for the recovery of bighorn sheep, population depressions as a result of disease epizootics, and bighorn sheep behavior all influence the likelihood that suitable habitats are occupied. These factors also influence the rate at which habitats are acquired and occupied and the likelihood of persistence once occupied.

Historically, bighorn sheep occupied suitable habitats over much of the western United States. Steep population declines followed Euro-American settlement from the mid-1800s through the early 1900s and were attributed to overharvest, habitat loss, forage competition with domestic livestock, and disease (Goodson 1982; Valdez and Krausman 1999). Currently, bighorn sheep are estimated at approximately 10% of historic numbers, occupying 30% of historic distribution patterns, and mostly occurring in small disjunct herds of less than 100 animals (Berger et al. 1990; Singer et al. 2000d).

The influences of disease epizootics on the geographic distribution and abundance of bighorn sheep has long been a significant factor influencing the occupation (and reoccupation) of historic habitats. An extensive body of scientific literature has accumulated on the effects of disease on bighorn sheep populations. The literature indicates the following: 1) numerous examples of bighorn dieoffs due to disease have been documented; 2) bighorn die-offs were documented as early as the mid-1800s and have been documented in every state in the western United States; 3) bighorn die-offs typically follow known or suspected contact with domestic sheep; 4) under experimental conditions, clinically healthy bighorn sheep have developed pneumonia and died within days to weeks following contact with clinically healthy domestic sheep; 5) a variety of diseases and pathogens have been implicated in die-offs, but most commonly the disease implicated in the die-off is bacterial pneumonia (Pasteurellosis) caused by *Mannheimia haemolytica* (formerly *Pasteurella haemolytica*) or other species of closely related *Pasteurella* bacteria; 6) there is consensus among wildlife biologists and veterinarians experienced in bighorn sheep management that domestic sheep and bighorn sheep must be kept separate in order to maintain healthy bighorn sheep populations (e.g., Foreyt and Jessup 1982; Goodson 1982; Onderka et al. 1988; Foreyt 1989; Desert Bighorn Council Technical Staff 1990; Callan et al. 1991; Cassirer et al. 1996; Martin et al. 1996; USDI BLM 1998; Bunch et al. 1999; Singer et al. 2000a, 2000b, 2000c, 2000d; Monello et al. 2001; Schommer and Woolever 2001; Singer et al. 2001; Dubay et al. 2002; Garde et al. 2005; Cassirer and Sinclair 2007; Clifford et al. 2009; George et al. 2008).

In Idaho's Hells Canyon, bighorn sheep populations were extirpated by 1945 (Cassirer 2004). Since 1971, reintroductions into Hells Canyon have resulted in the establishment of several herds in and adjacent to Hells Canyon (Cassirer 2004). Limited recolonization of historic habitats and expansion of bighorn sheep populations in Hells Canyon are largely influenced by recurring disease epizootics that impact adult survivability and lamb recruitment (Cassirer 2004; Cassirer and Sinclair 2007). Cassirer and Sinclair (2007) identify pneumonia as the primary factor limiting bighorn sheep population growth in eight Hells Canyon populations. Hells Canyon bighorn sheep populations that are disconnected from other bighorn sheep core populations, are disconnected from domestic sheep operations, and have limited contact with domestic sheep appear to perform better than interconnected bighorn sheep populations that have potential contact with domestic sheep (e.g., Asotin and Wenaha herds) (Cassirer 2004; Cassirer and Sinclair 2007; Idaho Dept. Fish and Game and Forest Service unpublished data).

Bighorn sheep that have persisted above Riggins, Idaho, along the Salmon River, are Idaho's only native bighorn sheep population. There have been no transplants or augmentation of bighorn sheep originating outside of the Salmon River population into this population. Hence, these sheep represent a unique genetic and population base. Historic disease epizootics are documented in this population going back to the 1870s (Smith 1954). As with the Hells Canyon population, disease epizootics have likely influenced both the abundance and distribution of bighorn sheep populations in the Salmon River drainage. Historically, source habitats likely connected the Salmon River and Snake River populations.

The analysis of suitable habitat, and the inference that suitable habitats are an accurate proxy for occupied habitats, is not useful in assessing the persistence of bighorn sheep populations. The distribution and abundance of bighorn sheep have been significantly reduced from presettlement conditions. Because disease epizootics are an integral factor in bighorn sheep persistence, analyses need to incorporate factors that contribute to the potential risk of these epizootics and address factors such as the availability and connectivity of suitable bighorn sheep habitats, bighorn sheep behavior and movement patterns, proximity of bighorn sheep to domestic sheep, likelihood of contact between the species, risk of disease transmission in contact events, and the perturbations in bighorn sheep populations as a result of disease transmission.

Clifford et al. (2009) utilized a contact and disease transmission model to assess potential implications of various grazing management strategies on the persistence of a Sierra Nevada bighorn sheep (*O. c. sierrae*) population. Building on concepts in that analysis, the Payette NF is conducting a similar analysis to assess the risks of contact and disease transmission between domestic sheep and bighorn sheep on the Payette NF. Per the Chief's remand, the primary purpose of this analysis is to provide a basis for the management of bighorn sheep habitats on the Payette NF such that habitats are maintained to support viable populations of bighorn sheep (36 CFR 219.19). A risk assessment approach that incorporates the species life requisites, the potential for contact between domestic sheep and bighorn sheep, and the influences of transmitted diseases on population dynamics provides a much better framework for management recommendations that will provide habitats to support viable populations of bighorn sheep.

The Payette NF built upon concepts in Clifford et al. (2009) to: 1) model bighorn sheep habitat suitability (source habitats assessment); 2) model the risks of contact between bighorn sheep and domestic sheep given bighorn sheep movement patterns and proximity to domestic sheep allotments (contact assessment); 3) infer disease transmission likelihood and rates; and 4) model the potential effects of diseases on bighorn sheep herd persistence (disease transmission assessment).

Source Habitat Assessment

Source habitats are those characteristics of macrovegetation (cover types and structural stages) that contribute to stationary or positive population growth for a species within its distributional range (Wisdom et al. 2000; Raphael et al. 2001). Further, source habitats contribute to source environments, which represent the composite of all environmental conditions that result in stationary or positive population growth in a specified area and within a specified time range (Wisdom et al. 2000; Raphael et al. 2001).

Source habitat by itself does not provide a meaningful metric for evaluating the impacts of domestic sheep on bighorn sheep viability. It does however provide a framework for assessing the potential for

contact, and hence allows researchers to model the potential effects of disease transmission between domestic and bighorn sheep. This portion of the analysis focused primarily on the delineation of source habitats. The implications of contact with domestic sheep, disease transmission, and perturbations in bighorn sheep populations are addressed in the contact assessment section below. Together these form the basis for source environment analyses.

For the Payette NF, source habitats for bighorn sheep were delineated utilizing LANDFIRE data (Keane et al. 2002) and incorporated other biophysical data considered important in bighorn sheep habitat selection and use from the literature (USDA Forest Service 2010). Figure 1 displays summer source habitats for bighorn sheep in the Snake River and Salmon River drainages on and adjacent to the Payette NF. Bighorn sheep source habitats in central Idaho are associated with large riverine systems and are thus well connected. A large telemetry data set (approximately 52,000 points from radio-collared bighorn sheep over 20 years) was used to assess the relationship between known sheep locations and modeled source habitats. The bighorn sheep data points and modeled source habitats show a strong correlation, as 92% of bighorn sheep telemetry points fall within identified source habitats. However, not all source habitats are occupied by bighorn sheep. Large areas of source habitat exist where bighorn sheep have not been detected, at least in recent years. Per previous discussion, this may be due to many reasons. Specific to Hells Canyon and the Salmon River, some possibilities are: 1) bighorn sheep may not have occupied historical habitats due to disease transmission events, 2) populations may need to increase before source habitats are more fully occupied, 3) exploration of transplanted bighorn sheep into adjacent unoccupied historic habitats may not have occurred.

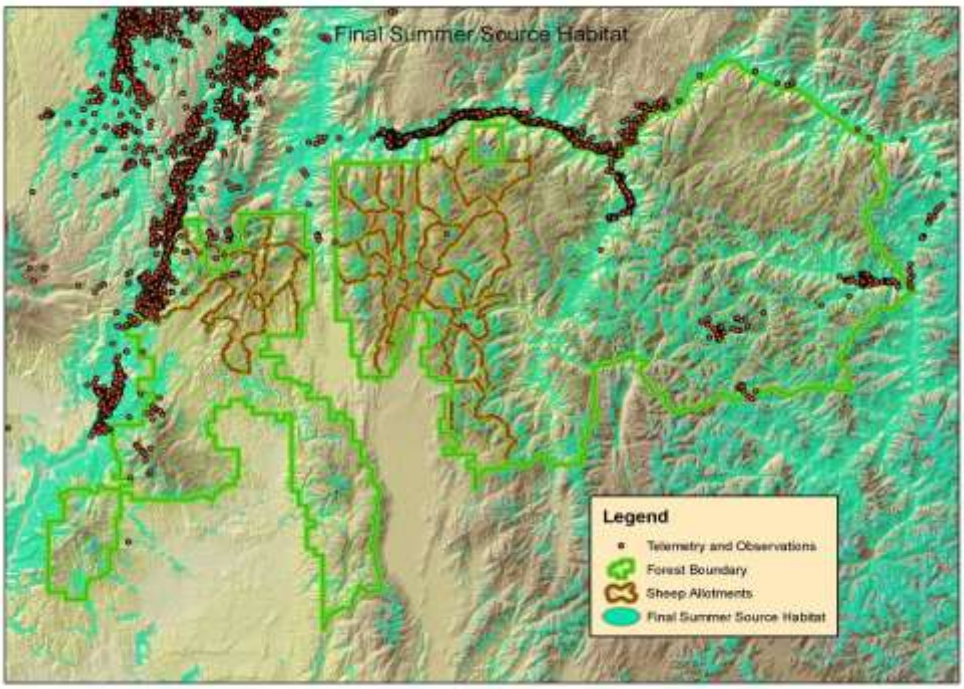

Figure 1. Summer source habitats for bighorn sheep on and adjacent to the Payette National Forest, with telemetry locations of radiocollared bighorn sheep

Contact Assessment

Assessing the potential for contact between bighorn sheep and domestic sheep involved a large telemetry data set (approximately 51,000 points). Data were used to develop individual home ranges within herds using a home range extension model developed for ArcView (Rogers et al. 2007). Individual home range models were coalesced into core herd home ranges for various bighorn sheep populations in Hells Canyon and the Salmon River drainage. The 95% isopleth was the outer boundary for bighorn sheep core herd home ranges. When a bighorn sheep herd 95% isopleth overlapped with domestic sheep allotment boundaries, researchers inferred a probability of interspecies contact at 100%. When analyzed for summer forays, 95.4% of the telemetry locations were within core herd home ranges. Of the 4.6% of the telemetry points outside of the core herd home ranges (forays), 4.4% were by rams.

Consistent with the bighorn sheep literature, bighorn sheep in Hells Canyon are capable of long-distance forays outside of core herd home ranges. This life history trait can put bighorn sheep at risk of contact with domestic sheep, particularly when suitable habitats are well connected and overlap with domestic sheep use areas (Gross et al. 2000; Singer et al. 2000d). The risk of contact between dispersing bighorn sheep (mostly rams) and domestic sheep is ostensibly related to bighorn sheep source habitats, the proximity of domestic sheep use areas (allotments), distance of bighorn sheep forays outside of core herd home ranges, and frequency of bighorn sheep forays outside of core herd home ranges.

Figure 2 displays the maximum distance of ram forays for the data set outside of core herd home range areas (95% isopleth) and the proportion of rams with forays from 0 to 35 kilometers (km) from core herd home range areas. All but one bighorn sheep telemetered forays were between 0 and 26 km. One ram had a foray documented at 35 km from its core herd home range. Foray distances were stratified into 1-km concentric rings emanating out from core herd home range areas and used as a basis for calculating the probability of contact. Along with the source habitats, foray distances allowed the analysis of potential contact with domestic sheep allotments.

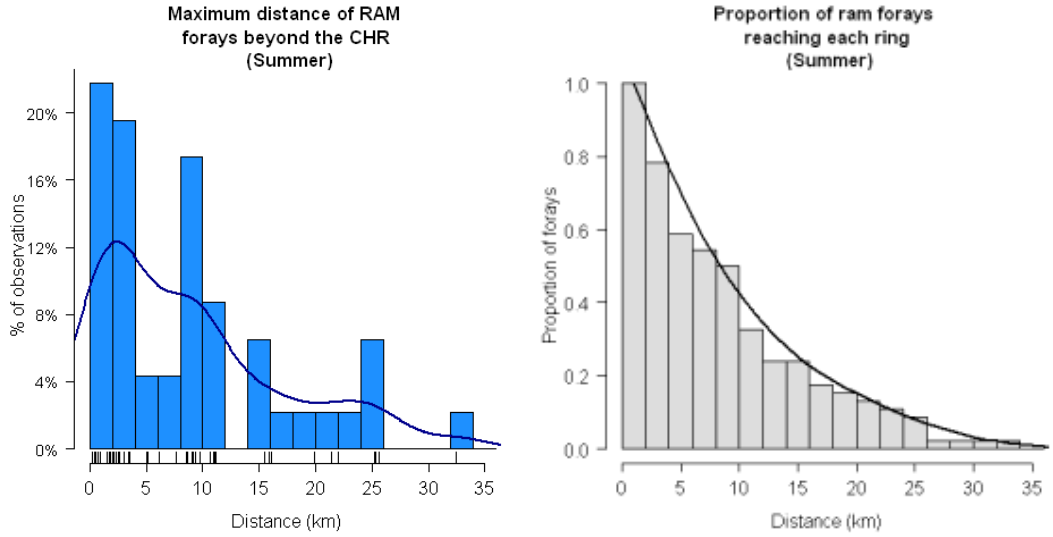

Figure 2. Maximum distance of ram summer forays beyond the core home range and proportion of ram summer forays reaching each ring. (Source: USDA Forest Service 2010)

The likelihood of contact for each kilometer ring outside of the core herd home range area can be expressed by the following equation (USDA Forest Service 2010):

$$P(\text{Contact}_{\text{Ring_k}}) = P(\text{Foray}) \times P(\text{Animal reaches ring k} \mid \text{Foray}) \times P(\text{Intersect allotment} \mid \text{Animal reaches ring k})$$

The overall probability of contact for each individual is:

$$P(\text{Contact}) = \max_{k} P(\text{Contact}_{\text{Ring_k}})$$

The probability of a bighorn sheep foray contacting domestic sheep was based on the size and pattern of the domestic sheep allotment relative to the distance of the foray ring (1–35 km) and the quality of habitat based on the source habitat map in those respective rings.

$$P(\text{Intersect allotment} \mid \text{Animal reaches ring k}) = \frac{\sum_{h} (\text{Area}_{h} \text{ in allotments w/in ring k}) \times (\text{Pref}_{h})}{\sum_{h} (\text{Area}_{h} \text{ in ring k}) \times (\text{Pref}_{h})}$$

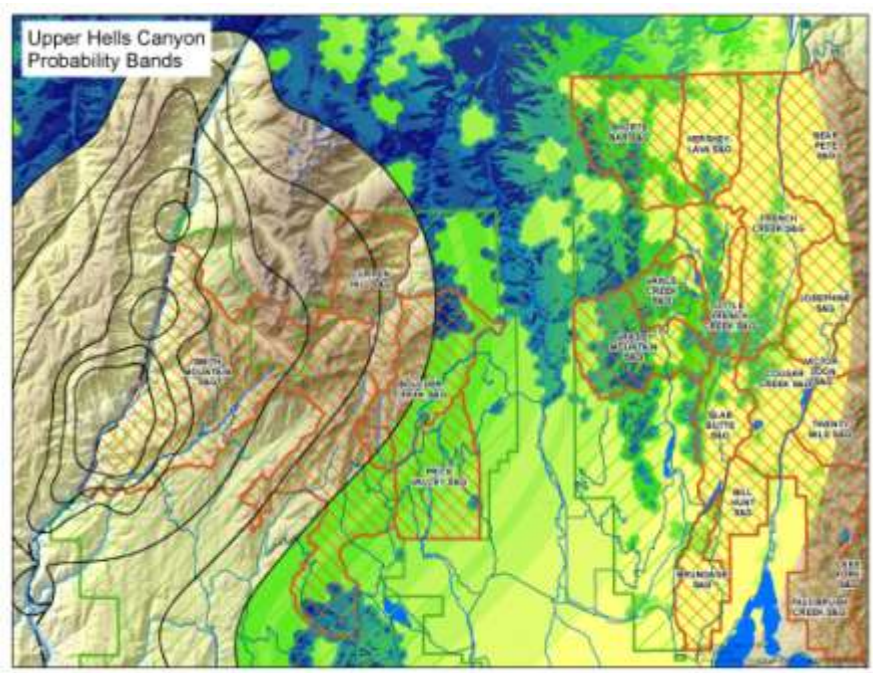

Figure 3. Example of probability of contact in the Upper Hells Canyon herd,where dark blue is the highest probability and light yellow is the lowest probability, based on source habitats in 1-kilometer rings outside of core herd home ranges (from 1 to 35 kilometers) and domestic sheep grazing allotments

The analysis allows for the integration of bighorn sheep source habitats, bighorn sheep behavior, and the proximity of domestic sheep allotments to determine the probability for contact between these species

(Figure 3). The probability of contact between these species is considered the key variable in determining the potential and extent of disease transmission. Relative to bighorn sheep, the use of source habitats are modified by these factors to reflect the potential effects of domestic sheep grazing on bighorn sheep. The contact assessment provides a foundation for assessing the potential for disease transmission between domestic sheep and bighorn sheep and the persistence of bighorn sheep populations within these source habitats.

Summary

In 2005, the Chief remanded the Forest Plan because management direction in the plan did not ensure that habitat management would maintain viable populations of bighorn sheep. The primary concern was the potential for contact, and disease transmission, between domestic sheep and bighorn sheep that would affect the distribution and viability of bighorn sheep populations on the Payette NF. The Chief instructed the Payette NF to conduct a bighorn sheep viability analysis that would lead to management direction compliant with agency regulation (e.g., 36 CFR 219.19). Since disease is likely the most significant factor influencing bighorn sheep habitat acquisition and occupancy, factors germane to this issue were a primary focus of the viability analysis.

The concept of occupied habitat is important in defining and delineating the distribution of species across landscapes and is often used as the basis for articulating how management will alter the abundance and distribution of species. Such analyses utilize species' habitat relationships to describe historic, current, and potential habitats and the implications of management on habitat requisites that potentially affect species.

Relative to bighorn sheep, there are problematic issues in defining occupied habitat on the basis of habitat suitability. Bighorn sheep currently occupy only an estimated 30% of historic habitats at population levels significantly diminished from pre–Euro-American settlement (approximately 10%). Source environments, and source habitats, should be components used in addressing "suitable habitats to support viable populations," but habitat alone does not equate to "population viability" for this species. Any viability assessment, and resulting management guidance for bighorn sheep, needs to address the potential for contact between domestic sheep and bighorn sheep and the implications for disease transmission between the species. This requires an understanding of bighorn sheep life requisites, how bighorn sheep move through and utilize habitats, and domestic sheep management (i.e., timing, location, densities, season of use, proximity of domestic sheep to bighorn sheep). Recent literature (e.g., Clifford et al. 2009) focuses on risk assessments that incorporate these principles into viability analyses.

The process being used by the Payette NF offers a risk analysis approach that couples a significant telemetry database with habitat analyses to provide a reasonable basis for analyzing the likelihood of contact between bighorn sheep and domestic sheep. This basis is used as a key construct in modeling the potential outcomes of such contact on the persistence of bighorn sheep populations.

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Appendix D

American Indian Background

Appendix D
American Indian Background Information

This appendix provides background information about the American Indian tribes with off-reservation interests and rights in the lands now administered by the Boise, Payette, and Sawtooth National Forests.

In response to tribal comments and consultation with the Shoshone-Paiute Tribes of the Duck Valley Reservation in Nevada, the following names of Tribes and Bands will update those found in the Draft Forest Plan Amendment to the 2003 Payette Land and Resource Management Plan.

Shoshone-Paiute Tribes of the Duck Valley Reservation, Nevada

Tribes and Bands

Northern Paiute, and Northern Shoshone/Bannock.

Appendix E

Biological Evaluation

Bighorn Sheep
Supplemental Environmental Impact Statement Analysis: Biological Evaluation

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Introduction

This biological evaluation (BE) documents the potential effects of the proposed Supplement to the *Payette National Forest Land and Resource Management Plan* (Forest Plan) (USDA Forest Service 2003) to threatened, endangered, and sensitive (TES) species.

The Supplemental Environmental Impact Statement (SEIS) for the Forest Plan is based on an analysis of 9 alternatives, which were issued for public review in a Draft SEIS. This Final SEIS incorporated those public comments and suggestions that may warrant further analysis or clarification.

Currently, 21 terrestrial vertebrate species (1 amphibian, 12 birds, and 8 mammals) are known or suspected to exist on the Payette National Forest (Payette NF, or Forest) (Table 1). This list is updated annually. The TES species and their management considerations are described below.

Table 1. Threatened, endangered, and sensitive terrestrial species

Type	*Common Name*	*Scientific Name*	*Global Rank* [a]	*Federal Status*	*State Rank* [b]	*Management Considerations*
Mammal	*Northern Idaho ground squirrel*	*Spermophilus brunneus brunneus*	*G2T2*	*Threatened*	*S1*	*Habitat fragmentation*
	Canada lynx	*Lynx canadensis*	*G5*	*Threatened*	*S1*	*Vulnerable during denning*
	Wolverine	*Gulo gulo luscus*	*G4T4*	*R-4 sensitive*	*S2*	*Vulnerable during denning*
	Fisher	*Martes pennatia*	*G5*	*R-4 sensitive*	*S1*	*Habitat fragmentation, snags, and logs*
	Western big-eared bat	*Corynorhinus townsendii pallescens*	*G4*	*R-4 sensitive*	*SC*	*Vulnerable to disruption*
	Spotted bat	*Euderma maculatum*	*G4*	*R-4 sensitive*	*SC*	*Vulnerable to disruption*
	Bighorn sheep	*Ovis canadensis*	*G4*	*R-4 sensitive*	*S3*	*Vulnerable to disease*
	Gray wolf	*Canis lupus*	*G4*	*R-4 sensitive*	*S2*	*Human caused mortality*
Bird	*Northern goshawk*	*Accipter gentilis*	*G5*	*R-4 sensitive*	*S3*	*Nest stand, prey availability*
	Bald eagle	*Haliaeetus leucocephalus*	*G5*	*R-4 sensitive*	*S3*	*Nest stand, prey availability*
	White-headed woodpecker	*Picoides albolarvatus*	*G4*	*R-4 sensitive*	*S2*	*Large snags, low crown density*
	Flammulated owl	*Otus flammeolus*	*G4*	*R-4 sensitive*	*S3B*	*Large snags and trees*
	Harlequin duck	*Histrionicus histrionicus*	*G4*	*R-4 sensitive*	*G/SC*	*Forest riparian*
	Mountain quail	*Oreortyx pictus*	*G5*	*R-4 sensitive*	*S1*	*Shrubby riparian*
	Boreal owl	*Aegolius funereus*	*G5*	*R-4 sensitive*	*S2*	*Large snags*
	Northern three-toed woodpecker	*Picoides dorsalis*	*G5*	*R-4 sensitive*	*S2*	*Abundant snags*
	Great gray owl	*Strix nebulosa*	*G5*	*R-4 sensitive*	*S3*	*Forested areas with meadows*
	Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	*G4T3*	*R-4 sensitive*	*S3*	*Shrubby wintering areas*
	Common loon	*Gavia immer*	*G5*	*R-4 sensitive*	*SC*	*Vulnerable during nesting, abundant small fish for prey*

	Peregrine falcon	*Falco peregrines anatum*	*G4T3*	*R-4 sensitive*	*E*	*Vulnerable during nesting*
Amphibian	*Spotted frog*	*Rana luteiuentris*	*G4Q*	*R-4 sensitive*	*Not ranked*	*Still or ponded water*

Global Rank = globally imperiled ranking, from Nature Serve (2009)1 = critically imperiled, 2=imperiled, 3=vulnerable, 4= apparently secure, 5=secure State Ranked, SC = species of concern, G/SC = game species and species of concern, S1 Critically imperiled, S2 imperiled, S3 Vulnerable, S3B Breeding vulnerable (Idaho and Utah CDC)

The SEIS reanalyzes the effects of current and proposed Payette National Forest management on Rocky Mountain bighorn sheep (*Ovis canadensis*) viability within the Payette NF. Specifically, the SEIS presents additional information concerning the following issues:

- Viability of bighorn sheep at the planning-unit scale
- Compliance with the Hells Canyon National Recreation Area (HCNRA Act [PL 94-199])
- Compliance with 36 CFR 292.48 (Domestic Livestock Grazing Activities on Other Lands, Wild and Scenic Rivers, and Wilderness Lands in the HCNRA)
- Compliance with the National Forest Management Act (NFMA)
- Compliance with 36 CFR 219.19 (Ecological, Social, and Economic Sustainability)

Alternative Description

Alternatives 1B, 2, 5, 7

The seven alternatives evaluated in the FEIS could be combined into two categories based on how the affected the risk of contact between domestic and bighorn sheep. The first category contains Alternatives 1B, 2, 5, and 7, which did not designate any acres on the Payette National Forest as unsuitable for grazing by domestic sheep. All trailing routes remained open in these alternatives.

Alternative 7 was chosen as the alternative to be implemented. To meet the appeal requirements related to the potential impacts of disease transmission from domestic sheep on the Forest, modifications to Alternative 7 are analyzed in Chapter 3. Because this alternative was found to not be compliant with the NFMA, it cannot be selected as the final decision. For Alternative 7, zero acres are identified as unsuitable for domestic sheep and 100 percent of the total risk of contact remains on the landscape.

Alternatives 3, 4, 6

These alternatives were also proposed in the FEIS and are grouped together as the second category of alternatives. In these alternatives, suitable rangeland portions of the Smith Mountain Allotment overlapping current bighorn sheep habitat were determined to be unsuitable for domestic sheep grazing. Management Area (MA) #1 outside of grazing allotments was also determined to be unsuitable for domestic sheep grazing. No trailing routes were closed.

Alternative 7E

Alternative 7E designates no area within the Payette National Forest as suitable for domestic sheep grazing, and leaves no trailing routes open to use within the entire Payette National Forest. The following allotments are affected by this Alternative: Smith Mountain, Curren Hill, Boulder Creek, Price Valley, Surdam, Shorts Bar, Hershey-Lava, French Creek, Bear Pete, Marshall Mountain, Vance Creek, Little French Creek, Josephine, Victor-Loon, Grassy Mountain, Slab Butte, Cougar Creek, Twenty Mile, Brundage, Bill Hunt, Fall/Brush Creek, North Fork Lick Creek, Lake Fork, and Jughandle.

Alternative 7G (Agency Preferred Alternative)

Alternative 7G utilizes the bighorn sheep geographic population ranges (GPRs) as boundaries and designates all land within the Hells Canyon and Salmon River GPRs as unsuitable for domestic sheep grazing. The following allotments are affected by this Alternative: Smith Mountain, Curren Hill, Boulder Creek, Price Valley, Shorts Bar, Hershey-Lava, French Creek, Bear Pete, Marshall Mountain, Vance Creek, Little French Creek, Josephine, Victor-Loon, Twenty Mile, Fall/Brush Creek, North Fork Lick Creek, and Lake Fork. This alternative also closes all trailing routes within the GPRs.

Alternative 7L

Alternative 7L was developed using the updated quantitative risk analysis and landmarks, such as watershed divides, streams, roads, and allotment boundaries to make the implementation easier. This alternative attempted to remove only the very highest risk areas from domestic sheep grazing and keep as much suitable range land open. The west side of the Forest closes the Curren Hill allotment and leaves the eastern 35% of Smith Mountain open and left Boulder Creek and the Price Valley allotment open. The east side of the Forest closes all of the Shorts Bar, and North Fork Lick Creek Allotments. All of the Hershey-Lava Allotment is closed except for the southwest 25% of the allotment. Only the very eastern 15% of the French Creek allotment is left open. The Bear Pete Allotment is left 40% open on the eastern side of the allotment. Seventy percent of the Marshal Mountain Allotment is left open on the western side of the allotment.

Alternative 7M

Alternative 7M was developed using the updated quantitative risk analysis and landmarks, such as watershed divides, streams, roads, and allotment boundaries to make implementation easier. This alternative was designed to remove more risk from the landscape and keep grazing outside of the herd home range areas. The west side of the Forest closes all of the Curren Hill Allotment and the Boulder Creek Allotment. The Smith Mountain allotment is left 25% open on the east side of the allotment. The Price Valley Allotment is left 85% open on the east side of the allotment. The eastside of the Forest closes all of the Shorts Bar, French Creek, Marshall Mountain, North Fork Lick Creek, and Lake Fork allotments. All of the Hershey-Lava allotment is closed except for the southwest 25% of the allotment. The Bear Pete allotment is left 30% open on the eastern side of the allotment. The northern 50% of the Victor-Loon allotment, the western 25% of the Twenty Mile allotment, and southern 90% of the Jughandle would all be left open.

Alternative 7N

Alternative 7N was developed using the updated quantitative risk analysis and landmarks, such as watershed divides, streams, roads, and allotment boundaries to make implementation easier. This alternative was designed to remove most of the high risk area and also attempting to add grazing areas of lower risk back in. The west side of the Forest closes all of the Curren Hill Allotment and the Boulder Creek Allotment. The Smith Mountain allotment is left 25% open on the east side of the allotment. The Price Valley Allotment is left 85% open on the east side of the allotment. The eastside of the Forest closes all of the Shorts Bar, Grassy Mountain, Vance Creek, Hershey Lava, Little French Creek, French Creek, Marshall Mountain, and North Fork Lick Creek allotments. The western 85% of the Josephine, the eastern 25% of Bear Pete, the northern 50% of the Victor-Loon allotment, and the western 25% of the Twenty Mile allotment are all left open.

Alternative 7O

Alternative 7O was developed using the updated quantitative risk analysis and landmarks, such as watershed divides, streams, roads, and allotment boundaries to make implementation easier. This alternative was designed to attempt to remove all areas of major risk and keep allotments as intact as possible and reduce and amount of monitoring need to minimal levels. The west side of the Forest closes all of the Curren Hill Allotment and the Boulder Creek Allotment. The Smith Mountain allotment is left 25% open on the east side of the allotment. The Price Valley Allotment is left 85% open on the east side of the allotment. The eastside of the Forest closes all of the Shorts Bar, Grassy Mountain, Vance Creek, Hershey Lava, Little French Creek, French Creek, Josephine, Bear Pete, Marshall Mountain, Victor Loon, North Fork Lick, and Lake Fork allotments. The western 25% of the Twenty Mile and the southern 90% of the Jughandle allotments would be open.

Alternative 7P

Alternative 7P was developed using the updated quantitative risk analysis and landmarks, such as watershed divides, streams, roads, and allotment boundaries to make implementation easier. This alternative was designed to keep many of the high risk areas as unsuited but add in areas that are of a lower risk. This alternative was designed to maximize bighorn sheep protection and maximize the amount of suitable range land. The west side of the Forest closes all of the Curren Hill Allotment and the Boulder Creek Allotment. The Smith Mountain allotment is left 25% open on the east side of the allotment. The Price Valley Allotment is left 85% open on the east side of the allotment. The eastside of the Forest closes all of the Shorts Bar, Little French Creek, French Creek, Marshall Mountain, and North Fork Lick Creek allotments. The southwest 25% of the Hershey Lava, western 85% of the Josephine, the eastern 25% of Bear Pete, the northern 50% of the Victor-Loon allotment, and the western 25% of the Twenty Mile allotment are all left open.

Federally Listed Species

The Idaho Fish and Wildlife Office of the U.S. Fish and Wildlife Service provided the Payette National Forest (14420-2009-SL-0039) with an updated list of threatened, endangered, and proposed species which occur or potentially occur on the Forest. Listed species include the Canada lynx and the northern Idaho ground squirrel.

Canada Lynx

The lynx was listed as threatened on March 24, 2000. This species is associated with boreal subalpine fir and lodgepole pine forested environments. The species forages on snowshoe hare and mice, voles, squirrels, and birds. Lynx are not common in Idaho and are primarily restricted to northern Idaho. Primary criteria for lynx habitat are forested elevations above 1,524 meters (5,000 feet) composed of stands of spruce, subalpine fir, and lodgepole pine. Primary foraging habitat is young pole-stage lodgepole pine where lynx prey on snowshoe hare. Optimum denning habitat is mature spruce and subalpine fir forest with extensive downfalls. Useable denning habitat is lodgepole pine with extensive downfalls.

Lynx are usually more active at night. Lynx eyes are well adapted for night hunting. Preferred winter food consists primarily of snowshoe hares, rodents such as red squirrels, and birds. Habitat for snowshoe hares generally consists of young conifer stands with relatively dense and interconnected canopies that provide both understory cover and food. Predation rates of snowshoe hares are high (>80 percent). Snowshoe hare populations tend to be cyclical in nature; however, there is limited evidence that population cycles occur in the southern portion of their range because of high predation rates (Wirsing et al. 2002). Snowshoe hare are nocturnal during the winter (Foresman and Pearson 1999).

Many decades of aggressive fire suppression has likely reduced the quality and quantity of lynx and snowshoe hare habitat by altering the amount and pattern of vegetation types and structural stages. Fire was a dominant influence historically in the northern Rocky Mountains (Gruell 1983; Agee 1999). Forest management practices—such as commercial harvest, road construction, and post-harvest thinning—can influence lynx habitat and prey. Snowshoe hares may reach highest densities in young, dense coniferous or coniferous-deciduous forest and forest with a dense understory of shrubs, aspen, and/or conifers. Red squirrels appear in the later stages of forest development when mature cone-bearing trees are common.

Northern Idaho Ground Squirrel

The northern Idaho ground squirrel (NIDGS) was listed as threatened on April 5, 2002. The historical distribution of NIDGS included parts of west-central Idaho in Adams and Valley Counties. The species has been documented on a tableland between Cuddy and Seven Devils Mountains, in the valleys to the east (Lost Valley Reservoir and Price Valley), and in Long Valley further east and south (Yensen 1991).

Populations range from less than 50 animals at 4 sites to more than 200 animals at 1 site, and occurrences can be separated from each other by more than several kilometers. Biologists working with the species estimate that a total of less than 500 squirrels exist today (R. Vizgirdas, USFWS, pers. comm. with E. Yensen, Albertson's College, 2002)

NIDGSs emerge in late March or early April and cease above-ground activity in late July or early August (Yensen 1991). Adult (over 2-years-old) males emerge first, followed by adult females then yearlings. Entrance into seasonal torpor occurs in about the same order, with pups active approximately 1 month later than adult males. Ground squirrels are diurnally active. Newly emerged females remain near their hibernacula, where they are courted by adult males. Females are sexually

attractive to males for only a few hours on the first or second afternoon following their emergence. The NIDGS diet consists of forbs, grasses, seeds, and various green vegetation (Yensen 1991).

The habitat of the NIDGS is drier meadows surrounded by ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) forests between 1,150 and 1,550 meters (3,773 and 5,085 feet) elevation. The xeric meadows typically have a shallow (<1 meter [<3.3 feet] to bedrock), reddish-brown to yellowish-red skeletal-loam or clay-loam soil (Yensen 1991). These drier portions of meadows are occupied by NIDGS only in the absence of Columbia ground squirrels (*Spermophilus columbianus*). Vegetation in these drier meadows is often dominated by stiff sage (*Artemisia rigida*) or mountain big sage (*A. tridentata vaseyana*), with desert parsley (*Lomatium* sp), wormleaf stonecrop (*Sedum stenopetalum*, *Allium* sp), scarlet gilia (*Gilia aggregata*), largeflower triteleia (*Brodiaea douglasii*), various bunchgrasses, and other forbs.

Sensitive Species

Forest Service Manual 2670.32 and 2672.1 directs the National Forests to avoid or minimize impacts to species whose viability has been identified as a concern and listed by the Regional Forester. If impacts cannot be avoided, the Forest must analyze the significance of the potential adverse effects on the population or its habitat within the area of concern and on the species as a whole. Sensitive species must receive special management emphasis. Impacts may be allowed, but the decision must not result in a trend toward Federal listing.

Wolverine

The wolverine is a species suited to extensive, usually high-elevation areas. Threats to wolverine include motorized and nonmotorized travel during winter and spring denning, especially in forested and alpine ecosystems where human use is presently low and habitats have not been greatly modified. Wolverines are primarily scavengers that forage on carcasses of large ungulates such as elk, moose, deer, mountain goats, and bighorn sheep. They also hunt hares, marmots, ground squirrels, and grouse, but will eat fruits and insects when other items are unavailable.

Wolverine home range sizes are influenced by prey remains and other food sources. Individual animals have large territories and can cover large distances in short time periods. In central Idaho, home ranges have been documented as large as 2,079 square kilometers (802 square miles) for males, although female ranges tend to be smaller. Wolverines do not show strong territorial behavior and have overlapping ranges. They use several habitats and have been located in forested drainage bottoms to high-elevation, sparsely timbered cirque basins. Two natal dens were located in subalpine cirque areas on north-facing slopes, suggesting that this type of habitat is important in central Idaho (Copeland and Harris 1994).

Due to their large home range size and habitat needs, this species is rare and uncommon and most likely always has been. Habitats within known wolverine habitat are the least modified by human activities, due to their remote, steep, and harsh environments (Sallabanks 1996). Wilderness and roadless lands account for much of the areas wolverines are known to use (Copeland and Harris 1994). Some very large fires have burned in the type of habitat wolverines inhabit. These fires were

generally characteristic (large, infrequent, and stand-replacing) for the plant communities and elevations in which they burned.

Human intrusion within denning habitat during the winter is probably the primary threat to this species (Wisdom et al. 2000). Human activities during denning may cause wolverines to relocate inferior habitat, which may reduce reproductive success. Moving vulnerable wolverine young can also expose them to predators and harsh weather. Recent technological advances in snowmobile capabilities have raised concerns about human intrusion in previously isolated areas (Wisdom et al. 2000) where natal denning may occur.

No known population trends exist for the wolverine within the Payette NF. Wisdom et al. (2000) estimate a 32 percent increase in source habitat from historic to current levels for this species within the Central Idaho Mountains Ecological Reporting Unit (ERU), which includes a majority of the Boise, Payette, and Sawtooth National Forests (Ecogroup). The IDCDC has 26 wolverine records for the Payette NF (ICDC 2009).

Fisher

Fishers are an uncommon predator found in mature to old forests with high canopy closure and large tree (both live and dead) structure. Fisher avoid large openings and are associated with mesic forest conditions and forested riparian areas. Natal dens have been located in pileated woodpecker cavities and other forest structures. Fishers eat small mammals, birds, fish, amphibians, insects, carrion, fruit, and nuts (Idaho State Conservation Effort 1995). Fishers hunt for prey on the forest floor and in trees and snags (Spahr et al. 1991). Vegetation management and fire suppression have influenced fisher habitat and prey by altering forest composition and structure. No known population trends exist for fishers on the Payette NF. Wisdom et al. (2000) estimate a 35 percent increase in source habitat from historical to current times for this species within the Central Idaho Mountains ERU, which includes an estimated 87 percent of the Ecogroup area. The ICDC has 14 fisher records for the Payette NF (ICDC 2009).

Western Big-eared Bat

Big-eared bats are nocturnal and feed primary on moths along forest edges. They roost in caves, old mines, canyons with cliffs, and buildings. Maternity and hibernation colonies occur almost exclusively in caves and mine tunnels (Groves et al. 1997). Unlike other species of bats that seek refuge in crevices, big-eared bats group in clusters on open surfaces, making them more vulnerable to disturbance (Idaho State Conservation Effort 1995). Most of the big-eared bat records have been in lower elevations outside large expanses of forest cover (Groves et al. 1997). This species is sensitive to human disruption during roosting and will abandon roost sites, which may increase mortality. No known population trends exist for the big-eared bats on the Payette NF, but these bats have been found on the Payette NF. Wisdom et al. (2000) estimate a 20 percent increase in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The ICDC has 7 western big-eared bat records for the Payette NF (ICDC 2009).

Spotted Bat

Spotted bats forage nocturnally and feed mainly on moths in open ponderosa pine stands and meadows. They roost in cracks in steep, rocky outcrops and cliff faces (personal comm. with L. Lewis 2000). This type of habitat does occur in some of the steep basalt canyons on the Payette NF. There has been no documented occurrence of spotted bats on the Payette NF, but surveys have been limited. Spotted bats are known to occur in the southwestern portion of Idaho, south of the Snake River (Groves et al. 1997). Wintering areas are unknown. This species is sensitive to human disruption during roosting and will abandon roost sites, which may increase mortality. No known population trends exist for spotted bats on the Payette NF. Wisdom et al. (2000) estimate an 18 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The IDCDC has 2 spotted bat records for the Payette NF (IDCDC 2009).

Bighorn Sheep

See Chapter 3 Bighorn Sheep Supplemental Environmental Impact Statement Analysis.

Gray Wolf

The gray wolf has a circumpolar distribution in the northern latitudes and occurs in Europe, Asia, and North America. In North America it is considered common in Alaska and most of Canada.

Wolves are native to Idaho and were historically fairly common in most parts of the state with abundant big game. The basic social unit in wolf populations is the pack. A pack can consist of 2–20 wolves (average of 11). Pack members have a strong social bond to each other and establish and defend territories. Home ranges vary in size from 80 square miles in Minnesota to over 600 square miles in Alberta. Home ranges over the last several years for central Idaho packs have ranged from 50 square miles to 360 square miles (USFWS 2000).

Gray wolves are primarily limited by nonhabitat factors. The primary threat to wolves is human-caused mortality from shooting and vehicle collisions (USFWS 1994; Quigley and Arbelbide 1997; Wisdom et al. 2000). New and existing roads improve the likelihood that humans can come into contact with wolves. Maintaining habitat for populations of prey species of large ungulates is also an important management consideration. Over the long term, human social pressures will most likely restrict the distribution of wolves to areas of limited human occupation and domestic livestock production. Human tolerance and lack of persecution will be needed to achieve long-term successful recovery. Both regulatory and educational efforts will be important parts of wolf conservation and management efforts (USFWS 2002).

The gray wolf is a habitat generalist and is found in most parts of the state that contain big game (i.e., elk *[Cervus canadensis]*, moose *[Alces alces]*, and deer *[Odocoileus spp.]*) populations able to support the species' prey needs. As social carnivores at the top of the ecological food web, wolves need comparatively large spaces to find sufficient and abundant prey. Elk populations statewide are currently near all-time highs, indicating that no major habitat limitations are present.

Northern Goshawk

The goshawk is a forest habitat generalist that uses a variety of forest types, ages, structural conditions, and seral stages (Graham and Jain 1998). It preys on small- to medium-sized birds and mammals (e.g., robins and chipmunks to grouse and hares), which it captures on the ground, in trees, or in the air. Goshawks and their prey require a variety of forest structures dispersed over large areas (Graham and Jain 1998).

Northern goshawks have been documented nesting on all Ranger Districts of the Payette NF and in all forested types). For this species, a change in population may not represent changes in habitat conditions on the Payette NF. Populations may be influenced by activities off the Payette NF, particularly in wintering areas, which are largely unidentified.

The major changes in habitat that have occurred on the Payette NF include selective harvesting of large-diameter trees, snag removal in harvest areas, mortality in ponderosa pine areas from wildfires during the last 15 years, and a change in composition and density of remaining stands because of long-term fire exclusion (Sloan 1998; Wisdom et al. 2000).

Nest Areas—Nest areas usually include one or more forest stands, several nests, and several landform characteristics. Nest areas are occupied by breeding goshawks from early March to late September. The size (generally 8.1-10 hectares [20–25 acres]) and shape of nest areas depend on topography and the availability of patches of dense, large trees.

Goshawks have a high fidelity to nest areas, which are often used more than one year and sometimes used intermittently for decades (Reynolds et al. 1992; Wisdom et al. 2000). Many pairs of goshawks have 2–4 alternate nest areas within their home range. All previously occupied nest areas may be important for maintaining nesting populations because they contain the habitat elements that originally attracted the goshawks. Replacement nest areas are advantageous because goshawk nest stands are subject to loss from catastrophic events and natural tree mortality.

Goshawk nest areas typically have high tree canopy cover and a higher proportion of larger trees then surrounding areas. Studies suggest that dense vegetation provides relatively mild and stable microenvironments and protection from predators. Nest areas are usually classified as mature and late structural forest stands (Reynolds et al. 1992; Graham and Jain 1998). Human activity during the nesting period may cause the nest to be abandoned and subsequent nest failure (Reynolds et al. 1992; Braun et al. 1996).

Post-fledging Family Area (PFA)—PFAs are used by the adults and young from the time the young leave the nest until they are no longer dependent on the adults for food. The PFA surrounds the nest area and, although it generally includes a variety of forest conditions, the vegetation structure resembles that found within nest stands. PFAs vary in size from 121 to 242 hectares (300 to 600 acres). PFAs provide the young hawks with cover from predators and sufficient prey to develop hunting skills so they learn to feed themselves before dispersing during mid-summer to fall. Therefore, PFAs should contain habitat attributes for producing prey species.

No known population trends exist for goshawks on the Payette NF. Wisdom et al. (2000) estimate a 7 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountain ERU. The IDCDC has 90 goshawk records for the Payette NF (IDCDC 2009).

Bald Eagle

The bald eagle occurs in most regions of North America. It is considered common in Alaska and Florida. Populations have been increasing during the last 10–15 years in North America, a trend attributed to banning DDT in 1972 and management protecting nesting habitat and birds.

During the breeding season, bald eagles eat mainly fish, but also waterfowl, shorebirds, upland birds, and small mammals. Eagles are opportunistic foragers, especially during the winter when they will eat whatever is available, including live fish, waterfowl, small mammals, and carrion. Wintering bald eagles tend to congregate near bodies of unfrozen water and roost communally. Major rivers and large reservoirs constitute the majority of winter habitats, although the temporary presence of high-quality foods may entice eagles to areas far removed from aquatic zones. Roost sites are usually located in stands or clumps of mature or old conifers or cottonwoods.

Nests are commonly found in large trees, mainly conifers and cottonwoods (*Populus spp*.), usually near water. Eagles build large nests. To accommodate these large nests, nests trees are often found in multistoried, older forest stands with open canopies (Quigley and Arbelbide 1997). Nests can also occur in single, isolated trees if the trees are large and strong enough to support the large nests that bald eagles build. Two known bald eagle nests exist on the Payette NF, and birds are regularly seen in winter along major river systems. The IDCDC has 79 bald eagle records on the Payette NF (IDCDC 2009).

White-headed Woodpecker

White-headed woodpeckers are found mainly in open and mature ponderosa pine and mixed ponderosa pine/Douglas-fir forests in Idaho (Frederick and Moore 1991; Groves et al. 1997). They feed on conifer seeds during fall and winter. Cone crops are different from year to year, and large trees usually produce more cones then small trees. During other times of the year, flying insects are important. Nests are usually excavated in large-diameter snags with a moderate degree of decay (Bull et al. 1986; Bull et al. 1997). Nesting snags need to be >50 centimeters (20 inches) in diameter (Wisdom et al. 2000). Nesting stands of ponderosa pine used by white-headed woodpeckers have a low canopy cover, generally <30 percent (Frederick and Moore 1991). Based on studies done in Idaho, white-headed woodpeckers rarely migrate and are considered year-round residents.

The habitat that white-headed woodpeckers occupy has changed during the last 100 years due to human activities (Sloan 1998; Morgan and Parsons 2001). Major changes in habitat have occurred within the Ecogroup area from selective harvesting of large-diameter ponderosa pine, snag removal in harvest areas, ponderosa pine mortality from wildfires during the last 15 years, and a change in composition and density of remaining stands because of long-term fire exclusion (Geier-Hayes 1995; ICBEMP 1997c; Morgan and Parsons 2001; Sloan 1998; Wisdom et al. 2000). These and other changes have reduced the quality, quantity, and distribution of white-headed woodpecker habitat.

White-headed woodpeckers are restricted to areas dominated by ponderosa pine. Management of large, low-density ponderosa pine, including snags, is an important consideration in mid- to low-elevation forest habitat for this species (Wisdom et al. 2000). Wisdom et al. (2000) estimate a 62 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The extent of large-tree and snag reduction on the landscape has likely had a

negative effect on species such as the white-headed woodpecker. The IDCDC has 84 white-headed woodpecker records on the Payette NF (IDCDC 2009).

Flammulated Owl

Flammulated owls are present on the Payette NF only during the breeding season and migrate off the Payette NF to winter. The habitat components considered most important for flammulated owls are (1) mature and old forests of Douglas-fir, ponderosa pine, and mixed conifer, including lodgepole pine and aspen; (2) a moderate density of large trees; and (3) snags created by larger woodpeckers and sapsuckers (Spahr et al. 1991; Groves et al. 1997). The entire home range of a flammulated owl pair during the breeding and nesting period is 12 hectares (30 acres). They feed almost entirely on flying insects.

Occupied flammulated owl habitat has changed during the last 100 years due to human activities (Sloan 1998; Morgan and Parsons 2001). Major changes in habitat have occurred within the Payette NF from selective harvesting of large-diameter ponderosa pine, snag removal in harvest areas, ponderosa pine mortality from wildfires during the last 15 years, and a change in composition and density of remaining stands because of long-term fire exclusion (Geier-Hayes 1995; ICBEMP 1997c; Sloan 1998; Wisdom et al. 2000; Morgan and Parsons 2001). These and other changes have reduced the quality, quantity, and distribution of flammulated owl habitat.

This owl has been documented on all Ranger Districts on the Payette NF. Important management considerations for this species include retaining or restoring older mid- to lower-elevation forests dominated by ponderosa pine and Douglas fir and retaining or restoring snags and down logs (Wisdom et al. 2000). No population trends exist for flammulated owls on the Payette NF. Wisdom et al. (2000) estimate a 52 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The IDCDC has 169 flammulated owl records on the Payette NF (IDCDC 2009).

Harlequin Duck

The harlequin ducks observed on the Payette NF are part of the Idaho-Wyoming population. The total estimated breeding population in the Pacific Northwest is 514 and is distributed between Washington (274), Oregon (50), Idaho (50), Montana (110), and Wyoming (40). Harlequin ducks are present in these states during the nesting and brood-rearing seasons; they migrate to the coasts of Oregon and Washington to winter. For nesting and brood rearing, these ducks require undisturbed, low-gradient, meandering mountain streams with dense, shrubby riparian areas and large woody debris. They also need log jams and overhanging vegetation for cover and loafing areas.

Harlequin ducks have been observed along the East Fork of the South Fork Salmon River. No nesting has been documented on the Payette NF. Harlequin ducks feed primarily on crustaceans, mollusks, insects, and small fish (Groves et al. 1997). For these migratory species, a change in population may not represent changes in habitat conditions on the Payette NF. Populations may be influenced by activities off the Payette NF, particularly in wintering areas. Logging in riparian areas may make these areas unsuited for this species. The IDCDC has 3 harlequin duck records for the Payette NF

(IDCDC 2009). The entire Idaho breeding population is estimated to be less than 100 birds located on approximately 30 streams in northern Idaho (Groves et al. 1997).

Mountain Quail

Mountain quail are found in dense shrub areas of coniferous forest and shrubby areas adjacent to meadows and riparian areas. They are known to occur on the Payette NF on brushy, low-elevation mountain slopes. Mountain quail have steadily declined in central and southwestern Idaho over the last 30 years (Spahr et al. 1991) for unknown reasons. Predation by feral cats is known to be a problem in areas near human habitation. Management of shrub cover adjacent to riparian areas needs to be considered as an important low-elevation habitat feature of this species. No known population trends exist for mountain quail on the Payette NF. Wisdom et al. (2000) estimate a 12 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The IDCDC has 15 mountain quail records for the Payette NF (IDCDC 2009).

Boreal Owl

Boreal owls nest in old woodpecker cavities in live and dead trees. Boreal owls are found in high-elevation spruce-fir, mixed conifer, and aspen forests year-round and do not migrate. They are known to prey extensively on redbacked voles. The largest nest sites recorded for boreal owls are 12 hectares (30 acres). Winter home ranges encompass about 1,456 hectares (3,600 acres). Summer home ranges are slightly smaller (USDA Forest Service 1991). Forest management can change the composition and structure of vegetation used by this species. Management activities that affect large snags and down logs are important habitat considerations for this species. No known population trends exist for boreal owls on the Payette NF. Wisdom et al. (2000) estimate a 1 percent increase in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The IDCDC has 34 boreal owl records on the Payette NF (IDCDC 2009).

Three-toed Woodpecker

Three-toed woodpeckers are primarily associated with mature forests with outbreaks of bark beetles and stand-replacing fires. They have been observed on the Payette NF mostly in lodgepole pine stands with mountain pine beetles and in burned-over areas (Groves et al. 1997). They forage mainly in dead trees, and a large percentage of their diet is wood-boring insect larvae. Three-toed woodpeckers excavate nesting cavities in snags or occasionally in live trees (Groves et al. 1997). This species is considered nonmigratory. Management for abundant snag densities that normally occurs in higher elevation forests is an important habitat consideration. The processes (i.e., fire, insects and disease) that generate these high densities of snags are essential to produce abundant habitat for this species.

No known population trends exist for three-toed woodpeckers on the Payette NF. Wisdom et al. (2000) estimate a 77 percent increase in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The IDCDC has 23 three-toed woodpecker records on the Payette NF (IDCDC 2009).

Great Gray Owl

The habitat components considered most important for this species are mature or older forest to provide suitable nesting sites and suitable foraging areas that include nonstocked and seedling forests, meadows, and open riparian habitats adjacent to meadows. Great gray owls hunt from perches and capture their prey, usually small rodents, on the ground (Groves et al. 1997). They do not build their own nests but use existing nests built by other species, debris platforms, or broken-topped trees and snags (Bull et al. 1997; Groves et al. 1997). Great gray owl nest sites average 137 meters (150 yards) from the nearest opening. The largest home range recorded for a great gray owl is 6.5 square kilometers (1,622 acres) (USDA Forest Service 1991).

The great gray owl is a year-round resident on portions of the Payette NF. In relation to other owls on the Payette NF, this owl is considered rare in terms of abundance because its preferred habitat (mid- to high-elevation old forests near meadows) is somewhat uncommon. Intensive timber harvest, snag removal, and removal of trees with broken tops in forested areas with meadows are important concerns for this species. No known population trends exist for great gray owls on the Payette NF. Wisdom et al. (2000) estimate a 32 percent increase in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. The IDCDC has 49 great gray owl records for the Payette NF (IDCDC 2009).

Columbian Sharp-tailed Grouse

These birds are known to occur in the Weiser River drainage (Mann Creek) but have not been detected on Payette NF.

Sharp-tailed grouse need low-elevation native shrub/grassland year-round. Abundant grass composition appears to be important within shrub/grassland communities during all life stages. During the summer, the shrubs are used for cover, and the grass and forbs, including insects that are available in these habitats, are used as food. During the winter, shrubs (i.e., serviceberry *[Amelanchier arborea]*, chokecherry *[Prunus virginiana]*, bitterbrush *[Purshia spp.]*, bitter cherry *[Prunus emarginata]*, hawthorn *[Crataegus spp.]*, and aspen *[Populus spp.])* are important food because they are above snow cover. In an Idaho study, winter food and cover were regarded as the most limiting habitat factors for long-term maintenance of grouse (Spahr et al. 1991; Groves et al. 1997; Apa 1998).

Sharp-tailed grouse populations statewide have been increasing over the past 10 years, but most populations are still small and isolated. Most of this increase has been attributed to the Conservation Reserve Program (CRP) on private lands (Apa 1998; Wisdom et al. 2000). Birds are making extensive seasonal use of the CRP seedlings that are annually maintained in grass/shrub cover year round. In some locations, these CRP fields are adjacent to National Forest System (NFS) lands. Livestock grazing management of native shrub/grassland and shrub-dominated riparian areas is also an important management consideration for this species. Many areas of shrub/grassland were historically burned, sprayed, plowed, and planted to nonnative grasses to improve conditions for livestock grazing and reduce erosion. These practices would be detrimental to grouse if they take place on wintering areas where shrubs used as food and cover protrude above the snow level.

Additional threats to sharp-tailed grouse habitat include habitat fragmentation and invasion of exotic plants (Wisdom et al. 2000).

Sharp-tailed grouse currently occupy <10 percent of their former range in the northwest United States; Wisdom et al. (2000) estimate a 24–56 percent decrease in source habitat in the Ecogroup area. The IDCDC has no sharp-tailed grouse records on the Payette NF (IDCDC 2009).

Common Loon

The common loon is a large diving bird weighing 7–9 pounds. Like many other diving birds, loons must run across the water surface to achieve enough speed to get airborne. Nests are made of mud and vegetation and are usually close to the shoreline in shallow-watered natural lakes without rapidly fluctuating water levels. Nests can be located on small islands that are mostly composed of emergent vegetation. Nesting usually occurs in early May just after ice breakup. Loons have a high fidelity to nest sites year after year. Loons avoid lakes with high levels of human activity, fluctuating water levels, turbid water, and no protective coves for nesting. These birds feed mostly on small fish such as yellow perch and various minnow species. Other aquatic organisms may also be consumed. Feeding occurs mainly under water (Spahr et al. 1991). Loons are not a high or moderate priority breeding bird species for Idaho Partners in Flight (2000) in Idaho. The IDCDC has 1 loon record for the Payette NF (IDCDC, 2009).

Peregrine Falcon

Peregrine falcons occupy a wide range of habitats and are typically found in open country near water. They capture prey by striking from above with their talons after a high-speed dive. Foraging habitat includes wetlands and riparian habitats; meadows and parklands; croplands such as hay fields and orchards; gorges and mountain valleys; and lakes that support populations of small- to medium-sized terrestrial birds, shorebirds, and waterfowl.

Cliffs are preferred nesting sites (known as eyries), although reintroduced birds now regularly nest on man-made structures such as towers and high-rise buildings. Peregrine falcons may travel more than 18 miles from the nest site to hunt for food; however, a 10-mile radius around the nest is an average hunting area, with 80 percent of foraging occurring within 1 mile of the nest. Peregrine falcons migrate south for the winter to the Gulf of Mexico and into Mexico and Central America or to large rivers and wildlife refuges in the southern United States (USDA Forest Service 1991).

Peregrines declined precipitously in North America following World War II. Research implicated pesticides—particularly DDT, DDE, and dieldrin applied in the United States and Canada during this same period—as causing the decline, which was linked to weakened egg shells (USFWS 1984). Use of these chemicals peaked in the 1950s and early 1960s and continued through the early 1970s (USFWS 1995).

The most significant event in the peregrine falcon recovery was pesticide restrictions. Use of DDT was restricted in Canada in 1970 and the United States in 1972. Restrictions that controlled the use of aldrin and dieldrin were imposed in the United States in 1974. Since these restrictions were implemented, pesticide residues have significantly decreased in many regions where they were formerly used. Consequently, reproductive rates in most surviving peregrine falcon populations in

North America improved, and numbers began to increase (USFWS 1984; ICBEMP 1997d). In Idaho, the peregrine falcon population has been increasing during the last 10 years.

Other known factors in the historical population decline—such as illegal shooting and collisions with wires, fences, cars, and buildings—are much less significant to population levels of the peregrine falcon in the West. On an individual nest-site basis, human-caused disturbance or habitat alterations close to an active peregrine falcon nest can be a problem. For example, in some areas, rock climbing is a growing sport and has resulted in nest failure due to abandonment (ICBEMP 1997d). Closure of rock-climbing cliffs in proximity to nesting peregrine falcons has recently prevented adverse effects. Power lines, especially distribution lines, can cause peregrine falcon mortality, but many peregrine falcons nest successfully each year near power lines, especially in urban areas. Land-use practices adjacent to peregrine falcon eyrie that do not result in extensive habitat changes or excessive disturbance appear to have little adverse effect on nesting success. The IDCDC has 1 peregrine falcon record for the Payette NF (IDCDC 2009).

Columbia Spotted Frog

Spotted frogs are most often found near permanent water, such as the marshy edges of ponds or lakes; in algae-grown overflow pools of streams; or in wet areas with emergent vegetation. They may move considerable distances from permanent water during rainy periods after breeding, often frequenting mixed conifer and subalpine forests, grasslands, and shrublands if puddles, seeps, or other waters are available. Spotted frogs are thought to hibernate in holes near springs or other areas where water remains unfrozen and is constantly renewed. The Columbia spotted frog uses a muddy or soft substrate in streams or ponds for hibernation (Spahr et al. 1991). The species feeds on invertebrates generally close to ponds or standing water in riparian areas.

Spotted frogs have been documented on the Payette NF in habitats that have standing or slow-moving water throughout the summer. Predation by bullfrogs, a nonnative species, is thought to be a major reason for spotted frog declines. Populations of spotted frogs may have also become fragmented and reduced in abundance because of introduced fish in systems that historically had no fish. These fish prey on both young and adult frogs. Alteration of riparian and wetland habitats is also an important management consideration for this species. No known population trends exist for spotted frogs on the Payette NF, but they are commonly observed in areas of shallow standing and ponded water during the summer. Wisdom et al. (2000) did not evaluate source habitat changes for the spotted frog. The IDCDC has 12 spotted frog records for the Payette NF (IDCDC 2009). Groves et al. (1997) thought this species was declining in parts of its range, but it appears widespread and abundant in Idaho

Direct and Indirect Effects

Northern Idaho Ground Squirrel

A conservation strategy and agreement on the Payette NF was developed in 1996 to improve conditions for this species. The NIDGS is Idaho’s only endemic animal, with an estimated total population of 250–500 individuals. Individual populations are small, disjunct, and isolated—a situation that challenges future management where the species occurs and historically occurred.

Because the NIDGS has such a limited distribution and extremely low population numbers, potential effects to this species are best addressed at a finer scale, as outlined in the conservation strategy and agreement and recovery plan. In the Forest Plan, specific direction is contained at the Management Area level in the three Management Areas where the species is known to occur. The LMRP provides broader Forest-wide direction in the Forest Plan (USDA Forest Service 2003, Chapter III, TEPC Species section): The direction is not always specific to ground squirrels, but reduces threats to ground squirrels through the management of Payette NF resource programs that may affect the species.

Table 2. Forest Plan direction designed to reduce threats to northern Idaho ground squirrel

Threats	Management Direction in Forest Plan (USDA Forest Service 2003, Chapter III)
Habitat loss, modification	TEPC Species: Goals 1, 3, 4, 5, 6; Objectives 1, 2, 3, 4, 5, 7, 14, 18, 22, 25, 26, 27; Standards 1, 2, 3, 5, 29; Guidelines 4, 6, 8, 10
Over-utilization	TEPC Species: Objectives 2, 5 Wildlife Resources: Objective 5,6 Recreation Resources: Standard 5
Disease or predation	Wildlife Resources: Objectives 4, 5, 6
Inadequacy of regulatory mechanisms	TEPC Species: Goals 1, 3, 4, 5, 6; Objectives 1, 2, 3, 4, 5, 7, 14, 18, 22, 25, 26, 27; Standards 1, 2, 3, 5, 29; Guidelines 1, 2, 4, 6, 8 Rangeland Resources: Goal 1; Objective 1 Recreation Resources: Goals 4, 5; Objective 18; Standard 5 Lands and Special Uses: Goal 1; Objective 1; Guideline 1 Facilities and Roads: Goal 1; Objectives 4, 6; Guidelines 4, 9
Other natural or human-caused concerns	TEPC Species: Standard 5

Of the management direction in Table 2, Standard 3 in the Forest-wide TEPC Species section may provide the most all-around protection for the NIDGS. This standard directs managers to "Design and implement projects to meet the terms of Forest Service approved portions of recovery plans."

The Payette NF is currently managing for the NIDGS under a Conservation Strategy and Agreement with the USFWS that was approved in 1996 (USFWS 1996), as well as a Habitat Restoration Plan (2001–2006) that was approved by both agencies in November 2002 and the NIDGS Recovery Plan that was approved in 2003. These documents provide comprehensive direction for protecting the species and restoring NIDGS habitat.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the Biological Assessment for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of NIDGS. The Forest Plan Biological Assessment determination for implementation of the Forest Plan was "May Affect, Likely to Adversely Affect" the northern Idaho ground squirrel.

This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for NIDGS. As this species is Federally listed, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction in the Forest Plan. The Forest Plan does not describe or mandate site-specific activities or projects. Because of this, determination of effects for site-specific activities will require further section 7 consultation as those site-specific activities are proposed under the direction of the Forest Plan.

Canada lynx

Forest-wide management direction meets the intent of the standards specified in the Lynx Conservation Strategy (USFWS 2000) developed to help conserve this species. The Forest Plan provides direction to protect this species and its habitat, including retention of mature forest conditions and coarse woody debris for denning and rearing habitat. A predicted reduction in roads under the Forest Plan would also reduce disturbance and vulnerability to hunting, trapping, and vehicle collisions

In addition to direction for wildlife species in Forest Service Manual 2670, as amended, (1995) and Handbook 2609, as amended (1992), the Forest Plan has Forest-wide management direction to reduce potential threats to Canada lynx. This direction appears in the Forest Plan (USDA Forest Service 2003, Chapter III) and has been summarized in Table 3. The direction is not always specific to lynx, but will reduce threats to lynx through the management of Payette NF resource programs that may affect the species.

Table 3. Forest Plan direction designed to reduce threats for Canada lynx

Evaluation Criteria/Threats	Management Direction in the Forest Plan (USDA Forest Service 2003, Chapter III)
Denning Habitat	TEPC Species: Goals 1, 3, 4; Objectives 12, 13, 18; Standards 1, 2, 3, 12, 14 Wildlife Resources: Standard 1
Foraging Habitat	TEPC Species: Goals 1, 3, 4; Objectives 12, 13, 23; Standards 1, 2, 3 14 Vegetation: Objective 1 Rangeland Resources: Goals 1, 6; Objective 1; Standard 1; Guidelines 2, 9
Vegetation Conversion*	TEPC Species: Goal 4; Objective 13; Standards 1, 2, 3, 14, 15; Guidelines 1, 2, 6 Wildlife Resources: Guideline 1 Vegetation: Goals 1, 2, 4, 7 Timberland Resources: Goal 3
Pre-commercial Thinning	TEPC Species: Goals 3, 4; Standards 1, 2, 3, 14, 15; Guidelines 1, 2, 6
Fire Management*	TEPC Species: Goal 4; Objectives 13, 18; Standards 1, 2, 3, 14, 15; Guidelines 1, 2, 6, 8 Wildlife Resources: Guideline 1 Fire Management: Goal 2, Objectives 1, 2, 5
Landscape Patterns*	TEPC Species: Goal 4; Objective 13; Standards 1, 2, 3, 14, 15, 16 Vegetation: Goals 1, 2, 4, 7; Objectives 5, 7 Fire Management: Goal 2; Objectives 1, 2, 5 Timberland Resources: Goal 3

Evaluation Criteria/Threats	Management Direction in the Forest Plan (USDA Forest Service 2003, Chapter III)
Forest Roads*	TEPC Species: Objectives 3, 27; Standards 1, 2, 3; Guidelines 1, 2, 6 Wildlife Resources: Objective 5; Guidelines 1, 4 Facilities and Roads: Goal 1, Objectives 4, 6; Standard 3; Guidelines 4, 9
Developed Recreation*	TEPC Species: Objectives 7, 27, 29, 31, 32; Standards 1, 2, 3, 14, 34; Guidelines 1, 2, 6 Recreation Resources: Goals 4, 5, 6; Objectives 18, 24, 25; Standard 5
Non-winter Dispersed Recreation	TEPC Species: Objectives 7, 27; Standards 1, 2, 3; Guideline 6 Recreation Resources: Goals 4, 5; Objective 18; Standard 5
Winter Dispersed Recreation*	TEPC Species: Objectives 7, 27, 28, 29; Standards 1, 2, 3, 34 Recreation Resources: Goals 4, 5, 6; Objectives 18, 24, 25; Standard 5
Minerals and Energy Development	TEPC Species: Objectives 7, 26; Standards 1, 2, 3, 14, 29, 34; Guidelines 1, 2
Land Adjustments	TEPC Species: Goal 1; Objective 25; Standards 1, 2, 3, 14, 15, 16; Guidelines 1, 2, 10 Wildlife Resources: Guideline 1 Lands and Special Uses: Goal 1; Objective 1; Guideline 1
Lack of Habitat Connectivity*	TEPC Species: Goal 5; Objectives 12, 23, 30, 32; Standards 1, 2, 3 Wildlife Resources: Objective 5; Guidelines 1, 4
Lack of Coordination between Jurisdictions and Agencies*	TEPC Species: Goal 1; Objectives2, 25; Standard 16; Guideline 4 Wildlife Resources: Objectives 4, 5; Guideline 4 Vegetation: Goal 7; Objective 5 Facilities and Roads: Objectives 2, 4, 6
Lack of Monitoring*	TEPC Species: Objective 1, 5, 11; Guidelines 2, 4

* One of eight (9) risk factors for the Northern Rocky Mountain Geographic Area from the BO

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the Biological Assessment for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of lynx. The Forest Plan Biological Assessment determination for implementation of the Forest Plan was “May Affect, Likely to Adversely Affect” the Canada lynx. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for lynx. The Forest Plan provides for Canada lynx and its habitat by providing direction that meets the intent of the 15 evaluation criteria identified in the Biological Opinion (USFWS 2000). As this species is federally listed, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the revised Forest Plan.

Wolverine

Wolverines are considered habitat generalists, and their home ranges are so large they are usually measured in hundreds of square miles rather than thousands of acres. Thus, specific habitat needs are

not as important as reducing human disturbance, particularly in natal den sites (subalpine talus cirques) during the denning period.

Because this species prefers high-elevation, remote areas in which to den and forage, wolverine habitat is found mostly on NFS lands and has generally been minimally affected by past management activities in terms of road construction, timber harvest, and altered fire regimes. It has been suggested that large unroaded areas are needed to maintain or improve conditions for wolverine in order to minimize disturbance and vulnerability from trappers, hunters, predators, and collision with vehicles. None of the proposed alternatives would affect wolverine management or habitat.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BA for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of wolverine. The Forest Plan BA determination for the implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the wolverine. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for wolverine. A large portion of the Ecogroup will remain undeveloped and roadless, which will reduce the presence of human activity within habitats that wolverine utilize. Direction is in place that will reduce human disturbance during denning activity for the wolverine. Additional direction is in place for sensitive species in general that should benefit wolverine if additional concerns become known in the future. As disclosed in the BE for the Forest Plan, habitat availability for the wolverine is expected to continue mostly unchanged because of anticipated increasing levels of tree mortality and areas burned by wildfire, minimal to no salvage efforts, reduced road densities, and allowing fire to play a more natural role. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the revised Forest Plan.

Fisher

Key components for fisher habitat are forested riparian areas, mature to old forests with moderate moisture conditions, and snags and coarse woody debris. Riparian forest communities are very important for fisher habitat.

The Forest Plan provides direction to increase the extent of large trees on the landscape and protect forested riparian areas. This direction exists because much of the habitat where this species occurs has limited amounts of mechanical management activities, and succession is producing additional multistoried stands with large trees. None of the proposed alternatives will affect this management direction.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of fisher. The Forest Plan BE determination for the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the fisher. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for fisher. Additional direction is in place for sensitive species in general that should benefit fishers if additional concerns become known in the future. Forest Plan projections estimate an almost doubling of the amount of fisher habitat by the end of 5 decades based on implementing the revised direction. Natural succession will tend to create additional habitat on unmanaged lands, while disturbance events—such as fire, disease, and wind-throw—will reduce green forests but create new snags and coarse woody debris over time. Large trees and snags with cavities will become more common on the landscape; cavities used as denning sites will likely increase. Factors unrelated to habitat are currently contributing to the absence or low population levels of fishers (Douglas and Strickland 1987). Mortality will likely continue to occur from hunting, trapping, and collision with vehicles and will likely influence improving conditions for this species more than habitat. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Western Big-eared Bat

The Townsend's big-eared bat is known to occur on the Forest. Forest-wide standards and guidelines exist for surveying and protecting bat hibernacula. Management direction has also been developed to protect roosting sites and hibernacula from disturbance when bats are detected.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of the big-eared bat. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the Townsend's big-eared bat. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for big-eared bat. Management Areas have been identified where this species is likely present and habitat may be a concern. Because only limited bat surveys have been conducted, this species' relative abundance is unknown. Additional direction is in place for sensitive species in general that should benefit the big-eared bat if additional concerns become known in the future. As

this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Bighorn Sheep

See Chapter 3 Bighorn Sheep Supplemental Environmental Impact Statement Analysis.

Spotted Bat

Spotted bats roost in crevices of high cliffs and forage in sagebrush shrub and low-elevation forest. This species is sensitive to human disturbance during roosting but has not been detected on the Payette NF. Forest-wide direction for surveying and protecting bat hibernacula exists. If bats were detected, actions would be taken to protect these sites from disturbance. Direction for habitat protection will decrease the risk to continued persistence and improve viability for this species.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of the spotted bat. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the spotted bat. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for spotted bats. Management Areas have been identified where this species is likely present and habitat may be a concern. Because limited bat surveys have been conducted, this species' relative abundance is unknown. Additional direction is in place for sensitive species in general that should benefit spotted bats if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Gray Wolf

Prey abundance is an important consideration for managing wolves. The Forest Plan provides direction to work cooperatively with states and tribes to manage big-game populations that would benefit wolves (USDA Forest Service 2003, Wildlife Resources section: Goals 2 and 3; Objectives 11 and 12; Standards 6 and 7; and Guidelines 8, 11, 13, and 14). Elk are at all-time high population levels statewide and are believed to be a primary prey species for wolves in this part of Idaho (IDFG 1999).

In addition, the Forest Plan includes a standard (TEPC Species Standard 12) to avoid or minimize impacts from management actions within known denning sites if those actions would disrupt reproductive success during the denning period.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of wolves. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the gray wolves. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for wolves. A large portion of the Ecogroup will remain undeveloped and roadless, which will reduce the presence of human activity within habitats that wolves utilize. Direction is in place for sensitive species in general that should benefit wolves if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the revised Forest Plan.

Northern Goshawk

Goshawks use all forest types within the Ecogroup, and they select nesting sites that usually have larger trees than surrounding areas and an abundant prey base. An estimated 570,606 hectares (1,410,000 acres) of habitat for this species currently occurs within the Ecogroup.

Forest Plan direction will increase the extent of area with large trees, which will benefit this species. Forest Plan direction for the management of snags will also benefit this species because many of its prey use snags as habitat. This increasing habitat trend should decrease the risk to continued persistence and improve viability for this species.

Management direction will also avoid or mitigate human activities within nesting stands and fledging areas.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of goshawks. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the goshawk. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for goshawk. Additional direction is in place for sensitive species in general that should benefit goshawk if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Bald Eagle

Bald eagle nesting, perching, roosting, and wintering sites tend to be near riparian areas near large bodies of water because this species relies primarily on fish for food during the spring, summer, and fall. During the winter, it feeds on waterfowl and scavenges on dead animals such as deer and elk. Because of this dependence, riparian area loss or modification is an important management consideration. The Forest Plan provides management direction to protect riparian areas. Improved riparian and aquatic resource management direction within Riparian Conservation Areas (RCAs) should maintain or restore fish populations important for bald eagle prey over the short and long term and provide large trees for nesting and roosting. This direction also includes goals to maintain or restore large trees where possible for other resource needs, such as to enhance shade and provide bank stabilization, large woody debris recruitment, and pool habitat. Large trees would also provide nesting, perching, and roosting habitat for bald eagles over the short and long term, in both existing and potential eagle territories.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of bald eagles. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the bald eagle. This Forest Plan SEIS would not change this determination.

White-headed Woodpecker

White-headed woodpeckers occur in forest types with a high proportion of large ponderosa pine with low tree densities (PVGs 1, 2, 3, and 5). Many unharvested areas (mostly unsuited timber lands) often do not benefit the white-headed woodpecker due to high tree densities. These areas likely have higher tree densities due to fire exclusion and little or no past stand treatments.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of white-headed woodpecker. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the white-headed woodpecker. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for the white-headed woodpecker. It is estimated that Forest Plan direction should almost double the extent of habitat available for this species in 5 decades. Additional direction is in place for sensitive species in general that should benefit white-headed woodpecker if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat

assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the revised Forest Plan.

Flammulated Owl

Flammulated owls use lower-elevation forested areas that contain large ponderosa pine and Douglas-fir trees of moderate densities, large-diameter aspen, and large snags for nesting.

Flammulated owl habitat will benefit from Forest Plan direction to increase the extent of large ponderosa pine, Douglas-fir, and aspen and reduce tree densities. Restoration and fire use emphases benefit this species because thinning and nonlethal fire use will reduce tree densities. Direction for snag management will also benefit this species. Revised management direction for the appropriate numbers and sizes of snags incorporated the needs of species dependent on these habitat attributes. Road decommissioning will also benefit this species by increasing snag retention by restricting access. This increasing habitat trend should decrease the risk to continued persistence and improve viability for this species.

Forest Plan direction includes the appropriate numbers and sizes of snag and down logs.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of flammulated owl. The Forest Plan BE determination for implementation of the Forest Plan was “May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species” for the flammulated owl. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for flammulated owl. As disclosed in the BE for the Forest Plan, it is estimated that the plan would increase the extent of habitat available for this species by 30 percent in 5 decades. Vegetation activities should improve conditions for this species (e.g., increase ponderosa pine abundance, decrease tree density, increase the average size of residual trees, and manage snag abundance). Management Areas have been identified where this species is present and habitat is a concern. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Harlequin Duck

Harlequin ducks nest along high-gradient mountain streams in north-central Idaho. No nesting has been documented during surveys for this species on the Payette NF. Observed birds are believed to be passing through to nesting areas outside the area. The locations where these birds have been observed are within forested riparian areas. Riparian area protection for Riparian Conservation Areas (RCAs) provided by Forest Plan direction will maintain or restore riparian habitat conditions and provide for

continued migration to and from nesting areas. Direction for habitat protection should decrease the risk of continued persistence and improve viability for this species as they pass through this area.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of the harlequin duck. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the harlequin duck. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for harlequin duck. Riparian area protection for Riparian Conservation Areas (RCAs) / Riparian Habitat Conservation Areas (RHCAs) would maintain or restore riparian habitat conditions and provide for continued migration to and from nesting areas. The Forest Plan protects riparian areas from excessive grazing, tree removal, and other management-related disturbances. Additional direction is in place for sensitive species in general that should benefit harlequin duck if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Mountain Quail

These birds use low-elevation dense shrub areas of coniferous forest and shrubby riparian area at the forest/nonforest interface. Wisdom et al. (2000) estimate a 12 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. No estimate of habitat amount is available for the Payette NF. Population numbers can be reduced by habitat degradation caused by human activities such as urbanization, predation by cats, and livestock overgrazing. The Forest Plan provides for protection of riparian areas from overgrazing and other management-related disturbances.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of mountain quail. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the mountain quail. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for mountain quail. Additional direction is in place for sensitive species in general that should benefit mountain quail if additional concerns become known in the future. As this species is a

Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Boreal Owl

Boreal owls inhabit mid- to higher-elevation forests that are capable of growing large-diameter trees. Snags and down logs are also necessary habitat attributes for denning sites and prey availability.

Large-scale management activities are not anticipated in extensive areas of boreal owl habitat, so succession and fire will cause most of the vegetation and habitat changes.

Forest Plan direction includes managing for the appropriate numbers and sizes of snags and down logs, direction that incorporated the needs of species dependent on these habitat attributes. None of the proposed alternatives would change management direction for this species.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of boreal owl. The Forest Plan BE determination for the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the boreal owl. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for boreal owl. Additional direction is in place for sensitive species in general that should benefit boreal owl if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Northern Three-toed Woodpecker

These birds take advantage of areas with tree mortality. They reside in most of the higher-elevation forests. They have evolved with forest systems where disturbances such as insects, disease, and fire create conditions (abundant snags and insects) for nesting and feeding. It is believed that wildfire was historically the disturbance that played the largest role in modification of these communities (Agee 1998, 1999). Species abundance cycles in response to these disturbances and should have benefited greatly from the hundreds of thousands of acres that burned during the last 10–20 years. Recent increasing insect activity in many of the lodgepole pine communities should also benefit this species in the near future.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of northern three-toed woodpeckers. The Forest Plan BE determination for the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend

Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the northern three-toed woodpecker. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for northern three-toed woodpecker. This species becomes more abundant in response to disturbances (i.e., fire, insect, and disease) and should have benefited greatly from the thousands of acres that burned during the last 10 years (141,639 hectares [350,000 acres] estimated). Additionally, recent increasing insect activity in many of the lodgepole pine communities should also benefit this species in the foreseeable future. Wisdom et al. (2000) estimate a 77 percent increase within the Central Idaho Mountains ERU from historical to current times. As disclosed in the BE for the Forest Plan, habitat availability for the three-toed woodpecker is expected to increase over the long term. This increase of habitat availability is expected due to anticipated increasing levels of tree mortality and areas burned by wildfire, minimal to no salvage efforts, and allowing fire to play a more natural role. Management Areas have been identified where this species is present and habitat may be a concern. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Great Gray Owl

The habitat components considered most important for this species are mature or older open forest habitat to provide suitable nesting sites and suitable foraging habitat that includes nonstocked and seedling forests, meadows, and open riparian habitats adjacent to forested vegetation.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of great gray owls. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the great gray owl. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for great gray owl. Additional direction is in place for sensitive species in general that should benefit great gray owl if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Columbian Sharp-tailed Grouse

In the past, some mountain shrub communities were converted and seeded to nonnative grasses to increase forage for livestock. Due to the importance of these habitats to sharp-tailed grouse and other species, these types of actions no longer occur. Another concern has been the recent extensive

modification of some of these communities due to wildfire in the 5 Management Areas where sharp-tailed grouse are known to occur. It is believed that wildfire was historically the disturbance that played the largest role in modification of these communities (Agee 1998). Once these areas have burned, it will take an estimated 20–30 years before sharp-tailed grouse can use them as wintering habitat. Fire is not undesirable in these communities, but the extent and timing can be a concern in localized areas and some management areas where habitat is limited or has burned recently.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of sharp-tailed grouse. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the sharp-tailed grouse. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for sharp-tailed grouse. Additional direction is in place for sensitive species in general that should benefit sharp-tailed grouse if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Common Loon

Loons are known to nest in extreme eastern Idaho in natural lakes. No nesting has been documented for this species on the Payette NF. The birds that have been observed on some of the natural and man-made lakes are believed to have been passing through to nesting areas outside the area. Wintering birds are mostly found on bays and coves along the coast of the Pacific Ocean. Loons and humans (at moderate densities) can coexist on lakes that provide some undisturbed suitable shoreline or islands for nesting. If nesting is documented on the Payette NF, appropriate direction is in place for sensitive species nesting habitat protection. No activity would influence the birds' ability to pass through the area to their nesting and wintering areas. Riparian area protection provided by Forest-wide direction will maintain or restore riparian habitat conditions. Direction for habitat protection should decrease the risk to continued persistence and improve viability for this species.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of common loon. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the common loon. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for loons. Riparian area protection for RCAs/RHCAs would maintain or restore riparian habitat conditions. If loon nest are found on the Payette NF, riparian area protection and protection from human disturbance during nesting provided by the Forest Plan direction and will benefit this species during nesting and other life stages. Additional direction is in place for sensitive species in general that should benefit common loons if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Peregrine Falcon

Peregrine falcon nesting habitat is typically on cliffs in natural environments. Open stands created through fire or vegetation management would likely increase foraging opportunities for peregrine falcons since they hunt small birds. Management direction is also in place to protect nesting birds from disturbance while nesting and raising their young. This management direction will contribute to habitat conditions for viability and persistence of this species.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of peregrine falcons. The Forest Plan BE determination for implementation of the Forest Plan was “May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species” for the peregrine falcon. This Forest Plan SEIS would not change this determination.

Rationale

Additional direction is in place for sensitive species in general that should benefit the peregrine falcon if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Spotted Frog

Forest Plan direction is expected to maintain the current distribution of spotted frogs on the Payette NF, and habitat conditions are expected to improve. The Forest Service will follow legal direction (Executive Order 11190) mandating that wetlands will not be destroyed or negatively affected. Management direction in RCAs/RHCAs provides additional protection to spotted frog habitat. The spotted frog has been eliminated in some high-elevation lakes because of past fish stocking. Current direction for habitat protection should decrease the risk to continued persistence and improve viability for this species.

Determination

None of the proposed alternatives would change the effects analysis and range of effects disclosed in the BE for the Forest Plan. Similarly, none of the alternatives would change current Forest Plan direction for conservation of the spotted frog. The Forest Plan BE determination for implementation of the Forest Plan was "May Impact, Individuals or Habitat, But is not Likely to Contribute to a Trend Toward Federal Listing or Cause a Loss of Viability to the Population or Species" for the spotted frog. This Forest Plan SEIS would not change this determination.

Rationale

None of the proposed alternatives would change the scope of the effects analysis to alter management direction for spotted frog. Riparian areas would be protected from excessive grazing, tree removal, and other management-related disturbances under Forest Plan RCA management direction. Forest Plan direction exists to reduce the impacts of fish stocking on native species, which should help maintain spotted frogs. Riparian area protection for RCAs/RHCAs would maintain or restore riparian habitat conditions. Additional direction is in place for sensitive species in general that should benefit spotted frogs if additional concerns become known in the future. As this species is a Region 4 sensitive species, further habitat assessment will occur with local information for any project proposal that may affect its habitat that is proposed under the direction of the Forest Plan.

Cumulative Effects

Northern Idaho Ground Squirrel

NIDGSs inhabit 3 Management Areas on the Payette NF that also include other land ownerships. Approximately half of the known populations occur on the Payette NF. There are 3 agreements in place 1Habitat Conservation Plan and 2 Safe Harbor Agreements. On non-Federal landownership, an agreement is in place to protect and restore ground squirrel habitat, but this area is limited to the landowner's property. The largest areas of non-Federal land that contain ground squirrel populations have no agreements to protect or restore habitat. A number of habitat improvement projects have been implemented since the NIDGS Recovery Plan (USFWS 2003) was approved involving both Federal and non-Federal partners. However, cumulative effects from habitat modification, livestock grazing, private construction, natural predation, shooting, and trapping remain a concern for this species' viability, particularly with regard to the extremely low and isolated populations that remain.

Lynx

The lynx has a circumboreal distribution. In North America, the Canada lynx ranges across nearly all of Canada and Alaska and extends south into the northern forested United States. In the western United States, lynx are known to occur in Washington, Idaho, Montana, and Wyoming along the spine of the Rocky Mountains.

Lynx may inhabit areas on NFS land and other adjacent ownerships, including private, State, and other Federal administration; however, much of their habitat is on higher-elevation lands administered by the Forest Service. Vegetation management on non-NFS land may not consider the needs of the

lynx or its primary prey species. Lynx in this part of their range may also be limited by non-habitat factors such as hunting, trapping, collision with vehicles, low population size, and competition with other predators. Limited local knowledge about lynx population size, density, and distribution suggests that lynx are rare within the southern portion of the species' range. Forest Plan direction has been added to manage for and protect lynx and prey habitat on the Payette NF. However, these management strategies could have a cumulative beneficial effect over this portion of the species range. The recent reestablishment of the gray wolf may also benefit the lynx by reducing other predators, like the coyote, that compete with the lynx for snowshoe hares.

Wolverine

The wolverine has a circumboreal distribution. In North America, the wolverine extends across Canada and Alaska and uses forested and nonforested environments. In the western United States, wolverines are known to occur in Washington, Idaho, Montana, and Wyoming. They are considered a Regional Forester sensitive species in Regions 1, 2, 4, and 6. Wisdom et al. (2000) estimate a 14 percent increase in source habitat within the Interior Columbia River Basin and a 32 percent increase in the Central Idaho Mountains ERU over historical conditions.

Because most wolverine habitat occurs on high-elevation and remote NFS lands, few cumulative effects are expected from management on private, State, or other Federal administration lands. It is doubtful that wolverine habitat would ever receive a very high level of commodity-oriented activities under any alternative, due to the remote and rugged terrain, the short growing season, and the relatively low values of timber and forage resources. Even mineral values, which are relatively high in localized portions of wolverine habitat, are somewhat neutralized by the additional production costs in these remote and rugged areas.

Perhaps the biggest threat to wolverines is disturbance from recreational activities occurring in denning areas, as these types of activities (e.g., snowmobiling, heli-sking, cross-country skiing, and snowshoeing) have expanded in recent years and may continue to expand in the future. Although management direction has been provided to specifically address this concern under the action alternatives, violations could still occur and have impacts on rearing wolverine young. This situation should be monitored and evaluated so that any needed adjustments can be made to protect this species over the long term.

Fisher

Fishers are native to North America, with most of their distribution occurring in Canada. Habitat is found in extensive areas of coniferous forest. In the recent past in the United States, fishers have occurred in California, Oregon, Washington, Idaho, Montana, Wyoming, Minnesota, Wisconsin, and the upper New England states. Wisdom et al. (2000) estimate a 20 percent decrease in source habitat within the Interior Columbia River Basin but a 35 percent increase within the Central Idaho Mountains ERU from historical to current times. Fishers inhabit private, State, and Federal land; however, much of their preferred habitat is on forested NFS lands. Vegetation management on non-NFS lands may not consider the needs of the fisher or its prey species, which would be of particular concern where management emphasis is on timber growth and yield prescriptions that do not emphasize maintaining large trees, snags, and coarse woody debris needed for denning sites and prey.

Effects will also occur to fisher habitat from natural processes, both on and off Payette NF lands. Natural succession will tend to create additional habitat on unmanaged lands, while disturbance events such as fire, disease, and wind-throw will reduce green forests but create new snags and coarse woody debris over time. Other factors besides habitat limitations are believed to be contributing to the low population levels of fishers. Mortality will likely continue to occur from hunting, trapping, and collision with vehicles.

It is believed that fisher populations were severely reduced or eliminated by the use of strychnine baits for predator control throughout much of the western United States and portions of Canada because fishers are attracted to baits and easily trapped (Douglas and Strickland 1987). Strychnine baits and compound 1080 were commonly used in the Ecogroup prior to 1972 as part of the livestock predator control program on public lands throughout the western United States. In February 1972, compound 1080 and strychnine use was halted for use of predator control on Federal lands as directed by Executive Order 11643. It is not known how long it will take for fisher populations to reestablish themselves in areas where they may have been eliminated by strychnine or other lethal poisons. Many states and providences in Canada are actively trying to reestablish fisher populations through transplant programs (Douglas and Strickland 1987). Mortality will likely continue to occur from hunting, trapping, and vehicle collisions.

Townsend's Big-eared Bat

This species ranges from southern British Columbia to southern Mexico and east to West Virginia in areas with deep canyons and high cliffs. This bat is considered common in the western United States. In the eastern United States, this species is listed as endangered. These bats are known to use buildings, snags, caves, and mine tunnels for roosting and hibernacula. Roosting and hibernacula sites are very important to the well-being of this species. Forest Plan direction exists to protect these features; however, buildings, caves, and mine tunnels occur on other ownerships where the presence of bats is not considered desirable. Important habitats used by this species may not be protected on other ownerships, which would negatively affect Townsend's big-eared bats.

Bighorn Sheep

See Chapter 3 Bighorn Sheep Supplemental Environmental Impact Statement Analysis.

Spotted Bat

This species is found from central Mexico north to southern British Columbia and east to Texas. Spotted bats are found from the southwestern portion of Idaho, south of the Snake River (Groves et al. 1997). They are also found from Twin Falls County north to the Middle Fork Salmon River. New methods of surveying and detecting this species have recently become available, which should better determine its distribution in Idaho. Little is known on wintering locations. Spotted bats are known to mostly use crevices of high cliffs for roosts. This type of habitat occurs within the Ecogroup area in steep basalt and limestone canyons and also outside the Ecogroup area. This species is sensitive to human disruption to maternity roosting and will abandon roost sites, which may increase young mortality. Off the Payette NF, some usable habitat has been turned into reservoirs. Also, some areas

adjacent to cliffs have been converted to agricultural land, which does not meet the foraging requirements of this species.

Gray Wolf

Within all recovery areas in the United States, gray wolf populations have been increasing, with the largest populations in Minnesota, Michigan, and Wisconsin. There are 3 recovery areas in Idaho. Gray wolf populations have been increasing on the Boise, Payette, and Sawtooth National Forests and within the Central Idaho Recovery Area since their reintroduction to central Idaho in 1995–96.

This increasing population trend is expected to continue over the short term due to high prey populations, large amounts of wilderness and roadless areas, and the formation of new packs. However, as populations increase they will begin to disperse from the Central Idaho Recovery Area in order to establish new packs. This dispersal will bring them into increasing contact with human population centers and activities on other land ownerships. Over the long term, human social pressures will most likely restrict the distribution of wolves to areas of limited human occupation and away from concentrated domestic livestock production. Human tolerance and lack of persecution will be needed to achieve long-term successful recovery. Both regulatory and educational efforts will be important parts of wolf conservation and management efforts.

Northern Goshawk

The northern goshawk ranges throughout the northern forests of North America, Europe, and Asia. In North America, goshawks breed in Canada, extending south through the mountains of the western United States into northern Mexico. Wisdom et al. (2000) estimate a 43 percent decrease in source habitat basinwide and a 7 percent decrease within the Central Idaho Mountains ERU from historical to current times. Minor short-term reductions in habitat are predicted on the Payette NF but would not likely have a significant cumulative impact on this species. Goshawk habitat is expected to increase on the Payette NF over the long term. Goshawks inhabit ponderosa pine, Douglas-fir, mixed conifer stands, and aspen that occur on NFS land and other Federal, private, and State land ownerships. Vegetation management on other ownerships has not emphasized retaining nesting and post-fledgling areas and may not in the future. Therefore, it is assumed that NFS lands will likely contribute the most to restoring and maintaining these important habitat attributes.

Bald Eagle

The bald eagle occurs in most regions of North America and is considered common in Alaska and Florida. Populations have been increasing during the last 10–15 years in North America. Nesting success in Idaho has been increasing during the last 10 years, a trend that is expected to continue (Beals and Melquist 2001).

Bald eagle nest and use areas occur on NFS land and other land ownerships where large water bodies (i.e., lakes, reservoirs, and larger rivers) occur. Actions such as vegetation management, fish population regulation by State agencies, and reservoir level and river flow management (by the Bureau of Reclamation, Idaho Power, other agencies, and irrigators) can have positive or negative effects on bald eagle habitat and populations. Also, some eagles that nest in the area spend their winters elsewhere. These wintering areas may be off NFS land and may not be managed for the

benefit of wintering bald eagles. Populations continue to increase in most of the 5 recovery areas in the United States.

White-headed Woodpecker

White-headed woodpeckers are resident in southern British Columbia; central Washington; and Oregon, Montana, Idaho, and into southern California. Wisdom et al. (2000) estimate a 61 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU and a 62 percent decrease within the Interior Columbia River Basin. White-headed woodpecker habitat is expected to increase on the Payette NF over the short and long term, which would contribute to restoration of deficient habitat. White-headed woodpeckers inhabit ponderosa pine areas that occur on NFS land and other Federal, private, and State land ownerships. Vegetation management on other ownerships has not emphasized retaining large trees and snags and may not in the future. Therefore, it is assumed that NFS lands will likely contribute the most to reestablishing and maintaining these important habitat attributes.

Flammulated Owl

Flammulated owls breed from British Columbia south through the western interior United States and into northern Mexico; they winter primarily in Central America. Wisdom et al. (2000) estimate a 56 percent decrease in source habitat within the Interior Columbia River Basin and a 52 percent decrease within the Central Idaho Mountains ERU from historical to current times. Although all action alternatives would increase flammulated owl habitat to varying degrees over the long term, predicted short-term reductions in habitat are a concern for this species, which has already lost so much historical habitat. Special consideration will be necessary for projects that could potentially reduce flammulated owl habitat on the Payette NF.

Harlequin Duck

The harlequin duck occurs from British Columbia south into Washington, Oregon, Idaho, Montana, and Wyoming. They winter on the west coast and move inland to breed and nest. Harlequin ducks are not known to breed or nest within the Ecogroup area. The birds may be present briefly in the spring when they pass through to their breeding and nesting locations outside the Ecogroup area. The riparian areas they use during their migration would be protected by Forest Plan management direction for riparian areas. Management activities outside the Payette NF have had, and will continue to have, a much stronger influence on harlequin ducks and their habitat.

Mountain Quail

Mountain quail reside from Vancouver Island, British Columbia, south to northern Baja California and into southeastern Washington, eastern Oregon, western Idaho, and central Nevada. Wisdom et al. (2000) estimate a 12 percent reduction in source habitat from historical to current times for this species within the Central Idaho Mountains ERU. Within the Interior Columbia River Basin, Wisdom et al. (2000) estimate a 16 percent increase in source habitat. It is believed that populations can be reduced by habitat degradation caused by human activities such as development and livestock overgrazing in riparian areas. Development and overgrazing are expected to continue on other ownerships, which will further degrade mountain quail habitat; however, RCA direction should

provide adequate Payette NF protection for this species. A risk to continued persistence and viability exists because most of the spring and summer habitat used by this species is not under Forest Service administration. Also, some of the populations are small and isolated putting them at additional risk to long-term persistence.

Boreal Owl

Boreal owls have a circumpolar distribution. In North America, they occur from Alaska east to Newfoundland in boreal forests. Regionally, they are found in Oregon, Washington, Idaho, Montana, and Wyoming in high-elevation forests. Wisdom et al. (2000) estimate a 61 percent decrease in source habitat basinwide but a 1 percent increase within the Central Idaho Mountains ERU from historical times. Boreal owl habitat is expected to increase on the Ecogroup over the long term. Because much of their preferred habitat is on forested lands administered by the Forest Service, few cumulative effects are expected from lands under private, State, or other Federal administration.

Northern Three-toed Woodpecker

The northern three-toed woodpecker occurs in North America from Alaska south through Canada along the western mountains into Arizona and New Mexico. This species usually occurs in higher-elevation forests that are dominated by smaller-diameter trees. They are considered opportunists that take advantage of fire, insect, and disease tree mortality within forests. Their numbers increase in areas of recent tree mortality due to insect or wildfire activity. Most of the higher-elevation forests this species uses are managed by the Forest Service and to some extent the National Park Service. Wisdom et al. (2000) estimate a 24 percent increase in source habitat within the Interior Columbia River Basin and a 77 percent increase within the Central Idaho Mountains ERU from historical to current times. Therefore, minor short-term reductions in habitat predicted on the Payette NF would not likely have a significant cumulative effect on this species. Three-toed woodpecker habitat is expected to increase on the Ecogroup over the long term because of anticipated increasing levels of tree mortality and areas burned by wildfire with minimal salvage efforts in high-elevation forests. Many of the large fires in the western United States over the past several years should benefit this species also. Because much of their preferred habitat is on forested lands administered by the Forest Service, few cumulative effects are expected from lands under private, State, or other Federal administration.

Great Gray Owl

The great gray owl has a circumpolar distribution. In North America, it is resident from Alaska, south and east across Canada, and south into the Sierra Nevadas and Rocky Mountains. Wisdom et al. (2000) estimate a 16 percent decrease in source habitat within the Interior Columbia River Basin but a 32 percent increase within the Central Idaho Mountains ERU from historical to current times. Great gray owl habitat is expected to increase on the Ecogroup over the long term. Great gray owls inhabit areas under private, State, and other Federal administration; however, much of their preferred habitat is on forested NFS lands. Therefore, few cumulative effects are expected from other land ownerships.

Great gray owls inhabit ponderosa pine, Douglas-fir, and mixed conifer stands with aspen that occur on NFS land and other Federal, private, and State land ownerships. Vegetation management on other ownerships has not emphasized retaining large trees and snags and may not in the future. Therefore, it is therefore that NFS lands will likely contribute the most to reestablishing and maintaining these important habitat attributes. Also, this species is migratory, so a change in population may not represent changes in habitat conditions on the Ecogroup. Populations may be influenced by activities off the Payette NF, particularly in areas where they may be wintering in Central America.

Columbian Sharp-tailed Grouse

The Columbian sharp-tailed grouse occurs in southwestern Canada, Washington, Oregon, Idaho, Montana, and Wyoming. Much of their low-elevation historical habitat has been converted for agriculture production. Forest Plan direction will likely maintain or restore sharp-tailed grouse habitat on the Payette NF; most of this habitat is considered wintering. However, most grouse summer habitat occurs at lower elevations on other Federal, private, and State lands. Removing or converting shrubland communities used as wintering habitat would further reduce habitat for the sharp-tailed grouse. Wheat is a common crop grown on private land that was once sharp-tailed grouse habitat. This habitat conversion to intensive agricultural use can negatively affect this species, especially if it occurs on wintering areas.

Sharp-tailed grouse populations statewide have been increasing over the past 12 years, but most populations are still small and isolated. Most of this increase has been attributed to the Conservation Reserve Program (CRP) on private lands (Apa 1998; Wisdom et al. 2000). These birds are making extensive use of these plantings that are annually maintained in permanent grass/shrub cover all year long. A risk to continued persistence and viability exists because most of the spring and summer habitat used by this species is not under Forest Service administration. Also some of the populations are small and isolated, putting them at additional risk to long-term persistence.

Common Loon

The common loon has a circumboreal distribution and is known to breed in Finland, Northern Siberian, Alaska, Greenland, Iceland, Canada, and most of the northern United States. An isolated population of loons exists in the Greater Yellowstone area of Idaho, Montana, and Wyoming. The birds in this area winter on the west coast of the Pacific Ocean and move inland to breed and nest. Loons have been threatened by unregulated harvest, chemical contamination from mercury, oil spills on their wintering areas, and shoreline development in nesting habitat. Excessive human disturbance during nesting can also be detrimental to loons. Because relatively few occurrences of loons and no loon nest sites have been observed on the Payette NF, it is assumed that management actions in the Ecogroup would have little if any negative effect on current populations. If loons begin nesting on the Payette NF in the future, riparian area protection and direction for sensitive species provided by the Forest Plan should benefit this species.

Peregrine Falcon

The peregrine falcon has an almost worldwide distribution. The American peregrine falcon occurs throughout much of North America, from the subarctic boreal forest of Alaska and Canada south to

Mexico. Peregrine falcons are now found nesting in all states within their historical range, except a few eastern states.

The recent apparent increase in the number of pairs of peregrine falcons in the western United States suggests that significant adverse factors affecting the western subspecies at the population level are being alleviated or have been reduced (Federal Register Vol. 64, No. 164, 1999).

Spotted Frog

The spotted frog is found in ponds and slow-moving water from western Canada south through Idaho, eastern Washington and Oregon, and into northern Nevada and Utah. Spotted frogs use wet areas with standing water. Riparian areas, lakes, and wetlands are protected under all alternatives by management direction. Executive Order 11190 also limits the loss or conversion of this type of habitat. Off the Payette NF, much of this frog's habitat is in private ownership because of the presence of impounded or standing water. Many wetlands have been turned into irrigated fields and converted to agricultural uses because of the availability of water. Also, one of the major threats to the species is thought to be competition from nonnative amphibians and introduced nonnative fish, more of which occur on lower-elevation private, BLM, and State lands. Therefore, it is assumed that NFS lands will likely contribute greatly to maintaining or improving important frog habitat.

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Appendix F

Best Management Practices Report

Evaluation of ”Best Management Practices”

By Tim Schommer

December 2009

Background

The Payette National Forest (Payette NF) asked me to complete a position statement on the value of . "best management practices" (BMPs) related to my past experience. This task is in preparation for their Final Supplemental Environmental Impact Statement (Final SEIS) to the Final Environmental Impact Statement (PElS) for the Land and Resource Management Plan (LRMP). The SEIS is being prepared for their response to appeal direction received from the Chiefs Office of the Forest Service pertaining to bighorn sheep *(Ovis canadensis)* viability, transmission issues between domestic sheep *(Ovis aries)* and bighorn sheep and compliance with the National Forest Management Act and the Hells Canyon National Recreation Area Act.

What Are Best Management Practices

The grazing term "Best Management Practice" has recently been utilized by Idaho State Agencies and the domestic sheep industry as a means to describe on-the-ground practices that reduce the risk of contact between domestic sheep and bighorn sheep where bighorn sheep exist. Many National Forest domestic sheep permittees have been using these practices in some form or another for at least 30 years. In some cases they have been added as terms and conditions to Federal Grazing Permits. LRMPs or Comprehensive Management Plans (CMP) may also include the practices as direction in the form of standards or guidelines. To my knowledge they have not been called BMPs until just recently.

Objectives of Best Management Practices

BMPs would be applied to grazing activities on permitted Federal allotments for several reasons, ranging from utilization levels and range readiness to resource protection. For the issue of disease transmission between domestic sheep and bighorn sheep (BHS), the objective of implementing BMPs is simply to avoid contact at any time between the two sheep species. Any contact may effectively transmit disease, and result in mortality of bighorn sheep. BMPs are designed to reduce the risk of contact by providing for adequate separation. Implemented BMPs that result in contact are ineffective.

Some Forest Service biologists and range conservationists have extensive field experience of where and when these practices are effective. During my role as National Bighorn Sheep Biologist for the Forest Service for the last 18 years, I worked with range conservationists using several of these grazing practices to increase the potential for effective separation. I have assisted approximately 28 National Forests in the western United States in developing and evaluating grazing practices in the field to increase effective separation between bighorn and domestic sheep. I believe I have a unique set of skills and experiences for evaluating BMPs.

How to Determine Best Management Practices

Most annual operating plans/instructions for domestic sheep allotments contain some of these grazing practices. Each allotment includes grazing practices specific to the allotment and permittee and each allotment carries its own set of unique circumstances that need to be evaluated. What works in one location may not work in another. The following factors affect the success or failure of a grazing practice: topography, bighorn sheep source habitat connectivity, bighorn sheep population size, proximity of domestic sheep grazing allotments to bighorn sheep populations, timing of allotment use, density of vegetation, and escape terrain. None of the BMPs discussed below can be determined effective without an active monitoring effort to detect the presence or absence of bighorn sheep near domestic sheep bands. To my knowledge, no peer reviewed literature exists that evaluates the effectiveness of these grazing practices for reducing the risk of contact between the two species.

Evaluation of Best Management Practices

The following is a list of BMPs that I have used, and the effectiveness that I have seen with each type:

1) ***Guard Dogs:*** Guard dogs are typically added to a band of sheep to help control predators and monitor the domestic sheep. Using guard dogs for keeping bighorn sheep away from domestic sheep has had limited success. These dogs are designed to protect domestic sheep and goats from predators, not other sheep. Some dogs have been quite tolerant of bighorn sheep (see attached photo). It is also hard for guard dogs to be at every location of domestic sheep if they are loosely herded across forested and irregular steep terrain.
2) ***Extra Herders:*** Some operators have added an extra herder. This practice may be of value in open gentle terrain with good visibility. Extra observers will help locate BHS and improve domestic sheep control during daylight hours.
3) ***Propane Guns:*** Using propane guns at the edge of domestic sheep flocks to scare away bighorns has not been successful because most states do not shoot females and young bighorns and have very restrictive ram hunting. Also, bighorns do not regularly associate negative effects with loud noise. Our experience in northeastern Oregon is that deer and elk become conditioned to the noise in 2-3 days and continue to damage crops. Continually moving these propane guns with the bands of sheep is also costly.
4) ***Trucking of Sheep:*** Trucking of domestic sheep instead of trailing has been effective in reducing strays. Strays increase the probability of contact with a bighorn sheep. However, because of cost and the potential for domestic sheep disease associated with this practice, most operators prefer to not truck their sheep.
5) ***Bedding of Sheep at Night:*** Although domestic sheep herders may want to bed the sheep together in a 5-acre area at night, this practice is difficult in steep terrain because sheep are spread out in a "loose herd" fashion and having fenced pens is not realistic. Predators such as coyotes, cougar, and wolves are very effective at killing or scattering domestic sheep at night. In open gentle terrain, this practice can be helpful in controlling domestic sheep.
6) ***Counting of Sheep:*** Most National Forests conduct a 100% count of all domestic sheep onto the allotment at the beginning of the grazing season. Normally, the sheep are not counted during or after the grazing season by the Forest Service. Counting at the end of the season can give an approximation of how many have been killed or lost. Looking for strays during and after the season can reduce the risk of contact with bighorn sheep. Marking domestic sheep is difficult and expensive for the operators. Some operators provide one marker sheep for every 25 head of domestic sheep and count the marker sheep daily. This practice can tell the operator if they are missing any large numbers of domestic sheep. However, this technique has limited effectiveness because it may only take one domestic sheep to transmit disease to bighorn sheep.
7) ***Herder Communication:*** Some operators are now equipping their herders with cell or satellite phones so they can immediately call authorities when bighorn sheep are observed in or close to domestic sheep. Authorities can either shoot, remove, or haze bighorn sheep. These practices can be helpful in preventing contact. However, some operators do not report to authorities when bighorn sheep are near their domestic sheep.
8) ***Bighorn Monitoring:*** Having observers out looking for bighorn sheep is always helpful in keeping the two species apart and radio collars on bighorn sheep can make that effort more productive. However, bighorn sheep monitoring is expensive and not all sheep are collared. Most of the radio collaring has been with conventional collars (VHF) which are usually monitored only twice a month. The new GPS collars report locations several times a day and are more beneficial than VHF collars. However, people need to be mindful of the following aspects: 1) only a sample of the bighorn sheep population is collared; 2) collaring is typically skewed toward ewes, which do not foray as far or as often as rams; 3) nobody knows where the bighorn sheep have been between monitoring efforts with VHF collars; and 4) collaring is expensive.

9) ***Sick Domestics:*** Not turning sick domestic sheep out on the allotment is standard practice. Unfortunately, the diseases that are transmitted from domestic to bighorn sheep do not make domestic sheep appear sick. While helpful, this practice does not reduce risk of contact or disease transmission.
10) ***Stray Domestics:*** Stray domestic sheep off the allotment need to be quickly removed. Unfortunately, most Forest allotments are in big areas of remote country with some timber where it is hard to detect strays. Many examples exist of strays being out for several weeks without detection. When they are detected, they are often very hard to find and remove. Grazing operators are usually very busy and can't redirect their attention to finding a few strays. Recently, a few operators have been willing to let authorities remove sheep for them under certain conditions. This practice can be helpful in reducing risk of contact, but many strays go undetected.

When all or most of the BMPs are implemented on an allotment, will enough separation be provided to effectively reduce the risk of contact and avoid contact? The key to successful BMPs depends on whether or not BMPs are consistently implemented on the ground, the operators have the ability to maintain tight control of domestics, the allotment is connected to quality bighorn sheep habitat, and bighorn sheep are in or adjacent to the allotment (up to 9 miles).

1) **Implementation:** Agreeing to BMPs on paper is easier; implementing them on the ground for the entire grazing season year after year is more difficult. Many examples of BMPs not always being implemented on the ground exist. And BMPs can only be effective if fully implemented and readily adapted if not working.
2) **Maintaining Control of Domestics:** Controlling domestic sheep in terrain that is forested, steep. or rocky is very difficult. In allotments such as the Allison-Berg on the Nez Perce NF, the best possible way to manage vegetation with domestic sheep in this steep rocky terrain is to "loose herd" the sheep-spreading the sheep out over large areas during the day and not tightly controlling them. Such a practice makes it is easy for domestics to stray from the herder(s). Visibility is very difficult for the herders, especially in forested habitat and predators such as wolves can cut into the herd and scatter them for miles. Under these situations BMPs are not likely to be effective. The Rock Creek allotment on the Inyo NF is open gentle terrain where a herder can see for miles and can detect bighorn sheep. The Rock Creek Allotment is not in bighorn sheep habitat. BMPs implemented on these types of allotments can be effective in keeping the two species separate and reducing the risk of contact.
3) **Bighorn Sheep Habitat and Presence:** Bighorn sheep source habitat is usually in steep, open, rocky terrain as described above where tight control of domestic sheep is usually difficult and herder visibility is limited. In and around the Payette NF, high quality source habitat is not a limiting factor. Habitat is well connected and well distributed across the Payette NF and no natural barriers exist to dissuade bighorn sheep from pioneering, colonizing, and exploring their landscapes as demonstrated by the telemetry and sighting data. This ease of movement for bighorns across the Payette NF leaves questions about the effectiveness of BMPs to successfully provide for avoiding contact or reducing the risk of contact between the two species. Bighorn sheep presence in habitat that is in or adjacent to an allotment makes developing effective BMPs even more difficult. Separation is highly unlikely, and if the allotment is within the herd home range of the bighorn sheep population, contact with the allotment is all but a guarantee. Last year's mixing of a radio-collared ram with domestics on the Allison-Berg Allotment, despite the implementation of BMPs, is an example of their limitations. When bighorn sheep habitat is high quality and continuous for many miles, keeping the two species separate is very difficult.

Although bighorn sheep do not favor timbered areas, they will pass through them and are extremely hard to detect when this happens. Such was the case when a band of domestics was grazing near Josephine Lake on the Payette NF; no one noticed the bighorn sheep ram until it was caught in a wolf snare trap. Without radio collars, bighorn sheep can be very difficult to detect. Even with radio collars, detection on the ground can be difficult. On the Smith Mountain Allotment on the Payette NF, radio collar data showed bighorn sheep located within the allotment during the grazing season without detection by the permittee.

On the Temperance Creek Allotment in Hells Canyon in the 1980s and early 1990s, domestic and bighorn sheep

were separated by over 20 air miles and almost all of the BMPs described above were implemented. Despite these grazing practices and large separation distances, the two species could not be kept apart. Detecting bighorn and domestic sheep in this open, rocky, continuous bighorn sheep habitat was very difficult. Known mixing of the two species approximately every other year resulted in large catastrophic bighorn sheep die-offs.

Conclusion

To avoid disease transmission between domestic and bighorn sheep, contact between the two sheep species should be avoided. In limited situations, implementing BMPs can lead a reduced risk for contact. BMPs that work in one situation mayor may not work in another so all BMPs need to be developed for site-specific situations. Connectivity of bighorn sheep source habitat, terrain, density of vegetation, and ruggedness all affect the ability to successfully implement BMPs. Monitoring bighorn sheep presence should be conducted in areas of high risk for contact. Based on my experience, the only significant reduction in risk of contact that I have witnessed is when BMPs are implemented in open, gentle, non-bighorn sheep habitat where domestic sheep can be easily controlled and monitored, and a large buffer exists between the two species.

/s/Timothy S. Schommer Date: 12/21/2009

National Bighorn Sheep Biologist, USDA Forest Service

Photo by D. Finley, CO Division of Wildlife

Appendix G

Hells Canyon National Recreation Area Compliance

Forest Service

Wallowa-Whitman National Forest

1550 Dewey Ave.
P.O. Box 907
Baker City, OR 97814

File Code: 2370/2600 Date: January 6, 2010

Subject: Payette Forest Plan SEIS Compatibility with HCNRA Act

To: Suzanne Rainville, Forest Supervisor, Payette National Forest

As you requested, the following is an evaluation of the alternatives you have selected for the final Payette National Forest Supplemental Environmental Impact Statement for compatibility with the Hells Canyon National Recreation Area (HCNRA) Act.

BACKGROUND

The Hells Canyon National Recreation Area Act (P.L. 94-199) was signed into law on December 31, 1975. The following sections of the Act are applicable when considering whether or not to graze domestic livestock in the HCNRA:

Section 7.(3) preservation, especially in the area generally known as Hells Canyon, of all features and peculiarities believed to be biologically unique including, but not limited to, rare and endemic plant species, rare combinations of aquatic, terrestrial, and atmospheric habitats, and the rare combinations of outstanding

and diverse ecosystems and parts of ecosystems associated therewith;

(4) protection and maintenance of fish and wildlife habitat;

(7) such management, utilization, and disposal of natural resources on federally owned lands, including, but not limited to, timber harvesting by selective cutting, mining and grazing and the continuation of such existing uses and developments as are compatible with the provisions of this Act.

Section 13. Ranching, grazing, farming, timber harvesting, and the occupation of homes and lands associated therewith, as they exist on the date of enactment of this Act, are recognized as traditional and valid uses of the recreation area.

Further, regulations governing the use of public lands in the HCNRA were promulgated on

July 19, 1994. HCNRA Public Lands Use Regulations at 36 CFR §292.48:

"The following standards and guidelines apply only to domestic livestock grazing activities on Other Lands, Wild and Scenic Rivers, and Wilderness Lands in the HCNRA:

(b) Where domestic livestock grazing is incompatible with the protection, restoration, or maintenance of fish and wildlife or their habitats; public outdoor recreation; conservation of scenic, wilderness, and scientific values; rare combinations of outstanding ecosystems, or the protection and enhancement of the values for which a wild and scenic river was designated, the livestock use shall be modified as necessary to eliminate or avoid the incompatibility. In the event in incompatibility persists after modification or modification is not feasible, livestock use shall be terminated."

HCNRA Comprehensive Management Plan (CMP)

The Revised CMP was signed in 2003. It includes a new standard and guide:

"Wld-S8: Prevent the spread of diseases from domestic sheep to wild sheep by maintaining separation of the two species. Vacant allotments will not be stocked with domestic sheep unless a vaccine or other technique is found that eliminates the incompatibility."

FINDING

Several bighorn sheep herds utilize HCNRA and move freely back and forth to other National Forest and BLM lands including the Payette NF. Bighorn sheep habitat is extensive and interconnected throughout the canyonland area and up into the high elevation mountain peaks of the Seven Devils Area and into the Salmon River drainage (see maps in EIS). Starting in 1994, a sample of bighorn sheep in the HCNRA have been fitted with telemetry radio collars and monitored bi-weekly. Utilizing this information, herd home range modeling has been completed for each of these 16 herd populations (see maps in EIS). This modeling demonstrates the inter-connectivity between the herd units and the extent at which bighorn sheep currently move across the landscape. In addition, bighorn sheep foray in and out of domestic sheep allotments located on the Payette NF, often returning to the HCNRA. Permitted domestic sheep grazing allotments on the Payette lie in and immediately adjacent to the HCNRA and inside the herd home range of the Upper Hells Canyon herd.

The Payette NF has developed several alternatives for consideration in their EIS. Alternatives 346, 1257, 7K, and 7L allow domestic sheep grazing in the Payette National Forest System lands within the boundary of the HCNRA or within modeled bighorn sheep herd home range outside the HCNRA boundary. Herd home range is where 95 percent of the bighorn sheep locations from radio telemetry

data have occurred in the recent past (see maps in EIS). Enough separation between the two species is needed to maintain bighorn sheep on the HCNRA (Schommer and Woolever, 2001). Probabilities of contact between bighorn sheep herds and domestic sheep allotments have been calculated for the Payette NF. Allotments lying within herd home range have a 100% probability of a bighorn sheep making contact with that allotment (EIS). The Smith Mountain Allotment is within and adjacent to the HCNRA. The majority of this allotment is within herd home range, which represents a very high risk of disease transmission to bighorn sheep. The risk will be higher when and if the bighorn sheep population increases. All of these alternatives are felt to not be in compliance with the compatibility requirements of the HCNRA Act.

Alternatives 7M, 7N, 7O, and 7P eliminate domestic sheep grazing from the Payette National Forest System lands within the boundary of the (HCNRA) and within modeled bighorn sheep herd home range. The EIS modeling results indicate a 4 percent or less risk rating for each of the alternatives. This indicates mixing of the two species would occur once every 25 years or less, which is considered a low risk of disease transmission. Elimination of domestic sheep grazing in HCNRA and surrounding area is compatible with the HCNRA Act and its implementing regulations by providing for the protection, restoration, and maintenance of bighorn sheep and their habitat. All four alternatives are in compliance with the Hells Canyon National Recreation Area Comprehensive Management Plan by maintaining a separation between bighorn and domestic sheep that is likely to keep the two species apart at current population levels. In all four alternatives, grazing would continue within 2 miles of the modeled bighorn sheep herd home range. If that grazing continues near herd home range, we recommend some effective monitoring both inside and outside of herd home ranges to help detect bighorn sheep before contact is made.

/s/ Steven A. Ellis
STEVEN A. ELLIS

Forest Supervisor

cc: Mary C DeAguero

Patricia H Anderson Soucek

Mark A Penninger

Appendix H

Update to Draft Forest Plan Amendment

United States
Department of
Agriculture

Forest Service

Intermountain
Region

January
2010

Payette

National Forest

Update to the Draft Amendment to the Land and Resource Management Plan

Photos by David Ede

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Chapter 2
Management Direction

Forest-Wide Management Direction

Consistent with 36 CFR §219.20(a), the following pages will update the 2008 Draft Amendment, pages III-1 thru IV-4, D-1 thru D-9, and E-1, to the 2003 Land and Resource Management Plan.

Wildlife Resources

Management Direction for Wildlife Resources		
Type	**Number**	**Direction Description**
Objectives	**Big Game**	
	WIOB13	Maintain separation between bighorn sheep on the Hells Canyon National Recreation Area (NRA) and bighorn sheep that use the Hells Canyon NRA from domestic sheep and goats permitted to graze on the Payette National Forest.
	WIOB14	Based on annual surveys, assess changes in bighorn sheep habitat use and, if needed, reanalyze the Core Herd Home Range (CHHR) and contact risk using appropriate analysis tools such as those utilized in this SEIS effort. Refer to Wildlife, Appendix E, Figure E-0 for habitat map.
	WIOB15	Evaluate landscape changes on the Payette National Forest, such as large-scale fire events, that could affect bighorn sheep source habitat, and determine if there is a need to change existing management strategies.
	WIOB16	Provide opportunities for bighorn sheep restoration and expansion across source habitat.
	WIOB17	Expand or enhance hunting opportunities, per Executive Order #13443, through management of wildlife habitat on the Payette National Forest.
	WIOB18	Re-evaluate the need for separation between bighorn sheep and domestic sheep or goats when an effective vaccine is produced for bighorn sheep that ensures a zero transmission risk.
Standards	**Sensitive Species**	
	WIST08	To allow for restoration of the species, reassess the risk for contact when bighorn sheep are located within previously undocumented areas or new herd units are documented (Refer to Wildlife, Appendix E, Figure E-4 for CHHR maps and Figure E-5 for current locations of bighorn sheep sightings).
	WIST09	Monitor for presence of bighorn sheep in identified high foray risk areas when domestic sheep or goats are present on adjacent or nearby permitted allotments .
Guidelines	**Big Game**	
	WIGU15	To recalculate and remap bighorn sheep Core Herd Home Range and contact risk follow appropriate science, analysis and modeling procedures such as those utilized in this SEIS effort.
	WIGU16	If a vaccine is developed that eliminates the risk for disease transmission between bighorn sheep and domestic sheep, recalculate the need for separation utilizing appropriate science methods.

Non-Native Plants

Management Direction for Non-native Plants		
Type	**Number**	**Direction Description**
Standards	NPST13	Domestic sheep or goats shall not be utilized as a management tool for weed control where domestic sheep grazing is not suitable.

Rangeland Resources

Management Direction for Rangeland Resources		
Type	**Number**	**Direction Description**
Goals	RAGO07	Manage domestic sheep and goat allotments to provide reasonable assurance of separation and lack of contact between bighorn sheep and domestic sheep and goats.
	RAGO08	Manage domestic sheep and goat allotments to eliminate straying.
Objectives	RAOB04	Incorporate adaptive management strategies designed to help prevent contact between bighorn sheep and domestic sheep into domestic sheep Allotment Management Plans and/or Annual Operating Instructions.
Standards	RAST10	Implement emergency actions when bighorn sheep presence is detected near active domestic sheep or goat grazing or trailing. Actions will be taken to ensure separation between bighorn sheep and domestic sheep or goats. On the westside of the Payette, 3 miles from the boundary of the herd home range is considered "near" as suitable grazing lands are adjacent to the herd home range. Emergency actions could include: 1. Moving domestic sheep back to an identified ridgeline; 2. Notifying Idaho Fish and Game of the bighorn location; or 3. Removing domestic sheep from the allotment or driveway.
	RAST11	Domestic sheep and goat grazing within areas suited for domestic sheep grazing may only be permitted where separation or no contact with bighorn sheep can be maintained. If separation cannot be maintained, permitted domestic sheep and goat grazing shall be prohibited.
	RAST12	Domestic sheep and goat grazing within areas suited for domestic sheep grazing may only be permitted when identified monitoring for bighorn sheep presence is conducted. If monitoring cannot be conducted, permitted domestic sheep and goat grazing shall be prohibited.

Chapter 3
Implementation of the Forest Plan

Monitoring and Evaluation

Monitoring and Evaluation Strategy

Annually survey bighorn sheep populations within high risk areas to determine if there is a need to reduce contact potential with active domestic sheep or goat grazing allotments. High risk areas are identified as those areas:

- Within the mapped Core Herd Home Range (CHHR) and, in particular, in areas near active domestic sheep and goat grazing
- In areas that are important for lambing and rearing
- In areas outside the CHHR where contiguous habitat exists
- In areas where suspected pioneering by bighorn sheep is occurring

This table will supplement Table IV-2, page IV-6, of the Monitoring Elements section in Chapter IV, Implementation of the Forest Plan, of the 2003 Payette National Forest Land and Resource Management Plan and update page V-1 of the DSEIS.

Table IV-2. Monitoring Elements

Activity, Practice, Or Effect To Be Measured	Monitoring Question	Indicator	Data Reliability	Measuring Frequency and Recommended Method	Report Period
Terrestrial sensitive species —bighorn sheep	Are bighorn sheep present in areas of high risk?	Sighting in a high risk area	High	Annually, via survey of selected areas	Annually
Terrestrial sensitive species —bighorn sheep	Are bighorn sheep present in or near active domestic sheep and goat allotments?	Presence of bighorn sheep	High	Annually, via survey of selected areas	Annually
Terrestrial sensitive species —bighorn sheep	Is No Contact between bighorn sheep and domestic sheep and goats maintained?	Presence of bighorn sheep and domestic sheep or goats co-mingling	High	Annually, via survey of all active domestic sheep and goat allotments	Annually

References

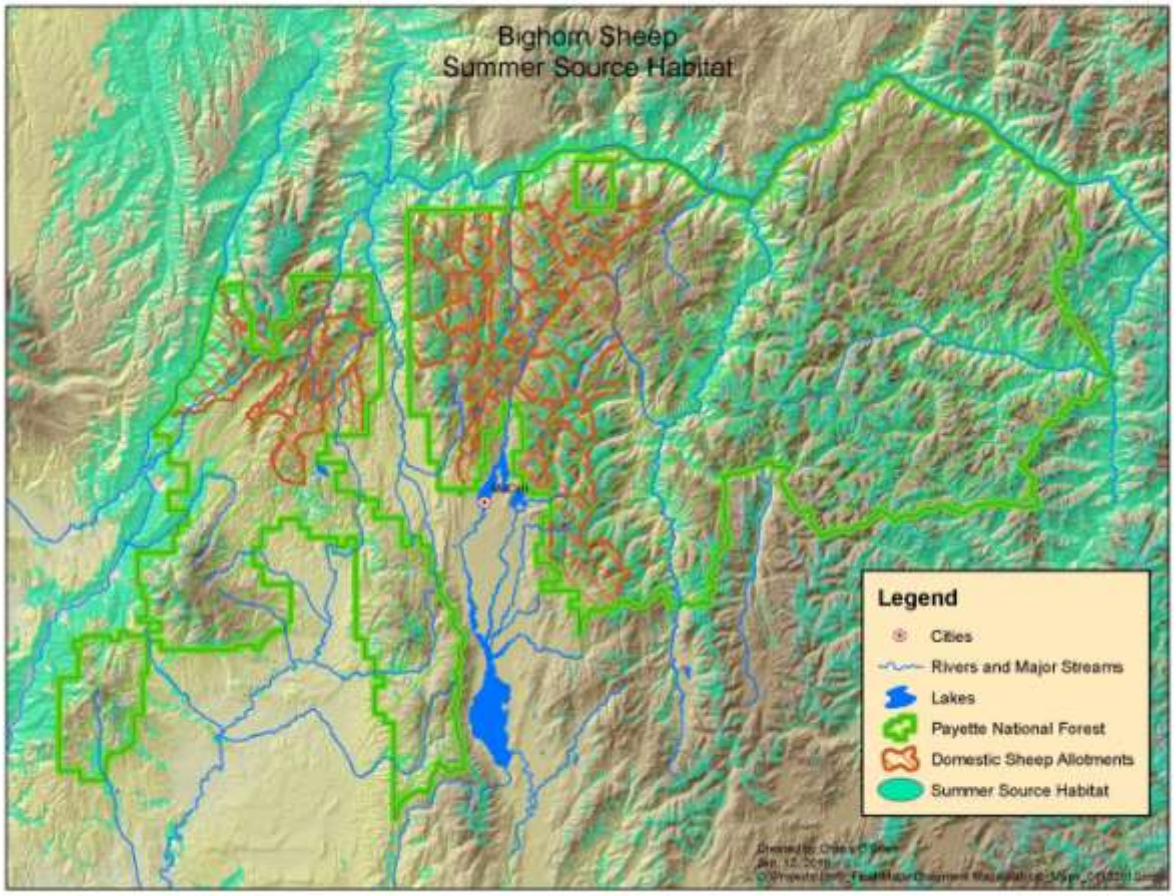
USDA Forest Service, 2003, *Southwest Idaho Ecogroup Land and Resource Management Plans: Final Environmental Impact Statement*. Ogden, Utah: USDA Forest Service, Intermountain Region

Appendix E.
Wildlife and Fish

This figure will supplement the Changes in Source Habitat for Selected Species section, page E-4, within Appendix E of the 2003 Payette National Forest Land and Resource Management Plan.

Changes in Source Habitat for Selected Species

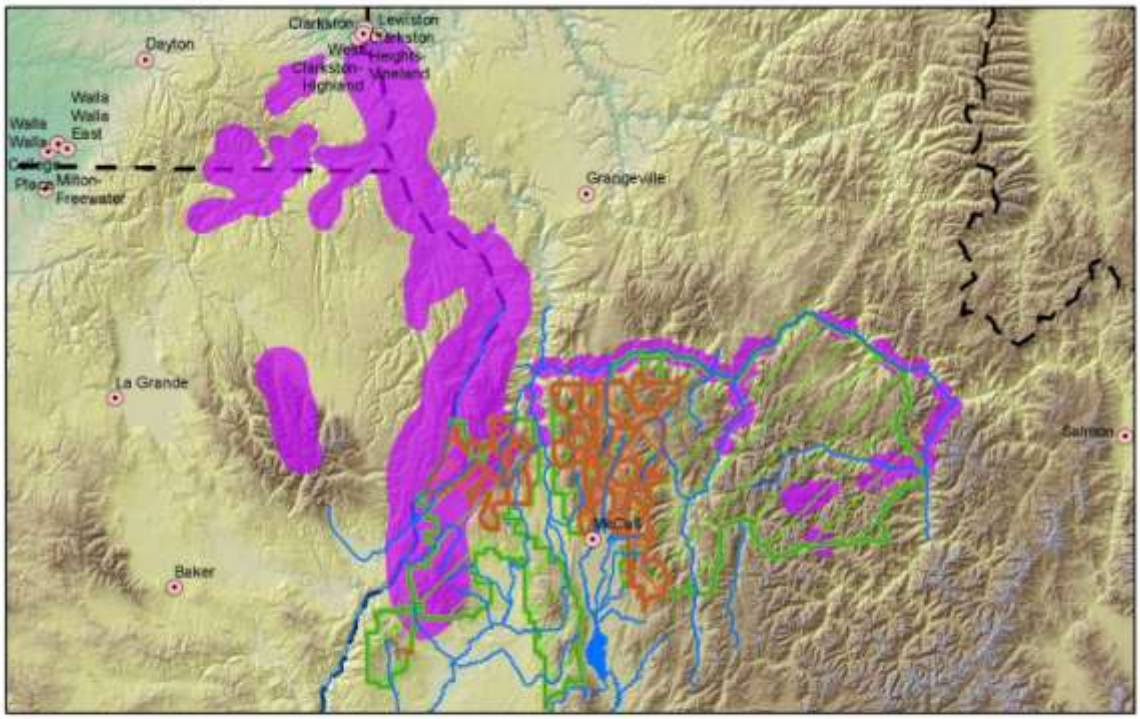
Figure E-0. Bighorn Sheep Summer Source Habitat



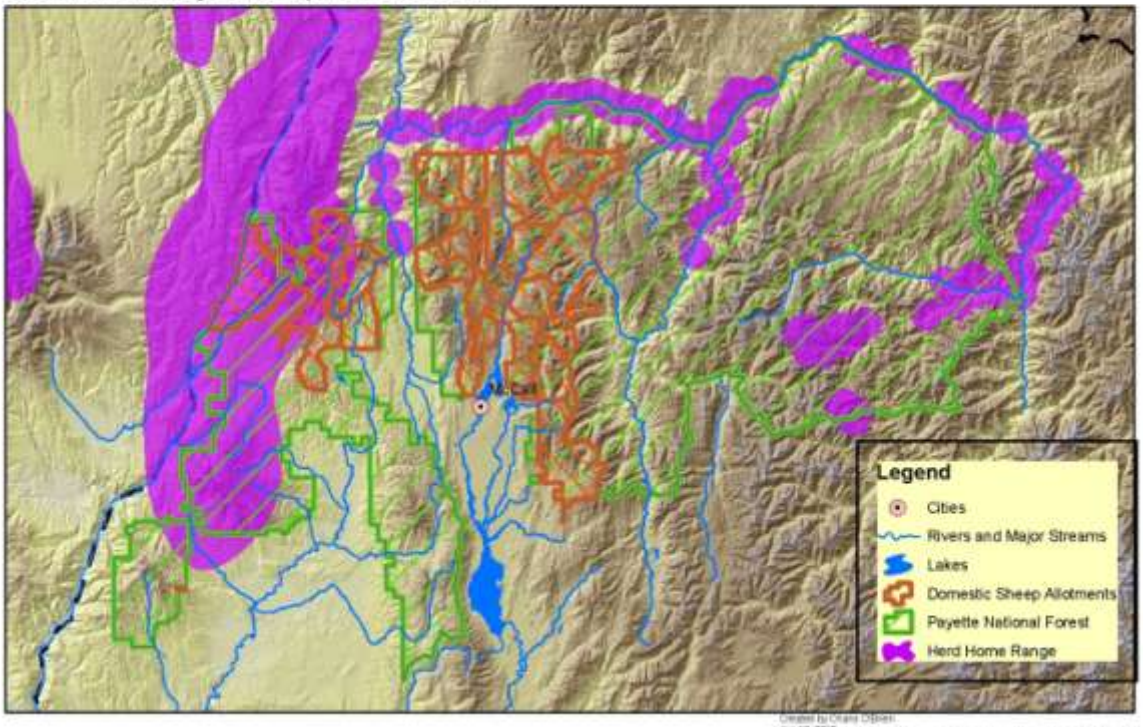
Core Herd home range for bighorn sheep

Figure E-4. Core Herd Home Ranges of Bighorn Sheep that Overlap the Payette National Forest, two scales

Core Herd Home Range with in Hells Canyon and The Salmon River Canyon

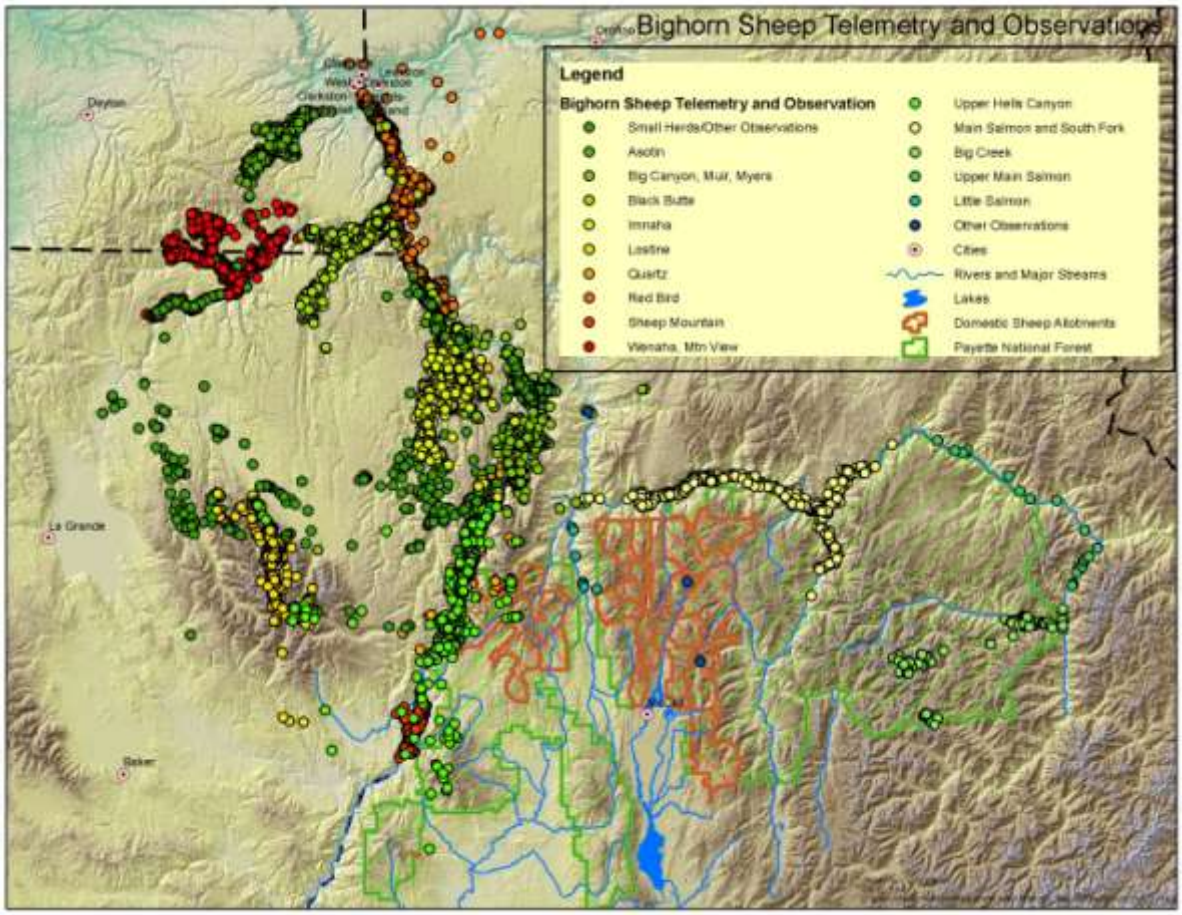


Core Herd Home Range on the Payette National Forest



Big Horn Sheep Telemetry and Observations

Figure E-5. Big Horn Sheep Telemetry and Observations in and Adjacent to the Payette National Forest



Appendix H.
Legal Requirements and Administrative Framework for Forest Planning and Resource Management

This text will supplement page H-13 of Appendix H in the 2003 Payette National Forest Land and Resource Management Plan.

Legal and Administrative Framework by Resource

Wildlife Resources

Facilitation of Hunting Heritage and Wildlife Conservation, Executive Order #13443— Directs the agency to evaluate trends in hunting participation and implement actions that expand and enhance hunting opportunities for the public; establish short- and long-term goals to conserve wildlife and manage wildlife habitat to ensure healthy and productive populations of game animals in a manner that respects state management authority over wildlife resources and values private property rights; and seek the advice of state fish and wildlife agencies and, as appropriate, consult with the Sporting Conservation Council (SCC) in regard to Federal activities to recognize and promote the economic and recreational values of hunting and wildlife conservation.