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Intermountain Region

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Southwest Idaho Ecogroup Land and Resource Management Plans

Update to the Draft Supplemental Environmental Impact Statement

Boise National Forest

Payette National Forest

Sawtooth National Forest

Photos by David Ede

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Update to the Draft Supplement to the Final Environmental Impact Statement for the Southwest Idaho Ecogroup Land and Resource Management Plans

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Abstract: This document has been prepared to cover updated information pertaining to the analysis in the Draft Supplemental Environmental Impact Statement and Draft Amendment to the 2003 Payette Land and Resource Management Plan (LRMP) which were released in October 2008. The Draft Supplemental Environmental Impact Statement was written to supplement the Southwest Idaho Ecogroup Land and Resource Management Plan's Final Environmental Impact Statement completed in 2003. The Draft Forest Plan Amendment was written to add direction to the 2003 LRMP that would provide for viability of bighorn sheep. The Intermountain Regional 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, thus threatening the viability of bighorn sheep through disease transmission.

On March 9, 2005, the Chief of the Forest Service concurred that the effects analyzed and the discussion of cumulative effects pertaining to bighorn sheep presented in the Final Environmental Impact Statement 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.

Specifically, this document contains the following updates:

- Since the release of the Draft Supplemental Environmental Impact Statement, the Payette National Forest has worked with population and disease modeling experts from the University of California at Davis to develop models and analyses based on telemetry data from bighorn sheep populations that utilize habitat on or adjacent to the Payette National Forest. This document will update the bighorn sheep source habitat maps, the core herd home range analysis, update the contact analysis and display the disease spread model.
- In September 2009, the Regional Forester determined that bighorn sheep merited designation as a sensitive species in Region 4 because of population declines from disease. This document will update and analyze the alternatives in light of this new designation.
- The Economic Impact analysis level has been changed to include both community level and regional level impact models in response to public comment on the Draft Supplemental Environmental Impact Statement. Also included are economic impacts of grazing fee payments to local governments, and economic value of the sheep industry to Idaho and its regional economies.
- A section on Environmental Justice has been added to the economic analysis. Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. Environmental Justice seeks to ensure that minority and low-income communities have access to public information relating to human health and environmental planning, regulations, and enforcement. The non-market value economic analysis has also been expanded.
- An update to the Draft Forest Plan amendment is included as an appendix to this document. It provides direction that discusses management actions to follow that provide for viability and monitoring requirements to track bighorn sheep presence.

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Executive Summary

This document updates the Draft Supplemental Environmental Impact Statement (DSEIS) and the Draft Forest Plan Amendment and reanalyzes the effects of current and proposed Payette National Forest management on Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) (bighorn sheep) viability within the Payette National Forest. Specifically, the updated document presents additional information concerning the following:

- Viability of bighorn sheep at the planning unit scale
- Compliance with the Hells Canyon National Recreation Area 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 Hells Canyon National Recreation Area)
- Compliance with the National Forest Management Act
- Compliance with 36 CFR 219.19 (ecological, social, and economic sustainability)
- Management direction needed to provide for bighorn sheep viability.

To assess the effects on these items, the Payette National Forest updated information pertaining to the following:

- Bighorn sheep source habitat model
- Bighorn sheep core herd home range analysis
- Bighorn sheep quantitative risk assessment
- Bighorn sheep disease model
- Regional economic impact analysis
- Non-market economic analysis
- Environmental Justice
- Analysis of alternatives
- Rangeland suitability for domestic sheep grazing.

The effects of management alternatives 1B, 2, 3, 4, 5, 6, and 7 are documented in the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement and in the DSEIS. They are also included in this updated information document. These seven alternatives can be combined into two categories based on how they affect 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 or goats; all trailing routes remained open in these alternatives. The second category contains Alternatives 3, 4, and 6, which determined suitable rangeland in all of Management Area #1 and a portion of Management Area #2 that overlapped current bighorn sheep habitat as unsuitable for domestic sheep grazing. Areas

inside and outside of current grazing allotments were determined to be unsuitable for domestic sheep grazing as were trailing routes from the areas.

Since the release of the DSEIS, the Forest has worked with population and disease modeling experts from the University of California at Davis to improve models based on telemetry data from bighorn sheep populations that utilize habitat on the Payette National Forest. Updates include revised suitable habitat and core herd home range models, a new risk for contact model and a new disease model. To better address the issue of bighorn sheep viability, several additional alternative management approaches were developed and analyzed in this update to the DSEIS. The new models and updated analyses lead to the development of five additional alternatives, which are described and analyzed in this document. With the exception of Alternatives 7E and 7G, the alternatives developed for the DSEIS (Alternatives 7H, 7J, and 7K) are not included for analysis in this update.

Alternatives 1B, 2, 3, 4, 5, 6, 7, 7E and 7G will be analyzed using the updated core herd home range analysis and new source habitat, contact, and disease models. Alternative 7E designates all land on the Payette NF as unsuitable for domestic sheep grazing. Alternative 7G utilizes a Geographic Population Range (GPR) and designates all land within the Hells Canyon and Salmon River GPRs as unsuitable for domestic sheep grazing and all trailing routes within the GPRs as closed for use. For a complete description of all alternatives, please see Chapter 2.

In the DSEIS, the economic impact of each alternative to the agriculture sector was analyzed for Riggins, Weiser, and Wilder. This analysis has been updated to include both community and Regional impact models, based on public comment. Also added in is an economic analysis pertaining to the benefits of having a bighorn sheep population on the landscape.

A section on Environmental Justice has been added to the economic analysis. Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, education level, or income with respect to the development, implementation, and enforcement of environmental laws. Environmental Justice seeks to ensure that minority and low-income communities have access to public information relating to human health and environmental planning, regulations, and enforcement.

Update to the Draft Supplemental Environmental Impact Statement

Introduction

Consistent with 36 CFR §219.20(a), the following pages will update the Introduction section, pages ix thru xv, of the 2008 DSEIS

BACKGROUND

The Payette National Forest completed a Draft Supplemental Environmental Impact Statement (DSEIS) to the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement (FEIS) and Record of Decision (ROD). This document responded to the appeal instructions received from the Chief of the Forest Service on March 9, 2005 pertaining to the issue of bighorn sheep viability. The assessment contains several alternative actions to the selected Alternative 7 in the FEIS. These alternatives were developed to analyze effects to bighorn sheep viability, rangeland resources, tribal rights and interests, and socio-economics.

The DSEIS was released for public review and comment in October 2008 followed by public meetings. Over 14,000 comments were received on the document and its analysis. The Forest completed a content analysis on the input received.

In response to the comments, the Payette updated some analysis methods and models to better address the concerns that were raised. Additional alternatives were developed to assist in comparison of effects.

Development of the Updated Information and Analysis Methods and Alternatives

Since the publication of the DSEIS the Payette NF has updated the source habitat model and core herd home range analysis in addition to completion of a new risk of contact model and development of a disease model. In response to field review and new research on persistent snow levels, the summer and winter bighorn sheep source habitat models were improved upon. The core herd home range was recalculated to better represent herd home ranges for bighorn sheep in both Hells Canyon and the Salmon River Mountains. The qualitative 2006 Risk Analysis for Disease Transmission between Bighorn Sheep and Domestic Sheep on the Payette National Forest was completely replaced and is no longer utilized in this effort. To assess the risk for contact between bighorn sheep and domestic sheep, the Forest developed a quantitative foray analysis to predict probabilities of contact. These core herd home range and foray analyses are now based on telemetry data and measured behaviors of bighorn sheep populations that have the potential to interact with domestic sheep on the Payette NF. The disease model was developed to provide the Payette Forest with a relative comparison tool for population persistence over time and cumulative effects of bighorn sheep. The disease model utilized the most recent epidemiological science on disease spread through populations.

For the DSEIS, the Payette NF developed several alternatives (7A through 7K) and analyzed them in addition to those identified in the Forest Plan FEIS which were 1B, 2, 3, 4, 5, 6, and 7. Five additional alternatives (7L through 7P) have been developed based on the telemetry data and modeling and analysis. For the update, they will be included along with 1B, 2, 3, 4, 5, 6, 7, 7E and 7G. For the Final SEIS, one of these alternatives will be selected and will become part of Alternative 7, the selected alternative in the Record of Decisions for the FEIS tied to the 2003 Forest Plan.

Alternate management strategies to Alternative 7 were developed utilizing issues developed and comments received on the FEIS, as well as comments received on the products of the DSEIS process. The issues used for this process are found in the FEIS (USDA Forest Service 2003, pp 1–14, 15, 19, and 23) and the DSEIS and remain the same for the update. They are as follows:

1. Terrestrial Wildlife Habitat and Species

Issue Statement 1: Forest Plan management strategies may affect habitat for terrestrial wildlife species, including species that are listed or proposed for listing under the Endangered Species Act, Region 4 sensitive species, Species of special interest, species at risk, and Forest Management Indicator Species.

Issue Statement 2: Forest Plan management strategies may affect disruption, vulnerability, and disease risk to terrestrial wildlife species.

2. Rangeland Resources

Issue Statement: Forest Plan management strategies may affect rangeland resources, including lands considered suitable for livestock grazing and the form of livestock grazing management authorized under permit for the Forests.

3. Tribal Rights and Interests

Issue Statement: Forest Plan management strategies may affect the availability of resources and the use of traditional places important to American Indian rights and interests.

Terrestrial, Wildlife, Habitat, and Species

To better address the issue of bighorn sheep viability, updated alternative management approaches were developed and analyzed. To update the reasonable range of alternatives, the Forest Service improved upon the bighorn sheep source habitat model and core herd home range analysis, developed a new quantitative contact model and developed a disease model to assist with a relative comparison between alternatives for population persistence and cumulative effects analysis.

Tribal Rights and Interests

The update for the *Tribal Rights and Interest* section of the DSEIS continues to be based on viability of the bighorn sheep and the amount of areas on the Payette not suited for domestic sheep grazing. Two assumptions remain for the analysis of tribal rights and interests:

1. Bighorn sheep viability is directly related to the ability of tribal members to harvest a bighorn sheep; and
2. The area of the Payette Forest not suited to domestic sheep grazing is directly related to tribal members harvesting bighorn sheep in locations that are culturally important.

As such, the federal tribal trust responsibilities continue to be reassessed to determine the effects on the availability of bighorn sheep and on the use of traditional cultural properties.

Socio-Economic Analysis

In direct response to public comment, the updated socio-economic analysis continues to display effects to the agriculture industry at the community level and in addition, at the regional level. Included in the analysis are information tied to benefits of the sale of domestic sheep products and the fees charged for grazing on National Forest lands. Improved upon on the updated information are the non-market values of hunting bighorn sheep via outfitter and guides, and a section on Environmental Justice.

Rangeland Resources

The rangeland resources section includes a comparison by alternative of the federal lands identified as suited for domestic sheep grazing by alternative. Rangeland suitability determinations continue to be the decision to be made for this resource.

Public Participation

The Notice of Intent (NOI) to prepare a DSEIS and amend the Forest Plan was published in the Federal Register in April 2007 (FR 72:18197–18198). Public scoping and involvement on the FEIS was extensive and spanned a 7-year period. The risk for disease transmission from domestic sheep to bighorn sheep and the subsequent population declines was identified early and noted as a concern by the U.S. Fish and Wildlife Service (USFWS). It was assumed for the FEIS that disease transmission can occur. Only one comment was received during the 7-year period questioning that assumption. Tribal consultation, both informal and formal, was also extensive during the 2003 Forest Plan development process.

The Forest Service has a long standing policy supporting the commitment to encourage cooperation among federal, state, local and tribal governments (USDA Forest Service 2007). Cooperating status was requested and granted beginning in August 2007 (USDA Forest Service Agreements 2007/2008) to the States of Idaho, Oregon and Washington and the Tribal governments of the Nez Perce, Shoshone-Bannock, Shoshone-Paiute and the Confederated Tribes of the Umatilla Indian Reservation. Prior to the first meeting, each Cooperating Agency and Tribal Representative was designated to represent their State or Tribe by the respective Governor or Tribal Chair (letters on file). Representation was reverified halfway through the process.

At the August 2007 meeting, and again at the May 2009 meeting, the Forest Service reviewed the established operational protocols and National Environmental Policy Act (NEPA) process. The roles and responsibilities of the Federal Agency and the Cooperating Agencies and Tribal Nations were also discussed. In those reviews, it was emphasized that the Forest Service retained the authority to make decisions for the SEIS, act as an expert, and author the document. The States and Tribes were to act as technical experts, bringing their

knowledge and data to the analysis, inform the Forest Service of pertinent policy expertise, provide comments, and review information. Meetings with the Combined Team continued thru January 2010. Documentation of meetings can be found in the meeting notes.

The DSEIS was made available to the public in September 2008. The comment period closed in March 2009. During the comment period the Forest conducted several public meetings and provided presentations to public groups as requested on the DSEIS. Over 14,000 comments were received during the comment period for the DSEIS. The full response to public comment will be included in the Final SEIS, which is scheduled for release in May 2010. The Forest Interdisciplinary Team (IDT) reviewed the comments and prepared information on what work needed to be updated based on the comments to the DSEIS. In May2009, this information was shared with the cooperating agencies, states and tribal representatives. The updates covered in this document respond to some of these comments that discussed economic analyses, tribal trust responsibilities, risk for contact.

Disease Review

Considerable debate about the science has surrounded the disease transmission issue since the SEIS process began. Even so, the preponderance of science literature still supports the notion that the issues are significant and warrant consideration of effects analysis and management direction.

Bighorn sheep are a New World species and are closely related to domestic sheep, which are an Old World species. Domestication and intense artificial selection have probably helped domestic sheep develop a resistance to important diseases (Jessup 1985). However, bighorn sheep can be highly susceptible to diseases carried by domestic sheep.

A long history of large-scale, sudden, all-age die-offs in bighorn sheep exists across Canada and the United States, many associated with domestic animal contact (Shackleton 1999). Although limited knowledge of transmission dynamics exists (Garde et al. 2005), extensive scientific literature supports the relationship between disease in bighorn sheep populations and contact with domestic sheep, including both circumstantial evidence linking bighorn die-offs in the wild to contact with domestic animals and controlled experiments where healthy bighorn sheep exposed to domestic sheep displayed subsequently high mortality rates (Foreyt 1989, 1990, 1992; Foreyt et al. 1994; Onderka et al. 1988; Onderka and Wishart 1988; Garde et al. 2005).

In a summary of risk to wild sheep from *Pasteurella* and *Mannheimia* spp., Garde et al. (2005) makes the following conclusions:

1. These bacteria can cause pneumonia in bighorn sheep, but there are benign commensal strains in the upper respiratory tract
2. Domestic sheep, goats, and llamas have been reported with these bacteria species
3. Wild sheep and mountain goats have been reported with these bacteria species
4. Transmission is by direct contact and aerosolization
5. These bacteria species do not persist in the environment
6. Acute-to-chronic die-offs in bighorn sheep can result in low to 100 percent mortality, although they can be present in healthy sheep
7. These bacteria are considered opportunistic and can result in pneumonia outbreaks
8. These bacteria can cause clinical disease in domestic sheep and goats, but are rarely primary pathogens.

Management Recommendations

The separation, either spatially, temporally, or both of bighorn sheep from domestic sheep has been recommended by leading bighorn sheep disease experts (Schommer and Woolever 2001, Garde 2005, Singer 2001). Experts also recommend developing site-specific solutions for each bighorn sheep population and domestic sheep allotment, and to develop a management strategy appropriate for the complexity of the management situation (Schommer and Woolever 2001). Each of the alternatives takes this approach; however, given the complexity of the issue on the Payette NF, each alternative has pros and cons associated with minimizing the risk of contact between domestic and bighorn sheep.

Chapter 1
Purpose and Need

INTRODUCTION

The information contained in the Purpose and Need for the DSEIS still remains pertinent for this update. No addition changes were made to Chapter 1.

Chapter 2
Alternatives Considered

INTRODUCTION

In response of updated information and methodology, the Payette National Forest (Payette NF) has developed an additional set of alternatives that utilize this information. This updated analysis incorporates results from an improved bighorn sheep Source Habitat Model, a Core Herd Home Range analysis, a quantitative contact risk analysis and a disease model. The contact risk analysis is a quantitative risk analysis that assesses the probability for contact between bighorn and domestic sheep allotments on the Payette NF. The quantitative contact analysis was used in development of the new alternatives, replacing the 2006 Qualitative Risk Analysis process.

The second model used in development of the additional alternatives is the Disease Model. Outputs from this model assist with determining the effects of domestic sheep grazing on the Payette to bighorn sheep populations beyond the administrative boundary of the Forest and allow for a relative comparison between alternatives.

As with the original range of alternatives developed for the DSEIS, this new set also responds to the direction outlined in the March 9, 2005 Decision for Appeal of the Payette NF Land and Resource Management Plan (Forest Plan) (USDA Forest Service 2003). This decision found that the management direction in the Forest Plan does not adequately provide for habitat to ensure the maintenance or a viable bighorn sheep population within the Payette NF (36 CFR 219.19). The decision also found that the Forest Plan does not adequately protect bighorn sheep populations and habitat in the Hells Canyon National Recreation Area (HCNRA) (35 CFR 292.48). The Payette NF was found not compliant with National Forest Management Act (NFMA) regulations concerning wildlife viability of bighorn sheep and may not be compliant with the HCNRA Act and its implementing regulations. The Payette NF was instructed to amend the Forest Plan as necessary to ensure viability for bighorn sheep.

The Forest continued to develop management strategies to Alternative 7 for bighorn sheep. Like the DSEIS, Alternatives from the LRMP FEIS—1B, 2, 3, 4, 5, 6, and 7 and 7E and 7G from the DSEIS are considered for this process. Additional alternatives developed and also included are 7 L, 7M, 7N, 7O and 7P

In addition to utilization of the updated information and methodology, the Forest continued to use the issues developed and the comments received on the FEIS and now also comments received on the DSEIS for this process. The issues used are found in the FEIS (pages 1-14, 15, 19, 20, and 23) and are as follows:

1) Terrestrial Wildlife Habitat and Species,

2) Rangeland Resources, and

3) Tribal Rights and Interests.

As explained in the DSEIS, public scoping and involvement on the FEIS was extensive and spanned over a 7-year period. The 5-month public comment period on the DSEIS resulted in the Forest receiving over 14,000 comments. Tribal consultation has continued and the Forest

continues to work with Cooperators from the States of Idaho, Oregon, Washington and the Tribal governments of the Nez Perce and Shoshone-Bannock.

Following are descriptions of the alternatives from the FEIS, as they relate to bighorn sheep management, and alternatives that were developed using the updated information and methodology. These alternatives will also be included in more detail in the environmental consequences section of this document for comparison of effects. Also displayed below are some summary alternative comparison tables for all of the alternatives carried into detail in this document. The comparison tables display numbers generated from the updated information and methodology.

Consistent with 36 CFR §219.20(a), the following pages will supplement the Development of Reasonable Range of Alternatives section, pages 2-1 through 2-131, of Chapter 2 of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement, and pages 2-1 through 2-18 of the 2008 DSEIS.

DEVELOPMENT OF REASONABLE RANGE OF ALTERNATIVES

To further develop the reasonable range of alternatives for bighorn sheep management, the Payette NF utilized all public comments, tribal and regulatory agency consultation, and the Appeal Decision instructions received on the FEIS and the Forest Plan (USDA Forest Service 2003). In addition, the Payette NF utilized comments received on the DSEIS (USDA Forest Service 2008); findings from science meetings held in California, Arizona, Utah and one from Idaho sponsored by the Idaho Woolgrowers; guidelines developed by the WAFWA; and feedback from the recognized cooperators at scheduled meetings.

As with the alternatives developed for the DSEIS, this additional set was developed to fulfill the purpose and need for the proposed action and address the significant issues. Also for this report, Alternative 7 is carried into detailed study for comparison purposes only as it was found to not be compliant with NFMA.

Significant issues utilized for alternative development included the following:

1) Terrestrial Wildlife Habitat and Species

Issue Statement 1: Forest Plan management strategies may affect habitat for terrestrial wildlife species, including species that listed or proposed for listing under the Endangered Species Act, the Region 4 sensitive species, Species of special interest, species at risk, and Forest Management Indicator Species.

Issue Statement 2: Forest Plan management strategies may affect disruption, vulnerability and disease risk to terrestrial wildlife species.

2) Rangeland Resources

Issue Statement: Forest Plan management strategies may affect rangeland resources, including lands considered suitable for livestock grazing and the form of livestock grazing management authorized under permit for the Forest.

3) Tribal Rights and Interests

Issue Statement: Forest Plan management strategies may affect the availability of resources and the use of traditional places important to American Indian rights and interests.

One key assumption carried over from the 2003 FEIS is that disease transmission from domestic sheep to bighorn sheep is a threat to the wild sheep species. The Forest did receive numerous comments in response to the DSEIS. Still, the overwhelming majority of published science supports this assumption and transmission from domestic sheep to bighorn sheep has been proven in laboratory settings. No published source has yet to demonstrate that transmission is disproven in a laboratory setting. Even with the controversy over this issue, scientists from both sides of the issue have recommended the separation of the two sheep species as the appropriate measure to be taken.

Risk of Contact

Prior to development of the new alternatives, the Payette NF improved upon and/or developed three critical baseline analyses and models: 1) bighorn sheep source habitat; 2) the risk for contact between bighorn sheep and domestic sheep on the Payette, which draws on a core herd home range analyses and foray analyses, and 3) a disease model which was developed to assess extirpation probabilities for bighorn sheep populations and assist with cumulative effects beyond the boundary of the Payette. The bighorn sheep Source Habitat Model was improved upon and now depicts more accurately where the highest quality bighorn sheep habitat exists and its connectivity in and around the Forest. The habitat was modeled for both summer and winter seasons. The core herd home range analysis was recalculated and now displays herd home ranges for the 17 herds in and around the Payette. The core herd home ranges continue to demonstrate overlap and connectivity between the individual herds that make up the larger meta-population of bighorn sheep. With the development of the herd home ranges, the concept of the Geographic Population Range is no longer utilized in alternative formulation. The Risk of Contact analysis was used to depict contact events between bighorn sheep and domestic sheep on the Payette using the core herd home range analysis and a newly developed foray analysis. This quantitative analysis was developed utilizing the vast dataset that exists for the bighorn sheep populations within the area of concern for this project. The foray analysis assesses the probability of bighorn sheep traveling to the variety of landscapes on the Payette. A second model, the Disease Model, was also developed to help assess extinction probabilities for bighorn sheep populations and based on the potential spread of disease within and beyond the boundary of the Forest which could then affect the larger metapopulation of bighorn sheep. The disease model helps inform the Payette about whether or not each alternative is providing adequate bighorn sheep habitat to help ensure viable populations are provided for. All of these models are more thoroughly described and documented in the environmental consequences chapter and in the technical reports provided in Appendix B.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

As in the DSEIS, Alternatives 7A, 7B, 7C, 7D, 7F, and 7I continue to be dropped from detailed study. Other alternatives were considered during this effort that were also dropped from detailed study. With development of the new contact and core herd home range analyses, the interdisciplinary team now had tools available that could help document the risk for contact between bighorn sheep and domestic sheep as the distance from core herd home range increased. These alternatives attempted to calculate the distance required to keep the two sheep species

separated. The objective was to discover how far from heard home range the risk for contact would approach zero. Distances modeled were 5K, 10K, 15K, 20K, 25K, and 30K and thus became the alternative names. These alternatives were dropped from detailed study for two reasons: 1) depiction of where these lines exist on the landscape would be difficult to locate and thus manage for; and 2) these alternatives were not sensitive to actual landscape conditions such as bighorn sheep source habitat.

ALTERNATIVES CONSIDERED IN DETAIL

The Appeal Reviewing Officer instructed the Regional Forester to further analyze and evaluate the viability of bighorn sheep for all the alternatives in the Forest Plan FEIS. As in the DSEIS, the original alternatives are also displayed below and reviewed.

Elements Common to All Alternatives

The alternatives considered in detail all pertain exclusively to Payette NF lands and not to other Ecogroup Forests or to surrounding National Forest or BLM lands.

Alternatives 1B, 2, 5, 7

The seven alternatives evaluated in the FEIS for the 2003 Land and Resource Management Plan could be combined into two categories based on how they 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 NF 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 in the Record of Decision for the FEIS which was subsequently appealed. The portion of Alternative 7 tied to bighorn sheep viability, disease transmission between domestic sheep and bighorn sheep and compliance with the Hells Canyon National Recreation Area Act was remanded back to the Regional Forester for improved and additional analysis. To meet the appeal requirements related to the potential impacts of disease transmission from domestic sheep on the Forest, modifications to Alternative 7 were developed and 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.

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species: Little or no habitat on the Payette is available to provide for viability of bighorn sheep with these alternatives. These alternatives do not address disease transmission between domestic sheep and bighorn sheep.

Rangeland Resources: This set of alternatives respond to rangeland resources by determining 100,310 acres on the Payette as suited for domestic sheep grazing.

Tribal Rights and Interests: Alternatives 1B, 2, 5 and 7 provides little or no long-term harvest ability of bighorn sheep for tribal members and thus do not respond to this issue.

Alternatives 3, 4, 6

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

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species Issue 2: These alternatives do not address disease transmission from domestic sheep to bighorn sheep by determining 7,228 acres as unsuitable for domestic sheep grazing. The risk of contact for this alternative for the Main Salmon South Fork herd is 95 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 112 percent per year because more than one contact can occur per year.

Rangeland Resources: These alternatives affect rangeland resources by determining 7,228 acreas as unsuited and 93,082 acres as suited for domestic sheep grazing and .

Tribal Rights and Interests: Alternatives 3, 4, and 6 greatly reduce the harvest ability for tribal members.

Alternative 7E

Alternative 7E designates no area within the Payette NF 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.

Issues Used to Develop this Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining capable domestic sheep grazing land (100,310 acres) would be deemed unsuitable for domestic sheep grazing and closing all trailing routes within the Payette NF. This reduces the risk of contact between bighorn sheep and domestic from the Payette to zero. Alternative E provides the most habitat for viable populations of bighorn sheep.

Rangeland Resources: This alternative has the greatest affect on rangeland resources by determining all 100,310 capable acres as unsuitable for domestic sheep grazing.

Tribal Rights and Interests: Because Alternative 7E removes risk for contact between bighorn and domestic sheep grazed on the Payette NF; it may provide the greatest long term ability to harvest bighorn sheep in all traditional locations influenced by the Payette NF

Alternative 7G

In the DSEIS, populations of bighorn sheep were identified using the Geographic Population Range (GPR) model. The GPR was developed utilizing the 2006 Risk Analysis that is no longer in effect for the update to the DSEIS. Alternative 7G for the update analysis utilizes the GPRs as a boundary only (not tied to the 2006 Risk Analysis) and designates all land within the Hells Canyon and Salmon River GPRs as unsuitable for domestic sheep grazing. This alternative also closes all trailing routes within the GPRs.

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.

Issues Used to Develop this Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining all 61,842 suitable acres unsuitable for domestic sheep grazing and closing all trailing routes within the GPRs. The risk of contact for this alternative for the Main Salmon South Fork herd is 35 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 9 percent per year.

Rangeland Resources: This alternative affects rangeland resources by determining 61,842 suitable acres as unsuitable for domestic sheep grazing and 38,468 acres as suited.

Tribal Rights and Interests: Alternative 7G considers no land within the GPRs as suitable for domestic sheep grazing, thus reducing contact between the two species and potentially providing for greater tribal harvest opportunity.

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 keeping as much suitable range land open.

The west side of the forest closes the Curren Hill allotment and leaves the eastern 35 percent 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 percent of the allotment. Only the very Eastern 15 percent of the French Creek allotment is left open. The Bear Pete Allotment is left 40 percent 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.

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining all 35,999 suitable acres unsuitable for domestic sheep grazing within a total area of 1,732,079 acres and closing all trailing routes within the alternative area. The risk of contact for this alternative for the Main Salmon South Fork herd is 31 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 113 percent per year as more than one contact per year may occur.

Rangeland Resources: This alternative affects rangeland resources by determining 35,999 suitable acres as unsuitable for domestic sheep grazing and 64,311 acres as suited.

Tribal Rights and Interests: Alternative 7L considers no land within the alternative area as suitable for domestic sheep grazing, thus reducing contact between the two species and potentially providing for greater tribal harvest opportunity.

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 percent open on the east side of the allotment. The Price Valley Allotment is left 85 percent 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 percent of the allotment. The Bear Pete allotment is left 30 percent open on the eastern side of the allotment. The northern 50 percent of the Victor-Loon allotment, the western 25 percent of the Twenty Mile allotment, and southern 90 percent of the Jughandle allotment would all be left open.

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining all 57,065 suitable acres unsuitable for domestic sheep grazing within a total area of 1,939,397 acres and closing all trailing routes within the alternative area. The risk of contact for this alternative for the Main Salmon South Fork herd is 19 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 5 percent per year.

Rangeland Resources: This alternative affects rangeland resources by determining 57,065 suitable acres as unsuitable for domestic sheep grazing and 43,245 acres as suited.

Tribal Rights and Interests: Alternative 7M considers no land within the alternative area as suitable for domestic sheep grazing, thus reducing contact between the two species and potentially providing for greater tribal harvest opportunity.

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 percent open on the east side of the allotment. The Price Valley Allotment is left 85 percent 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 percent of the Josephine, the eastern 25 percent of Bear Pete, the northern 50 percent of the Victor-Loon allotment, and the western 25 percent of the Twenty Mile allotment are all left open.

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining all 61,918 suitable acres unsuitable for domestic sheep grazing within a total area of 1,947,629 acres and closing all trailing routes within the alternative area. The risk of contact for this alternative for the Main Salmon South Fork herd is 8 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 3 percent per year.

Rangeland Resources: This alternative affects rangeland resources by determining 61,918 suitable acres as unsuitable for domestic sheep grazing and 38,392 acres as suited.

Tribal Rights and Interests: Alternative 7N considers no land within the alternative area as suitable for domestic sheep grazing, thus reducing contact between the two species and potentially providing for greater tribal harvest opportunity.

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 percent open on the east side of the allotment. The Price Valley Allotment is left 85 percent 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 percent of the Twenty Mile and the southern 90 percent of the Jughandle allotments would be open.

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining all 68,718 suitable acres unsuitable for domestic sheep grazing within a total area of 2,033,121 acres and closing all trailing routes within the alternative area. The risk of contact for this alternative for the Main Salmon South Fork herd is 4 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 3 percent per year.

Rangeland Resources: This alternative affects rangeland resources by determining 68,718 suitable acres as unsuitable for domestic sheep grazing and 31,592 acres as suited.

Tribal Rights and Interests: Alternative 7O considers no land within the alternative area as suitable for domestic sheep grazing, thus reducing contact between the two species and potentially providing for greater tribal harvest opportunity.

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 area as unsuited but add in area 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 percent open on the east side of the allotment. The Price Valley Allotment is left 85 percent 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 percent of the Hershey Lava, western 85 percent of the Josephine, the eastern 25 percent of Bear Pete, the northern 50 percent of the Victor-Loon allotment, and the western 25 percent of the Twenty Mile allotment are all left open.

Issues Used to Develop the Alternative

Terrestrial Wildlife Habitat and Species Issue 2: This alternative addresses disease transmission from domestic sheep to bighorn sheep by determining all 54,204 suitable acres unsuitable for domestic sheep grazing within a total area of 1,918,474 acres and closing all trailing routes within the alternative area. The risk of contact for this alternative for the Main Salmon South Fork herd is 12 percent per year. The risk of contact for this alternative for the Upper Hells Canyon Herd is 5 percent per year.

Rangeland Resources: This alternative affects rangeland resources by determining 54,204 as unsuitable for domestic sheep grazing and 46,106 as suited.

Tribal Rights and Interests: Alternative 7P considers no land within the alternative area as suitable for domestic sheep grazing, thus reducing contact between the two species and potentially providing for greater tribal harvest opportunity.

COMPARISON OF ALTERNATIVES

Alternatives were evaluated on their merits for providing separation, and minimizing likelihood of contact, between bighorn sheep and domestic sheep on seven bighorn sheep populations on, and adjacent to, the Payette National Forest. The alternatives were compared on the basis of outputs from the summer source habitats model, the contact model (per the core home range and foray analysis) and the disease model.

Source Habitats Analysis

Those alternatives that provided the highest amount of summer source habitat, and the least suited rangelands open to domestic sheep grazing were considered the best options for bighorn sheep population persistence.

Table 2-1. Relative Ranking of Alternatives Based on Protection of Bighorn Sheep Summer Source Habitats and Rangeland Remaining Suited for Domestic Sheep Grazing.

Alternative	Summer Source Habitat Protected (%)	Summer Source Habitat Protected (Acres)	Suited Rangeland Habitat for Domestic Sheep (%)	Suited Rangeland Habitat for Domestic Sheep (Acres)	Relative Ranking of Alternatives For Providing Separation Between Domestic and Bighorn Sheep
1B, 2, 5, and 7	0.00	0	100.00	100310	9
3, 4, and 6	9.20	33918	92.79	93082	8
7G	71.43	263338	38.35	38468	6/7
7L	85.64	315715	64.11	64311	6/7
7M	91.94	338934	43.11	43245	4/5
7N	91.56	337532	38.27	38392	2/3
7O	94.05	346696	31.49	31592	2/3
7P	90.16	332372	45.96	46106	4/5
7E	100.00	368641	0.00	0	1

Another consideration in managing to protect summer source habitats for bighorn sheep is the potential for overlap between core home ranges and domestic sheep allotments, and distances between core home ranges and domestic sheep allotments. We infer that any overlap between bighorn sheep core home ranges and domestic sheep allotments will result in a disease transmission between the species. Table 2-2 displays percent of bighorn sheep core home ranges within domestic sheep allotments. This table suggests that Alternatives 1B257 and 346 pose significant threats to the Muir and Upper Hells Canyon bighorn sheep populations. Further, Alternatives 7G and 7L also pose threats to the Upper Hells Canyon population.

We further evaluated distances from bighorn sheep core habitats to domestic sheep allotments, the inference being the greater distance between the species offers the greatest probability for persistence of bighorn sheep herds. These data suggest Little Salmon, Main Salmon S. Fk., Upper Hells Canyon and Muir are at high risk in all alternative scenarios, except 7E. This may explain why contact scenarios, and resulting disease modeling indicate high risk probabilities to these allotment under most alternatives, even when probabilities of contact/outbreak are assumed to be low. Table 2-3 displays distances from bighorn sheep core home ranges to domestic sheep allotments. Alternatives 7N and 7O provide the greatest separation between core home ranges and domestic sheep allotments.

Table 2-2. Overlap between Bighorn Sheep Core Herd Home Ranges and Domestic Sheep Allotments Among Alternatives.

Core Home Range	Total Acres	1B257	346	7E	7G	7L	7M,7N,7O,7P
Big Canyon	45688	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Little Salmon	26199	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Main Salmon S. Fk.	187380	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Muir	285539	5.97%	0.68%	0.00%	0.00%	0.00%	0.00%
Myers	154961	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Upper Hells Canyon	592005	15.83%	10.84%	0.00%	0.02%	3.13%	0.00%
Sheep Mountain	21459	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Big Creek		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 2-3. Distance in Km from Bighorn Sheep Core Herd Home Ranges to Domestic Sheep Allotments

Herd Home Range	1B257	346	7E	7G	7L	7M	7N	7O	7P
Big Canyon	35	35	No allotments	42	42	43	51	51	43
Little Salmon	1	1	No allotments	1	1	1	8	8	1
Main Salmon S. Fk.	0	0	No allotments	5	3	11	12	22	12
Upper Hells Canyon	0*	0*	No allotments	0*	0*	0	0	0	0
Muir	0*	0*	No allotments	15	7	13	13	13	13
Myers	6	6	No allotments	21	20	20	30	30	20
Sheep Mountain	12	16	No allotments	20	20	20	20	20	20
Big Creek	38	38	No allotments	39	39	40	40	43	39

* Domestic sheep allotment overlaps bighorn sheep core herd home range.

Contact Model

Alternatives were ranked based on the frequency of interspecies contact modeled through the core home range and foray analyses. Logically, the greater the likelihood of contact, the greater the potential for disease transmission and resulting disease outbreaks. Table 2-4 displays relative ranking of alternatives based on the number of contacts per year.

Alternative 7E is the only alternative that prevents interspecies contact. Some level of contact is expected for all bighorn sheep populations except for Big Canyon in the action alternatives. Alternatives 7N and 70 reveal low contact rates (0.13 and 0.09) respectively. Although these are the lowest contact rates, there still is the potential for contact in the two herds that contribute to the largest populations on, or adjacent to, the Payette National Forest. Alternatives 1B257, 346, 7G and 7L have moderate to high contact rates that involve four to seven of the populations.

Alternatives 7M and 7P have moderate contact rates that affect the Main Salmon South Fork, Little Salmon and Upper Hells Canyon populations, with the greatest contact risk to the Main Salmon South Fork (highest current population).

Table 2-4. Relative Ranking of Alternatives Based on Modeled Contact between Bighorn Sheep and Domestic Sheep Allotments

HerdName	1B257	346	7G	7L	7M	7N	7O	7P	7E
Big_Canyon	0	0	0	0	0	0	0	0	0
Little_Salmon	0.07	0.07	0.04	0.04	0.03	0.01	0.01	0.03	0
Main_Salmon_S.Fk.	1.01	1.01	0.35	0.31	0.19	0.08	0.04	0.12	0
Upper Hells Canyon	0.15	0.15	0.09	0.13	0.05	0.03	0.03	0.05	0
Muir	0.06	0.03	0.01	0.01	0	0	0	0	0
Myers	0.01	0.01	0	0	0	0	0	0	0
Sheep_Mountain	0.03	0.01	0	0	0	0	0	0	0
CONTACTS/year	1.33	1.27	0.49	0.5	0.28	0.13	0.09	0.21	0
Relative Ranking of Alternatives For Minimizing Contact	8/9	8/9	6/7	6/7	4/5	2/3	2/3	4/5	1

Disease Model

Alternatives were compared using low (0.05), moderate (0.25) and high (1.0) probabilities of contact leading to a disease outbreak. Under all alternatives the Sheep Creek population has a high probability of extirpation. This is due to recurrent disease outbreaks that have reduced this population to 11 individuals, all ewes in older age classes. Alternative 7E (no allotments) was not included. The probability of a disease outbreak for all herds under this alternative is 0. Alternatives were ranked from 1 to 8, with 1 having the highest likelihood of persistence for all populations.

When the inferences for a contact/disease outbreak are assumed to be low, all populations have a high probability of persistence under alternatives 7G to 7P. Under alternatives 1B257 and 346, Little Salmon, Main Salmon South Fork, and Upper Hells Canyon have moderate to high probabilities of extirpation.

Under moderate assumptions for contact leading to a disease outbreak; Little Salmon, Main Salmon S. Fk. and Upper Hells Canyon have a high probability of extirpation under Alternatives 1B257, 346, 7G and 7L.

Under high probability assumptions for contact leading to a disease outbreak (1.0), all populations show a high probability of extirpation under alternatives 1B257 and 346. Big Canyon, Muir and Myers may persist under alternatives 7G – 7P. Little Salmon, Main Salmon S. Fk. and Upper Hells Canyon have a high probability of extirpation under all alternatives.

Assumptions on contacts leading to a disease outbreak have implications for the persistence of these bighorn sheep populations on, and adjacent to, the Payette National Forest. However, for all of these scenarios, the relative rankings of the action alternatives are similar, with Alternatives 7N and 7O offering the greatest persistence probabilities for all populations. Alternatives 1B257 and 346 consistently had the highest probabilities of extirpation. The remaining alternatives fell in between 1B257/346 and 7N/7O, with Alternatives 7M and 7P generally contributing to higher population persistence than Alternatives 7G and 7L.

Summary and Determinations

The results the three separate models (source habitat, risk of contact and disease) result in a similar ranking of alternatives. The severity of the outcomes from the disease model is largely dependent on assumptions made relative to a contact leading to a disease outbreak. However, even though these assumptions varied, the alternative rankings for this model are still unchanged.

Alternative E provides the greatest protection to bighorn sheep habitats, the least likelihood of contact, and the highest probabilities of persistence for all bighorn sheep populations. For bighorn sheep, as a sensitive species, **this alternative would have a Beneficial Impact.**

Of the action alternatives, 7N and 7O protect the most source habitat, and the retain the least suited rangeland for domestic sheep. Contacts per year are low (0.13 and .09). At moderate inferences of contact (e.g. 0.25), several herds show moderate to high probabilities for persistence. The Upper Hells Canyon has a low probability of persistence under this alternative. For bighorn sheep, as a sensitive species, these alternatives **May Impact Individuals or Habitat, But Will Not Likely Contribute to a Trend Towards Federal Listing or Loss of Viability to the Population or Species.**

Alternatives 7M and 7P are viewed as middle ground alternatives. 7M and 7P have similar outputs from the 3 models. The risk of contact is also considered moderate. The disease model suggests that The Little Salmon, Main Salmon South Fork and Upper Hells Canyon may not persist under these alternatives. As two of these are significant contributors to bighorn sheep populations on the Forest, the results are considered severe. For bighorn sheep, as a sensitive species, these alternatives **May Impact Individuals or Habitat, But Will Not Likely Contribute to a Trend Towards Federal Listing or Loss of Viability to the Population or Species.**

Alternatives 7G, 7L, 1B257 and 346 would have the highest risks of contact and protect the least amount of source habitats. These alternatives would likely not insure bighorn sheep populations on and adjacent to the Payette National Forest. For bighorn sheep, as a sensitive species, these alternatives **Will Impact Individuals or Habitat with a Consequence that the Action May Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species.**

Alternatives are thus ranked from the highest to lowest probability for bighorn sheep persistence: 7E – 7N/7O – 7M/7P – 7G/7L – 1B257/346.

Compliance with the Hells Canyon National Recreation Area Act (P.L. 94-199)

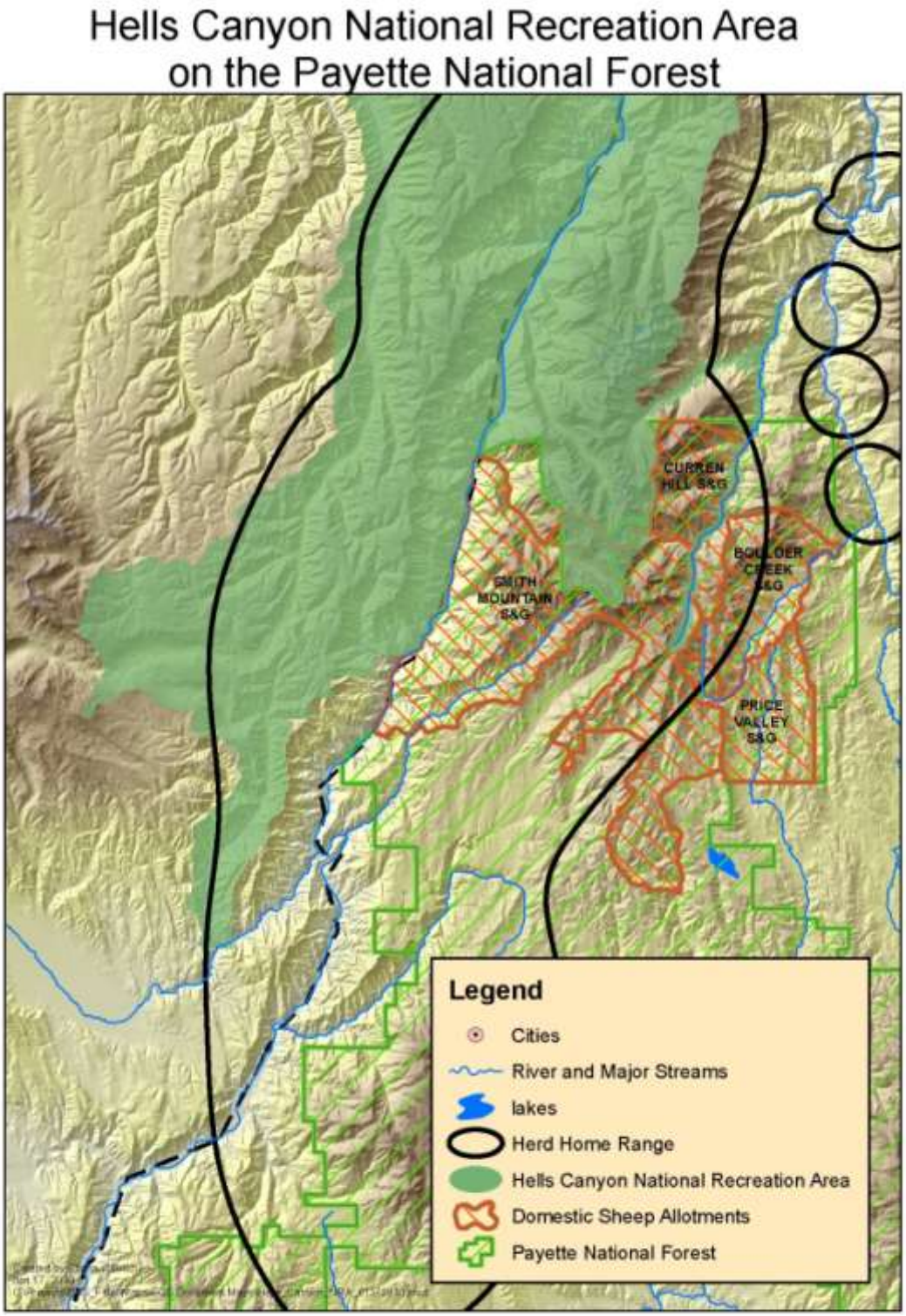
Consistent with 36 CFR §219.20(a), the following pages update and add to the Compliance with the Hells Canyon National Recreation Area Act (P.L. 94-199) information found in the DSEIS on pages 2-16 thru 2-18.

The description of the Hells Canyon National Recreation Area Act and the Comprehensive Management Plan remain unchanged for this update to the DSEIS.

Compatibility with the Hells Canyon National Recreation Area Act

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 Chapter 3, Bighorn Sheep Core Herd Home Range analysis). 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, core herd home range analysis has been completed for each of these 16 herd populations. This analysis 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 core herd home range of the Upper Hells Canyon and Muir herds. In consideration of the above information, the following determinations have been made regarding compatibility with the HCNRA Act and the HCNRA CMP for the action alternatives analyzed for the update to the DSEIS.

Figure 2-1. Hells Canyon National Recreation Area on the Payette National Forest



Alternatives 1B257, 346, and 7L

Alternatives 1B257, 346, and 7L allow domestic sheep grazing in the Payette National Forest system lands within the boundary of the HCNRA or within modeled bighorn sheep core herd home range outside the HCNRA boundary. Core herd home range is where 95 percent of the bighorn sheep locations from radio telemetry data have occurred in the recent past (see Chapter 3, Bighorn Sheep Core Herd Home Range Analysis). 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 utilizing a quantitative risk for contact analysis. Allotments lying within core herd home range have a 100% probability of a bighorn sheep making contact with that allotment (See 3 Tables 2-2 and 2-3). The Smith Mountain and Curren Hill Allotments are within and adjacent to the HCNRA. The majority of these allotments are within core 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 not in compliance with the compatibility requirements of the HCNRA Act.

Alternative 7E

Alternative 7E eliminates domestic sheep grazing from the Payette National Forest System lands within the boundary of the HCNRA and within modeled bighorn sheep core herd home range. It also determines all of the Payette as unsuited for domestic sheep grazing. 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. Alternative 7 is in compliance with the Hells Canyon National Recreation Area Comprehensive Management Plan by maintaining no potential for contact between bighorn and domestic sheep and may allow the population to recover and expand.

Alternatives 7G

Alternative 7G eliminates domestic sheep grazing from the Payette National Forest system lands within the boundary of the HCNRA. It also eliminates domestic sheep grazing at least 6 air miles from the boundary of the HCNRA. Only a small sliver of the core herd home range is within suitable area for domestic sheep grazing,

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. Alternative G is in compliance with the HCNRA CMP by maintaining a separation between bighorn and domestic sheep that is likely to keep the two species apart at the current population levels. If the population levels of bighorn sheep increase, the likelihood of contact may increase and this evaluation may need to be revisited. Monitoring should be conducted to assess future locations of bighorn sheep and assure no contact occurs with domestic sheep on permitted allotments.

Alternatives 7M, 7N, 7O, 7P

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 core herd home range. The contact model 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 core herd home range. If that grazing continues near core herd home range, some effective monitoring both inside and outside of herd home ranges is recommended to help detect bighorn sheep before contact is made.

Table 2-5. Compatibility with the Hells Canyon National Recreation Area Act for each Alternative

Alternative	Compatible	Not Compatible
7E, 7G	No grazing in HCNRA, or within 6 air miles of HCNRA	
7M, 7N, 7O, 7P	No grazing in HCNRA, or within 2 air miles of HCNRA. Mixing of the two species would occur once every 25 years or less, which is considered a low risk of disease transmission. Monitoring recommended.	
1B257, 346, 7L		Grazing in and adjacent to HCNRA, contact probability 100%.

OCCUPIED HABITAT

For detailed discussion regarding occupied habitat, see report Occupancy, Risk and the Potential for Contact between Bighorn Sheep and Domestic Sheep on the Payette National Forest in Appendix C.

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 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 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."

Documenting bighorn sheep occupied habitat on the Forest 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.

Analyses that only address 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 pre-Euroamerican settlement 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 National Forest is conducting a similar analysis to assess the risks of contact and disease transmission between domestic sheep and bighorn sheep on the Forest. 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 Forest 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.

Chapter 3
Affected Environment and Environmental Consequences

Terrestrial Wildlife Habitat and Species

Consistent with 36 CFR §219.20(a), the following pages will supplement the Species of Special Interest section, pages 3-286 through 3-287, of the Chapter 3 Terrestrial Wildlife Habitat and Species section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement, and updates the Terrestrial Wildlife Habitat and Species section, pages 3-1 thru 3-69 of the DSEIS.

INTRODUCTION

Chapter 3 describes the physical, biological, and human dimension resources of the environment that may be affected by the new alternatives presented in Chapter 2, as well as the effects that the alternatives may have on those resources. The environmental effects analysis forms the scientific and analytic basis for the comparison of the alternatives that appears at the end of Chapter 2.

All resource sections have been updated to reflect pertinent information. The alternatives developed as a result of this information, Alternatives 7L through 7P, are analyzed in the environmental consequences, along with Alternative 1B, 2, 5, 7; 3, 4, 6; 7E; and 7G.

The effects analysis for threatened, endangered and sensitive species can be found in the Biological Evaluation (Appendix E.). The pileated woodpecker and white-headed woodpecker are management indicator species for the Payette National Forest. Given the habitat requisites of these species (i.e. forested habitats), changes in domestic sheep grazing to conserve bighorn sheep habitats will likely have only minor effects. The FEIS will contain a thorough analysis for these species.

Since the release of the Draft Supplemental Environmental Impact Statement (DSEIS), bighorn sheep have been listed as a Sensitive Species for the Intermountain Region of the Forest Service. Hence, bighorn sheep will be addressed as Sensitive Species, rather than as a Species of Special Interest as was done in the DEIS.

CURRENT CONDITIONS

Sensitive Species

At present, there are 17 terrestrial vertebrate species within the ecogroup that are on the U.S. Forest Service, Intermountain Region sensitive species list. The bighorn sheep was added to this list by the Regional Forester on July 29, 2009. The following will be added to Table W-2 in the LRMP FEIS, pages 3-268 and 3-269.

Table W-2. Sensitive Terrestrial Species of the Ecogroup

Type	Common Name	Global Rank	Federal Status	State Rank	Management Considerations
Mammal	Bighorn Sheep		R-4 Sensitive		

Bighorn Sheep

History

Prior to the mid-1800s, bighorn sheep (*Ovis canadensis*) were abundant and widely distributed throughout the western United States. Numbers of bighorn sheep in North America were estimated to be about 1.5 to 2 million sheep (Buechner 1960; Queen et al. 1994). Large declines in both abundance and distribution of bighorn sheep occurred during the late 1800s and early 1900s as a result of overharvest, habitat loss, and competition for forage with and disease transmission from domestic livestock (Goodson 1982, Valdez and Krausman 1999). Bighorn sheep occur at less than 10 percent of historic numbers and the current distribution is estimated at less than 33 percent of historic distribution, with most existing within relatively small and isolated populations, despite recurring recovery efforts (Berger 1990, Singer et al. 2000b).

Bighorn sheep were abundant in Idaho prior to the mid-1800s (Smith 1954, Toweill and Geist 1999), and included both California (*O. c. californiana*) in the southwest portion of the state and Rocky Mountain bighorn sheep (bighorn sheep) (*O. c. canadensis*) northeast of the Snake River Plains. Human settlement of Idaho in the mid-1800s increased harvest of bighorn sheep and introduced domestic sheep onto these landscapes. Historic accounts of major die-offs of bighorn sheep in the Salmon River Mountains began in approximately 1870 (Smith 1954). In 1969, Idaho began reintroducing Rocky Mountain bighorn sheep, and increased their numbers to nearly 4,000 sheep by 1989. By 1998, that number had again decreased to 1,710, with population declines attributed to disease outbreaks (Toweill and Geist 1999).

Payette National Forest

Two Rocky Mountain bighorn sheep metapopulations currently occur on the Payette National Forest, one within the Hells Canyon of the Snake River and the other among the Salmon River Mountains (USDA Forest Service 2003b). Historically, these populations were likely connected by suitable habitats between the two major drainages. More than 10,000 bighorn sheep may have once lived in the Hells Canyon and surrounding mountains, but they were extirpated by the mid-1940s by competition for forage with domestic livestock, disease, and unregulated hunting (HCBSRC 2005). Reintroduction efforts began in 1971; and 474 bighorn sheep were transplanted into Hells Canyon between 1971 and 2004 (HCBSRC 2005). In 2005, the Hells Canyon Bighorn Sheep Restoration Committee estimated 875 bighorn sheep within Hells Canyon (HCBSRC 2005). This number represents a positive population growth since 1971, although seven bighorn sheep die-offs have been reported since 1971 (HCBSRC 1997).

The Salmon River metapopulation was never extirpated (Toweill and Geist 1999), although the population has experienced periodic die-offs. Recent winter population surveys document at least 508 bighorn sheep within the various drainages of the Salmon River; in 2001 and 2003, and

an additional 137 bighorn sheep were surveyed in the South Fork Salmon River and main Salmon River (IDFG 2004).

Bighorn Sheep Habitat Use and Movement

Bighorn sheep are typically structured in metapopulations: each metapopulation is composed of discrete local populations that interact with each other as a result of limited movement between the local populations (Bleich et al. 1996, Singer et al. 2000a). The fragmented nature of sheep habitat and the relatively small size of most bighorn herds suggest that bighorns evolved with a metapopulation structure where small populations would not persist without movement and reproduction among herds (Gilpin and Hanski 1989, Berger 1990, Bleich et al. 1990). The term "population" is used loosely here, as a large amount of "mixing" can occur between bighorn sheep populations, and at the same time, coexist with other populations that are somewhat isolated or better defined as a subpopulation. For the purpose of this document, the term population will be used, recognizing that populations are not always clearly delineated with metapopulations of bighorn sheep.

Sheep with geographically separate winter ranges have been observed sharing summer ranges (Akenson and Akenson 1992). These interactions can have positive effects, such as population augmentation, colonization, and enhancement of genetic diversity; however, negative effects, such as disease transmission, can also occur. Bighorn sheep ewes can travel as far as 24.8 miles from winter ranges to lambing areas. On Bureau of Land Management (BLM) lands in Idaho, bighorn sheep were documented to have traveled up to nearly 50 miles, through towns and across major rivers (Coggins 2002). Telemetry data has shown that desert bighorn sheep regularly cross the broad valleys that separate the majority of desert mountain ranges (Ough and deVos 1984, Schwartz et al. 1986, Jaeger 1994). These complex spatial and temporal range use patterns occur among populations of sheep, with resulting effects on forage and vulnerability to disease and parasite transmission (Akenson and Akenson 1992). Bighorn Sheep herds in Hells Canyon and the Salmon River drainages have been recorded in telemetry and observation data moving from canyon bottom winter ranges to high elevation summer ranges. The presence of dispersal corridors between suitable patches of habitat, and the ability for sheep to move between patches, influences their ability to disperse into suitable, but unoccupied habitats (Noss 1987, Simberloff and Cox 1987, Hudson 1991, Douglas and Leslie 1999).

Hells Canyon Metapopulation

The Hells Canyon metapopulation contains 16 populations, largely defined by reintroduced cohorts that established in specific areas within Hell's Canyon. The Hells Canyon bighorn sheep restoration project covers 5,617,062 acres in the Snake River drainage in Washington, Oregon, and Idaho (HCBSRC 2005). When the Hells Canyon bighorn sheep restoration project was established, it was believed that sheep would not cross from the Oregon side of Hells Canyon to the Idaho side; however, that has not been the case and bighorn sheep have been observed swimming across the reservoir and walking on Brownlee Dam (Vic Coggins, personal communication, 2008). Winter range is limited at the higher elevations of the Wallowa and Seven Devils mountains but is extensive within the Snake River portion of the project area (HCBSRC 1997). Extent of habitat does not appear to currently limit the number of bighorn sheep since they do not occupy much of the suitable habitat; however, habitat quality such as

forage species composition and nutritional value may affect herd size, productivity, and distribution (HCBSRC 1997).

Salmon River Metapopulation

Bighorn sheep were never extirpated from the Salmon River Mountains, making them important native genetic stock. The Salmon River metapopulation has several populations distributed along the South Fork of the Salmon River, main Salmon River Canyon, and Middle Fork of the Salmon River. Of these populations, the only ones known within the boundaries of the Payette National Forest occur in the South Fork Salmon River drainage and the Big Creek drainage (Akenson and Akenson 1992). Due to the nature of a metapopulation and the high vagility characteristics of this species, bighorn sheep adjacent to the Payette National Forest may affect or be affected by management on the Payette National Forest. The main Salmon River populations may overlap the Payette National Forest, with the Middle Fork of the Salmon River populations just east and adjacent to the Payette National Forest.

History of Pneumonia Infections Near the Payette National Forest

Hells Canyon Metapopulation

At least, seven population die-offs have been reported since reintroductions were initiated in Hells Canyon (HCBSRC 1997). *Pasteurella multocida* was associated with a major die-off in Hells Canyon in 1995 to 1996 (Frank et al. 2004). During this time, over 300 bighorn sheep died of pasteurellosis in Hells Canyon, possibly caused by contact with one goat (Cassirer et al. 1996, Coggins 2002). During this period of die-off, bighorn sheep on the Idaho side of the river showed signs of respiratory disease, but no die-off was documented (Cassirer et al. 1996). Five die-offs within the Hells Canyon metapopulation have been circumstantially linked to domestic sheep (Coggins 1988). Cassirer and Sinclair (2007) describe the effects of chronic, repeated pneumonia outbreaks on bighorn sheep populations in Hells Canyon, and their potential adverse effects on bighorn sheep population persistence.

Five bighorn sheep populations of the Hells Canyon metapopulation have occurred near domestic sheep allotments on the west side of the Payette National Forest since 2000. These populations are Muir, Myers, McGraw, Upper Hells Canyon, and Sheep Mountain. One of these, the McGraw population, is no longer considered extant (IDFG 2004b). The other populations have had pneumonia outbreaks, resulting in substantial mortality. Disease has reduced the population growth rate of the Hells Canyon metapopulation by at least 40 percent (HCBSRC 1997). Population counts in Big Game Management Unit (BGMU) 18 (Fig. 3-1) corroborate the aforementioned discussion of population declines associated with respiratory disease in this part of Hells Canyon (Fig. 3-2).

Salmon River Metapopulation

Population count summaries for Big Game Management Units (BGMUs) 19, 20, 20a and 26 (Fig. 3-2), suggest significant recent declines in these bighorn sheep populations. Evidence suggests that disease has had severe implications on the South Fork Salmon River population, main Salmon River population and Big Creek populations of the Salmon River Mountains metapopulation on the east side of the Payette National Forest (IDFG 2004, 2006).

The small numbers of bighorn sheep within the South Fork Salmon River raise concern over the viability of this population. From 1987 to 1991, a population on Big Creek experienced 5 years of low lamb-to-ewe ratios and an all-age die-off in 1990 (Akenson and Akenson 1992). Research conducted in April 2000 found a highly virulent strain of *Pasteurella* spp. in the Big Creek population (IDFG 2004, 2006).

Figure 3-1. Bighorn Sheep Populations on and Adjacent to the Payette National Forest by Idaho Dept. of Fish and Game Big Game Management Units

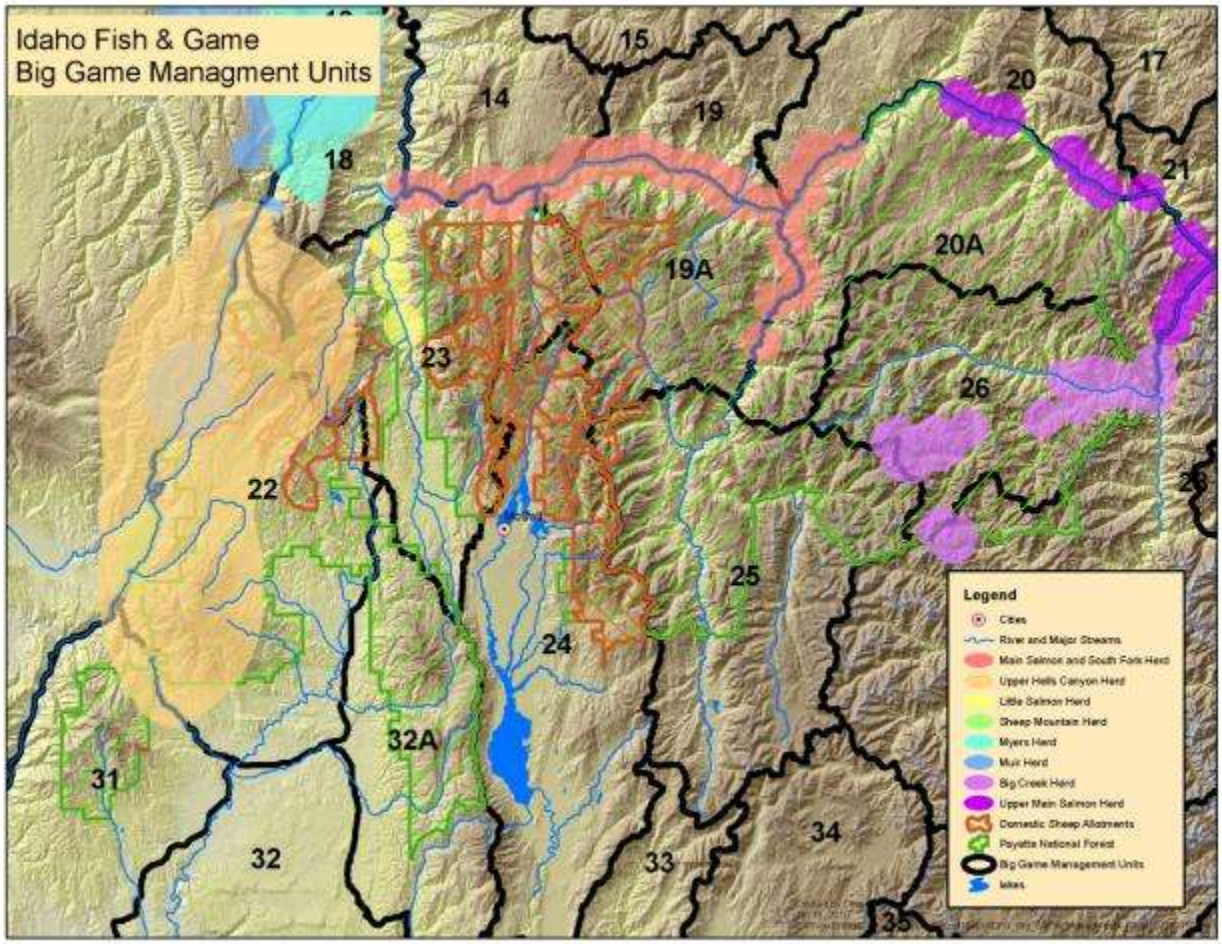


Figure 3-2. Population Trends for Bighorn Sheep by Big Game Management Units (Idaho Dept. of Fish and Game)

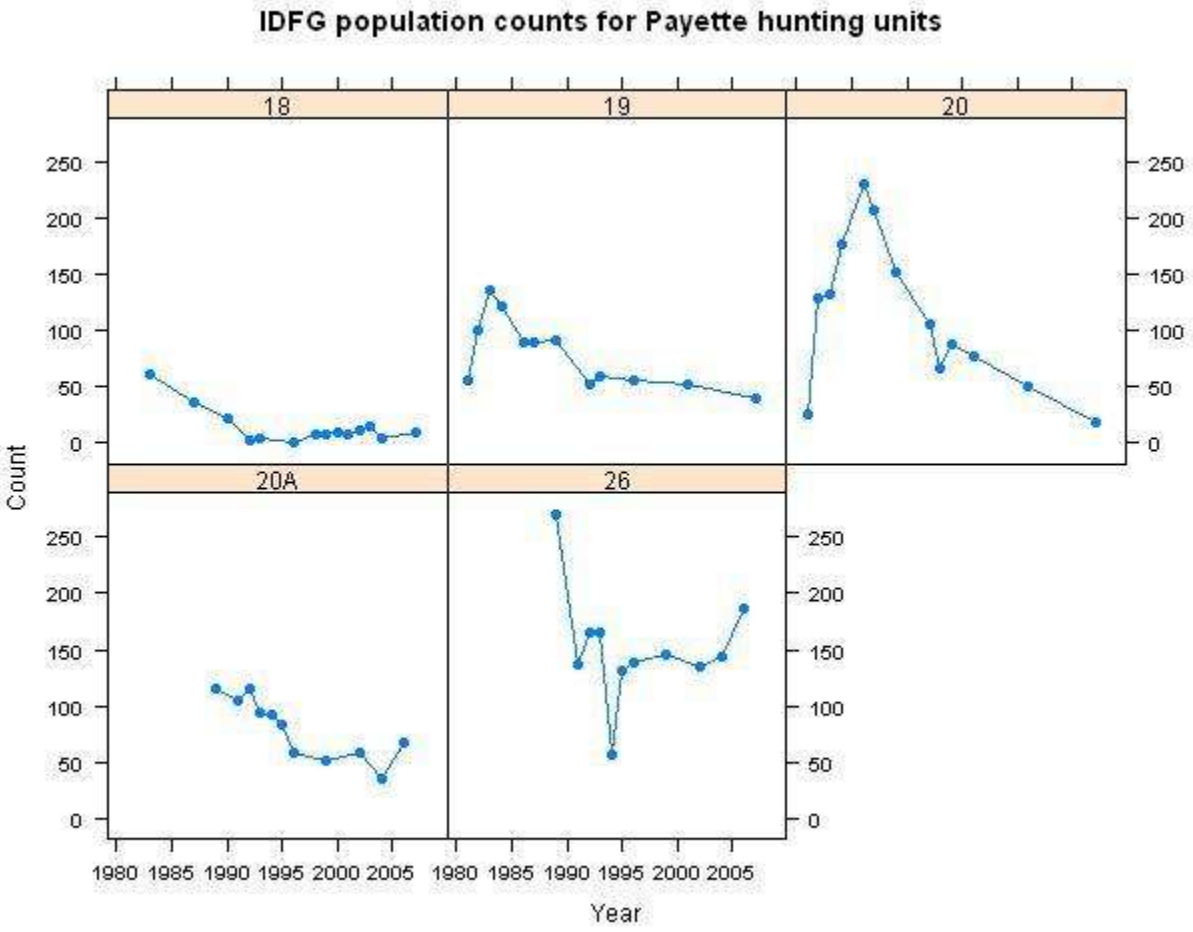
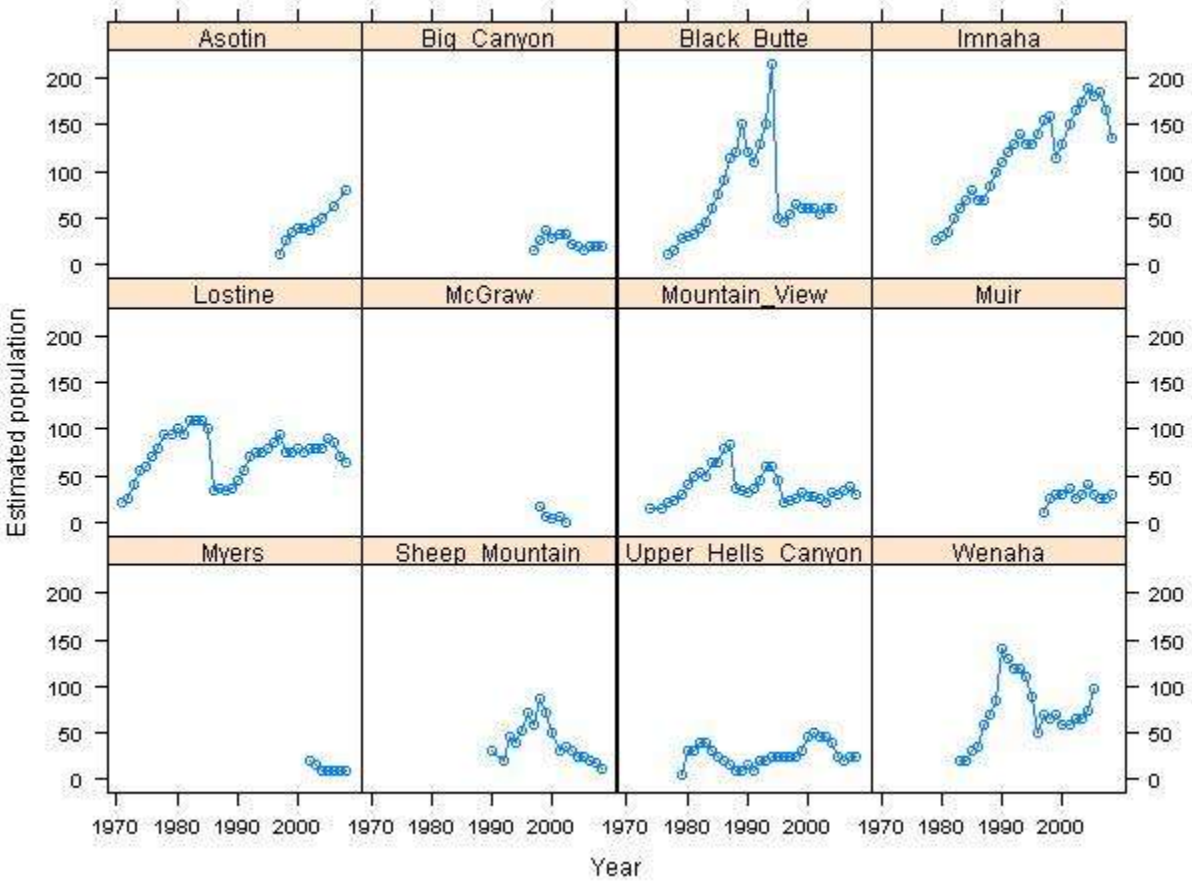


Figure 3-3. Population Trends for Bighorn Sheep by Herd in Hells Canyon (Washington Dept. of Fish and Wildlife, Oregon Dept. of Fish and Wildlife, and Idaho Dept. of Fish and Game)



Risks of Contact between Domestic Sheep and Bighorn Sheep on the Payette National Forest

As stated in the 2003 Forest Plan EIS, a principal assumption from the published literature is that direct contact between domestic sheep and bighorn sheep results in a high likelihood of disease transmission to bighorn sheep and disease outbreaks in local bighorn herds. Risk factors include distance between the sheep allotment and nearest bighorn sheep populations, amount of geographic information system-modeled bighorn sheep habitat within the sheep allotment and between the allotment and the nearest bighorn sheep herd, the amount and quality of bighorn sheep habitat, presence of incidental bighorn sightings in or near allotments, bighorn sheep distribution and movement near the allotments, and characteristics of each sheep allotment.

The current analysis uses the published literature and expert knowledge about bighorn sheep habitat and life history traits to model the potential implications of contact and disease transmission in populations on, or adjacent to, the Payette National Forest.

Review of Disease Transmission and Bighorn Sheep

Bighorn sheep are a New World species and are closely related to domestic sheep, which are an Old World species. Domestication and intense artificial selection have probably helped domestic sheep develop a resistance to important diseases (Jessup 1985). However, bighorn sheep can be highly susceptible to diseases carried by domestic sheep.

A long history of large-scale, rapid, all-age die-offs in bighorn sheep has been documented across Canada and the United States, many presumed associated with domestic animal contact (Shackleton 1999). Although limited knowledge of transmission dynamics exists (Garde et al. 2005), extensive scientific literature supports the relationship between disease in bighorn sheep populations and contact with domestic sheep, including both circumstantial evidence linking bighorn die-offs in the wild to contact with domestic animals and controlled experiments where healthy bighorn sheep exposed to domestic sheep displayed subsequently high mortality rates (Foreyt 1989, 1990, 1992; Foreyt et al. 1994; Onderka et al. 1988; Onderka and Wishart 1988; Garde et al. 2005). While much of the evidence for competition between domestic sheep and bighorn sheep is circumstantial, a large literature base has emerged documenting bighorn sheep die-offs in proximity of domestic sheep. These have prompted management decisions to eliminate shared use of ranges by bighorn and domestic sheep by federal land management agencies and state wildlife departments (Goodson 1982).

Although various stressors and organisms are implicated in these disease complexes, deaths are most often caused by bacterial pneumonia, which is caused by *Pasteurella* spp.—an incredibly large and diverse group of bacteria that is continually undergoing reclassification (Garde et al. 2005)—and *Mannheimia haemolytica* (formerly *Pasteurella haemolytica*[1]) (Foreyt 1990). In fact, these bacterial species have been reported as the number one cause for bighorn sheep population declines throughout North America (Garde et al. 2005).

Additional stressors include overcrowding on limited range; loss of escape cover; harassment by dogs; encroachment by humans; heavy snowfall and other weather stressors (Bunch et al. 1999); parasitism; poor nutrition; predation; and other human disturbances such as roads, habitat degradation, noise, and high dust levels (Festa-Bianchet 1988, Jenkins et al. 2000, Jones and Worley 2004). These stressors may reduce the ability of bighorn sheep to resist disease (Garde et al. 2005). Other factors that can potentially predispose a bighorn sheep to disease or exacerbate its risk of mortality when exposed to *Pasteurella* spp. include the presence of other bacteria, respiratory viruses, other microbial agents, lungworms, gastrointestinal and external parasites; genetics; capture and restraint techniques; breeding behavior; and the presence of other wildlife (Foreyt 1998).

Pasteurella spp. are common commensals on the mucous membranes of most animal species in all climatic zones (Biberstein 1979) and most ruminants are asymptomatic carriers. *Pasteurella* spp. are also common commensals of native North American ruminant species (Biberstein 1979, Thorne 1982, Jaworski et al. 1998). Only sporadic cases of pasteurellosis, usually associated with *Pasteurella multocida*, have been reported in bison, elk, moose, mountain goats, mule deer, and pronghorn (Thorne 1982). Bighorn sheep did not co-evolve with the same set of pathogens

[1] Future references to *Pasteurella* spp. include both *Pasteurella* spp. and *Mannheimia haemolytica.*

as domestic sheep (Dubay et al. 2002), and domestic animals have been selected for disease resistance and are subjected to regular treatment with vaccines and other preventative measures (Jessup 1985). Furthermore, *in vitro* studies have revealed a reduced capacity of bighorn sheep immune systems to kill bacteria compared with domestic sheep (Dubay et al. 2002). Bighorn sheep also display a lower tolerance to habitat destruction, competition, and other stressors compared with other wild North American ungulates (Martin et al. 1996, Schommer and Woolever 2001).

Beginning in 1937, multiple die-offs of bighorn sheep throughout North America have been documented in literature and *Pasteurella* spp. were often cited as the cause (Potts 1937, Marsh 1938, Post 1962, Foreyt and Jessup 1982, Onderka and Wishart 1984, Spraker et al. 1984, Hobbs and Miller 1992, Ryder et al. 1992, McCarty and Miller 1998). Epidemics in bighorn sheep and other native North American wild ruminants generally followed the settlement and establishment of domestic livestock grazing and may have reflected an historical introduction of novel pathogens into native wildlife populations by the late 1800s (Grinnell 1928, Skinner 1928, Honess and Frost 1942, Miller 2001). Limited understanding and/or access to bacteriological techniques probably precluded diagnoses of pasteurellosis in many early field investigations, thus the role of *Pasteurella* spp. in bighorn sheep epidemics was probably underestimated in studies reported prior to 1980 (Frank et al. 2004.).

Although there appears to be a high propensity for bighorn sheep mortality following direct contact with domestic sheep, domestic sheep appear to be refractory to most wild sheep pathogens (Martin et al. 1996, Schommer and Woolever 2001). Furthermore, domestic sheep are often carriers of *Pasteurella* spp. but do not exhibit clinical signs. Foreyt (1989) raised six Rocky Mountain bighorn sheep in captivity, five from birth and one that was taken from the wild as a lamb. He kept all six in captivity for 1 year. Six clinically normal domestic sheep were then placed on the 2 hectares of pasture with the bighorn sheep. *Mannheimia haemolytica* (formerly *Pasteurella haemolytica*) was isolated from swab specimens from four of the six domestic sheep but none from the bighorn sheep. All six bighorn sheep died within 4 to 71 days exposure to the domestic sheep. *Mannheimia haemolytica* was isolated from the respiratory tract tissue of the bighorn sheep at the time of death. None of the domestic sheep were clinically ill during the study, but three of the six were later euthanatized, and *Mannheimia haemolytica* was isolated from two of them. Routine isolation of *Pasteurella* and *Mannheimia* spp. does occur in bighorn sheep, although it is uncommon (Foreyt 1989).

In another experiment, two bighorn rams were raised in captivity and maintained in a room with concrete walls and a concrete floor. After 3 months of acclimation, two domestic Suffolk sheep were introduced into the room. At introduction, *Mannheimia haemolytica* was isolated from the domestic sheep (each domestic sheep had a different strain of *Mannheimia haemolytica*) but not from the bighorn sheep. All animals were asyptomatic at introduction. On day 13, both bighorn sheep developed respiratory disease; one died on day 14 and the other was euthanatized the same day. *Mannheimia haemolytica* was isolated from both bighorn sheep, post-mortem (Foreyt 1990). No other viruses or lungworms were present, and other parasite numbers were negligible. The domestic sheep were still asymptomatic on day 14. In another series of experiments, isolates of a particular strain of *Mannheimia haemolytica* from healthy domestic sheep were intratracheally inoculated into eight bighorn sheep and seven domestic sheep. Seven

of the eight bighorn sheep died within 48 hours, whereas all seven domestic sheep remained asymptomatic (Foreyt et al. 1994).

Mannheimia haemolytica generally requires direct physical contact between animals for transmission (Foreyt et al. 1994). However, bighorn sheep and domestic sheep are attracted to each other, particularly during rut, increasing the potential for close contact and disease transmission (Onderka et al. 1988, Foreyt 1989, Ward et al. 1997, Dubay et al. 2002).

After episodes of pneumonia in bighorn sheep populations, lambs are born healthy but will often subsequently die within several weeks. Researchers presume the lambs are initially protected via passive immunity from their mother's colostrum (Foreyt 1990). The impacts to recruitment can last for several years (Foreyt 1990, McCarty and Miller 1998, Miller et al. 2000, Cassirer et al. 2001, Miller 2001, Cassirer and Sinclair 2007, George et al. 2008). In fact, once *Pasteurella* spp. or *Mannheimia haemolytica* have been introduced to bighorn sheep populations, they may become endemic and continue cycling for decades (Miller et al. 1991, Hobbs and Miller 1992, Miller et al. 1995).

Although the exact mechanism for developing pneumonia in bighorn sheep following association with domestic sheep is unknown, experimental and field data indicate the two species are not compatible on sympatric ranges (Foreyt 1992).

Phenotypic traits of *Pasteurella* spp. isolated from bighorn sheep are similar to those of isolates from domestic ruminants (Frank et al. 2004). Physiologically, the two species have different alveolar macrophage function and arachidonic acid metabolism, which may cause increased sensitivity of bighorn sheep to respiratory disease (Silflow et al. 1991). Silflow and Foreyt (1994) found that bighorn sheep neutrophils were more susceptible to cytotoxin damage than domestic sheep neutrophils. Dassanayake et al. (2009) showed that the A1 serotype of *Mannheimia haemolytica*, carried by domestic sheep but not pathogenic to them, is highly lethal in bighorn sheep. In addition, by injecting some experimental animals with a mutant of serotype A1 from which the leukotoxin gene had been deleted, the researchers succeeded in pinpointing a single gene that is the primary virulence factor of *M. haemolytica*. Divergences in host–parasite co-evolutionary paths may explain observed differences in pulmonary host defense mechanisms between bighorn and domestic sheep (Silflow et al.1989). The development of immunity to pasteurellosis in bighorn sheep is complex and poorly understood (Miller 2001); vaccines to protect bighorn sheep have been ineffective (Foreyt 1992, Foreyt 1998, Foreyt and Silflow 1996). However, bighorns that recover from pasteurellosis remain healthy during subsequent epidemics (Miller et al. 1991).

Overall, bighorn sheep abundance and distribution appears to be limited by recurrent pasteurollosis epidemics (Hobbs and Miller 1992, Jorgenson et al. 1997, McCarty and Miller 1998). Significant mortality across all age classes and suppressed recruitment for the following 1 to 15 years impair population recovery and stability (Frank et al. 2004). A die-off in the Lostine herd of northeastern Oregon in 1986 to 1987 eliminated 66 percent of the herd, and poor lamb survival kept the herd at static levels for 3 years following the pneumonia episodes (Coggins and Matthews 1992). In a summary of risk to wild sheep from *Pasteurella* and *Mannheimia* spp., Garde et al. (2005) offers the following conclusions:

- These bacteria can cause pneumonia in bighorn sheep, but there are benign commensal strains in the upper respiratory tract
- Domestic sheep, goats, and llamas have been reported with these bacteria species
- Wild sheep and mountain goats have been reported with these bacteria species
- Transmission is by direct contact and aerosolization
- These bacteria species do not persist in the environment
- Acute-to-chronic die-offs in bighorn sheep can result in low to 100 percent mortality, although they can be present in healthy sheep
- These bacteria are considered opportunistic and can result in pneumonia outbreaks
- These bacteria can cause clinical disease in domestic sheep and goats but are rarely primary pathogens

Predisposing factors such as stress or a viral infection may cause the organism to shift from being a commensal to pathogenic (Srikumaran 2007).

Singer et al. (2001) found that the persistence of bighorn sheep populations was significantly correlated with the presence of domestic sheep: populations located closer to domestic sheep were smaller and had lower population growth rates than bighorn populations located farther from domestic sheep.

In summary, field observations suggest that bighorn sheep have a high probability of contracting fatal pneumonia following contact with domestic sheep, which has led to numerous independent experiments. The results of these experiments provided strong corroboration that bighorn sheep have a high probability of contracting fatal pneumonia following contact with domestic sheep.

The impact of disease on bighorn sheep conservation is likely to increase as habitat loss and fragmentation restrict their movement and concentrate them into smaller areas, increasing contact rates and the spread of disease (Scott 1988, Levins et al. 1994, Schrag and Wiener 1995). Several agencies and experts have weighed in on the issue. U.S. Department of Agriculture (USDA) Forest Service Region 2 identified the following threats to the long-term viability of their bighorn sheep: the risk of disease outbreaks resulting from contact with domestic sheep and goats is identified as the most significant threat facing bighorns in both Region 2 and across their range, followed by lack of connectivity and/or loss of genetic fitness due to habitat fragmentation; habitat loss; human disturbance; competition with domestic livestock; and predation on small, isolated herds (Beecham et al. 2007). Given the substantial concern raised in the published literature over the last 20-30 years, management guidance has focused on the separation of these species to prevent disease transmission from domestic to bighorn sheep.

Current Analysis

Several models were developed to better understand bighorn sheep habitat suitability, the potential for contact between bighorn sheep and domestic sheep, and the inferences for disease transmission between the species. These models included: 1) a bighorn sheep source habitat

model, 2) risk of contact model, which utilize a bighorn sheep core home range analysis and bighorn sheep foray analysis, and 3) a disease model. A detailed description of these models can be found in the *Bighorn Sheep Supplemental Environmental Impact Statement Analysis: Modeling Technical Report*. Outputs from these models were used to describe current conditions on the Payette National Forest and adjacent areas, and as a basis for alternative comparison. Models used in this document updated the previous analyses conducted for the DEIS. Detailed rationale for these changes are discussed in the *Bighorn Sheep Supplemental Environmental Impact Statement Analysis: Modeling Technical Report* and are summarized in Chapter 2.

Source Habitat Model

Bighorn sheep occupy rugged canyons, foothills, and mountainous terrain at elevations ranging from 1,450 to 10,500 feet. Key habitat features include steep, rugged "escape" terrain, grasses and forbs for forage, and a limited amount of tall vegetation. Native bunchgrasses and forbs are important components of forage (IDFG 2005).

Source habitats are those characteristics of macrovegetation that contribute to positive population growth for a species in a specified area and time (Wisdom et al. 2000, Raphael et al. 2001). 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).

Wisdom et al. (2000) describe source habitats for bighorn sheep in alpine, subalpine, upland shrubland, and upland herbland community groups. Alpine and subalpine community groups are primarily summer range and upland herbland and shrubland are used in both seasons, depending on elevation (Wisdom et al. 2000). Old-forest and stand initiation stage of whitebark pine and stand initiation stage of other forested cover types are other source habitat.

Visibility is an important habitat variable for bighorn sheep: vegetation height and structure are probably more important than plant species composition for predator detection (Risenhoover and Bailey 1985, Wakelyn 1987), and a negative correlation between forest cover and bighorn sheep occurrence has been observed (Bentz and Woodard 1988). Open habitat provides good visibility for detecting predators and communicating to other herd members (Risenhoover et al. 1988). Post-fire habitats can benefit bighorn sheep by improving forage quality (McWhirter et al. 1992) and increasing visibility (Bentz and Woodard 1988). Seasonal use of different slopes and aspects results in the use of a mosaic of plant communities and phenological patterns, which provides foraging and security opportunities for bighorn sheep (Valdez and Krausman 1999).

Source habitat capacity is defined as all acres with the potential to provide habitat for bighorn sheep, based only on their requirement for escape terrain. Escape terrain is so critical for ewes during lambing (Blood 1961, Kornet 1978, Hall 1981) that they will sacrifice access to high-quality forage for security (Festa-Bianchet 1989, Cook 1990, Bleich et al. 1997). Escape terrain habitat components consist of slopes between 31 degrees and 85 degrees, a buffer of 300 meters or land areas less than or equal to 1,000 meters wide bounded on two or more sides by escape terrain (500 meters), and a minimum area of 1.6 hectares (HCBSRC 2004). For this update, a component was added to the escape terrain to filter out areas that have the steepness, but not the ruggedness, that contributes to source habitat capacity. A ruggedness surface was created using an ArcGIS script (Sappington 2007) then the telemetry and observations were overlaid to create

a histogram of the ruggedness with a range from 0 to 3455. With the ruggedness histogram a value of 310 or less on the surface was used to filter out area of over mapping. The vegetation is not considered a component of source habitat capacity since vegetation will vary by successional and disturbance processes, but escape terrain remains constant. Therefore, while source habitat capacity is constant, source habitat will vary spatially and temporally across the landscape.

Source habitat capacity for bighorn sheep falls within suitable rangeland on the Payette National Forest. Suitable rangelands include lands suitable for grazing both cattle and sheep. Although impacts to habitat from historic livestock grazing have been substantially reduced under current practices, livestock grazing can still cause localized areas of damage, including changes in understory vegetation from livestock foraging, trampling of reproducing tree seedlings, soil erosion, and other habitat degradation. Damage can result in the subsequent introduction and spread of invasive weeds and other non-natives, disruption of ecological and physical processes, and changes in historic fire regimes. Bighorn sheep have been found to actively avoid habitats occupied by cattle (Wilson 1968, McQuivey 1978, Jones 1980, Dodd and Brady 1986, Steinkamp 1990). Overgrazing by domestic livestock reduces the overall carrying capacity of bighorn sheep range and may lead to more predation by increasing cover for predators. Succession of grassland to shrub communities may also increase competition with deer and increase cougar populations, the major predator of bighorn sheep (Beecham et al. 2007). Competition with domestic sheep and goats is considered even more serious than with cattle because of their similar preferences in forage and topography, and the higher potential for disease transmission between the species (Beecham et al. 2007).

The existing vegetation layer from the national LANDFIRE layer (The National Map LANDFIRE 2006) was used to assess the current source habitat available for bighorn sheep. This information was utilized because it allows the analysis of landscapes which extend beyond, but include the Payette National Forest, and can be used to address habitat connectivity issues at broader scales. The vegetative cover types used by the Hells Canyon Restoration Committee (HCBSRC 2004) and Wisdom et al. (2000) were crosswalked into the LANDFIRE ecological systems (NatureServe 2004) to identify summer and winter source habitat. Winter source habitat is a subset of summer source habitat in that it encompasses only those areas below 4,500 feet on southerly aspects.

On the Payette National Forest, 369,641 acres of summer source habitat and 156,919 acres of winter source habitat exist, representing 15.4 percent and 6.5 percent, respectively of the Payette National Forest (Figures 3-4 and 3-5). Outside of wilderness areas, the percentages are 14.4 percent and 5.7 percent, respectively. Source habitat for bighorn sheep is distributed across the Payette National Forest, and bighorn sheep habitat is considered contiguous, although not all of it is currently known to be occupied.

This mid-scale habitat modeling may not represent finer-scale conditions. For example, not all special habitat features may be delineated and invasions by exotic plants, forage quality, and human disturbance factors may not be detectible. Changes in the patch and pattern of range mosaics have changed since historical times as fire suppression has resulted in an increased density of trees in formerly open stands, with a resultant loss of foraging quantity, quality, and open habitat (Wisdom et al. 2000). Fire-suppressed stands have created barriers between historical winter and summer range, preventing occupancy of the total range, although each isolated range may be suitable (Wakelyn 1987). In other cases, fires have opened up forested

areas and increased habitat. Mixed-lethal fire regimes may have followed historical patch and pattern, but the same may not be true for non-lethal fire regimes. Disruption of hydrological regimes from a variety of sources has also resulted in the loss of riparian vegetation in many foraging areas (Wisdom et al. 2000).

Figure 3-4. Modeled Bighorn Sheep Summer Source Habitats on and Adjacent to the Payette National Forest.

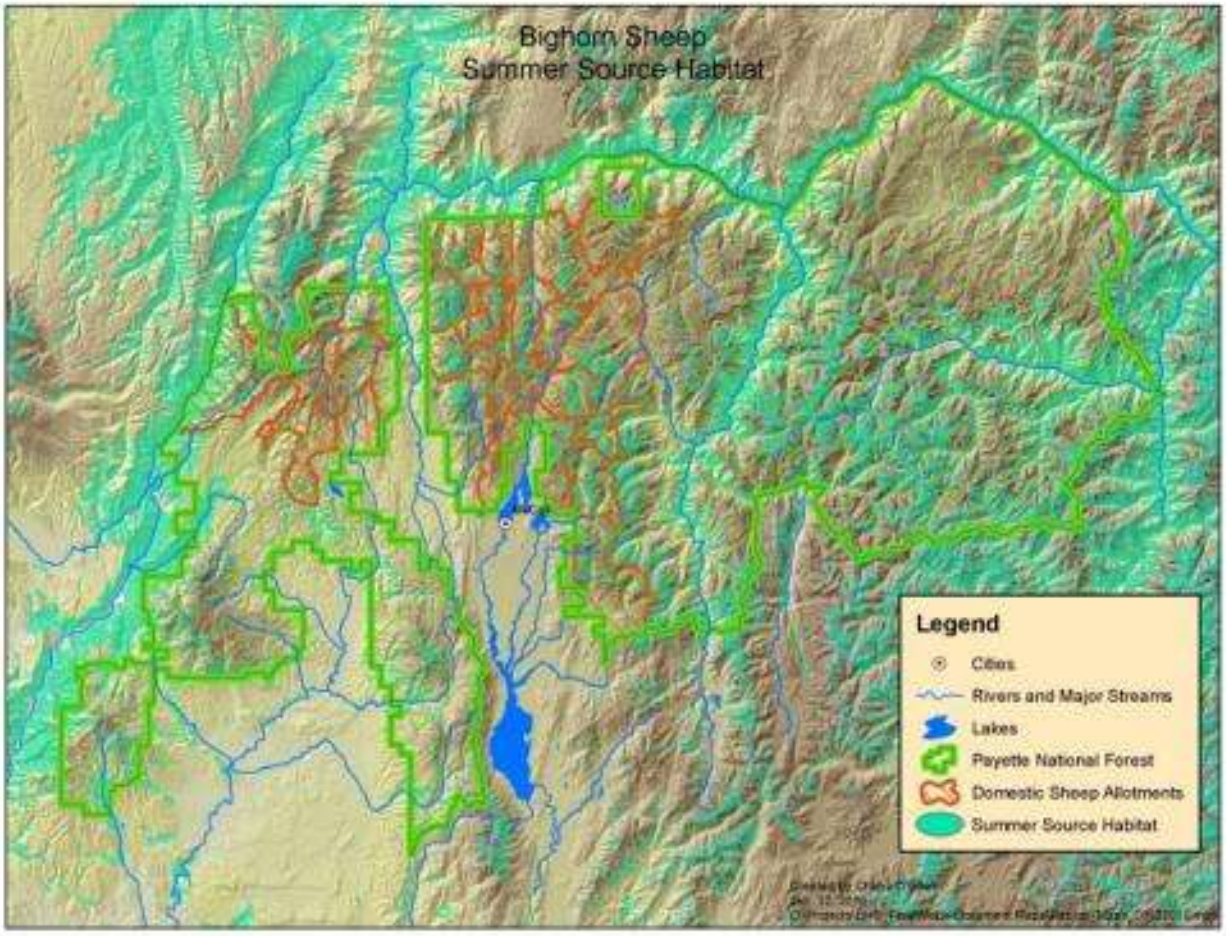
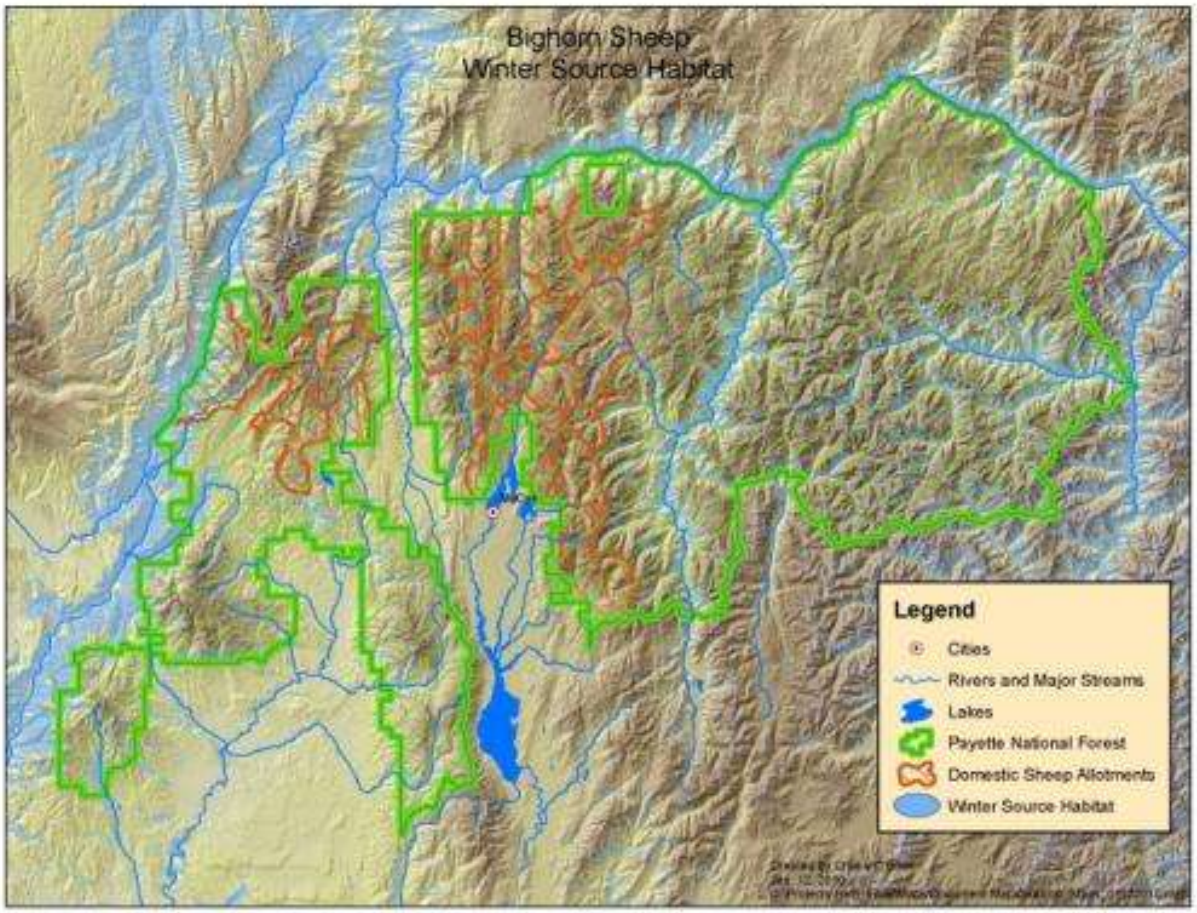


Figure 3-5. Modeled Bighorn Sheep Winter Source Habitats on and Adjacent to the Payette National Forest.



Risk of Contact Model

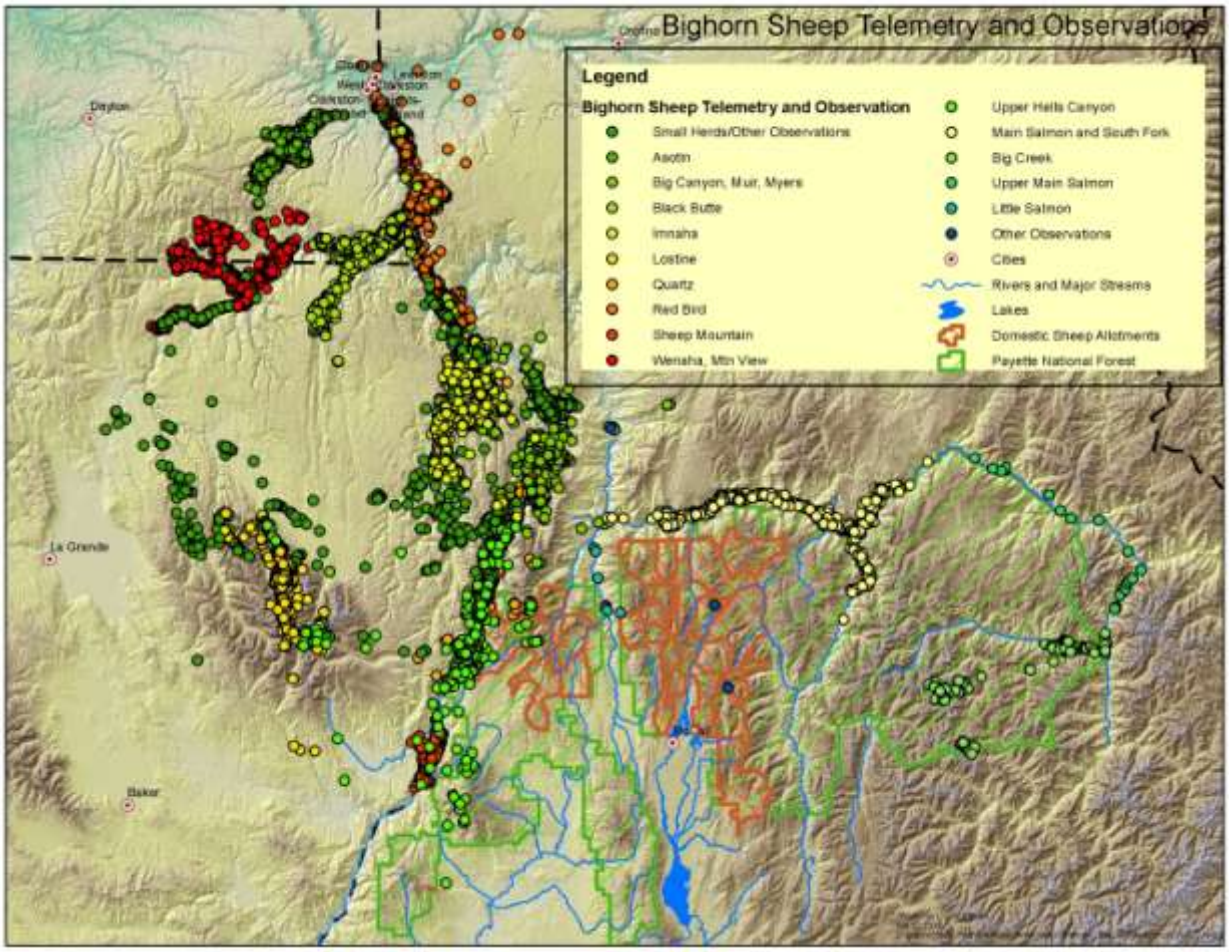
Bighorn Sheep Core Herd Home Range Analyses

Discussion Telemetry Data

Figure 3-6 displays telemetry and observational data collected by the Idaho Department of Fish and Game (IDFG), University of Idaho, USDA Forest Service, and other federal personnel, overlapped with the Payette National Forest. Overall, these data include over 50,000 telemetry points, representing approximately 400 individuals for the two metapopulations collected from March 1997 through December 2006, except for the University of Idaho data in the Frank Church River of No Return Wilderness, which was collected in 1989 to 1990.

Telemetry data were integral to the core herd home range and foray analyses, which were used as input parameters for the disease model.

Figure 3-6. Telemetry Data and Observations of Bighorn Sheep near the Payette National Forest.



The telemetry data suggests that bighorn sheep do utilize habitats within allotments managed by the Payette National Forest. As an example, Figures 3-6 and 3-7 display telemetry points of bighorn sheep documented on the allotments on the west and east zones of the Payette National Forest in Hell's Canyon.

Figure 3-7. Telemetry Points for Ewes and Rams within Allotments on the West Side of the Payette National Forest.

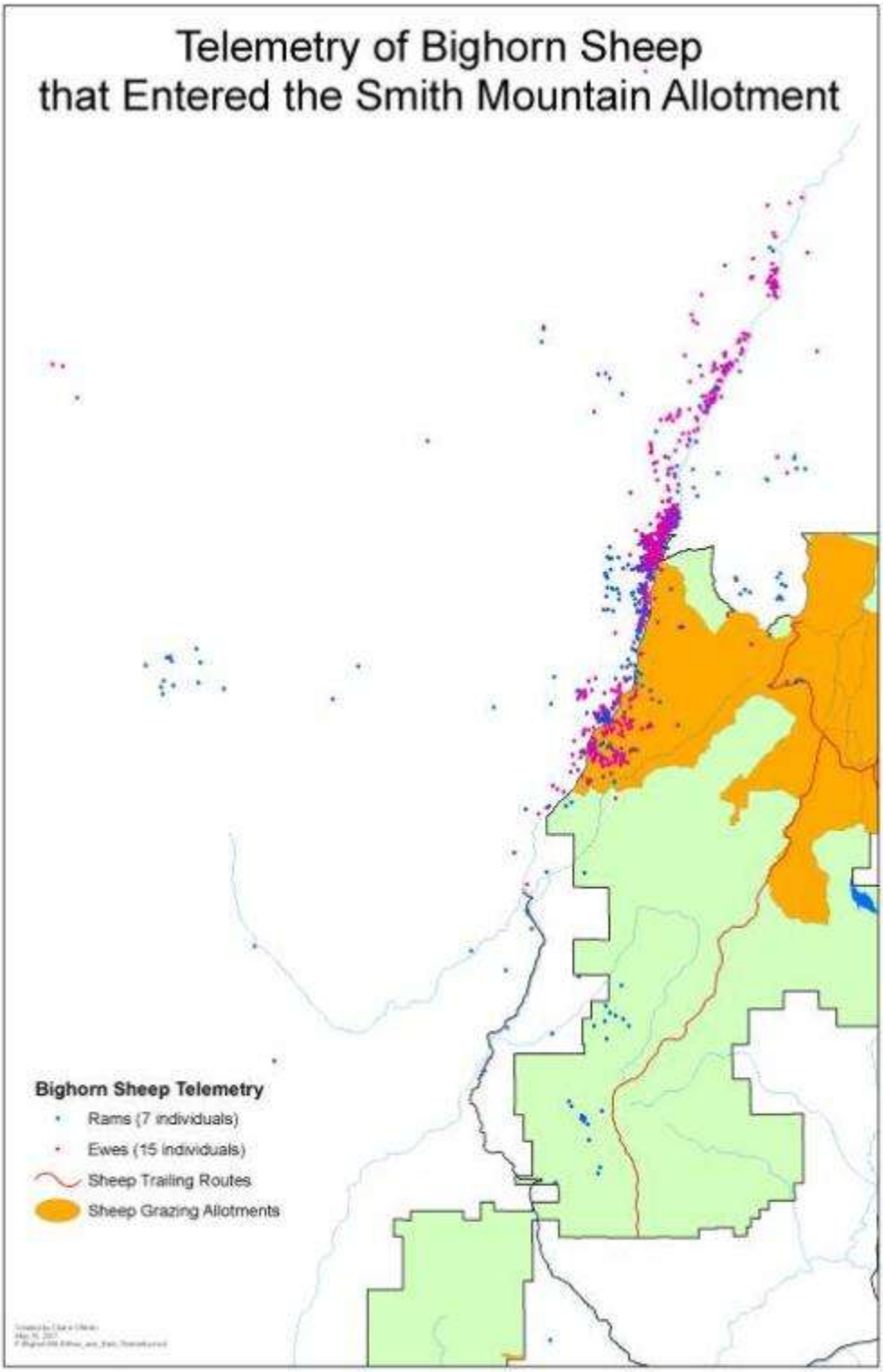
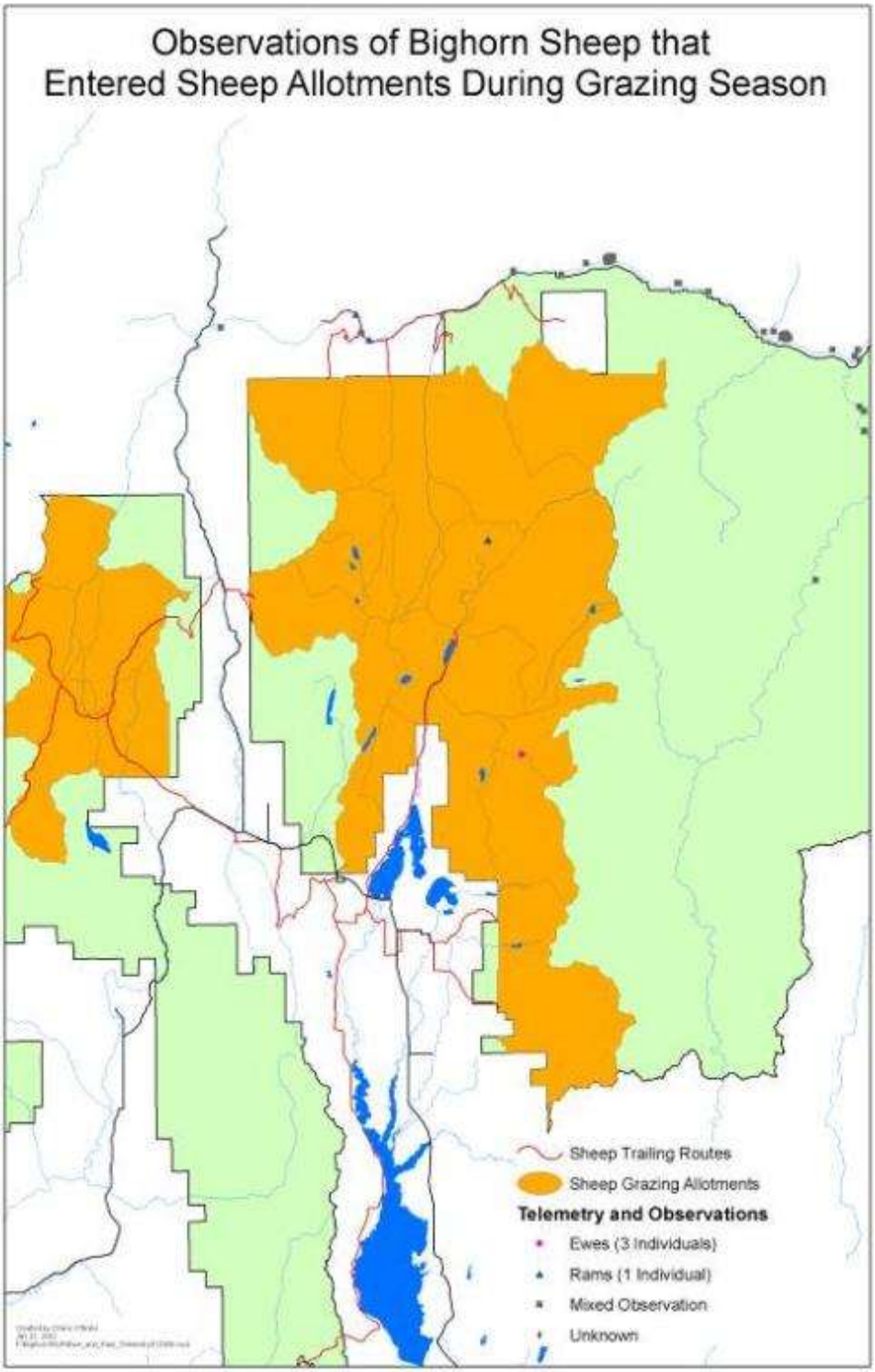


Figure 3-8. Observational Data of Bighorn Sheep that Entered Occupied Domestic Sheep Allotments on the East Zone of the Payette National Forest



Hells Canyon Metapopulation

The Hells Canyon telemetry data have been collected by IDFG, the Oregon Department of Fish and Wildlife, and the Forest Service. The telemetry data were used in modeling, which is described in the Environmental Consequences section on DSEIS page 3-24. In any given year, approximately 150 animals have telemetry collars. Figure 3-6 shows those known (from telemetry data) bighorn sheep that entered the Payette National Forest allotments. Between 1997 and 2004, radio-collared bighorn sheep were detected within the Smith Mountain Allotment on 319 occasions and within 1 to 4 miles of the Curren Hill Allotment on 22 occasions). These telemetry data account for 22 individuals: 7 rams and 15 ewes. Of these 22 individuals, 18 (7 rams and 11 ewes) entered the allotments when domestic sheep were present (May–October), with a total of 163 telemetry points amongst those 18 individuals within that time period. All of these recorded individuals are now deceased. It is unknown how many bighorn sheep without telemetry collars entered the allotments when domestic sheep were present.

A 6,567-acre area of the Smith Mountain allotment is within the boundaries of the Hells Canyon National Recreation Area (HCNRA). The Curren Hill Allotment no longer exists within the HCNRA but is immediately adjacent to it.

Salmon River Metapopulation

There is currently only a limited telemetry data set available for analysis of the Salmon River metapopulation. Hence, the uncertainty is greater relative to the risk of contact and potential subsequent disease transmission on the east side of the Payette National Forest. One observation of a bighorn sheep ram was noted within the Josephine Allotment, and three ewes were sighted within the North Fork Lick Creek Allotment one year and two ewes a second year, along the border with the Lake Fork Allotment. These individuals entered the allotments when domestic sheep were present (May–October). The Payette National Forest, IDFG, and Nez Perce Tribe currently have a cooperative project that is placing Global Positioning System (GPS) collars on Salmon River Mountain bighorn sheep. Fifteen sheep were collared in fall 2007 and spring 2008. One of those collared sheep was lethally removed by IDFG in early 2008 due to contact with domestic goats. Eighteen more sheep were collared in the fall of 2008. One collared sheep was lethally removed late spring 2009 after suspected contact with domestic sheep. One collared sheep was harvested by a hunter and one other collared sheep was killed by a mountain lion. This information has provided additional data on bighorn sheep movement on the east side of the Payette National Forest. Forested area and large rivers, which bighorn sheep do not prefer for movement and which serve as partial barriers to bighorn sheep movement (Singer et al. 2000b), are located between bighorn sheep habitat on the South Fork Salmon River and the east side allotments.

Furthermore, the effects of the 2007 fires within the Payette National Forest on bighorn sheep habitat and movement are unknown. However, bighorn sheep have been observed swimming large rivers and have been found in locales where their routes to arrive there were unknown (). Akenson and Akenson (1992) observed ewes from different parts of the winter range utilizing four different drainages for lambing, and they had three separate summer ranges, indicating a high degree of movement for this population. They also observed ewes traveling more than 50 miles in less than 3 days, and pregnant ewes swimming Big Creek during flood stage to begin spring migration. Ewes followed rock outcrops and broken open terrain, but the migration

corridor also included forested ridges and a snow covered pass (Akenson and Akenson 1992). Big Creek bighorn sheep had separate winter ranges from the Middle Fork of the Salmon River bighorn sheep but did share some summer range, which would increase the risk of disease transmission between populations of the Salmon River Mountains metapopulation (Akenson and Akenson 1992). The lack of telemetry data makes it impossible to know if other bighorn sheep utilize domestic sheep allotments. Unlike re-introduced sheep in Hells Canyon, these native sheep are considered migratory, and historical migration routes are important to their population dynamics. As native populations of bighorn sheep that have persisted since historic times, loss of the genetic diversity of these populations could affect bighorn sheep persistence and restoration at scales much larger than the Payette National Forest.

Core Home Range Analysis

Home range modeling was conducted as part of the Hells Canyon Complex and the Main and South Fork Salmon Rivers bighorn sheep herd analyses. Modeling the core herd home range enabled Forest managers to analyze the impacts of domestic sheep grazing on the Forest to the broader bighorn sheep metapopulations. The analysis also showed the extent of the interchange between the different herds throughout the Hells Canyon Complex and the Main and South Fork Salmon Rivers.

The first step for developing the core herd home range model was to calculate the home range of each animal separately. Occasional movement outside of this the area could be exploratory in nature and was not considered part of the home range. However, these excursions—or sallies—were of great interest to the modelers and analyzed separately in the foray model (see "Foray Model" section below).

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 conducted with the observations and telemetry data collected by the HCI from 1997 to 2008. These telemetry data were used by HCI to divide the bighorn sheep populations into herds. The following herd assignments were based on transplant cohorts to specific locations and breeding groups of ewes that shared the same range: Asotin, Big Canyon, Black Butte, Imnaha, Lostine, Upper Hells Canyon, Main Salmon and South Fork, Mountain View, Muir Creek, Myers Creeks, Redbird, Sheep Mountain, and Wenaha. Several small herds had too few points to accurately create a core herd home range or telemetry from transplants that failed to form a herd, thus home range modeling was not conducted on the following herds—05IMREL, Lower Hells Canyon, Saddle Creek, Quartz Creek, Minam, and Sheep Creek.

The home range modeling was completed with Home Range Extension version 1.1 for ArcGIS (Rogers et al. 2007). The home range analysis utilizes a fixed-kernel with a bandwidth h_{ref}, calculated as described below. Volume contours were calculated for the 50th, 60th, 70th, 80th, 90th, and 95th isopleths (e.g., the contours of the 95th isopleth encompass an area where telemetry points were found 95 percent of the time). Points beyond the 95th isopleth were considered forays and analyzed separately (see "Foray Model" section below). This process of home range analysis was done for each identifiable individual within a herd that 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 but were used to verify the accuracy of the final core herd home range volume contours. One of the byproducts of the process is a surface raster from

which the volume contours were created. To create an overall core 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 (Beyer, H.L. 2004). This process is similar to more traditional home range analysis that is conducted on individuals—the bandwidth 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) co-ordinates divided by the sixth root of the number of points (Worton 1995):

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

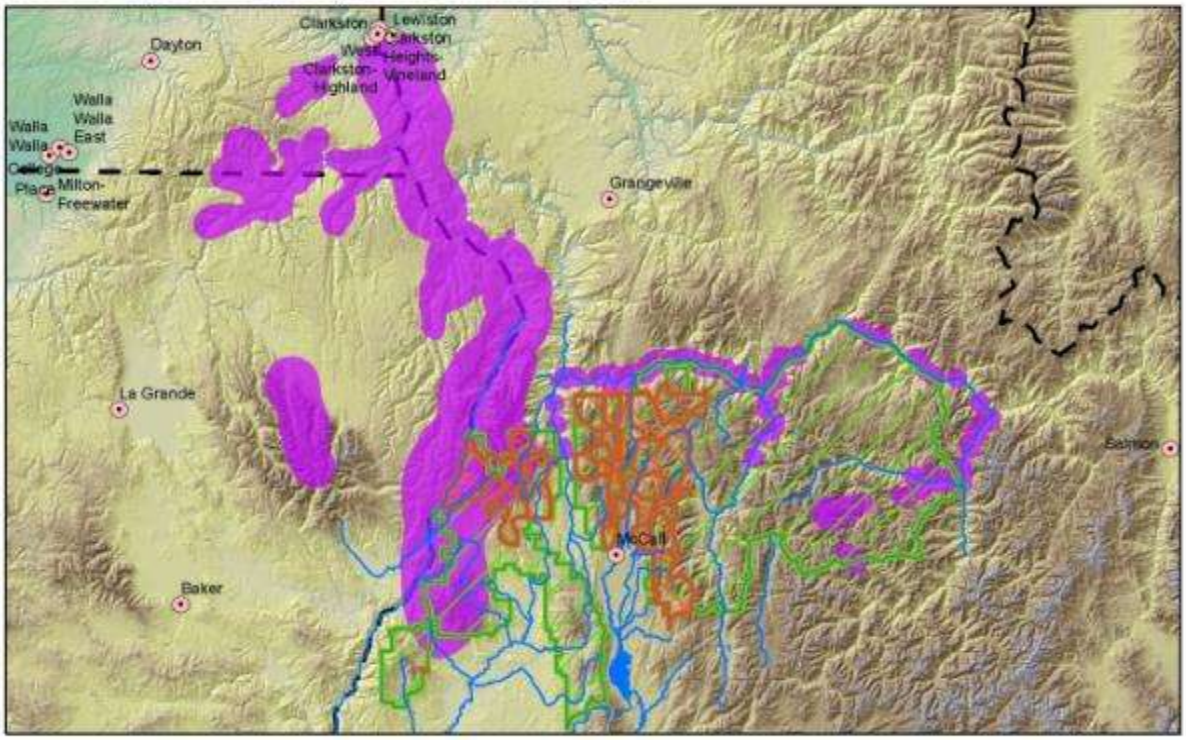
This method is widely used for extrapolating from the dispersion of observed locations to the likely extent of the full home range.

For several reasons, this process did not follow the same process used by Clifford et al. (2007), which was referenced in the DSEIS. The original model drew the core herd home range at the 100 percent volume contour, however, the Home Range Extension uses a Gaussian kernel which never reaches 0 and mathematically cannot calculate a 100 percent volume contour. When a user inputs 100 percent into the software, the software limits 100 percent to an internal value such as 99.9999 percent. The Home Range Extension version used in the DSEIS was actually 0.99 percent, which had a different internal limit than the upgraded version of the software that was used in the analysis for the update to the DSIES.

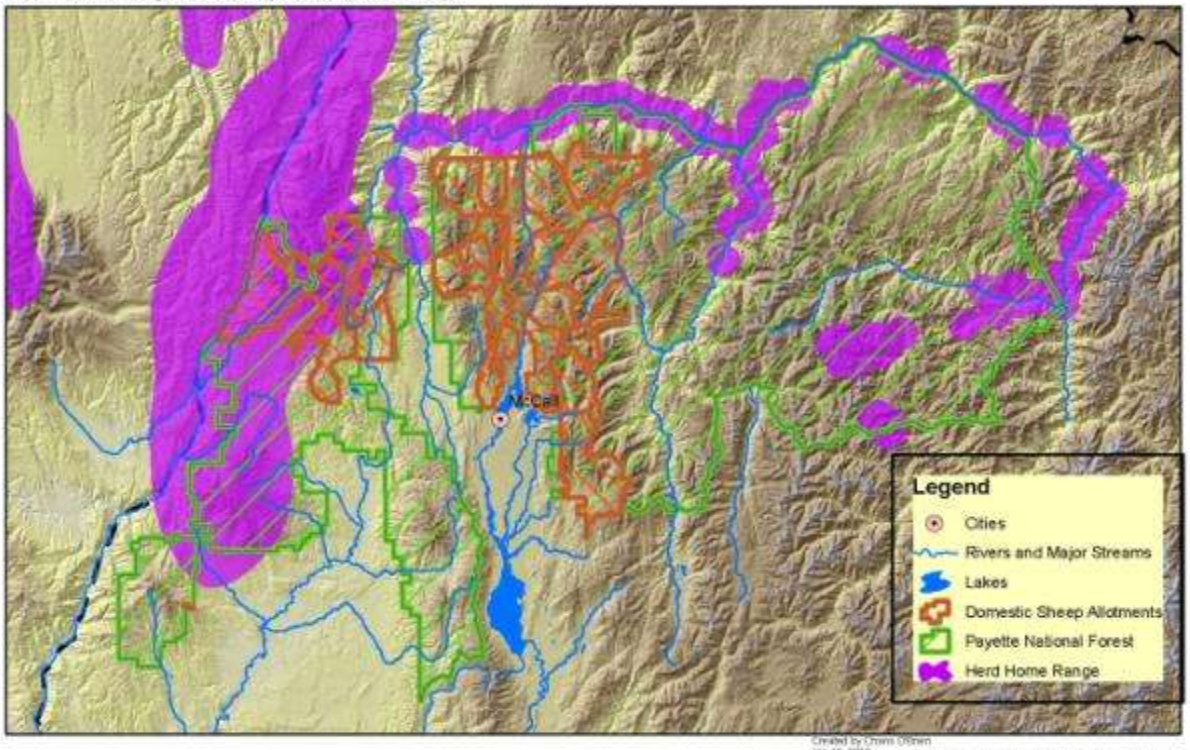
Because of these discrepancies, the analysis for the update to the DSIES was split into two parts. The first part is the core herd home range that defines the core areas of habitat use. The analysis for the DSEIS used the 50 to 90 percent volume contours to define this area of core habitat usage and referred to this area as the Geographic Population Range (GPR). The second part is an analysis for the foray behaviors that bighorn sheep exhibit, especially young rams. The draft analysis used the 90 to 100 percent volume contour areas to analyze these foray behaviors. However, the core herd home range and the forays are two different types of habitat usage behaviors and needed to be handled by two separate models. While this analysis differs from Clifford et al. (2007), it allowed the modelers to better calculate the annual rates of contact between bighorn sheep populations and domestic sheep allotments.

Figure 3-9. Combined Core Herd Home Ranges for the Entire Project Area and for the Payette National Forest

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



Herd Home Range on the Payette National Forest



Foray Analyses

Similar to bighorn sheep elsewhere, Hells Canyon and Salmon River bighorn sheep—particularly rams—make occasional long-distance movements beyond their core herd home range. Singer et al. (2001) called these movements "forays" and defined them as any short-term movement of an animal away from and back to its herd's core 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 (Singer et al. 2000, Gross et al. 2000), even when domestic sheep use is outside of core herd home range areas. 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 a bighorn sheep core herd home range, the distribution of bighorn sheep source habitats across the landscape, and the frequency and distance of bighorn sheep forays outside of the core herd home range.

The sequence of events by which an outbreak could result from contact between a foraying bighorn sheep and domestic sheep in an active allotment can be broken down into a number of steps: a bighorn sheep must leave the core herd home range, travel far enough to reach the allotment, and intersect the allotment (i.e., rather than intersect a different area at the same distance from the core herd home range). Although some pathogens can be transmitted without contact, this model assumes that for transmission of highly lethal pathogens that cause bighorn die-offs, bighorn sheep must come into contact with an occupied domestic sheep allotment. The exact probability of contact between bighorn sheep and domestic sheep occupying the same allotment at the same time is hard to know, so different model runs were run differently with a range of values from 25 to 100 percent. For an outbreak to affect the animal's home herd, the infected bighorn sheep must return to the core herd home range and transmit the disease to other members of the herd.

The modelers looked at how far animals wandered outside of their home range using a Gaussian distribution with standard deviations of 1 and 2 (indicates where an animal spends 95 percent of its time) and on a log-scale (indicates how much time an animal spends at greater distances away from the home range).

The foray model analyzed how often bighorn sheep leave the core herd home range, whether they travel far enough to reach an allotment, and whether they intersect an allotment. Movement behavior estimates were formed by analyzing the same large telemetry dataset of bighorn sheep movements in Hells Canyon that was used to determine the core herd home range of each herd. The dataset consists of approximately 54,000 point locations from more than 400 animals in 13 herds, collected from 1997 to 2008. In the Salmon River system, there is only a single year of telemetry data from 30 individuals in the Main Salmon/South Fork herd. Those data were useful in estimating the herd's core herd home range, but 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 probable 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; therefore, the analysis began by calculating the probability of intersection in each of 35 "rings" or annuli, each 1 kilometer (km) wide, located between 1 and 35 km from the core herd home range boundary. That probability was broken into three parts:

1. The probability of a foray movement

2. The probability a bighorn sheep will intersect an allotment

3. The probability of effective contact between bighorn sheep and domestic sheep within an allotment.

Probability of a Foray Movement

Most bighorn sheep, especially ewes, never move beyond the core herd home range in most years. Figure 3-10 displays the maximum distance of ram forays outside of core herd home range areas (95 percent isopleth) for the data set. Figure 3-11 displays the proportion of rams with forays from 0 to 35 km from core herd home range areas for the data set. Forays from all but one bighorn sheep were between 0 and 26 km; one ram had a documented foray that extended 35 km from its core herd home range. Foray distances were stratified into 1-km concentric rings that emanated from core herd home range areas and used as a basis for calculating the probability of contact.

Figure 3-10. Maximum Distance of Ram Summer Forays beyond the Core Herd Home Range

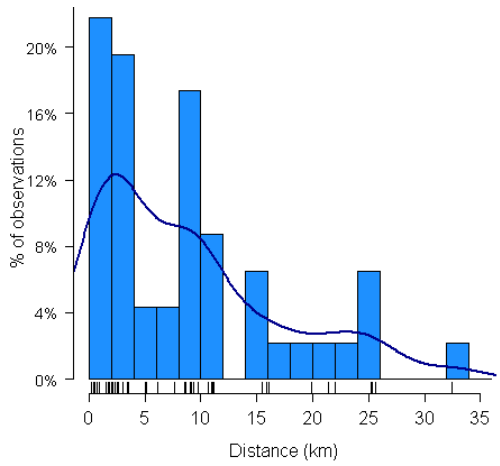


Figure 3-11. Proportion of Ram Summer Forays Reaching Each Ring

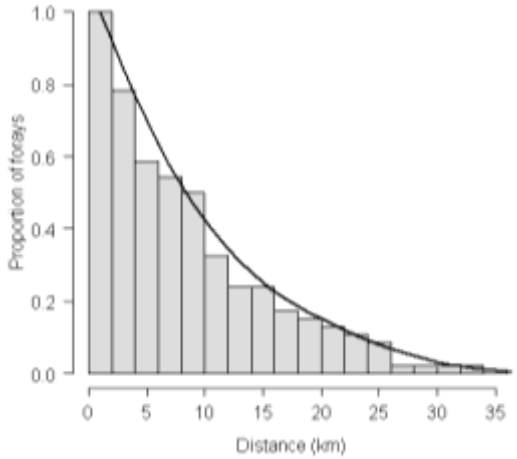


Table 3-1 summarizes the frequency of foray movements, by both rams and ewes, in summer (May–October) and winter (November–April). The probability of bighorn sheep-domestic sheep contact in summer and winter were calculated separately because characteristic movement patterns differ between seasons (e.g., the rut occurs in November/December and produces relatively frequent and long-distance exploratory forays by rams) and the allotments are only open to domestic sheep during the summer.

According to Table 3-1, 28.8 percent of radiocollared rams left the core home range at least once (in summer) during the years they were observed. In any one summer, however, just 14.1 percent of rams left the core home range. Accordingly, in the foray model, each ram was given a 14.1 percent probability per summer of making a foray outside of the core herd home range. Similarly, ewes were given a 1.5 percent probability of leaving the core herd home range each summer.

Table 3-1: Summary of Telemetry Observations Made Outside of the Core Herd Home Range

Summer (May–October)	**Ewes**		**Rams**	
Animals leaving CHHR at least once	**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%**	(29/17,258)	**4.40%**	(160/3,674)
Winter (November–April)	**Ewes**		**Rams**	
Animals leaving CHHR at least once	**12.9%**	(28/217)	**34.9%**	(38/109)
Animal-years with at least one foray	**5.6%**	(60/1,062)	**17.8%**	(68/380)
Telemetry points outside of CHHR	**0.8%**	(109/12,941)	**3.7%**	(156/4,200)

The Probability a Bighorn Sheep will Intersect an Allotment

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 decreases as the travelling distance increases. To characterize that decreasing probability, the modelers first extracted from each foray the maximum distance from the core herd home range at

which an animal was observed (Figure 3-10). In the dataset, the maximum distance was 35 km so the model distribution extends to that distance.

It is known that an animal located 25 km from the core herd home range has crossed each ring between itself and the core herd home range. Also, 100 percent 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 3-11, along with a smooth curve fitted to it. Figure 3-11 illustrates that half of the rams who leave the core herd home range travel at least 10 km from the core herd home range and almost a quarter of the rams travel 16 km. However, just one ram has been observed (in summer) to travel more than 26 km from the core herd home range. This model uses the distribution in Figure 3-10 to calculate the probability that an animal will reach any given ring surrounding its core herd home range, P(Animal reaches ring_k | Foray).

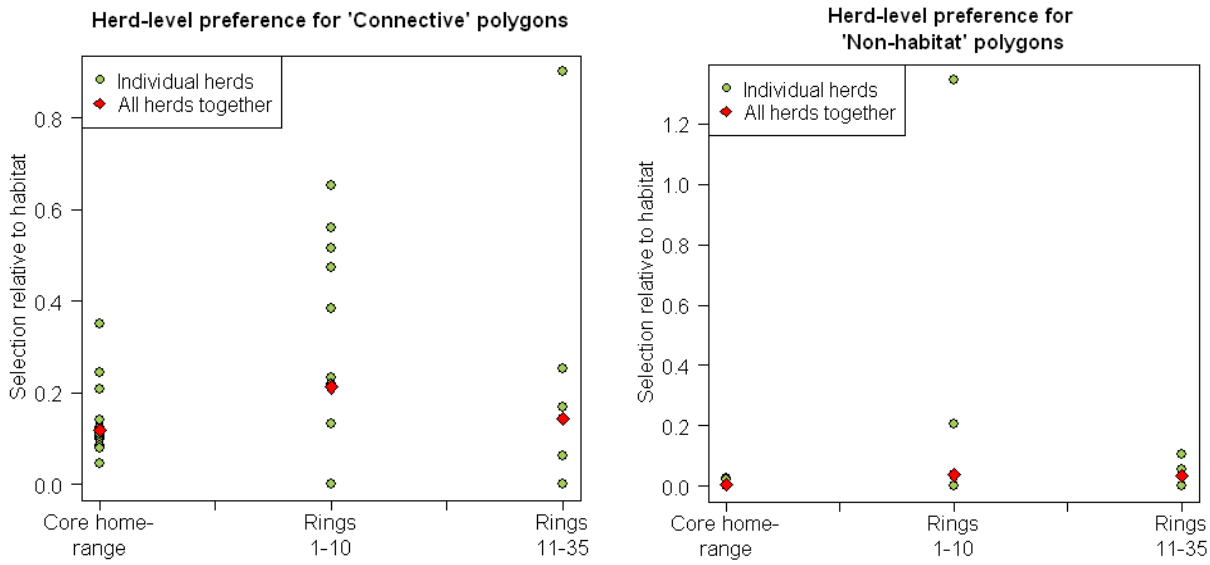
Given that an animal has reached a ring, the probability that it will be in an allotment is proportional to the size of the allotment and to the quality of the habitat in the allotment relative to the size and quality of habitat in the ring as a whole. Calculating the size of the allotment is simple, but determining if a bighorn sheep will intersect an allotment first requires knowing bighorn sheep habitat preference.

Next, the relative preference of bighorn sheep for these three classes of habitat was calculated using a resource selection function (Boyce et al., 2002; Manley et al., 1993). The resource selection function was constructed using a use/availability approach that yields high values for habitat classes with many observations of bighorn sheep relative to their area. If the animals in a herd have available to them equal areas of Habitat A and Habitat B, but spend 90 percent of their time in Habitat A, their preference for Habitat A would be 9 times their preference for Habitat B.

Based on the source habitat model, all areas within 35 kilometers of the core herd home ranges were assigned to one of three habitat classes—source habitat, connectivity area, and non-habitat. Source habitats are areas with vegetation and topography that fit the criteria described in the source habitat model section above. Connectivity areas do not meet those criteria, but are located within 350 meters of source habitat. Areas of non-habitat are located more than 350 meters from source habitat. (Connectivity areas were distinguished from non-habitat because even when bighorn sheep are found outside of areas mapped as source habitat, they are usually not far from it. Of the 3,177 observations of bighorn sheep located outside of source habitat, all but 80 have been within 350 meters of source habitat.)

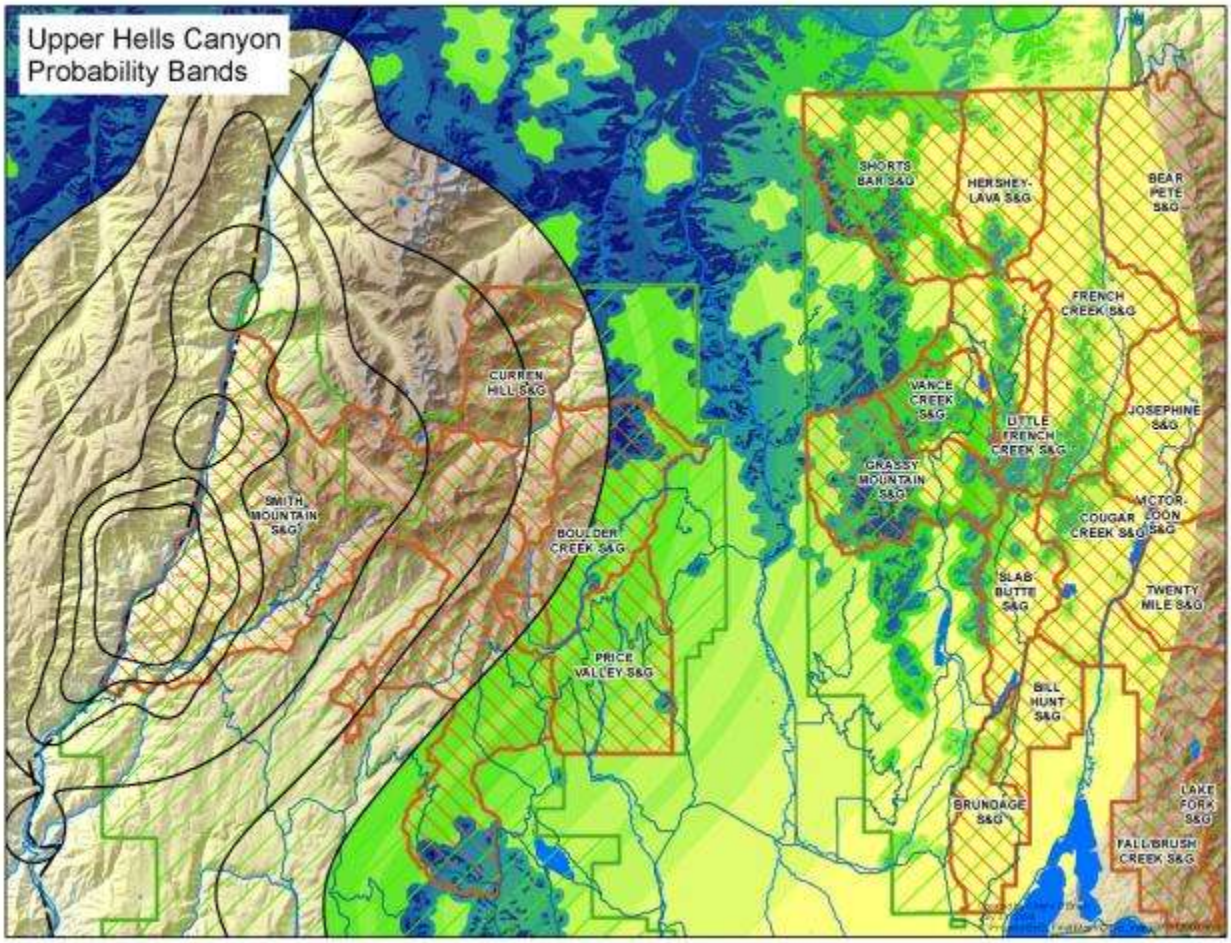
While on forays, bighorn sheep in the 13 Hells Canyon herds prefer source habitat to connectivity areas, and prefer both of those to non-habitat. Relative to a preference of 1.00 for source habitat, bighorn sheep showed a preference of 0.177 for connectivity areas, and a preference of 0.029 for non-habitat (Figure 3-12). In other words, within the 35-km-wide ring surrounding a core herd home range, bighorn sheep were 5.6 times more likely to be found in a given square-kilometer of source habitat than in a square-kilometer of connectivity area, and 35 times more likely to be found in source habitat than in non-habitat.

Figure 3-12. Herd-Level Habitat Preference.



Finally, habitat preference and the distribution of habitat within each ring surrounding a core herd home range was used to calculate the probability that a bighorn sheep that reaches a particular ring would cross the ring into an allotment.

Figure 3-13. Visualization of the Foray Probabilities for the Upper Hells Canyon Herd



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%.

Disease Model

The connectivity of habitats, bighorn sheep use within those habitats and the probability of contact were used as a basis to simulate disease effects on bighorn sheep populations. Since disease can spread between interconnected bighorn sheep herds, actions performed on the Forest can have effects beyond the Forest's administrative boundary. For the update to the DSEIS, modelers developed a disease model to examine the cumulative effects of grazing domestic sheep at several locations inside and outside the Forest boundaries. While the foray model estimates the annual rate of contact of individual bighorn sheep with domestic sheep expected under each alternative, the disease model takes these contact rates, and estimates their impact on bighorn populations over time.

The disease model was constructed using a commercially available spreadsheet and was probabilistic (stochastic), using a commercially available spreadsheet add-in. Outputs generated by the disease model include distributions for annual population numbers for each of the 15 bighorn sheep herds, number of times a herd will become extirpated, and effects of each of the Alternatives examined.

Fifteen herds (Asotin, Big Canyon, Big Creek, Black Butte, Imnaha, Lostine, Main Salmon, Upper Hells Canyon, Mountain View, Myers, Redbird, Sheep Mountain, Upper Main Salmon, and Wenaha) and two areas of concern (Lick Creek and Little Salmon) were simulated in the bighorn sheep disease model. Herd populations could be extended or contracted by copying equations across the spreadsheet or by setting initial herd populations to zero, respectively. For a detailed discussion of the disease model and an example of the model inputs and outputs, please see Appendix B.

Demographic Input Specifications

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

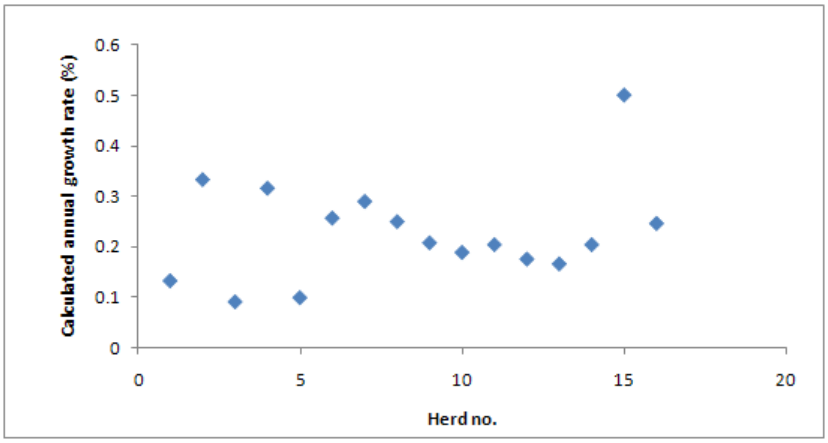
Initial herd populations—Population estimates of the 15 herds and 2 areas of concern were taken from observations recorded by the Idaho Department of Fish and Game, Oregon Department of Fish and Game, Washington Department of Fish and Wildlife, and Salmon River Bighorn Sheep Project (administered by the Nez Perce Tribe). Herd sizes ranged from 10 to 186; the areas of concern had fewer than 10 individuals. All herds together accounted for 1,033 bighorn sheep in 17 areas.

Interim herd level (IHL)—The IHL was used as a proxy for carrying capacity. The model limited population growth once the herd size approaches the IHL and populations were not allowed to exceed the IHL. The IHLs were determined from herd sizes observed in the 1980s and ranged from 34 to 975.

Nonviable herd numbers (NVNs)—The minimum population size, referred to as the NVN, was the threshold below which a population would not continue to grow at a disease-free rate and would, in fact, decline. The model used 30 individuals as the NVN for all herds except Big Canyon, Muir, and Myers—because these herds overlap, they were treated as a single herd with a combined NVN of 30.

Population growth rates—Population growth rates were calculated individually for each herd except Big Canyon, Muir, and Myers, whose populations were also combined for the population growth estimate. 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 3-14).

Figure 3-14. Calculated Growth Rate Data Model Input



Source: McCarty and Miller (1998)

The growth rate equation is from the model is complex and can be interpreted as follows. If the current population is less than the NVN, it will decline annually at a proportion equal to a set value. Conversely, if the population remains at or above the NVN and there is not a disease outbreak, the herd will continue growing at the rate described by McCarty and Miller (1998). Figure 3-14 illustrates that without disease or herd size constraints, a bighorn sheep herd will grow at the rate of 0 to 60 percent per year. Rates are typically (85 percent of the time) between 10 and 35 percent, and a 10 percent chance exists that the growth rate will be less than 10 percent or greater than 42 percent.

However, in this model, growth rate was limited by the IHL:

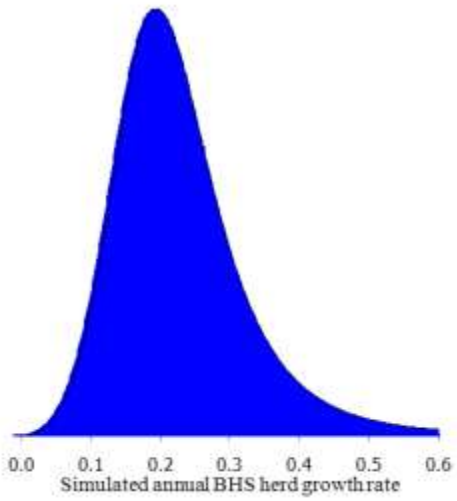
$$dN/dt = N*r*(K-N)/K$$

Where:

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

If a disease outbreak occurred in the current, but not the previous year, the growth (actually a decline) was calculated as the product of the probability of an outbreak times the disease impact.

Figure 3-15. Probability Density Function of Growth Rate without Disease Input



Epidemiologic Input Specifications

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. Values in the matrix represent the annual probability of an individual animal in a given herd making adequate contact that could result in disease transmission with at least one individual in another herd. Probability values were calculated on an individual animal basis.

The estimates of contact probabilities in the matrix were obtained from the foray and risk analyses, which were based on observations of movements of bighorn sheep in herds in the Hells Canyon and Salmon River areas.

However, this model further modifies the probability of disease transmission to account for the fact that all contacts of a bighorn sheep from a susceptible herd with animals in an infected bighorn sheep herd will not result in transmitting the disease back to the susceptible herd. Two factors may result in the lack of transmission: 1) the susceptible sheep might not contact an infectious sheep and 2) if an effective contact is made, the newly infected sheep might not return to its herd of origin. To account for these possibilities, a probability term was included in the model to reflect this <100 percent transmission probability that results from herd-level contact.

Initial herd infection status—In year one, the infection status of each bighorn sheep herd is specified by the user to indicate if the herd is susceptible or infected. In the initial year, the probability of an infection in a given bighorn sheep herd was calculated in the individual herds.

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

Bighorn sheep-to-bighorn sheep transmission—As discussed above, outbreaks occurring in year one can be initiated by the user. If none of the bighorn sheep herds were assumed to be infected in year one, the only route of infection would come from contact with a neighboring, infected domestic sheep herd.

To simplify subsequent transmission equations, an approach based on the Reed-Frost equation (Abbey 1952) was used:

$$P = 1 - q^C$$

Where:

P = the probability that a bighorn sheep from a susceptible herd will become infected—this value was 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,
C = the number of infectious individuals

The original equation was modified to reflect infection risk coming from individuals in specific herds rather than randomly distributed individuals in all bighorn sheep herds:

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

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,
C_n = 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 equation:

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

Instead of calculating the numerable combinations of how a bighorn sheep herd could become infected (e.g., by one or more infected bighorn sheep herds), the probability of avoiding infection

from the other 15 bighorn sheep herds (Q) was calculated first. That value was 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}). Please see Appendix B for an example of this calculation.

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 and the number of animals in the contact herd. The probability of any herd being the source of its own infection is zero since the probability of a herd contacting itself is zero.

Domestic sheep-to-bighorn sheep transmission—The probability of a bighorn sheep herd becoming infected from contact with an infected domestic sheep herd was calculated similar to the probability of transmission from one bighorn sheep herd to another. As for bighorn sheep transmission estimates, the probability of transmission from a domestic to bighorn sheep herd was based on bighorn sheep movement data regarding domestic sheep grazing allotments in the Forest. These probabilities vary by each bighorn sheep herd and Alternative. Please see Appendix B for an example of this calculation.

Combined bighorn sheep or domestic sheep to bighorn sheep transmission—Data were used to calculate the overall transmission probability of a bighorn sheep herd becoming infected from either an infected bighorn sheep or domestic sheep herd. This probability depends on herd size, bighorn sheep movements, and current herd infection status of contacted bighorn and domestic sheep herds.

The probability a herd becomes infected in the current year depends on the probability of the herd not avoiding adequate contact with infected sheep from either a bighorn sheep or a domestic sheep herd in the previous year. If a herd does not avoid these adequate contacts, it was simulated as becoming infected and the duration of the infection was drawn from a uniform distribution, ranging from 4 to 10 years. Finally, if none of the above was true, then the herd was simulated to have successfully avoided infection and was simulated to be noninfected in the current year.

Disease outbreak impact—The impact of a disease outbreak was measured as the product of the herd size and proportion of impact. Although an outbreak might not occur, the model tracks what the impact had an outbreak occurred. Data used to estimate this parameter were from seven suspected pneumonia outbreaks that occurred in Hells Canyon herds from 1995 to 1999. The mortality proportions in five outbreaks reported from 1995 to 1996 were 0.33, 0.50, 0.65, 0.69, and 0.75 (Table 3.2). 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. The two 1999 outbreaks involved the McGraw and Sheep Mountain herds, where approximately 80 percent 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 being assumed to have an equal probability (1/7) of occurring, except the 80 percent mortality, which was reported twice and assumed a probability of (2/7) (Table 3-2).

Table 3-2. 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. 2000c) reported a highly variable mortality rate (13 to 100 percent) during the epidemic, with a mean (SE) of 69 percent (4 percent).

Table 3-3 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 3-3. 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—When a simulated herd becomes infected, animals in the herd remain infectious for a variable length of time, generally more than a year. The duration of infectiousness ranges from 1 to 4 years and follows a uniform distribution.

For each herd, a series of three calculations was performed to determine if the herd were simulated as being infected and if so, to determine the duration of the infection, with this information being recorded with a "counter" and used to determine subsequent infections in other bighorn sheep herds.

If a herd were determined to not be infected, the cell value was 0. If the herd were infected, this cell would take on a value ranging from 1 to 4. Once infected, a herd was assumed to remain infectious for 1 to 4 years, and the probability of the duration would follow a uniform distribution, meaning the probability of being infectious was equal for each year, or 25 percent each.

In the second and subsequent years of disease introduction into a bighorn sheep herd, the impact was assumed to be between 0 and –13 percent, with a uniform distribution. Note that during this time, the herd might be infectious for multiple years. However, the herd would not be susceptible

since the extended adverse growth period implies an endemic level of disease in the population, which implies the herd is currently infected and not susceptible until the following year.

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

Extended adverse effect impact—The adverse effect due to disease in a bighorn sheep herd was represented as the depressed population growth rate, which was simulated during the adverse effect duration as described above. The population growth rate for a diseased herd was assumed to range from –13 to 0 percent with a uniform distribution. Therefore, if a herd was infected in the current year, it would have an adverse population growth, ranging from a low of –13 percent to a high of 0 percent (no change). This adverse impact will vary, but remain within this range for the duration of the adverse effect period. Appendix B contains an example that illustrates how this information is used in the model simulation.

Stochastic Features of the Model Using @RISK

@RISK is an EXCEL add-in, which permits the model to include components of uncertainty and variability, thereby expanding 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.

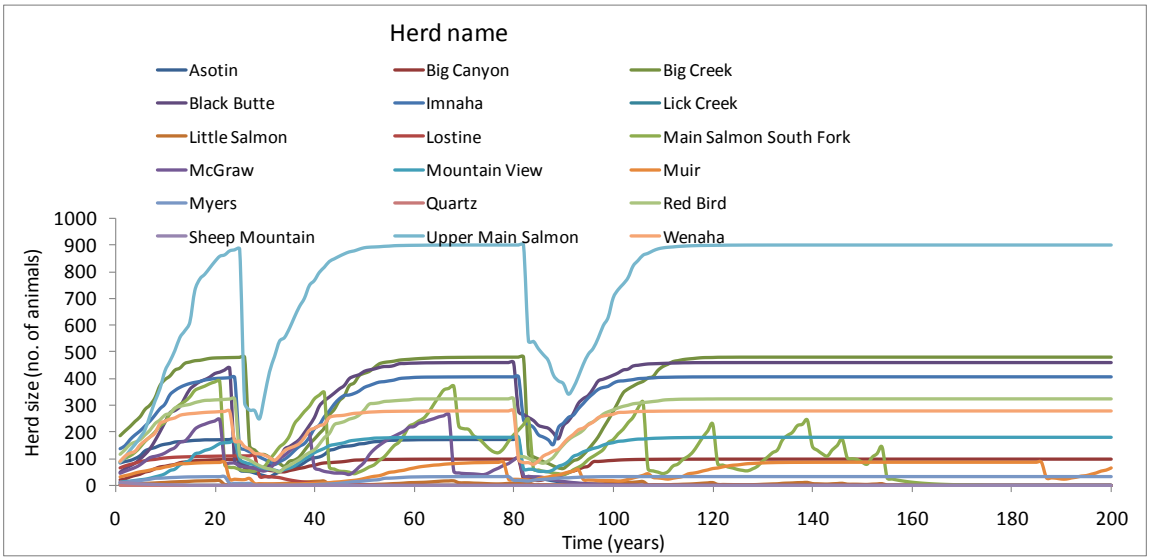
When constructing the model, the user can either select “Random Values,” which will give a new value for each new calculation or the “Static Values” option, which will show a single value that does not change as new calculations are made. (Note: regardless of the option selected, when iterations are performed @RISK will use random values, which will result in stochastic simulations.)

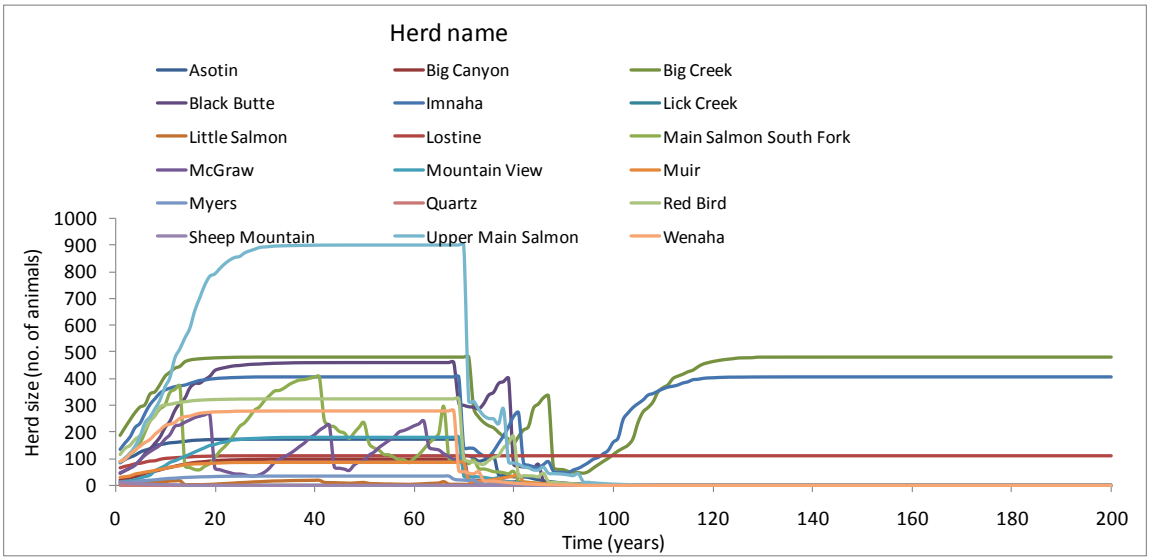
The type of random sampling (Sampling Type) used in the stochastic simulations can be either Monte Carlo (MC) (completely random) or Latin Hypercube, (a stratified random sampling technique), which samples for a portion of the distribution based on its probability of occurring. In practice, MC is selected if you want complete randomness to be simulated, and Latin Hypercube is selected if you want to make sure your iterations are truly representative of the population distribution you are sampling from. If the number of iterations is large (i.e., $\geq$1,000), the results will be similar, regardless of sampling type selected.

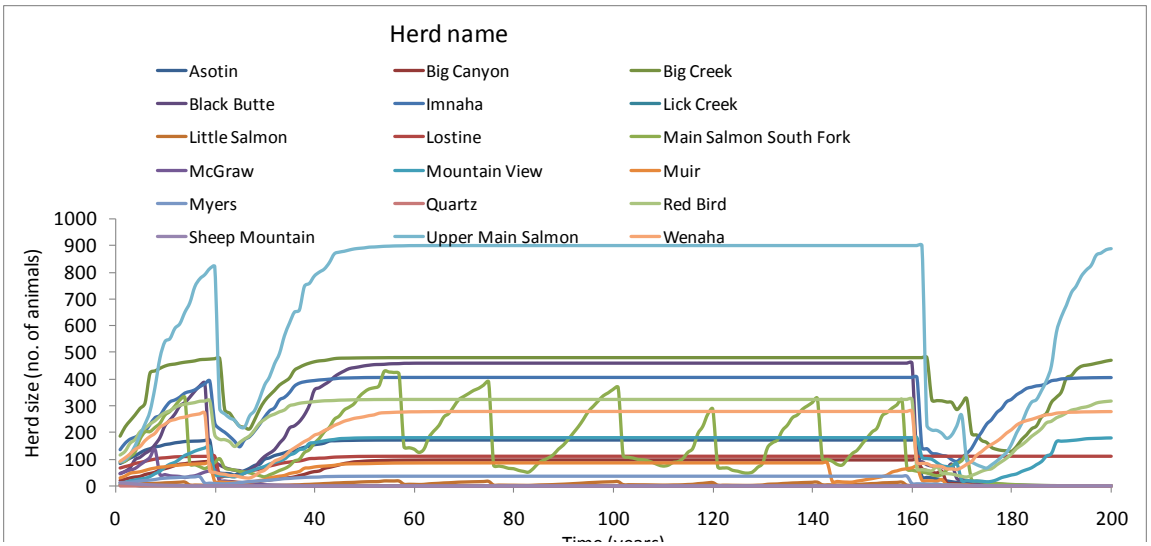
Examples of the simulated individual herd populations for different outbreak results over 200 years are presented in Figure 3-16. Different outbreak results are presented to illustrate the stochastic nature of the model—each time the model is run, the results are different. These outputs were chosen because they show the range of possible outcomes that might result from a single management scenario.

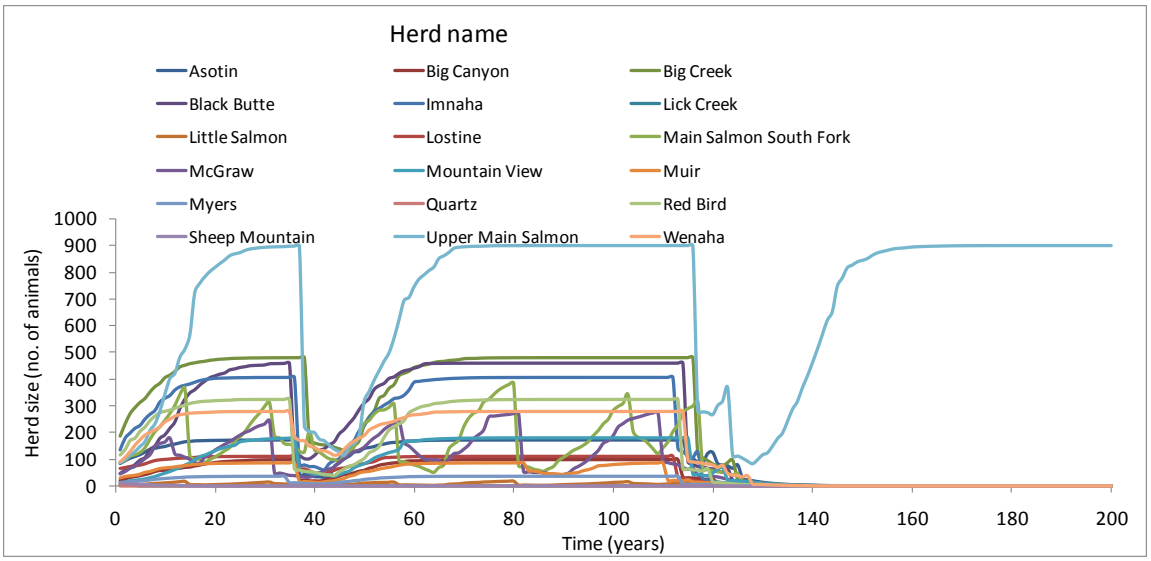
Although the examples are shown for 200 years, the model is designed to simulate events over 1,000 years.

Figure 3-16. Four Examples of the Outputs Possible from the Disease Model for a Single Management Scenario.









Summary

Bighorn sheep currently occupy only an estimated 30 percent of historic habitats at population levels significantly diminished from pre-Euroamerican settlement (approximately 10 percent). 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. Addressing the potential for contact 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, and proximity of domestic sheep to bighorn sheep).

The aforementioned analyses 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. The results of these analyses allow the

modeling of the potential outcomes of interspecies contact on the persistence of bighorn sheep populations on and adjacent to the Payette National Forest.

Consistent with 36 CFR §219.20(a), these following pages will supplement the Direct and Indirect Effects by Alternative section, page 3-316, of the Chapter 3 Terrestrial Wildlife Habitat and Species section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement, and updates the Terrestrial Wildlife Habitat and Species Environmental Consequences section, pages 3-23 thru 3-69 of the DSEIS.

ENVIRONMENTAL CONSEQUENCES

Direct and Indirect Effects by Alternative

Species of Special Interest

Bighorn Sheep

Viability

The DSEIS was written in response to direction from the Forest Service Chief (Chief) to analyze bighorn sheep viability commensurate with the concerns and questions raised in the appeal decision related to the potential impacts of disease transmission from domestic sheep grazed on the Payette National Forest. However, the metapopulation structure of bighorn sheep is complicated by the fact that only portions of two different metapopulations occur within the Payette National Forest boundaries. Traditional population viability analyses are usually done within the context of isolated populations (Hanski 1998), and a viability analysis restricted to bighorn sheep on the Payette National Forest is meaningless unless the dynamics of the metapopulation are also considered. Therefore, viability discussions will need to go beyond the borders of the Payette National Forest, although the analysis of how domestic sheep use of the Payette National Forest affects the two metapopulations is relevant.

Viability is generally expressed using two components—number of individuals and time, which can be used to describe population persistence over time. For example, Thompson (1991) describes population persistence as 99 percent of the population persisting for 1,000 years, or 95 percent persisting over 100 years (Thompson 1991). Singer and Gudorf (1999) found no unequivocal minimum viable number for bighorn sheep, but suggest a minimum population size of 100 individuals if disease is not a factor, and 300 individuals to buffer against the loss of genetic heterozygosity if severe or moderate epizootics are present. Singer et al. (2001) also found a strong correlation of population persistence with larger habitat patch sizes, greater distances from domestic sheep, higher population growth rates, greater home-range sizes, larger population sizes, and migratory movements. Larger populations (> 250 animals) were more likely to recover following an epizootic, but habitat patch size was the primary correlate of both population performance and persistence (Singer et al. 2001).

Source Habitats

Current source habitat does not appear to be limiting for bighorn sheep, as much of the apparently suitable bighorn habitat appears to be unoccupied (HCBSRC 1997). At scales below the Forest or watershed level, however, it is expected that the quality of habitat can have

variances that cannot be detected at larger scales. The 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement (FEIS) included successional modeling of both forested potential vegetation groups and sagebrush cover types. Comparable modeling was not completed for bighorn sheep habitat, as the information needed to model the change through time of grasslands, mountain mahogany, bitterbrush, and forest cover types with ≤ 10 percent canopy cover is sparse or unavailable.

The FEIS did, however, provide information on the trends of grassland vegetative response under each of the seven alternatives and ranked the alternatives (pages 3-572 through 3-574). This discussion represented generalized grassland trends for the entire Ecogroup (Payette, Boise, and Sawtooth National Forests) and was not specific to the Payette National Forest, although it did consider those management areas (i.e., Hells Canyon, Snake River, and Weiser River) that overlap the Hells Canyon bighorn sheep metapopulation and contain some of the higher risk domestic sheep allotments and trailing routes. Furthermore, these generalized trends represent more than bighorn sheep habitat but do not account for the escape terrain and other special habitat features important to bighorn sheep. Bighorn sheep habitat is a subset of these trends for grassland response.

The FEIS also discussed the generalized trends for deciduous riparian vegetation under the seven alternatives (pages 3-575 through 3-576), which Wisdom et al. (2000) identified as a special habitat feature. Again, bighorn sheep habitat is a subset of deciduous riparian vegetation. Sagebrush cover types and their component grassland successional stages are discussed on pages 3-539 through 3-572 of the FEIS.

Other factors that affect bighorn sheep habitat include patch dynamics of nonforest and forested habitats, and their juxtapositions to each other. For example, suppression of wildfires for several decades has resulted in a reduced fire return interval and larger wildfires in some vegetation types. One effect has been that the patch size of burned areas has increased relative to historical conditions, which has occurred to some extent, on the community types used by bighorn sheep. However, without specific information on the juxtaposition of needed patches on the landscape (size and arrangement) for this species, it is difficult to further compare trends with the species' needs. Patch dynamics, which vary historically, may affect dispersal between source habitat patches for bighorn sheep. Although bighorn sheep can use a diverse array of terrestrial and aquatic systems for movement across the landscape, alteration of historical vegetation dynamics can potentially affect migratory routes. Large patch sizes of burned areas can open up forested and dense shrub areas to bighorn sheep. In some fire regimes, these large patch sizes would have been historically present. However, their location on the landscape shifts over time as a burned area successes back to denser vegetation and new areas experience periodic disturbances. Livestock grazing practices can affect the balance between shrub and herbaceous vegetation and contribute to changes in the floristic composition of grass and shrub communities, both of which can result in altered fire regimes. These changes can also contribute to altering historical patch sizes.

In addition to patch dynamics, habitat quality is an important predictor of whether a species may be present. Degradation of habitat quality through exotic weed invasions is a threat to habitat for this species. Depending on the type of exotic weed, food resources can be depleted and fire cycles disrupted, which can further alter species composition and structure. Livestock grazing

can contribute to exotic weed invasions and damage to biological soil crusts, which can contribute to declines in source habitat quality.

Associated riparian areas within the ecosystem may also be affected by livestock grazing, with declines in habitat quality. Riparian systems can be particularly susceptible to livestock concentrations and grazing damage (Berry 1979). Defoliation; soil compaction; and floodplain water table subsidence, due to channel widening or downcutting, have resulted in the loss of densely rooted sedges and rushes and willows, cottonwoods, and other woody species (Berry 1979, Kovalchik and Elmore 1992). Natural recovery of native riparian vegetation once occurring along the margins of the riparian area may be extremely slow, even with reductions in livestock grazing because of deteriorating physical conditions of the stream during the last 150 years, dominance of exotic annuals within the riparian area, and loss of native seed sources (Clary et al. 1996). Livestock grazing can affect riparian vegetation by altering vegetation composition and seral stages. Excessive runoff from poor condition sagebrush and grasslands and direct damage to riparian vegetation and stream banks can result from livestock grazing and trampling, road construction, and recreational use (Blaisdell et al. 1982). Often, lowered water tables, resulting from heavy grazing pressure, have modified or destroyed normal riparian vegetation (Blaisdell et al. 1982), which has affected riparian ecosystem function. The ability of streams, associated vegetation, and wildlife populations to recover after reducing grazing stress appears to be situation specific and related to site characteristics, degree of degradation, and availability of native plant materials (Shaw 1992, Krueper 1993).

Human activities are also primary sources of potential habitat degradation for bighorn sheep. Roads can be a source of direct mortality through vehicle strikes, and their presence can increase disturbance to bighorn sheep during critical periods throughout the year. Road construction can exacerbate effects from other risk factors, such as the spread of exotic species. Another human factor that can accelerate risks associated with roads and weeds is the dramatic increase of off-highway vehicle use, which can facilitate expansion of invasive species and adversely increase the potential for human disturbance and unlawful take. Roads and trails provide the primary access corridors for invasive plants, and some invasive species are able to out-compete native species, which can result in a substantial change in the overall biological diversity of the affected area and changes in historic fire regimes. The susceptibility of source habitat to weed establishment is important to investigate at finer scales in relation to ground-disturbing activities, such as prescribed fire, roads, livestock grazing, energy development/exploration, etc. Finally, winter recreation can also disturb bighorn sheep.

The DSEIS alternatives vary in the acres of rangelands located outside each alternative. The general effects listed above will also vary according to available rangelands, trailing routes, roads, and human disturbance associated with each alternative. This analysis can be an oversimplification as site specific ecological conditions and livestock grazing practices will have different effects on more localized areas. Although habitat is not limiting at a forest-wide scale on the Payette National Forest, these localized effects can limit habitat in some areas.

Evaluation Methods Used to Analyze Risk of Contact between Domestic and Bighorn Sheep and Implications for Disease Transmission

Outputs derived from the three models are used as a basis for comparing alternatives with respect to to the risk of contact between domestic and bighorn sheep, and to estimate implications for

disease transmission between the species. Three factors are considered in assessing the potential impacts of disease on populations: 1) rate of contact between bighorn sheep and domestic sheep, 2) probability that contact will result in transmission of disease, and 3) effect of disease on the bighorn sheep population.

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oversimplification as site specific ecological conditions and livestock grazing practices will have different effects on more localized areas. Although habitat is not limiting at a forest-wide scale on the Payette National Forest, these localized effects can limit habitat in some areas.

Evaluation Methods Used to Analyze Risk of Contact between Domestic and Bighorn Sheep and Implications for Disease Transmission

Outputs derived from the three models are used as a basis for comparing alternatives with respect to the risk of contact between domestic and bighorn sheep, and to estimate implications for disease transmission between the species. Three factors are considered in assessing the potential impacts of disease on populations: 1) rate of contact between bighorn sheep and domestic sheep, 2) probability that contact will result in transmission of disease, and 3) effect of disease on the bighorn sheep population.

Modeling completed by Clifford et al. (2007) also suggests that for some bighorn populations, there is likely no, or an extremely minimal, level of contact at which a bighorn population can persist. For the Sierra Nevada bighorn populations that they modeled, they estimated that a 2 percent annual risk of contact would result in at least one respiratory disease outbreak causing greater than 40 percent bighorn sheep mortality with a 50 percent probability during the next 70 years.

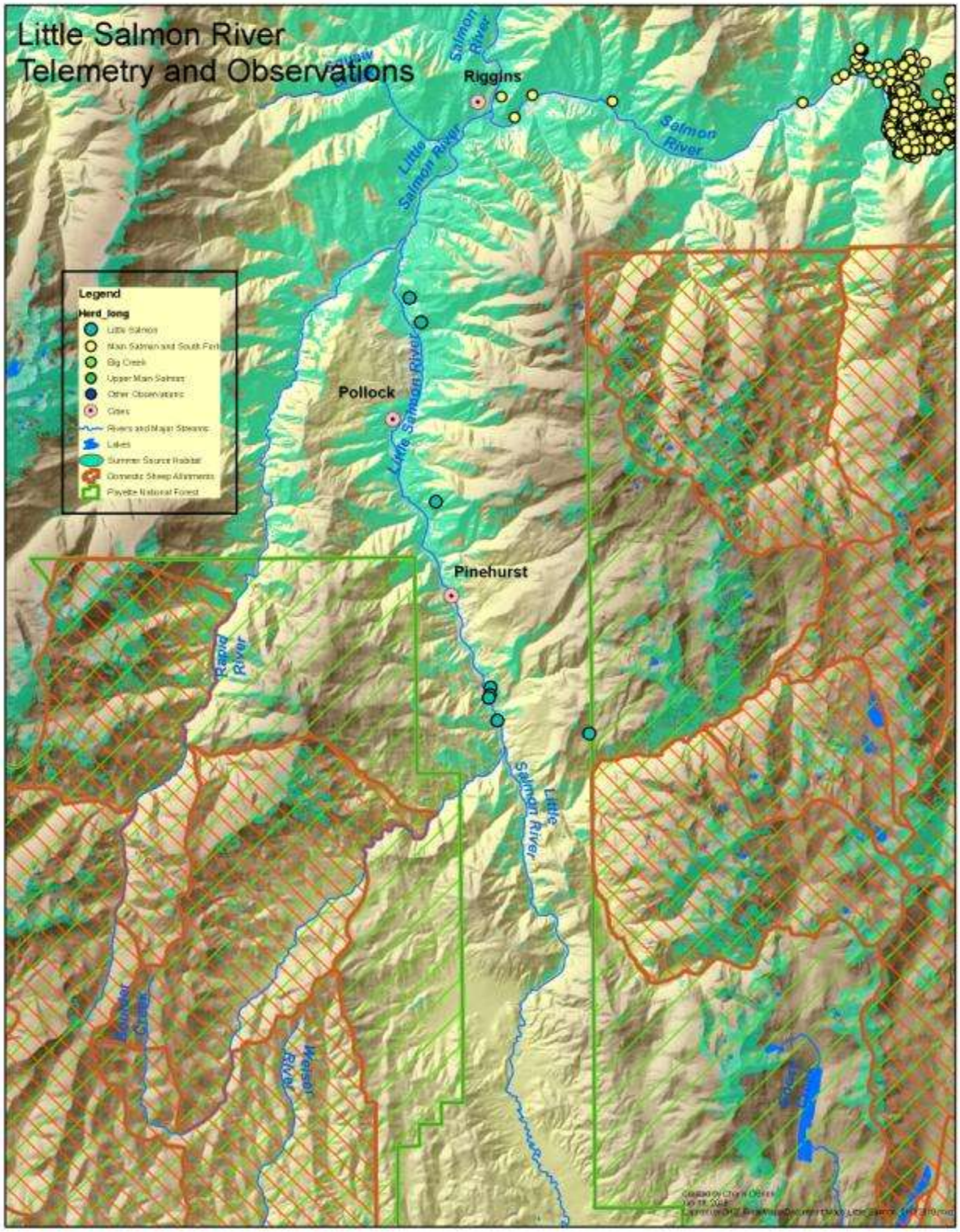
In the current analysis, the rate of contact was estimated by using a large and robust telemetry data set to model core herd home ranges and bighorn sheep forays outside of home ranges relative to the availability of source habitats. Outputs of the core herd home range and foray analyses were used to determine the likely rate of bighorn sheep contact with domestic sheep allotments.

Comparison of Alternatives

Considerations in Evaluating Alternatives

Alternatives were evaluated on their merits for providing separation, and minimizing likelihood of contact, between bighorn sheep and domestic sheep on seven bighorn sheep populations on, and adjacent to, the Payette National Forest. These include Big Canyon, Little Salmon, Main Salmon South Fork, Muir, Myers, Sheep Creek and Upper Hells Canyon. Other populations were analyzed, but are not included in the DEIS. These include Big Creek and Upper Salmon River, and Lostine. Little Salmon was included because recent observations (both incidental and telemetry) suggest that some animals already occupy the area and that there is a high likelihood that a new population has been or will soon form in the area. The Little Salmon animals may comprise an important connectivity population between the two metapopulations (Fig.x).

Figure 3-17. Telemetry Data and Observations for the Little Salmon River.



Source Habitat Model - Bighorn Sheep Summer Source Habitats

Although both summer (May to October) and winter (November to April) bighorn sheep source habitats were evaluated (see Technical Report), we focused primarily on summer source habitats, as domestic sheep are mostly present on the Payette National Forest and in close proximity to bighorn sheep source habitats during this period. The source habitat model was used to estimate, for each alternative, the amount of bighorn sheep summer source habitat receiving protection and the percentage of rangelands on the Payette NF identified as suited for domestic sheep grazing. The juxtaposition and distances between bighorn sheep summer source habitats and suited rangelands for domestic sheep are important attributes and influence the probability of contact between the species. The alternatives exhibit substantial variation on both measures. The percentage of summer source habitat protected varies from 0% (Alternative 1257) to 100% (Alternative E). Similarly, the percentage of rangelands designated as suited for domestic sheep varies between 0% (Alternative E) to 100% (Alternative 1257). Alternative maps spatially display these areas on and adjacent to the Payette National Forest. Table 3-4 displays the amount and percent of summer source habitat protected, and remaining suited rangelands by alternative.

Table 3-4. Comparison of Alternatives Displaying Protected Summer Source Habitats for Bighorn Sheep, and Remaining Suited Habitats for Grazing in Summer Bighorn Sheep Habitat.

Alternative	Protected BHS Summer Habitat (Acres)	Protected BHS Summer Habitat (Percent)	Suitable Range Acres	Suitable Range Percent
1b, 2, 5, 7	0	0.00%	100310	100.00%
3, 4, 6	33918	9.20%	93082	92.79%
7E	368641	100.00%	0	0.00%
7G	263338	71.43%	38468	38.35%
7L	315715	85.64%	64311	64.11%
7M	338934	91.94%	43245	43.11%
7N	337532	91.56%	38392	38.27%
7O	346696	94.05%	31592	31.49%
7P	332372	90.16%	46106	45.96%

Risk of Contact Model - Contact between Bighorn Sheep and Domestic Sheep

The Contact Model (core home range and foray analyses) is perhaps the most critical aspect of the analysis, as the consequences of interspecies contact are potentially severe for bighorn sheep. Because the model is based on a large telemetry data set and corroborated with source habitats, it is considered a reliable proxy for how bighorn sheep utilize landscapes in Hells Canyon and the Salmon River metapopulations, and can be used to determine the likelihood that bighorn sheep will transect domestic sheep allotments. Obviously, the lower the probability of contact, the more likely a bighorn sheep population will persist. At current population sizes, the number of contacts with allotments expected each year varies among alternatives from 0 for Alternative E to 1.33 for Alternative 1257. For all alternatives, the Main Salmon South Fork and Upper Hells Canyon populations contributed the greatest number of contacts, due to their combination of relatively large population sizes and proximity to domestic sheep allotments. Table 3-5 displays

modeled contacts per year for bighorn sheep populations on and adjacent to the Payette National Forest. A contact is considered a bighorn sheep transecting a domestic sheep allotment boundary.

Table 3-5. Contact between bighorn sheep and domestic sheep allotments for seven bighorn sheep herds on the Payette National Forest

Herd Name	Population Estimate	1257	346	7G	7L	7M	7N	7O	7P
Big Canyon	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Little Salmon	4	0.07	0.07	0.04	0.04	0.03	0.01	0.01	0.03
Main Salmon South Fork	210	1.01	1.01	0.35	0.31	0.19	0.08	0.04	0.12
Upper Hells Canyon	45	0.15	0.15	0.09	0.13	0.05	0.03	0.03	0.05
Muir	30	0.06	0.03	0.01	0.01	0.00	0.00	0.00	0.00
Myers	10	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Sheep Mountain	11	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
CONTACTS/year		1.33	1.27	0.49	0.50	0.28	0.13	0.09	0.21

Disease Model - Bighorn Sheep Population Persistence

Lastly, the Disease Model displays the potential effects of contact on the persistence of bighorn sheep populations in these metapopulations. Rates of contact for the seven bighorn sheep populations in the Hell's Canyon and Salmon River metapopulations were used as inputs to the Disease Model. One important summary of the disease model output is the probability of herd extirpation over the next 100 years, given assumptions of contact and disease transmission. The complexity of the model, and number of variables whose estimation was necessary to run it (i.e. demographic characteristics of bighorn sheep herds, disease transmission rates resulting from contact between domestic sheep and bighorn sheep, disease transmission rates resulting from infected bighorn sheep contacting uninfected bighorn sheep, lethality of the diseases, time of recovery in infected bighorn sheep herds, etc.) imply a high degree of uncertainty of its results. Although the model does follow well-documented and logical processes, the results should be viewed as a means of comparing the relative impacts of alternatives, not as "hard and fast values". Results of the model also support our current understanding of these bighorn sheep populations, and outputs can be explained based on the understanding of contact/disease outcomes resulting from contact. Because there is so much uncertainty surrounding the probability that contact of a bighorn sheep with an allotment will lead to infection of its herd with pneumonia, we ran the disease model with a range of values running from 0.05 (1 in 20 contacts would result in a disease event) to 1.00 (every contact would result in a disease event). Extirpation probabilities were analyzed for seven populations. The timeframe used was 100 years for each of the herds.

Figure 3-18. Modeled Probability of Extirpation for Seven Bighorn Sheep Populations Under Varying Assumptions of Contact Leading to Disease Outbreaks.

Big Canyon						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_1257	0.196	0.261	0.364	0.519	0.612	0.698
Alt_346	0.156	0.205	0.264	0.371	0.46	0.538
Alt_7G	0.089	0.107	0.13	0.171	0.196	0.228
Alt_7L	0.097	0.111	0.156	0.188	0.242	0.289
Alt_7M	0.057	0.099	0.132	0.177	0.216	0.238
Alt_7N	0.04	0.06	0.109	0.151	0.189	0.213
Alt_7O	0.035	0.046	0.104	0.138	0.178	0.207
Alt_7P	0.051	0.089	0.126	0.172	0.213	0.249
No Allotments	0	0	0	0	0	0

Little Salmon						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_1257	0.417	0.694	0.933	0.995	0.999	1
Alt_346	0.376	0.645	0.931	0.995	0.999	1
Alt_7G	0.148	0.282	0.558	0.818	0.931	0.973
Alt_7L	0.151	0.257	0.532	0.793	0.918	0.958
Alt_7M	0.076	0.176	0.369	0.605	0.754	0.861
Alt_7N	0.034	0.074	0.203	0.334	0.501	0.594
Alt_7O	0.022	0.04	0.129	0.211	0.292	0.393
Alt_7P	0.051	0.12	0.251	0.481	0.616	0.728
No Allotments	0	0	0	0	0	0

Main Salmon South Fork						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_1257	0.417	0.694	0.933	0.995	0.999	1
Alt_346	0.376	0.645	0.931	0.995	0.999	1
Alt_7G	0.148	0.282	0.558	0.818	0.931	0.973
Alt_7L	0.151	0.257	0.532	0.793	0.918	0.958
Alt_7M	0.076	0.176	0.369	0.605	0.754	0.861
Alt_7N	0.034	0.074	0.203	0.334	0.501	0.594
Alt_7O	0.022	0.04	0.129	0.211	0.292	0.393
Alt_7P	0.051	0.12	0.251	0.481	0.616	0.728
No Allotments	0	0	0	0	0	0

Muir						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_1257	0.198	0.266	0.371	0.534	0.628	0.72
Alt_346	0.158	0.209	0.267	0.378	0.476	0.552
Alt_7G	0.096	0.111	0.132	0.174	0.2	0.23
Alt_7L	0.102	0.114	0.157	0.19	0.245	0.295
Alt_7M	0.059	0.105	0.136	0.179	0.221	0.244
Alt_7N	0.041	0.064	0.111	0.152	0.194	0.218
Alt_7O	0.036	0.049	0.104	0.138	0.182	0.211
Alt_7P	0.052	0.093	0.129	0.176	0.22	0.255
No Allotments	0	0	0	0	0	0

Myers						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_1257	0.217	0.284	0.391	0.558	0.652	0.735
Alt_346	0.177	0.231	0.293	0.409	0.513	0.592
Alt_7G	0.106	0.12	0.159	0.192	0.222	0.252
Alt_7L	0.113	0.124	0.182	0.215	0.274	0.324
Alt_7M	0.068	0.115	0.155	0.203	0.243	0.27
Alt_7N	0.046	0.075	0.127	0.174	0.206	0.23
Alt_7O	0.039	0.054	0.12	0.157	0.202	0.23
Alt_7P	0.061	0.105	0.15	0.2	0.245	0.282
No Allotments	0	0	0	0	0	0

Upper Hells Canyon						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_1257	0.527	0.777	0.952	0.994	0.999	1
Alt_345	0.489	0.726	0.94	0.995	0.999	1
Alt_7G	0.297	0.512	0.801	0.957	0.989	0.995
Alt_7L	0.367	0.588	0.881	0.987	0.995	1
Alt_7M	0.165	0.323	0.633	0.834	0.932	0.967
Alt_7N	0.093	0.174	0.402	0.673	0.806	0.891
Alt_7O	0.084	0.151	0.375	0.635	0.796	0.89
Alt_7P	0.145	0.294	0.587	0.84	0.931	0.97
No Allotments	0	0	0	0	0	0

Sheep Mountain						
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1**
Alt_346	1	1	1	1	1	1
Alt_1257	1	1	1	1	1	1
Alt_7G	1	1	1	1	1	1
Alt_7L	1	1	1	1	1	1
Alt_7M	1	1	1	1	1	1
Alt_7N	1	1	1	1	1	1
Alt_7O	1	1	1	1	1	1
Alt_7P	1	1	1	1	1	1
No Allotments	1	1	1	1	1	1

Alternatives

Alternative 1257

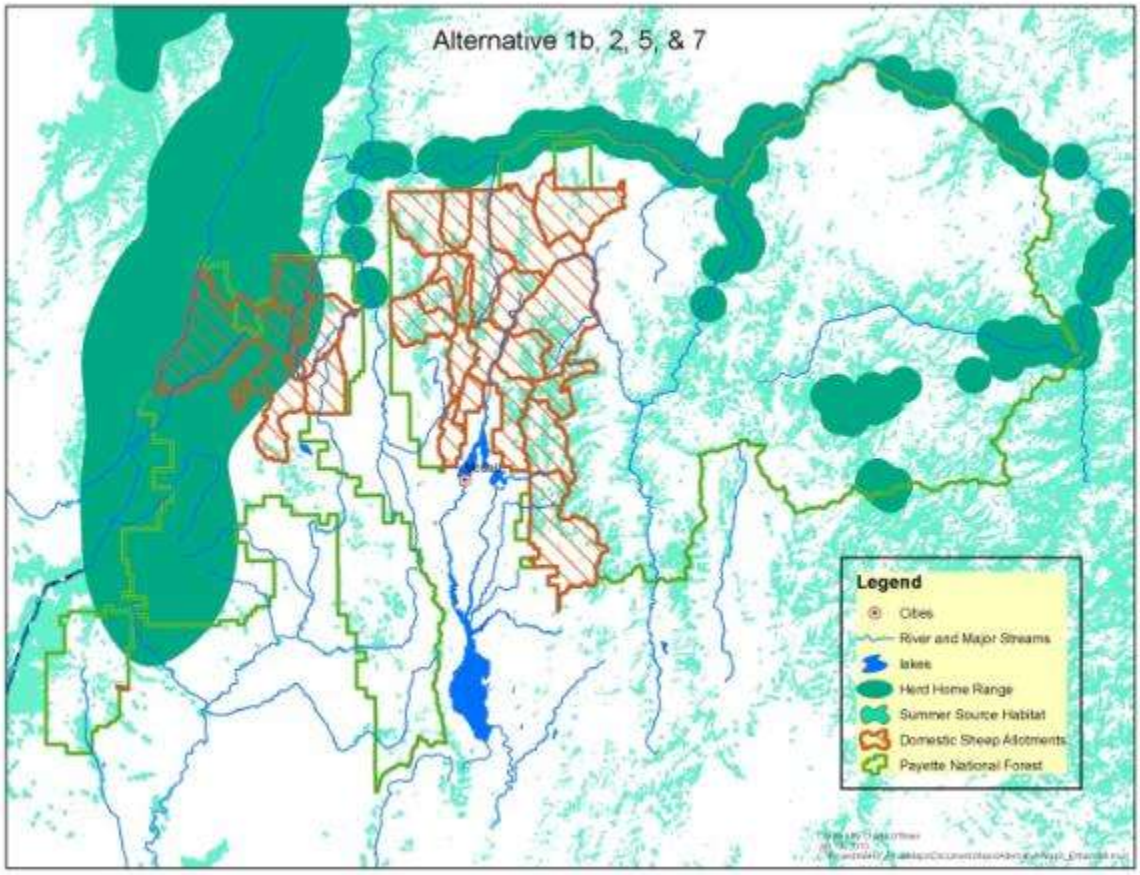
This alternative leaves all allotments open. No bighorn sheep summer habitats are protected from domestic sheep grazing. This alternative results in the highest likelihood of contact between bighorn sheep and domestic sheep (1.33 contacts/year) with most of the contacts occurring in the Main Salmon South Fork and Upper Hells Canyon populations.

The Little Salmon, Main Salmon South Fork, and Upper Hells Canyon populations have a high probability of extirpation under this alternative, even when the probability of contact resulting in an outbreak is assumed to be low (e.g. 1 in 20 or 0.05). All populations have a high likelihood of extirpation if the probability of an outbreak resulting from contact is 0.5 (1 in 2).

Table 3-6. Modeled Probability of Extirpation of Seven Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 1257.

Alternative _1257	P(Outbreak | Intersection with an allotment)					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.196	0.261	0.364	0.519	0.612	0.698
Little Salmon	0.417	0.694	0.933	0.995	0.999	1
Main Salmon S. Fk.	0.417	0.694	0.933	0.995	0.999	1
Muir	0.198	0.266	0.371	0.534	0.628	0.72
Myers	0.217	0.284	0.391	0.558	0.652	0.735
Upper Hells Canyon	0.527	0.777	0.952	0.994	0.999	1
Sheep Mountain	1	1	1	1	1	1

Figure 3-19. Alternative 1257. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest.



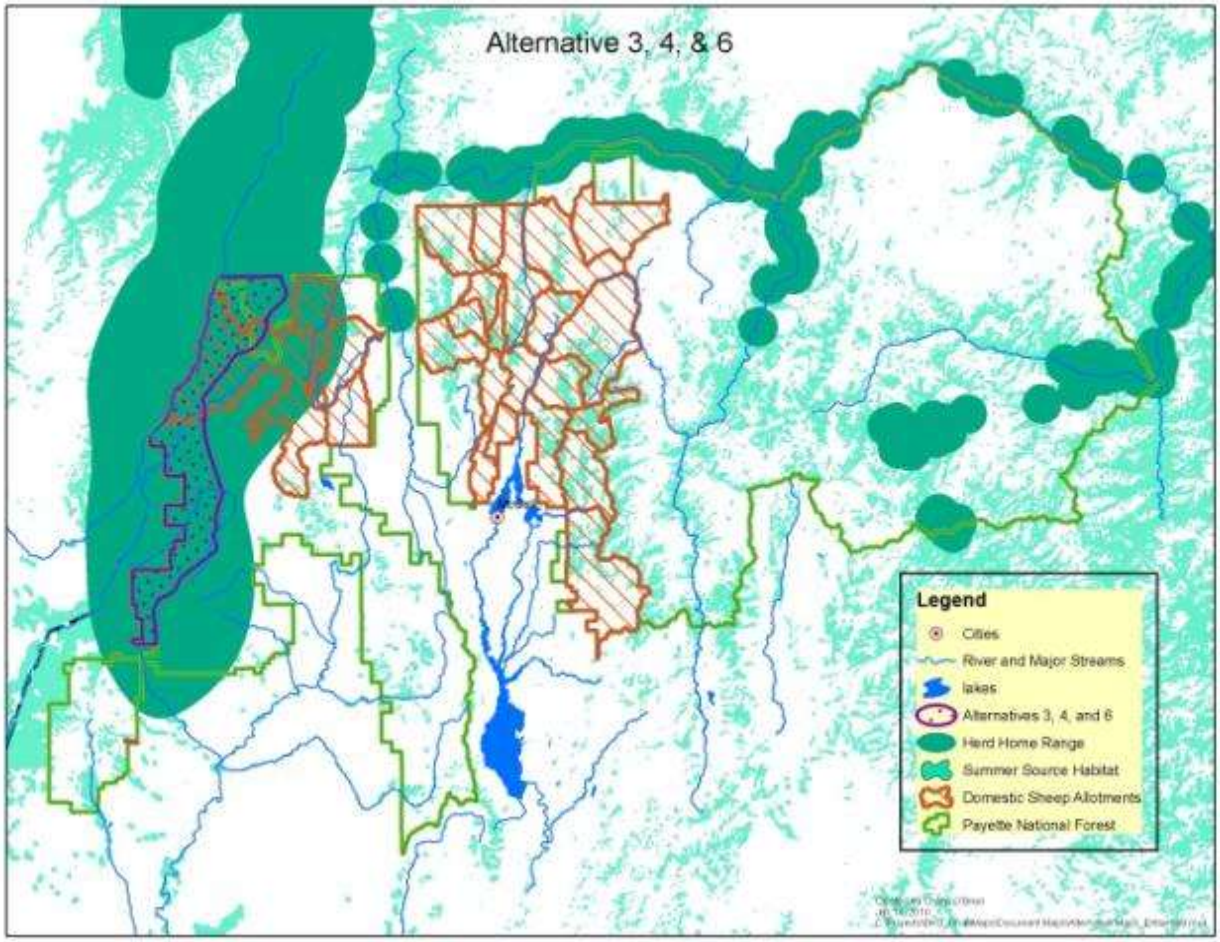
Alternative 346

This alternative protects 9.2% of the summer bighorn sheep habitat on the Payette National Forest. Approximately 93% of the suited rangelands where domestic sheep grazing is currently permitted are retained. This alternative results in the second highest rate of contact between bighorn sheep and domestic sheep allotments (1.27 contacts/year). As with the previous alternative, most of the contacts occur in the Main Salmon South Fork and Upper Hells Canyon populations, however low rates of contact are expected in all herds, with the exception of Big Creek. As with Alternative 1257, there is a high likelihood of extirpation of the Upper Hells Canyon, Main Salmon and Little Salmon populations even when contact/outbreak probabilities are assumed to be low. The scenario under this alternative appears to be slightly better for bighorn sheep populations in Hells Canyon.

Table 3-7. Modeled Probability of Extirpation of Four Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 346.

Alternative _346	**P(Outbreak | Intersection with an allotment)**					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.156	0.205	0.264	0.371	0.46	0.538
Little Salmon	0.376	0.645	0.931	0.995	0.999	1
Main Salmon S. Fk.	0.376	0.645	0.931	0.995	0.999	1
Muir	0.158	0.209	0.267	0.378	0.476	0.552
Myers	0.177	0.231	0.293	0.409	0.513	0.592
Upper Hells Canyon	0.489	0.726	0.94	0.995	0.999	1
Sheep Mountain	1	1	1	1	1	1

Figure 3-20. Alternative 346. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest.



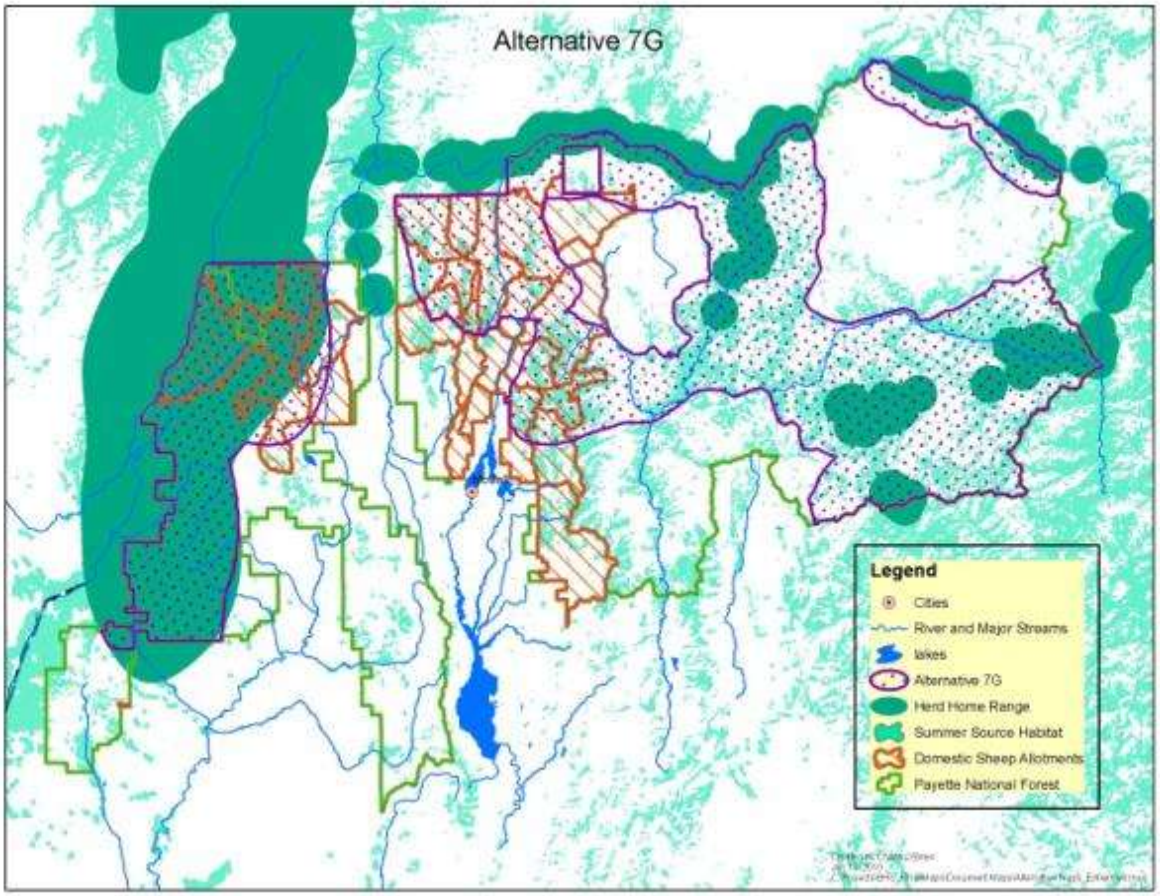
Alternative 7G

This alternative protects 9.2% of the summer bighorn sheep habitat on the Payette National Forest. Approximately 93% of the suited rangelands where domestic sheep grazing is currently permitted are retained. This alternative results in the second highest rate of contact between bighorn sheep and domestic sheep allotments (1.27 contacts/year). As with the previous alternative, most of the contacts occur in the Main Salmon South Fork and Upper Hells Canyon populations, however low rates of contact are expected in all herds, with the exception of Big Creek. As with Alternative 1257, there is a high likelihood of extirpation of the Upper Hells Canyon, Main Salmon and Little Salmon populations even when contact/outbreak probabilities are assumed to be low. The scenario under this alternative appears to be slightly better for bighorn sheep populations in Hells Canyon.

Table 3-8. Modeled probability of extirpation of four bighorn sheep populations under varying assumptions for probabilities of contact leading to disease transmission and outbreaks for Alternative 7G.

Alternative 7G	P(Outbreak | Intersection with an allotment)					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.089	0.107	0.13	0.171	0.196	0.228
Little Salmon	0.148	0.282	0.558	0.818	0.931	0.973
Main Salmon S. Fk.	0.148	0.282	0.558	0.818	0.931	0.973
Muir	0.096	0.111	0.132	0.174	0.2	0.23
Myers	0.106	0.12	0.159	0.192	0.222	0.252
Upper Hells Canyon	0.297	0.512	0.801	0.957	0.989	0.995
Sheep Mountain	1	1	1	1	1	1

Figure 3-21. Alternative 7G. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest.



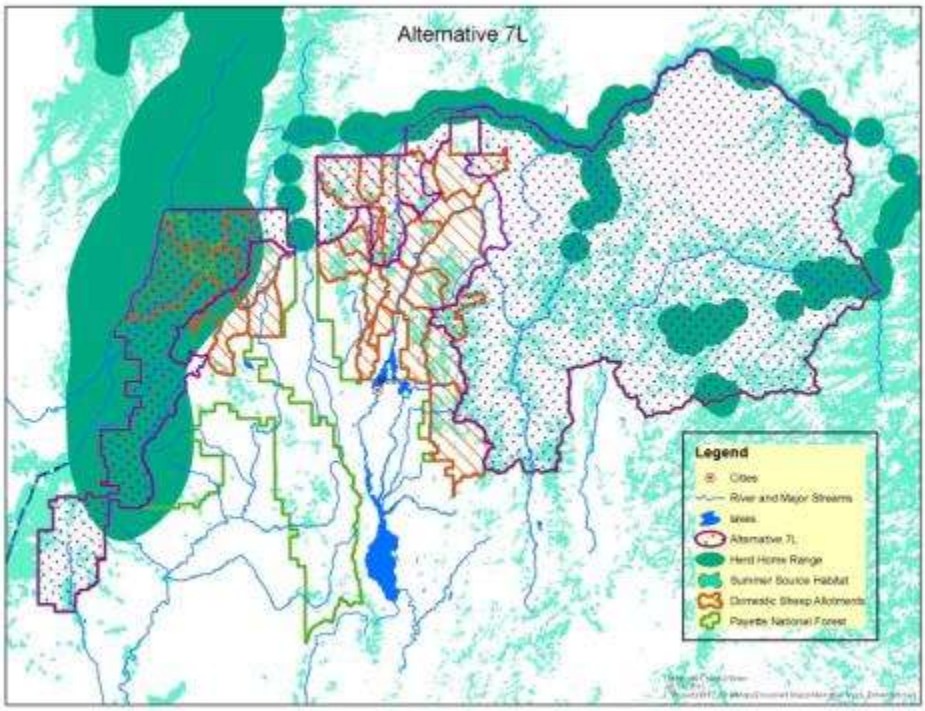
Alternative 7L

Under Alternative 7L, 85.6% of bighorn sheep summer habitat is protected. Approximately 64% of rangelands suited for domestic sheep are retained. Implementation of this alternative would result in 0.50 contacts/year between bighorn sheep and domestic sheep allotments. Although this alternative provides protection to additional bighorn sheep summer source habitats, it retains a higher percent of suited rangelands for domestic sheep grazing. The outcomes for this alternative are similar to those described for Alternative 7G.

Table 3-9. Modeled Probability of Extirpation of Four Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 7L.

Alternative L	**P(Outbreak | Intersection with an allotment)**					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.097	0.111	0.156	0.188	0.242	0.289
Little Salmon	0.151	0.257	0.532	0.793	0.918	0.958
Main Salmon S. Fk.	0.151	0.257	0.532	0.793	0.918	0.958
Muir	0.096	0.111	0.132	0.174	0.2	0.23
Myers	0.113	0.124	0.182	0.215	0.274	0.324
Upper Hells Canyon	0.367	0.588	0.881	0.987	0.995	1
Sheep Mountain	1	1	1	1	1	1

Figure 3-22. Alternative 7L. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest.



Alternatives 7M and 7P

Alternatives 7M and 7P were combined because the outputs from implementing these alternatives have similar environmental consequences for bighorn sheep. Alternatives M and P protect 92% and 91% of bighorn sheep summer habitats, respectively; and retain 43% and 46% of rangelands suited for domestic sheep, respectively. Annual rates of contact for Alternatives 7M and 7P are 0.28 and 0.21, respectively. Although contact estimates are lower than previously discussed alternatives, there is still is a high likelihood of extirpation, even with moderate assumptions on contact (e.g. 0.25 probability of an outbreak resulting from a contact) leading to a disease outbreak.

Table 3-10. Modeled Probability of Extirpation of Four Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 7M

Alternative 7M	**P(Outbreak | Intersection with an allotment)**					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.057	0.099	0.132	0.177	0.216	0.238
Little Salmon	0.076	0.176	0.369	0.605	0.754	0.861
Main Salmon S. Fk.	0.076	0.176	0.369	0.605	0.754	0.861
Muir	0.051	0.12	0.251	0.481	0.616	0.728
Myers	0.068	0.115	0.155	0.203	0.243	0.27
Upper Hells Canyon	0.165	0.323	0.633	0.834	0.932	0.967
Sheep Mountain	1	1	1	1	1	1

Table 3-11. Modeled Probability of Extirpation of Four Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 7P

Alternative 7P	**P(Outbreak | Intersection with an allotment)**					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.057	0.099	0.132	0.177	0.216	0.238
Little Salmon	0.051	0.12	0.251	0.481	0.616	0.728
Main Salmon S. Fk.	0.051	0.12	0.251	0.481	0.616	0.728
Muir	0.052	0.093	0.129	0.176	0.22	0.255
Myers	0.061	0.105	0.15	0.2	0.245	0.282
Upper Hells Canyon	0.145	0.294	0.587	0.84	0.931	0.97
Sheep Mountain	1	1	1	1	1	1

Figure 3-23. Alternative 7M. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest

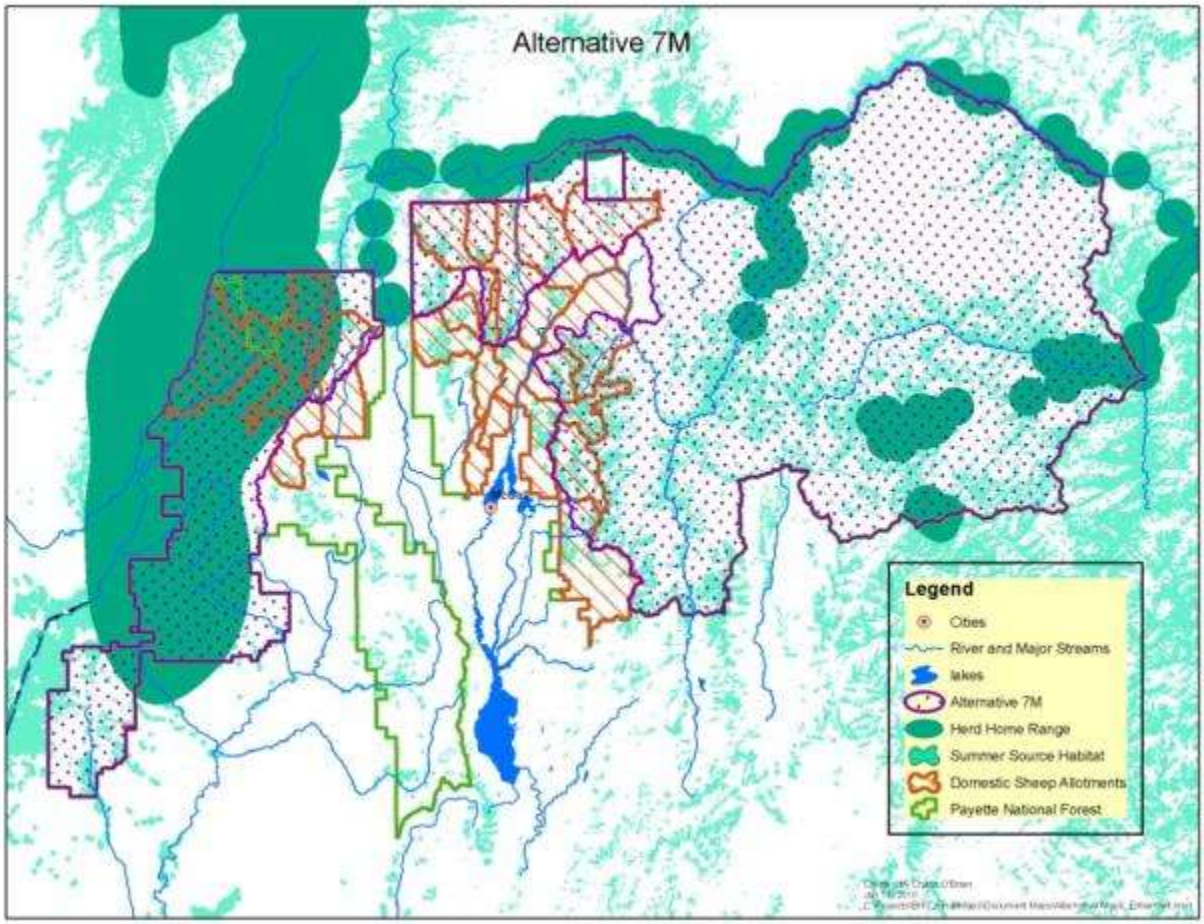
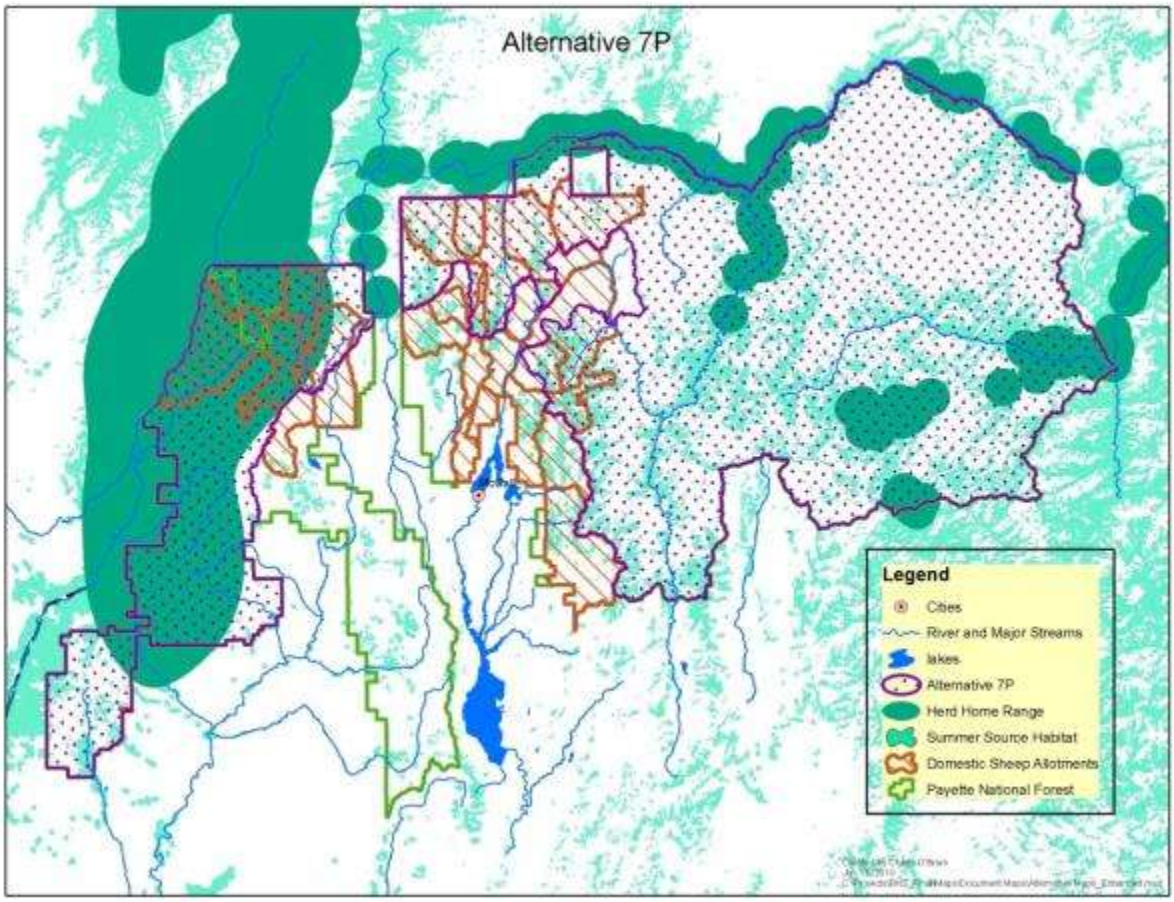


Figure 3-24. Alternative 7P. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest



Alternatives 7N and 7O

Alternatives 7N and 7O were combined because the outputs from implementing these alternatives have similar environmental consequences for these bighorn sheep herds. Alternatives N and O protect 92% and 94% of summer bighorn sheep source habitats, respectively. They retain 38% and 31% of suited rangelands for domestic sheep. The annual rate of contact between bighorns and domestic sheep allotments was calculated at 0.13 and 0.09 (i.e. approximately one contact every seven and eleven years), respectively. Even with contact rates this low, the disease model projects moderate to high likelihood of extirpation when probabilities of contact/outbreak are assumed to be high. Similar to previous alternatives, the Little Salmon, Main Salmon South Fork and Upper Hells Canyon populations show the highest risks for extirpation. Of the action alternatives, these have the lowest probabilities of contact, and the highest probabilities of herd persistence.

Table 3-12. Modeled Probability of Extirpation of Four Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 7N

Alternative 7N	**P(Outbreak | Intersection with an allotment)**					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.04	0.06	0.109	0.151	0.189	0.213
Little Salmon	0.034	0.074	0.203	0.334	0.501	0.594
Main Salmon S. Fk.	0.034	0.074	0.203	0.334	0.501	0.594
Muir	0.041	0.064	0.111	0.152	0.194	0.218
Myers	0.046	0.075	0.127	0.174	0.206	0.23
Upper Hells Canyon	0.093	0.174	0.402	0.673	0.806	0.891
Sheep Mountain	1	1	1	1	1	1

Table 3-13. Modeled Probability of Extirpation of Four Bighorn Sheep Populations Under Varying Assumptions for Probabilities of Contact Leading to Disease Transmission and Outbreaks for Alternative 7O

Alternative 7O	**P(Outbreak | Intersection with an allotment)**					
	0.05	**0.1**	**0.25**	**0.5**	**0.75**	**1.0**
Big Canyon	0.035	0.046	0.104	0.138	0.178	0.207
Little Salmon	0.022	0.04	0.129	0.211	0.292	0.393
Main Salmon S. Fk.	0.022	0.04	0.129	0.211	0.292	0.393
Muir	0.036	0.049	0.104	0.138	0.182	0.211
Myers	0.039	0.054	0.12	0.157	0.202	0.23
Upper Hells Canyon	0.084	0.151	0.375	0.635	0.796	0.89
Sheep Mountain	1	1	1	1	1	1

Figure 3-25. Alternative 7N. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest

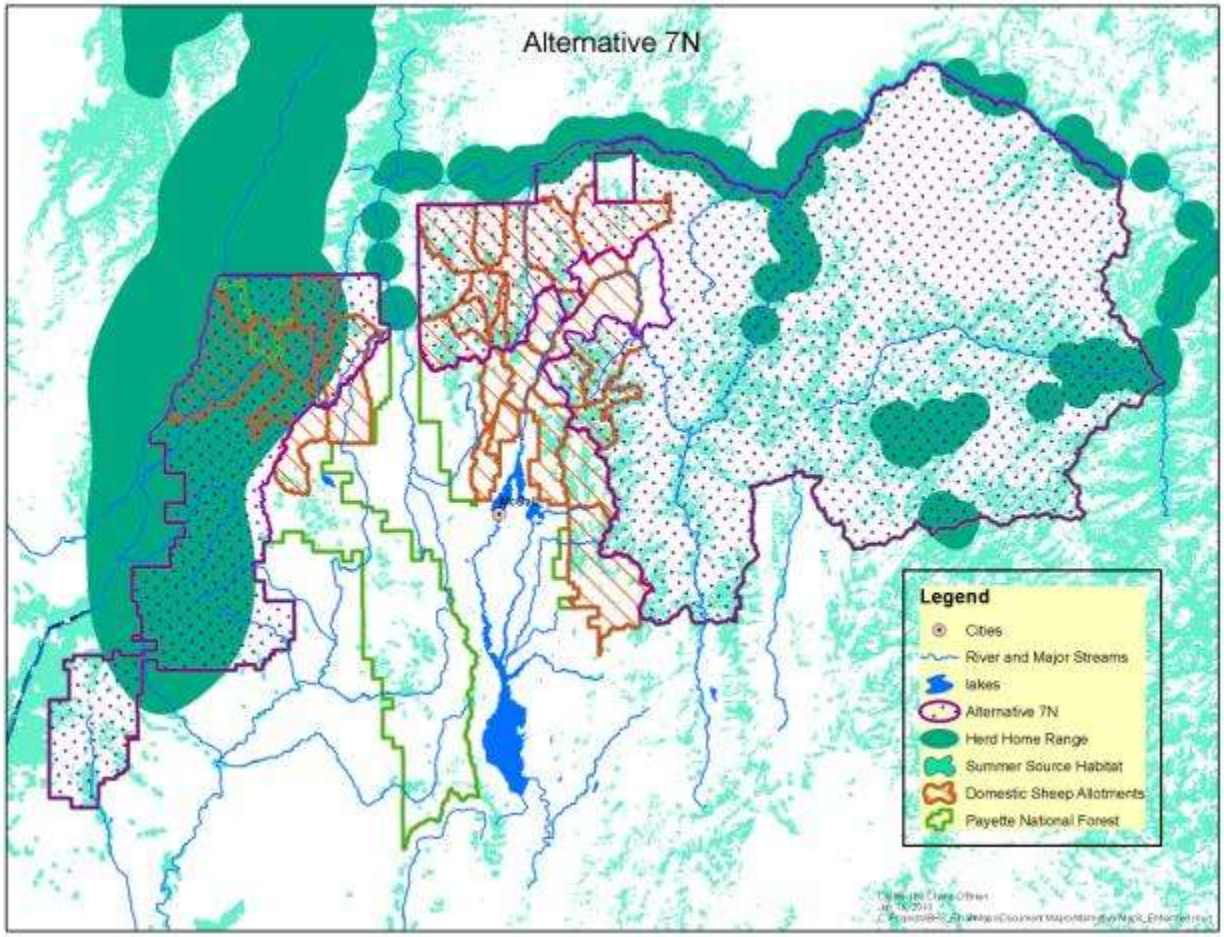
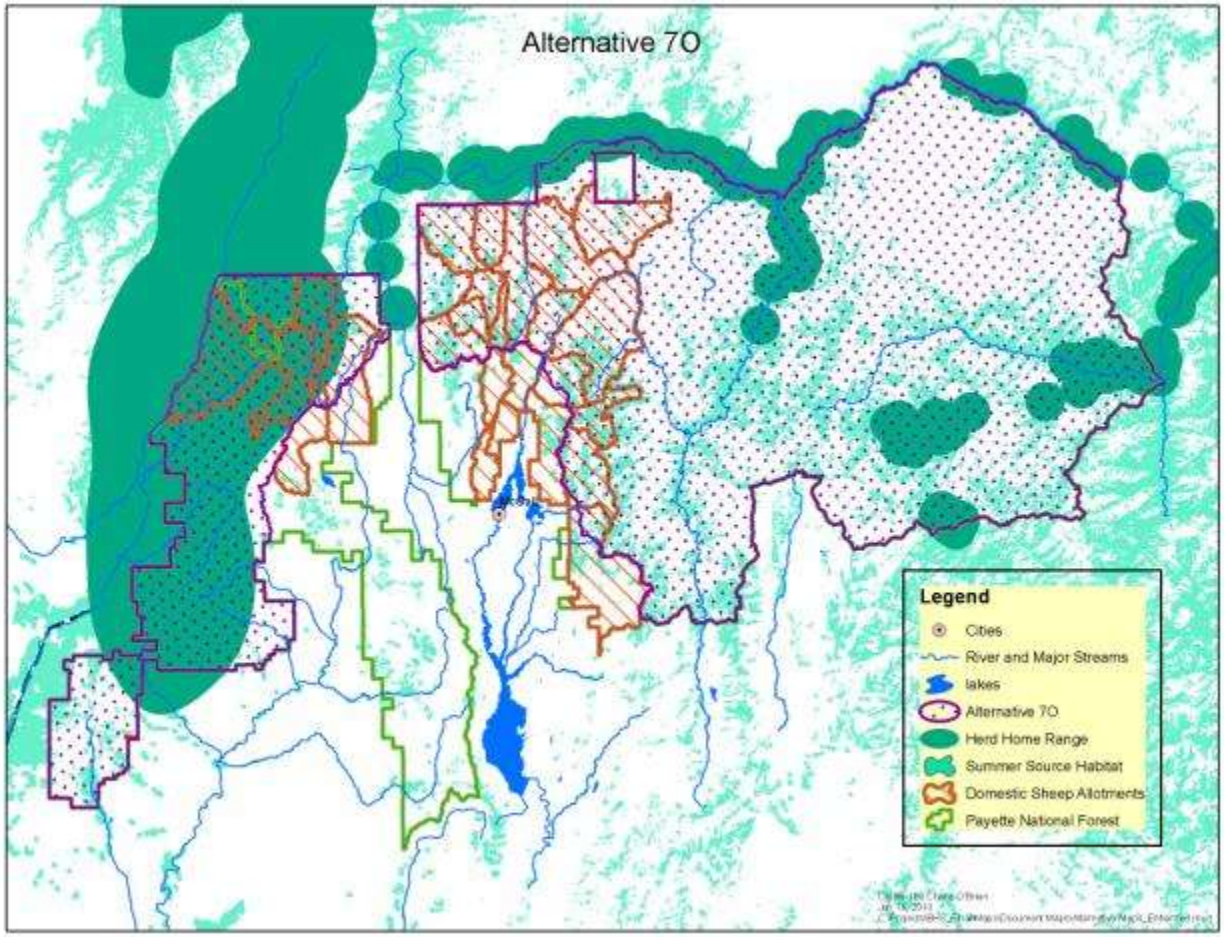


Figure 3-26. Alternative 7O. Bighorn Sheep, Domestic Sheep Allotments and Summer Source Habitats on the Payette National Forest



Comparison of Alternatives

Assessing the likelihood of persistence for these bighorn sheep herds is a complex undertaking. Previous discussion cites literature documenting the potential for severe impacts when even limited contact is made between these two species. George et al. (2008) discuss the severe ramifications of contact between a single domestic sheep and resulting disease epidemic that involved three interconnected wintering populations of bighorn sheep in Colorado.

Both the Snake River and Salmon River metapopulations include highly connected populations that interact with each other. Both of these metapopulations exhibit characteristics of repeated disease epizootics that have influenced both the distribution and abundance of bighorn sheep in Hells Canyon and the Salmon River (e.g. see Cassirer and Sinclair 2007 and IDFG 2004, 2006).

Although the alternatives vary widely in the amount of bighorn sheep source habitat protected from domestic sheep grazing, suited rangelands for domestic sheep, and interspecies contact probabilities, the disease model still infers relatively high risks for extirpation with even modest assumptions on disease transmission leading to an epizootic are made. Although the outcomes

of the model may seem severe, they are consistent with findings in the literature, and hence are useful in the comparison of alternatives.

Source Habitats

Ideally alternatives which protect the highest acres (and percent) of bighorn sheep summer source habitat, with the least acres in suited rangelands for domestic sheep offer the greatest likelihood of conserving habitats contributing to bighorn sheep viability. Table 3-14 displays bighorn sheep summer source habitats, habitats remaining suited for domestic sheep, and a relative ranking of alternatives based on these criteria.

Table 3-14. Relative Ranking of Alternatives Based on Protection of Bighorn Sheep Summer Source Habitats and Separation Between Allotments and Bighorn Sheep Core Herd Home Ranges (CHHR).

Alternative	Summer Source Habitat Protected (%)	Suited Rangeland Habitat for Domestic Sheep (%)	Sheep allotments within a CHHR	Distance from Main Salmon herd to nearest allotment (km)	Distance from Little Salmon herd to nearest allotment (km)	Relative Ranking of Alternatives For Providing Separation Between Domestic and Bighorn Sheep
1B, 2, 5, and 7	0.0	100.0	YES	0	1	9
3, 4, and 6	9.2	92.8	YES	0	1	8
7G	71.4	38.4	YES	5	1	6/7
7L	85.6	64.1	YES	3	1	6/7
7M	91.9	43.1	YES	11	1	4/5
7N	91.6	38.3	NO	12	8	2/3
7O	94.0	31.5	NO	22	8	2/3
7P	90.2	46.0	NO	12	1	4/5
7E	100.0	0.0	NO	NA	NA	1

Another consideration in managing to protect summer source habitats for bighorn sheep is the potential for overlap between source habitats and domestic sheep allotments. We infer that any overlap between occupied bighorn sheep habitat, and domestic sheep allotments will result in a disease transmission between the species. Table 3-15 displays percent of bighorn sheep core home ranges within domestic sheep allotments. This table suggests that Alternatives 1257 and 246 pose significant threats to the Muir and Upper Hells Canyon bighorn sheep populations. Further, Alternatives 7G and 7L also pose threats to the Upper Hells Canyon population.

Table 3-15. Percent of Bighorn Sheep Core Home Ranges within Domestic Sheep Allotments

Herd Home Range	Total Acres	1257	346	7E	7G	7L	7M,7N,7O,7P
Big Canyon	45,688	0.00	0.00	0.00	0.00	0.00	0.00
Little Salmon	26,199	0.00	0.00	0.00	0.00	0.00	0.00
Main Salmon S. Fk.	187,380	0.00	0.00	0.00	0.00	0.00	0.00
Muir	285,539	5.97	0.68	0.00	0.00	0.00	0.00
Myers	154,961	0.00	0.00	0.00	0.00	0.00	0.00
Upper Hells Canyon	592,005	15.83	10.84	0.00	0.02	3.13	0.00
Sheep Mountain	21,459	0.00	0.00	0.00	0.00	0.00	0.00
Big Creek	113,975	0.00	0.00	0.00	0.00	0.00	0.00

We further evaluated distances from bighorn sheep core habitats to domestic sheep allotments, the inference being the greater distance between the species offers the greatest probability for survivorship of bighorn sheep herds. These data suggest Little Salmon, Main Salmon S. Fk., Upper Hells Canyon and Muir are at high risk in all alternative scenarios, except 7E. This may explain why contact scenarios, and resulting disease modeling indicate high risk extirpation probabilities to these bighorn sheep populations under most alternatives, even when probabilities of contact/outbreak are assumed to be low.

Table 3-16. Distance in Km from Bighorn Sheep Core Home Ranges to Domestic Sheep Allotments.

Herd Home Range	1257	346	7E	7G	7L	7M	7N	7O	7P
Big Canyon	35	35	No Allotments	42	42	43	51	51	43
Little Salmon	1	1	No Allotments	1	1	1	8	8	1
Main Salmon S. Fk.	0	0	No Allotments	5	3	11	12	22	12
Upper Hells Canyon	0*	0*	No Allotments	0*	0*	0	0	0	0
Muir	0*	0*	No Allotments	15	7	13	13	13	13
Myers	6	6	No Allotments	21	20	20	30	30	20
Sheep Mountain	12	16	No Allotments	20	20	20	20	20	20
Big Creek	38	38	No Allotments	39	39	40	40	43	39

* Inside Herd Home Range

Contact Risk – Core Home Range and Foray Analyses

Alternatives were ranked based on the frequency of interspecies contact modeled through the core home range and foray analyses. Logically, the greater the likelihood of contact, the greater the potential for disease transmission and resulting disease outbreaks. Table 3-17 displays relative ranking of alternatives based on the number of contacts per year.

Table 3-17. Relative Ranking of Alternatives Based on Modeled Contact Between Bighorn Sheep and Domestic Sheep Allotments

HerdName	1257	346	7G	7L	7M	7N	7O	7P	7E
Big_Canyon	0	0	0	0	0	0	0	0	0
Little_Salmon	0.07	0.07	0.04	0.04	0.03	0.01	0.01	0.03	0
Main_Salmon_S.Fk.	1.01	1.01	0.35	0.31	0.19	0.08	0.04	0.12	0
Upper Hells Canyon	0.15	0.15	0.09	0.13	0.05	0.03	0.03	0.05	0
Muir	0.06	0.03	0.01	0.01	0	0	0	0	0
Myers	0.01	0.01	0	0	0	0	0	0	0
Sheep_Mountain	0.03	0.01	0	0	0	0	0	0	0
CONTACTS/year	1.33	1.27	0.49	0.5	0.28	0.13	0.09	0.21	0
Relative Ranking of Alternatives For Minimizing Contact	8/9	8/9	6/7	6/7	4/5	2/3	2/3	4/5	1

Alternative 7E is the only alternative that prevents interspecies contact. Some level of contact is expected for all bighorn sheep populations except for Big Canyon in the action alternatives. contact. Alternatives 7N and 70 reveal low contact rates (0.13 and 0.09) respectively. Although these are the lowest contact rates, there still is the potential for contact in the two herds that contribute to the largest populations on, or adjacent to, the Payette National Forest. Alternatives 1257, 346, 7G and 7L have moderate to high contact rates that involve four to seven of the populations. Alternatives 7M and 7P have moderate contact rates that affect the Main Salmon South Fork, Little Salmon and Upper Hells Canyon populations, with the greatest contact risk to the Main Salmon South Fork (highest current population).

Summarizing and Comparing the Disease Model

Alternative were compared using low (0.05), moderate (0.25) and high (1.0) probabilities of contact leading to a disease outbreak. Under all alternatives the Sheep Creek population has a high probability of extirpation. This is due to recurrent disease outbreaks that have reduced this population to 11 individuals, all ewes in older age classes. Alternative 7E (no allotments were included). The probability of a disease outbreak for all herds under this alternative is 0. Alternatives were ranked from 1 to 8, with 1 having the highest likelihood of persistence for all populations.

When the inferences for a contact/disease outbreak is assumed to be low, all populations have a high probability of persistence under alternatives 7G to 7P. Under alternatives 1257 and 346, Little Salmon, Main Salmon South Fork, and Upper Hells Canyon have moderate to high probabilities of extirpation.

Table 3-18. Relative Ranking of Alternatives Extirpation when using Low Inference for Contact to Disease Outbreak (0.05).

	1257	346	7G	7L	7M	7N	7O	7P
Big Canyon	0.196	0.156	0.089	0.097	0.057	0.04	0.035	0.051
Little Salmon	0.417	0.376	0.148	0.151	0.076	0.034	0.022	0.051
Main Salmon S. Fk.	0.417	0.376	0.148	0.151	0.076	0.034	0.022	0.051
Muir	0.198	0.158	0.096	0.102	0.059	0.041	0.036	0.052
Myers	0.217	0.177	0.106	0.113	0.068	0.046	0.039	0.061
Upper Hells Canyon	0.527	0.489	0.297	0.367	0.165	0.093	0.084	0.145
Sheep Mountain	1	1	1	1	1	1	1	1
Relative Ranking of Alternatives	7/8	7/8	5/6	5/6	3/4	1/2	1/2	3/4

Under moderate assumptions for contact leading to a disease outbreak; Little Salmon, Main Salmon S. Fk. and Upper Hells Canyon have a high probability of extirpation under Alternatives 1257, 246, 7G and 7L.

Table 3-19. Relative Ranking of Alternatives for Extirpation when using Low Inference for Contact to Disease Outbreak (0.25).

	1257	346	7G	7L	7M	7N	7O	7P
Big Canyon	0.364	0.264	0.13	0.156	0.132	0.109	0.104	0.126
Little Salmon	0.933	0.931	0.558	0.532	0.369	0.203	0.129	0.251
Main Salmon S. Fk.	0.933	0.931	0.558	0.532	0.369	0.203	0.129	0.251
Muir	0.371	0.267	0.132	0.157	0.136	0.111	0.104	0.129
Myers	0.391	0.293	0.159	0.182	0.155	0.127	0.12	0.15
Upper Hells Canyon	0.952	0.940	0.801	0.881	0.633	0.402	0.375	0.587
Sheep Mountain	1	1	1	1	1	1	1	1
Relative Ranking of Alternatives	8	7	5/6	5/6	4	2	1	3

Under high probability assumptions for contact leading to a disease outbreak (1.0), all populations show a high probability of extirpation under alternatives 1257 and 234. Big Canyon, Muir and Myers may persist under alternatives 7G – 7P. Little Salmon, Main Salmon S. Fk. and Upper Hells Canyon have a high probability of extirpation under all alternatives.

Table -20. Relative ranking of Alternatives for Extirpation when using Low Inference for Contact to Disease Outbreak (1.0).

	1257	346	7G	7L	7M	7N	7O	7P
Big Canyon	0.698	0.538	0.228	0.289	0.238	0.213	0.207	0.249
Little Salmon	1	1	0.973	0.958	0.861	0.594	0.393	0.728
Main Salmon S. Fk.	1	1	0.973	0.958	0.861	0.594	0.393	0.728
Muir	0.720	0.552	0.23	0.295	0.244	0.218	0.211	0.255
Myers	0.735	0.592	0.252	0.324	0.27	0.23	0.23	0.282
Upper Hells Canyon	1	1	0.995	1	0.967	0.891	0.89	0.97
Sheep Mountain	1	1	1	1	1	1	1	1
Relative Ranking of Alternatives	8	7	5	6	4	2	1	3

Assumptions on contacts leading to a disease outbreak have huge implications for the persistence of these bighorn sheep populations on, and adjacent to, the Payette National Forest. However, if for all of these scenarios,the relative rankings of the action alternatives are similar, with Alternatives 7N and 7O offering the greatest persistence probabilities for all populations. Alternatives 1257 and 346 consistently had the highest probabilities of extirpation. The remaining alternatives fell in between 1257/346 and 7N/7O, with Alternatives 7M and 7P generally contributing to higher population persistence than Alternatives 7G and 7L.

Summary

We compared alternatives by source habitats, areas remaining in suited rangelands for domestic sheep, and interspecies contact results (Figure 3-27). Although there is a noticeable relationship between the percent of source habitats protected from domestic sheep grazing and interspecies contact (i.e. more protected habitats infers lower contact likelihood), there is even a stronger correlation between the percent of suited rangelands for domestic sheep and interspecies contact. The inference is that even relatively small amounts of suited rangelands remaining result in high likelihood of contact, which ultimately can be translated to increased disease transmission opportunities and disease outbreaks. This is consistent with the previously discussed literature.

The results the three separate models (source habitat, risk of contact and disease) result in a similar ranking of alternatives. The severity of the outcomes from the disease model is largely dependent on assumptions made relative to a contact leading to a disease outbreak. However, even though these assumptions varied, the alternative rankings for this model are still unchanged.

Alternative E provides the greatest protection to bighorn sheep habitats, the least likelihood of contact, and the highest probabilities of persistence for all bighorn sheep populations.

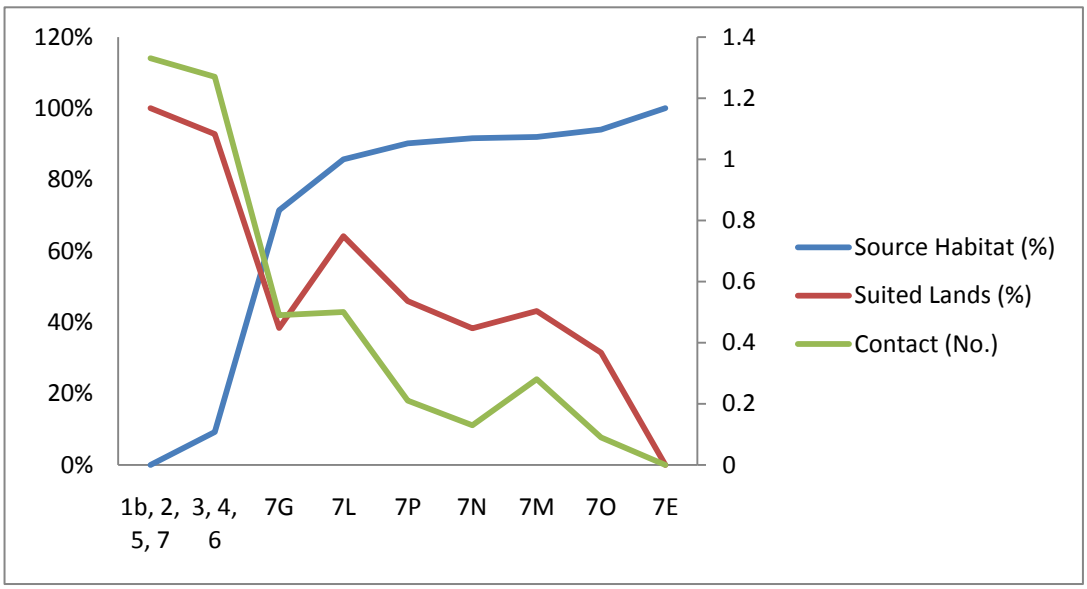
Of the action alternatives, 7N and 7O protect the most source habitat, and the retain the least suited rangeland for domestic sheep. Contacts per year are low (0.13 and .09). At moderate inferences of contact (e.g. 0.25), several herds show moderate to high probabilities for persistence. The Upper Hells Canyon has a low probability of persistence under this alternative.

Alternatives 7M and 7P are viewed as middle ground alternatives. 7M and 7P have similar outputs from the 3 models. The risk of contact is also considered moderate. The disease model suggests that The Little Salmon, Main Salmon South Fork and Upper Hells Canyon may not persist under these alternatives. As two of these are significant contributors to bighorn sheep populations on the Forest, the results are considered severe.

Alternatives 7G, 7L, 1257 and 246 would have the highest risks of contact and protect the least amount of source habitats. These alternatives would likely not insure bighorn sheep populations on and adjacent to the Payette National Forest.

Alternatives are thus ranked from the highest to lowest probability for bighorn sheep persistence: 7E – 7N/7O – 7M/7P – 7G/7L -- 1257/246.

Figure 3-27. Comparison of source summer habitats protected, suited rangelands for domestic sheep, and estimated contacts by Alternative.



Cumulative Effects

<u>Species of Special Interest</u>

Bighorn Sheep

Activities and disturbances that take place on National Forest System lands can affect larger-scale functions beyond National Forest borders, and conversely, the management of lands outside of the National Forest may influence National Forest ecosystems. Management on other adjacent ownerships, including private, state, and other federal lands, may or may not consider the broad needs of ecosystem integrity or the more specific components, including wildlife populations. Therefore, National Forest System lands must provide for these attributes to contribute to functioning ecosystems and viable populations, regardless of ownerships. Adjacent lands under varied ownerships and interspersed ownerships may have different management direction regarding wildlife populations than the National Forests. Therefore, any Forest Service management activities affecting the specific components, particularly those components that are scarce outside of National Forest System lands, would affect the overall ecology and habitat

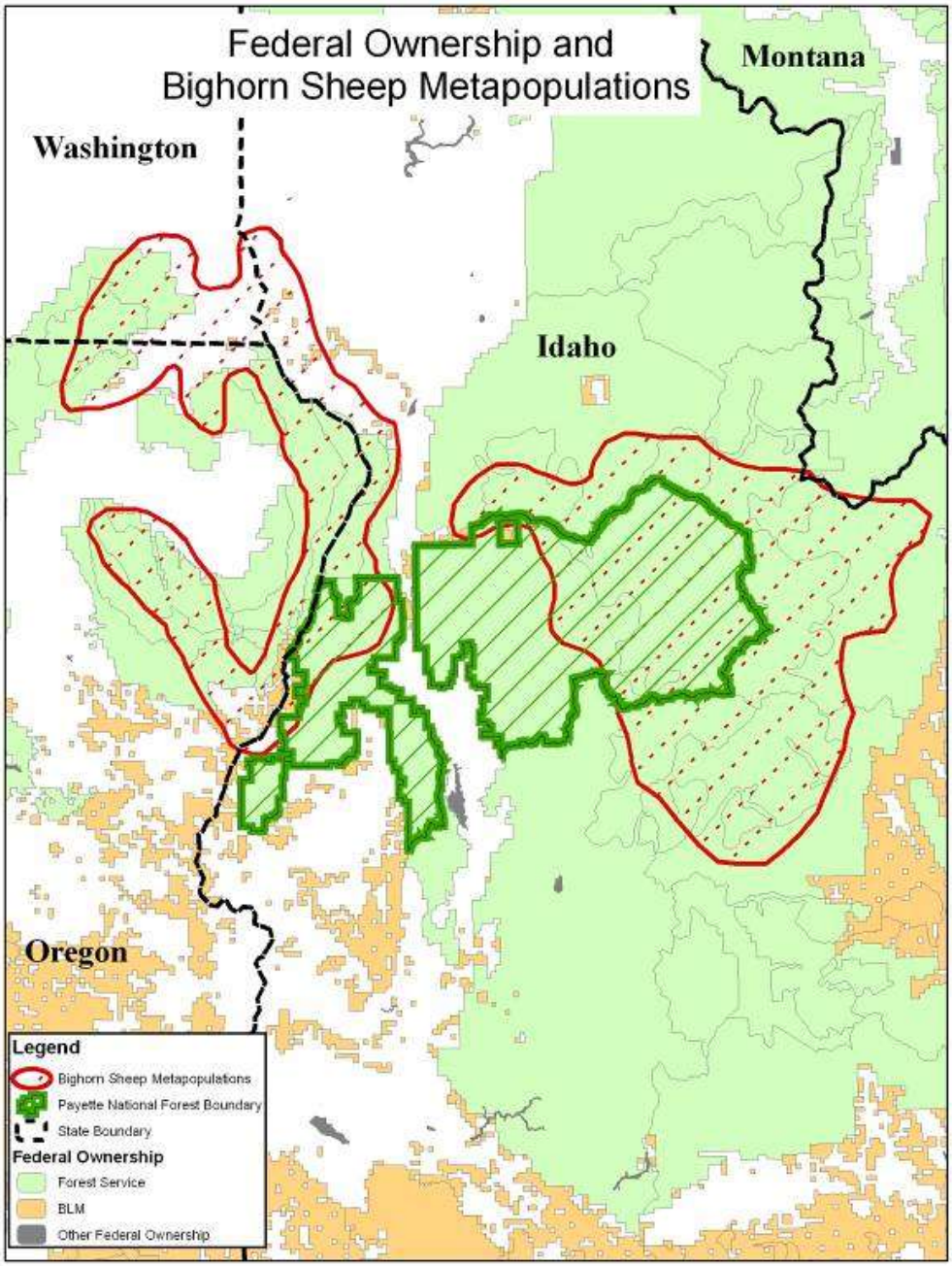
properties these components provide for the entire region. How the Payette National Forest manages habitat can have far-reaching impacts on other ownerships and throughout the region, such as the dispersal of wildlife, and in this specific case, the impacts of disease. National Forest System lands can also be influenced in similar ways by the habitat management on other ownerships. Understanding the interactions that generate processes in wildlife populations and how they change with management actions through space and time is crucial to providing for well-distributed habitat across the Planning Unit.

Each one of the alternatives discussed above would have effects both off and on National Forest System lands. Those alternatives that eliminate all or most of the potential risk of contact between domestic and bighorn sheep on the Payette National Forest (e.g. Alternatives 7N and 7O) are hoped to also provide a large benefit to the broad metapopulations by reducing the probability of disease transmission between the species and subsequent spread across the metapopulation. The alternatives that reduce the risk so that current bighorn sheep core home ranges on the Payette National Forest, and lands considered unsuited for domestic sheep grazing, should also reduce the probability of disease in the metapopulations, although sheep can have contact at the boundaries of these habitats or through foraying bighorn sheep. Those areas of potential moderate risk and even high risk contribute to this effect at and beyond the boundaries of core home ranges. As discussed above, those alternatives with higher potential risks for contact are expected to result in effects of disease that extend well beyond the boundaries of the Payette National Forest within the larger metapopulations.

Other ownerships can also be affected by changes in National Forest domestic sheep allotments. Other federal and state agencies that issue domestic sheep permits can see changes in their capacity to issue permits if some of the biological and physical infrastructure needed to continue domestic sheep grazing is lost on the Payette National Forest. A similar trend could also extend to private lands. While reducing the infrastructure could have effects on the economics associated with domestic sheep grazing, it could also reduce additional risks to bighorn sheep by reducing potential risks of contact from other ownerships.

Figure 3-28 displays the ownerships that can affect the potential risk of contact to bighorn sheep on the Payette National Forest. Even if the Payette National Forest eliminated all domestic sheep grazing (Alternative 7E), a potential risk of contact could exist from the adjoining ownerships that graze domestic sheep, particularly given the overlap of the core herd home ranges, potential foray movements and metapopulations onto adjacent ownerships. Domestic sheep are currently grazed on adjacent National Forests, the BLM, and private farm flocks. Therefore, disease could still be a factor for bighorn sheep populations on the Payette National Forest, regardless of how much domestic sheep grazing remains outside of the alternatives. The effects to the two metapopulations are unknown, since the potential risk of contact from lands other than the Payette National Forest is unknown.

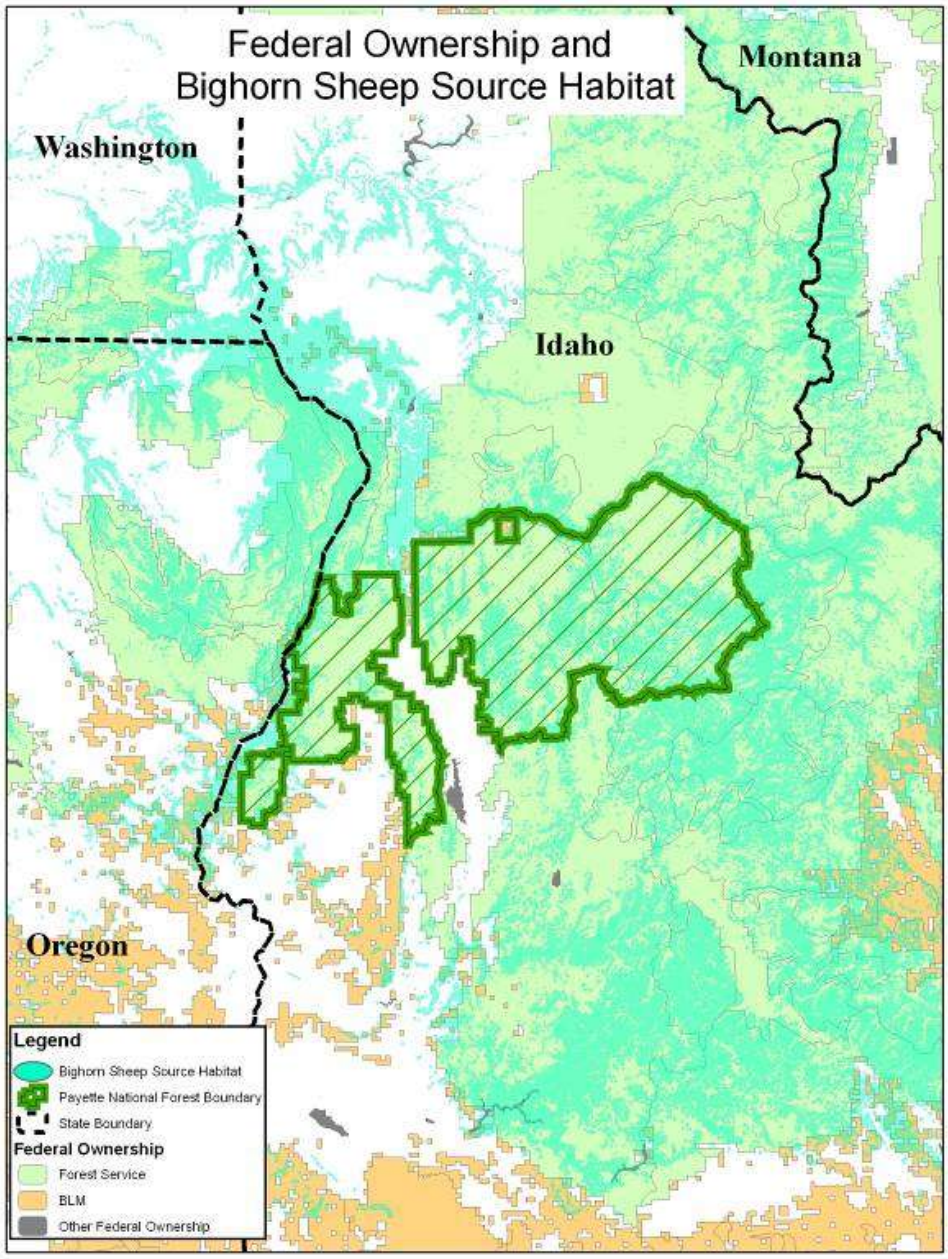
Figure 3-28. Regional Metapopulations and Landownerships



Furthermore, given the continuous bighorn sheep source habitat that exists in the region (Figure 3-29), across state boundaries, and throughout Idaho, the effects of the potential risk of contact from the Payette National Forest can extend beyond the boundaries of the known metapopulations. It is unknown how many bighorn sheep intermingle between populations, although given their metapopulation structure, intermingling throughout the region can be assumed. Radiotelemetry data from the Hells Canyon metapopulation indicates that subpopulations are interconnected, which increases the risk of disease transmission moving throughout the metapopulations, as demonstrated by the Disease Model. Conversely, other ownerships that graze domestic sheep can be a potential source of disease to populations of

bighorn sheep on the Payette National Forest, regardless of the alternative implemented by the Payette National Forest.

Figure 3-29. Source Habitats for Bighorn Sheep Displaying the Continuity of these Habitats at Large Spatial Scales.



Trailing Routes

Trailing routes are the stock trails that producers use to move domestic sheep onto and off of the Payette National Forest. Trailing routes are treated as linear features in the model and rated separately, depending on their relationship core home ranges, bighorn sheep foray routes and

current domestic sheep allotments (where domestic sheep are likely to be). Those trailing routes that intersect bighorn sheep core home ranges have a high probability of contributing to interspecies contact. Those that intersect bighorn sheep source habitats and domestic sheep allotments also have implications for contact and disease transmission.

Implications for trailing sheep can also result in stray domestic sheep that utilize habitats occupied by bighorn sheep outside of the grazing season (e.g. potential contact on winter source habitats). There are trailing routes that are in close proximity to bighorn sheep core ranges (e.g. Sheep Mountain). Strays from trailing domestic sheep may contact these sheep for prolonged periods, thus threatening herd persistence.

Trailing routes on lands rangelands unsuited for domestic sheep will be closed. Thus, under Alternative E, no trailing routes would remain open. The action alternatives leave varying percentages of suited rangelands for domestic sheep open between 31% (Alternative O) and 100% (Alternative 1257). A contact analysis was done that displayed the risk of contact with a trailing route area, which was mapped as a polygon the length of trail segment remaining open, buffered by 0.5 miles (1/4 mile on each side of the trail). However, since domestic sheep only use these areas for a short period of time, the results were not considered instructive.

The trailing routes will be discussed separately from the overall risk of contact model in the Final EIS.

Compliance with the Hells Canyon National Recreation Area Act

The Forest Plan (USDA Forest Service 2003) had an appeal issue related to the consistency between language in the HCNRA Act and its implementing regulations (36 CFR 292.48) and maintaining domestic sheep grazing because of the risk of disease transmission (.

The following determinations have been made regarding compatibility with the HCNRA Act and the HCNRA Comprehensive Management Plan (CMP) for the action alternatives analyzed for this DSEIS (Letter from Steven Ellis to Suzanne Rainville dated January 6, 2010).

Alternatives 7M, 7N, 7O, and 7P

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 contact model 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, some effective monitoring both inside and outside of herd home ranges is recommended to help detect bighorn sheep before contact is made.

Alternative 7G

Alternative 7G eliminates domestic sheep grazing from the Payette National Forest system lands within the boundary of the HCNRA. It also eliminates domestic sheep grazing at least 6 air miles from the boundary of the HCNRA. Only a small sliver of the herd home range is within suitable area for domestic sheep grazing,

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. Alternative G is in compliance with the HCNRA CMP by maintaining a separation between bighorn and domestic sheep that is likely to keep the two species apart at the current population levels If the population levels of bighorn sheep increase, the likelihood of contact may increase and this evaluation may need to be revisited. Monitoring should be conducted to assess future locations of bighorn sheep and assure no contact occurs with domestic sheep on permitted allotments.

Alternatives 1B257, 346, and 7L

Alternatives 1B257, 346, 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 (Fig. 3-6). 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 utilizing a quantitative risk for contact analysis. Allotments lying within herd home range have a 100% probability of a bighorn sheep making contact with that allotment (See Chapter 3 Table 3-15). The Smith Mountain and Curren Hill Allotments are within and adjacent to the HCNRA. The majority of these allotments are 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 not in compliance with the compatibility requirements of the HCNRA Act.

Alternative 7E

Alternative 7E eliminates domestic sheep grazing from the Payette National Forest System lands within the boundary of the HCNRA and within modeled bighorn sheep herd home range. It also determines all of the Payette as unsuited for domestic sheep grazing. 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. Alternative 7 is in compliance with the Hells Canyon National Recreation Area Comprehensive Management Plan by maintaining no potential for contact between bighorn and domestic sheep and may allow the population to recover and expand.

Conclusion

The extent of connectivity between the Hells Canyon metapopulation and the Salmon River metapopulation is unknown, since both populations are at depressed levels. The connectivity corridors, which are the routes bighorn sheep move between areas, are also unknown.

The high connectivity of source habitats indicates that historically, these metapopulations would have been more interconnected. They may have even been one larger metapopulation. A disease outbreak affecting one metapopulation may readily spread to another, given the continuous source habitat, the potential for individuals of separate adjacent populations to contact each other, and the telemetry data which indicates movement between the Hells Canyon and Salmon River habitats. Shared summer ranges may also contribute to disease spread; therefore, if one population is at a higher risk of contracting disease, it increases the risk to other populations within the metapopulation, above and beyond just the immediate risk of proximity to domestic sheep and goats. This information can be used to infer that for habitat and population connectivity risks between the Payette National Forest and other ownerships do occur. This DSEIS only considers risks from the Payette National Forest commercial livestock allotments. Pack animals, domestic sheep grazing on private lands, and other potential disease sources are not considered. Furthermore, Singer and Gudorf (1999) found grazing domestic cattle was negatively correlated with success of bighorn sheep populations (based on forage competition), although the effect on bighorn sheep population persistence was not as large as with grazing domestic sheep. This effect would also occur across ownerships.

Models have shown that reducing the impact of disease on bighorn sheep has greater effects to population persistence than increasing areas of suitable habitat and/or corridors (Gross et al. 2000). Empirical data found that persistence of bighorn sheep populations was negatively correlated with the presence of domestic sheep, and that larger patch size, larger home-range size, greater migratory tendency, and the absence of domestic sheep are the most critical factors for population persistence in bighorn sheep (Singer et al. 2001). Habitat is not currently limiting to bighorn sheep on the Payette National Forest, but the successful establishment of bighorn sheep in those habitats is limited, and even detrimental, when domestic sheep are present. Competition for the same habitat and the species' inherent attraction to each other increases the risk of contact whenever the species are in close enough proximity. Given the wide-ranging behavior of bighorn sheep, close proximity can encompass fairly large areas. Modeling done by Gross et al. (2000) found that mild disease events tended to have more persistent effects on population growth than severe infections, due to the dispersal of bighorn sheep from populations with mild disease. More severe events resulting in rapid, large die-offs tend to prevent dispersal. If the social structure is destroyed at the time of the event, regardless of the disease severity, population dispersal and dynamics can be affected (V. L. Coggins, Oregon Department of Fish and Game, pers. comm., 2008). Larger population sizes with higher rates of dispersal had higher rates of persistence in the absence of disease; increased rates of movement facilitated disease transmission but also buffered the effects of disease by contributing to a spatially structured population and overall larger population size (Gross et al. 2000). Genetic exchange between populations is crucial for healthy metapopulations to function (Bleich et al. 1996). Careful attention to substructuring within and between populations is critical to management plans (Bleich et al. 1996). Furthermore, small populations and small patches of suitable habitat should not be undervalued, as these can be critical in a larger colonization process (Krausman and Leopold 1986). Unoccupied habitat patches represent an important aspect of bighorn sheep metapopulation dynamics because these areas may be the sites of future populations and critical for long-term persistence (Nunney and Campbell 1993, Hanski 1998).

The bighorn sheep is a species that needs large areas to create the spatially structured populations required for their persistence. Small, isolated populations are not optimal for this species.

Therefore, the need to minimize contact with domestic sheep within the large areas needed by bighorn sheep is crucial for strong, healthy populations of bighorn sheep. Keeping an adequate spatial buffer between bighorn sheep and domestic sheep is the most reliable method of preventing contact between these species (Desert Bighorn Council Technical Staff 1990, Schommer and Woolever 2001, Singer et al. 2001), but spatial buffers are not always adequate given the distances bighorn sheep rams will travel (Wehausen et al., unpublished data). Clifford et al. (2009) recommended that if eliminating the risk of interspecies contact (thereby eliminating the probability of respiratory disease transmission to bighorn sheep from domestic sheep) is a management goal, at a minimum, domestic sheep grazing should not occur within the known population utility distribution of the bighorn sheep. Husbandry practices such as removing domestic sheep well before the onset of rut, following vigilant herd management to reduce strays, and responding to wandering bighorn sheep, are other methods to separate the species and reduce risk, but extensive monitoring efforts are required and are not always effective (DSEIS IDT and Cooperators 2007, 2008).

In large portions of habitat found in Alaska and Canada where domestic sheep are not grazed, the distribution of native sheep remains essentially unchanged from historical distribution (Valdez and Krausman 1999). Singer and Gudorf (1999) also reported that bighorn sheep were more successful if they were located further from domestic sheep. Similar effects have also been observed in Hells Canyon.

As bighorn sheep numbers increase and populations expand their geographic range, probabilities of domestic sheep contact could increase (Clifford et al. 2009). The models and expert opinions used in this analysis are based on current population levels and documented movements of bighorn sheep using telemetry based home range and foray analyses; future movement of bighorn sheep can change during population growth or exploration by rams seeking mates (Clifford et al. 2009). Habitat is based on current habitat conditions, which may also change due to succession, disturbance, and management. Changes in habitat could alter quantity and/or location on the landscape. Continued monitoring is essential to understanding the management implications of bighorn sheep movement, population growth, changing habitat, and changes in livestock grazing practices. Adjustments to the selected alternative may be needed, based on this monitoring.

Rangeland Resources

The following information is an update to the Rangeland Resources section of the Bighorn Sheep Viability Draft Supplemental Environmental Impact Statement for the FEIS of the 2003 Land and Resource Management Plan for the Payette National Forest.

Consistent with 36 CFR §219.20(a), the following pages will supplement the Rangeland Capability section, page 3-669, of the Chapter 3 Rangeland Resources section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement and updates the Rangeland Resources section, pages 3-70 thru 3-78 of the DSEIS.

CURRENT CONDITIONS

Rangeland Capability

Domestic Sheep Grazing On the Payette National Forest

Similar to many areas throughout the West, large numbers of domestic sheep (*Ovis aries*) were grazed on Payette National Forest lands during the late nineteenth and early twentieth centuries. This practice significantly changed vegetation structure and composition and soil resources (Hockaday 1968, Jones 1989). Sheep were historically grazed across the entire Payette National Forest, including areas now classified as the Frank Church River of No Return Wilderness (Jones 1989). In 1915, 174,445 sheep were permitted on the Payette National Forest. This number declined throughout the twentieth century to 19,112 in 2005 (Hockaday 1968).

Figure 3-30 displays the spatial location of the sheep allotments on the west zone of the Payette National Forest, and Figure 3-31 displays the sheep allotments on the east zone. Twenty-one percent of summer source habitat and 9 percent of winter source habitat for bighorn sheep is within domestic sheep allotments and trailing routes across source habitat (Figures 3-32 and 3-33). This habitat is essentially unavailable to bighorn sheep when domestic sheep are on the allotments. A risk of contact results from any overlap between source habitat and domestic sheep allotments and the travel corridors that bighorn sheep traverse between their source habitats. See Chapter 3 Bighorn Sheep Habitat Use and Movement section.

For populations of bighorn sheep in and around the Payette Forest, rams are known to have travelled up to 35 kilometers and ewes up to 32 kilometers during the Payette permitted grazing season. Like bighorn sheep, domestic sheep are known to travel long distances. A stray ewe traveled a minimum of 48 kilometers from private land to bighorn range, through very rugged terrain and heavy timber, and across at least one river (Coggins 2002).

Figure 3-30. Domestic Sheep Allotments and Trailing Routes for the West Zone of the Payette National Forest

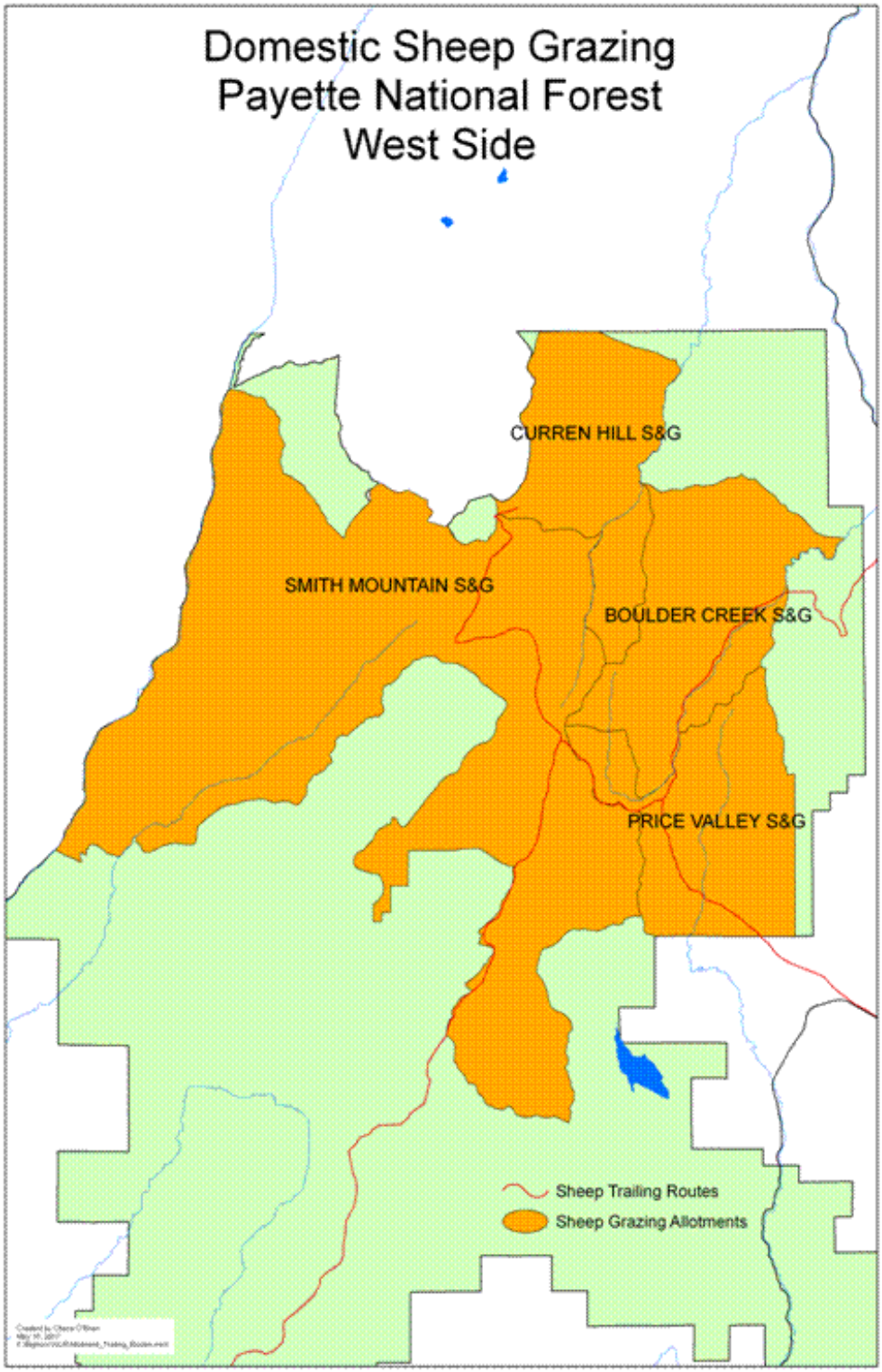


Figure 3-31. Domestic Sheep Allotments and Trailing Routes for the East Zone of the Payette National Forest

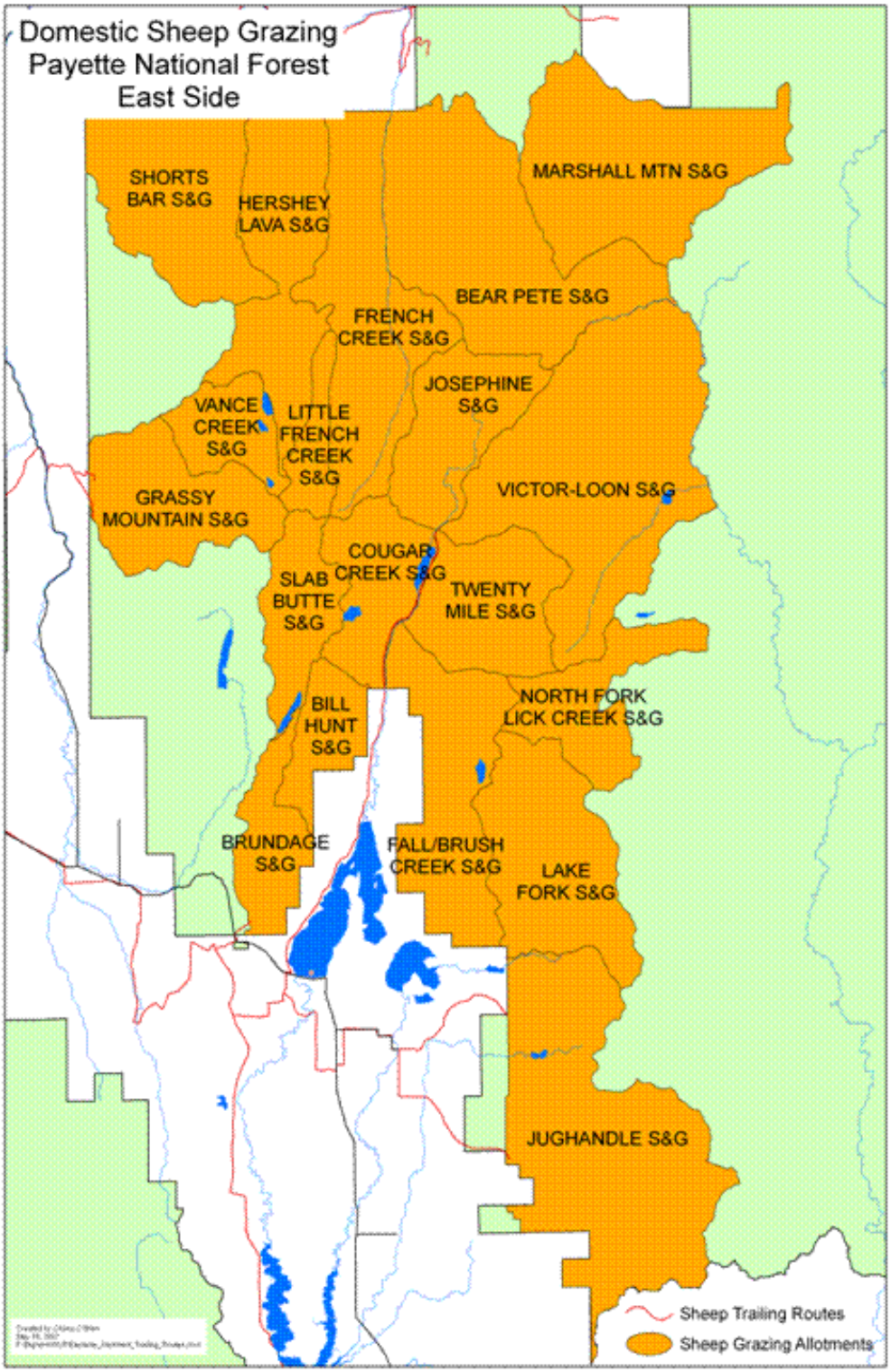


Figure 3-32. Domestic Sheep Allotments and Current Summer Source Habitat on the Payette National Forest

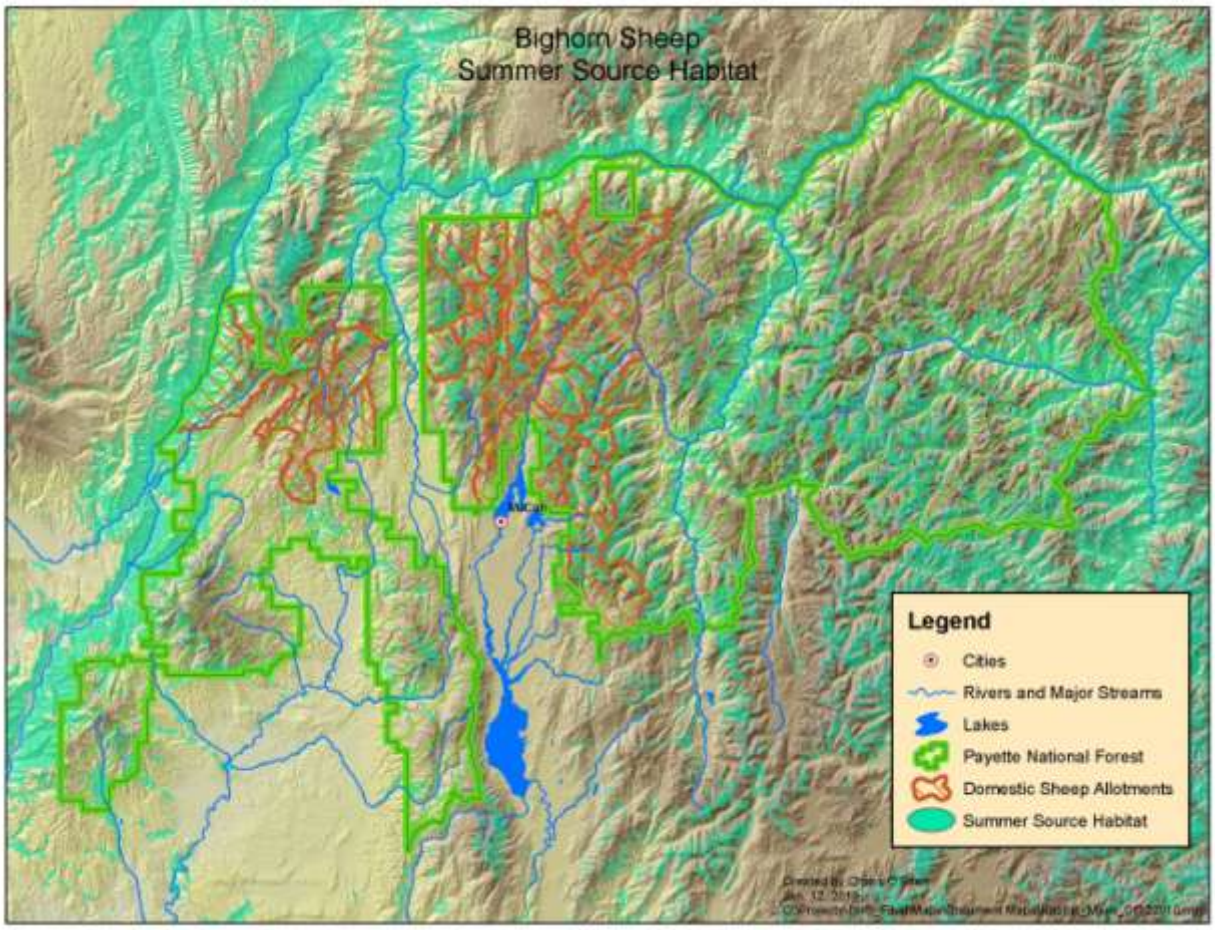
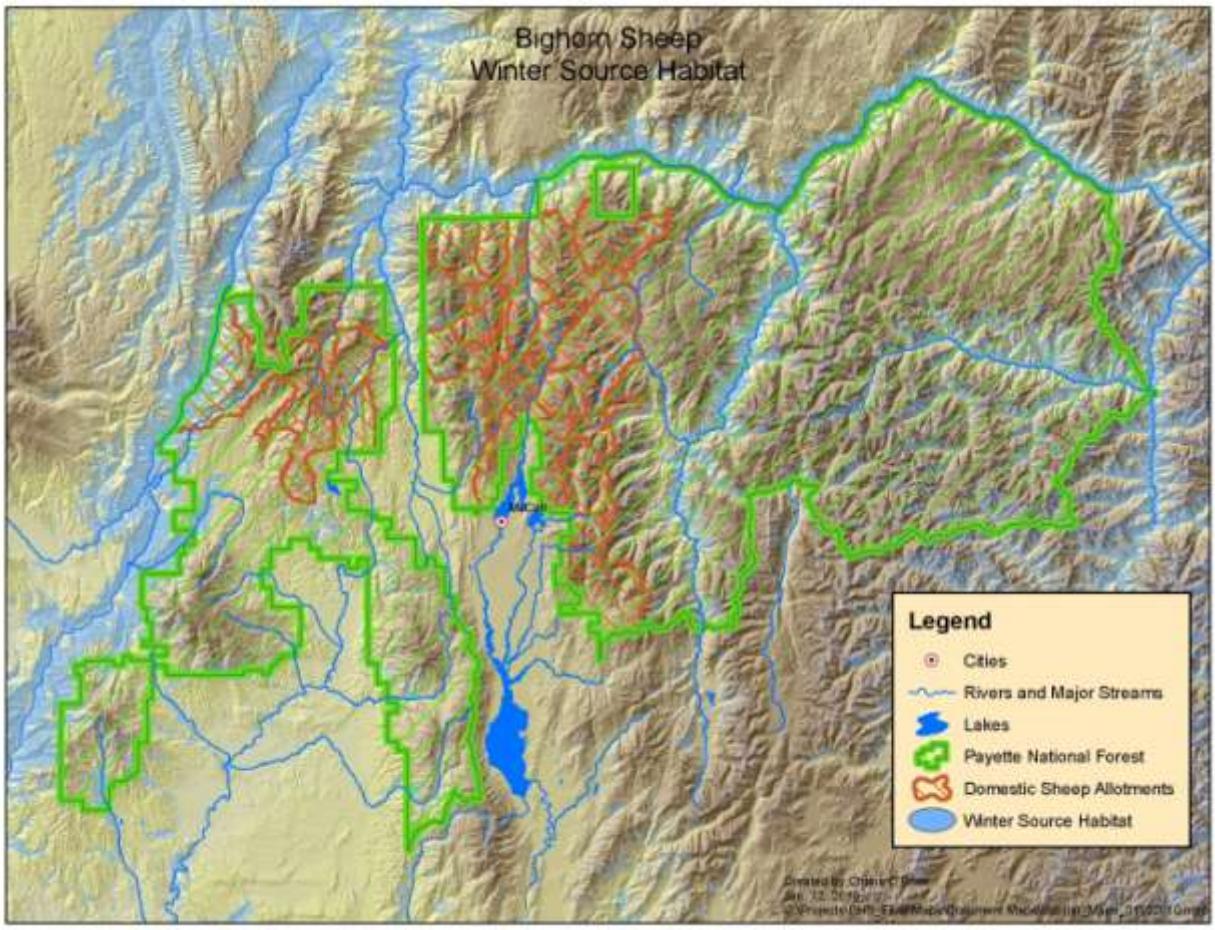


Figure 3-33. Domestic Sheep Allotments and Current Winter Source Habitat on the Payette National Forest



Consistent with 36 CFR §219.20(a), these paragraphs and Table 3-21 will replace the corresponding paragraphs and table of the Environmental Consequences, Effects Common to All Alternatives and the Direct and Indirect Effects by Alternative, Rangeland Suitability sections, page 3-672, 3-676 through 3-678, of the Chapter 3 Rangeland Resources section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement and updates the DSEIS on pages 3-76 thru 3-78. Tables RR-9 and RR-11 are unchanged and can be found in the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement.

ENVIRONMENTAL CONSEQUENCES

Effects Common to All Alternatives

Alternatives considered in this analysis are 1B, 2, 5, and 7 (1257), 3, 4, and 6 (346), 7E, 7G, 7L, 7M, 7N, 7O, and 7P. Alternatives 7L thru 7P were developed in response to the updated information. The alternatives considered in detail pertain exclusively to Payette National Forest

lands and not to other surrounding National Forests or BLM lands. Rangeland designated for bighorn sheep is not considered suitable for domestic sheep grazing in this analysis. This concept is based on the need for separation between the two species, therefore reducing the risk of contact and potential disease transmission as discussed previously in the wildlife section of Chapter 3 in this document in the section titled Risks of Contact between Domestic Sheep and Bighorn Sheep on the Payette National Forest.

Direct and Indirect Effects by Alternative

Rangeland Suitability

Capable rangelands were analyzed for grazing suitability by alternative. This analysis considered other uses or values of the area and also identified areas where grazing may not be appropriate. See Rangeland Resources Technical Report No. 3 for detailed information. Tables RR-8 through RR-10 display the acres of suitable rangelands by Forest and the deductions used to determine suitability, by category, for each alternative. For the Payette National Forest, Table 3-31 indicates Alternatives 7E through 7O retain the least amount of capable rangelands as suitable for domestic livestock grazing. Alternatives 1B257 and 346 retain the most acres of capable rangelands as suitable for domestic livestock grazing.

Alternatives 1B, 2, 5, 7

The seven alternatives evaluated in the FEIS for the 2003 Land and Resource Management Plan could be combined into two categories based on how they 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. Permitted domestic sheep grazing is allowed within the herd home ranges for bighorn sheep. The risk for contact between the two sheep species is very high.

Alternatives 3, 4, 6

These alternatives were also proposed in the FEIS and are grouped together as the second category of alternatives that determined suitable rangeland portions of the Smith Mountain Allotment overlapping Management Area #1 (MA1) as unsuitable for domestic sheep grazing. MA #1 (Hells Canyon Management Area) outside of grazing allotments was also determined to be unsuitable for domestic sheep grazing. All trailing routes remained open in these alternatives. Permitted domestic sheep grazing is allowed within the herd home ranges for bighorn sheep. The risk for contact between the two sheep species is very high.

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 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 in DSEIS)

In the DSEIS, populations of bighorn sheep were identified using the Geographic Population Range (GPR) model. The GPR was developed in part, utilizing the 2006 Risk Analysis that is no longer in effect for the FSEIS. This Alternative 7G utilizes the GPRs simply as a boundary and designates all land within the Hells Canyon and Salmon River GPRs as unsuitable for domestic sheep grazing. Permitted domestic sheep grazing is allowed within the herd home ranges for bighorn sheep. The risk for contact between the two sheep species is very high. 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 leaves no trailing routes open within the GPRs. The remaining allotments have no change to suitable acres for domestic sheep grazing.

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 for contact areas from domestic sheep grazing and kept as much suitable rangeland open to domestic sheep grazing as possible. Some domestic sheep grazing occurs within bighorn sheep herd home range on the Smith Mountain Allotment. On the west side of the forest, the Curren Hill and Surdam allotments are designated unsuitable for domestic sheep grazing, the eastern 35% of Smith Mountain Allotment and all of Boulder Creek and the Price Valley allotments are designated suitable for domestic sheep grazing. The east side of the forest designates all of the Shorts Bar and North Fork Lick Creek allotments unsuitable for domestic sheep grazing. The southwest 25% of the Hershey-Lava Allotment, the very eastern 15% of the French Creek Allotment, 40% of the Bear Pete Allotment on the eastern side of the allotment, and 70% of the Marshal Mountain Allotment on the western side of the allotment is suitable for domestic sheep grazing. The remaining allotments are designated suitable for domestic sheep grazing.

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, in comparison to 7L, was designed to remove more risk for contact from the landscape and keep grazing outside of the herd home range areas. On the west side of the forest, the Curren Hill, Boulder Creek, and Surdam allotments are designated unsuitable for domestic sheep grazing. The Smith Mountain Allotment is designated 25% suitable for domestic sheep grazing on the east side of the allotment. The Price Valley Allotment is designated 85% suitable for domestic sheep grazing on the east side of the allotment. The east side of the forest designates all of the Shorts Bar, French Creek, Marshall Mountain, North Fork Lick Creek, and Lake Fork allotments unsuitable for domestic sheep grazing. The Hershey-Lava Allotment is designated unsuitable for domestic sheep grazing except for the southwest 25% of the allotment. The Bear Pete Allotment is designated 30% suitable for domestic sheep grazing 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 Allotment are designated suitable for domestic sheep grazing. The remaining allotments are designated suitable for domestic sheep grazing. No permitted domestic sheep grazing is within the bighorn sheep herd home range.

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 retain grazing areas of lower risk by putting them back in. On the west side of the forest, the Curren Hill, Boulder Creek, and Surdam allotments are designated unsuitable for domestic sheep grazing. The Smith Mountain Allotment is designated 25% suitable for domestic sheep grazing on the east side of the allotment. The Price Valley Allotment is designated 85% suitable for domestic sheep grazing on the east side of the allotment. The east side of the forest designates all of the Shorts Bar, Grassy Mountain, Vance Creek, Hershey Lava, Little French Creek, French Creek, Marshall Mountain, and North Fork Lick Creek allotments unsuitable for domestic sheep grazing. The western 85% of the Josephine Allotment, the eastern 25% of Bear Pete Allotment, the northern 50% of the Victor-Loon Allotment, and the western 25% of the Twenty Mile Allotment are designated suitable for domestic sheep grazing. The remaining allotments are designated suitable for domestic sheep grazing. No permitted domestic sheep grazing is within the bighorn sheep herd home range.

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 remove all areas of major risk and keep allotments as intact as possible and reduce the amount of bighorn sheep presence monitoring to minimal levels. On the west side of the forest, the Curren Hill, Boulder Creek, and Surdam allotments are designated unsuitable for domestic sheep grazing. The Smith Mountain Allotment is designated 25% suitable for domestic sheep grazing on the east side of the allotment. The Price Valley Allotment is designated 85% suitable for domestic sheep grazing on the east side of the allotment. The east side of the forest designates 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 unsuitable for domestic sheep grazing. The western 25% of the Twenty Mile and the southern 90% of the Jughandle allotments are designated suitable for domestic sheep grazing. The remaining allotments are designated suitable for domestic sheep grazing. No permitted domestic sheep grazing is within the bighorn sheep herd home range.

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 area as unsuited but add in area that are of a lower risk. This alternative was designed to maximize bighorn sheep protection and maximize the amount of suitable range land. On the west side of the forest, the Curren Hill, Boulder Creek, and Surdam allotments are designated unsuitable for domestic sheep grazing. The Smith Mountain Allotment is designated 25% suitable for domestic sheep grazing on the east side of the allotment. The Price Valley Allotment is designated 85% suitable for domestic sheep grazing on the east side of the allotment. The east side of the forest designates all of the Shorts Bar, Little French Creek, French Creek, Marshall Mountain, and North Fork Lick Creek allotments unsuitable for domestic sheep grazing. The southwest 25% of the Hershey Lava Allotment, western 85% of the Josephine Allotment, the eastern 25% of Bear Pete Allotment, the

northern 50% of the Victor-Loon Allotment, and the western 25% of the Twenty Mile Allotment are designated suitable for domestic sheep grazing. The remaining allotments are designated suitable for domestic sheep grazing. No permitted domestic sheep grazing is within the bighorn sheep herd home range.

The following paragraphs identify the other resource considerations and their effects on the rangeland environment.

Acres Deducted Due to Closing Vacant Allotments—This section is updated with the following information:

For the Payette National Forest, Alternatives 7E through 7P would remove 2,413 acres from the suitable rangelands, based on the closure of one vacant allotment that is within bighorn sheep habitat.

Acres Deducted Due to Bighorn Sheep Habitat—This section is updated with the following information:

Total suitable acres include all suitable rangelands, both for cattle and domestic sheep. Bighorn habitat acres deducted included only acres from existing domestic sheep allotments that were determined to be unsuitable for domestic sheep grazing. Other suitable acres may be considered unsuitable for domestic sheep grazing but still suitable for cattle. The total amount of suitable rangeland remaining for domestic sheep and cattle grazing is displayed by alternative in Table 3-31.

Table 3-21. Payette National Forest Rangeland Suitability Acres by Alternative

Criteria	Capable Acres[2]	Vacant Allotment Acres Deducted[3]	Bighorn Habitat Acres Deducted	Total Deductions	Total Suitable Acres[4]
Alt.1257	233,672	0	0	0	233,672
Alt. 346	233,672	2,413	7,228	7,228	226,444
Alt. E	233,672	2,413	100,310	100,310	133,362
Alt. G	233,672	2,413	61,842	61,842	171,830
Alt. L	233,672	2,413	35,999	35,999	197,673
Alt. M	233,672	2,413	57,065	57,065	176,607
Alt. N	233,672	2,413	61,918	61,918	171,754
Alt. O	233,672	2,413	68,718	68,718	164,954
Alt. P	233,672	2,413	54,204	54,204	179,468

[1] Includes all capable rangeland for both cattle and sheep allotments.

[2] The vacant allotment acres deducted are within the area deducted for bighorn habitat and to avoid double counting these acres are therefore not added into the total deductions.
[3] Includes all capable rangeland that remains suitable for livestock grazing for both cattle and sheep allotments.

The loss of suitable rangeland for domestic sheep on the Payette National Forest will result in decreased sheep numbers authorized on National Forest System (NFS) lands, and subsequent loss of quality forage, and some bucking grounds to continue high lamb recruitment and birth weights. This lost NFS rangeland may not be able to be substituted by private land, and therefore quality feed and lambing conditions may be reduced, potentially affecting the overall sheep production.

Cumulative Effects

As rangelands are classified as unsuitable for domestic sheep grazing, bighorn sheep may begin utilizing the vacated acreage suitable for their habitat without the immediate risk of contact. As the bighorn populations increase because their vulnerability to disease transmission is reduced, they may enter into new areas they have not recently utilized, which are occupied by domestic sheep. As the bighorn sheep available suitable habitat increases, and their populations increase, they are expected to roam or foray more and may come into contact with domestic sheep on other lands outside the Payette Forest.

Each one of the alternatives would have effects both off and on National Forest System lands. Other ownerships could be affected by changes in National Forest domestic sheep grazing allotments. Other Federal and State agencies that issue domestic sheep grazing permits could see changes in their capacity to issue permits if they rely on the NFS lands to supplement their allotments. Most BLM and State grazing allotments are used in conjunction with NFS allotments. A similar trend could also extend to private lands. The Forest permittees rely on their allotments to supplement their private land pastures, and to maintain their current sheep numbers. A loss of suitable rangeland for domestic sheep grazing could also result in a loss of revenue for the other Federal and State agencies, as well as the NFS. The economic impact associated with the alternatives that reduce suitable acres for domestic sheep grazing on the Payette National Forest is discussed in the Economics section of this document. If the other agencies decide not to authorize grazing because of dependency of NFS lands, the loss of suitable habitat availability for domestic sheep grazing on these various lands could also reduce additional risks to bighorn sheep by reducing potential risks of contact from other ownerships.

Conclusion

Eliminating domestic sheep grazing from bighorn sheep suitable rangelands on the Payette National Forest may prevent contact and disease transmission between the two species in the short-term; however as the bighorn populations grow, they are expected to expand into areas domestic sheep occupy outside of this analysis. This may further reduce the suitable domestic sheep grazing acres on the Payette Forest.

Private, State and other Federal lands located within and adjacent to the Payette National Forest that continue to graze domestic sheep will perpetuate the risk for contact and disease transmission between the two species.

The adoption of Best Management Practices for sheep management coupled with an intense monitoring program is designed to reduce the risk of contact as the bighorn sheep expand their territory. But their effectiveness is not substantiated by research and in some cases it is questionable (Schommer, 2009, Appendix F). Husbandry practices such as removing domestic sheep well before the onset of rut, following vigilant herd management to reduce strays, and responding to wandering bighorn sheep, are other methods to separate the species and reduce risk, but extensive monitoring efforts are required and are not always effective (DSEIS IDT and Cooperators 2007, 2008).

Continued monitoring is essential to understanding the management implications of bighorn sheep movement, population growth, changing habitat, and changes in livestock grazing practices. Adjustments to the selected alternative may be needed, based on this monitoring.

Tribal Rights and Interests

TRIBAL RIGHTS AND INTERESTS INTRODUCTION

In response to the updated information and development of an additional set of alternatives, the effects to tribal rights and interests are also updated in this section. As in the Draft Supplemental Environmental Impact Statement (DSEIS), the *Tribal Rights and Interest* section of the FEIS includes an analysis of the effects Forest Service management would have on the ability of the agency to meet general federal trust duties and treaty-specific statutory obligations. Unless included below, the information contained in the DSEIS still pertains to the analysis and this document simply updates the DSEIS with new information.

Consistent with 36 CFR §219.20(a), this analysis will supplement the *Tribal Rights and Interests* section of the LRMP FEIS and DSEIS to: 1) identify additional affected tribes; 2) specifically identify the effects of alternatives on the availability of bighorn sheep; and 3) disclose the effects on the associated use of traditional cultural properties important to American Indian rights and interests.

Consistent with 36 CFR §219.20(a), the following information will replace the names of bands within the Shoshone-Paiute Tribes discussed in Table TR-1 on page 3-81 of the DSEIS and Table TR-1 of the Current Conditions in the Boise, Payette, and Sawtooth National Forests section, page 3-800, of the Chapter 3 Tribal Rights and Interests section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement.

CURRENT CONDITIONS

Cultural Interests in the Boise, Payette, and Sawtooth National Forests

Table TR-1. Federally Recognized Tribes within the Ecogroup Area

Federally Recognized Tribe	Culture Area	Name of Bands within Tribe
Shoshone-Paiute Tribes (Duck Valley Reservation)	Great Basin	Northern Shoshone, Northern Paiute

Consistent with 36 CFR §219.20(a), the following paragraph will supplement the Cultural Interests in the Boise, Payette, and Sawtooth National Forests section, page 3-803, of the Chapter 3 Tribal Rights and Interests section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement and update page 3-81 of the DSEIS.

Factors Affecting Tribal Rights and Interests

The effects are directly related to: 1) the analysis discussions found in the *Terrestrial Wildlife Habitat and Species* section of this updated information analysis; 2) the amount of source habitat available for bighorn sheep; and 3) the distribution of the bighorn sheep source habitat that is

free of permitted domestic sheep and goat grazing. The *Terrestrial Wildlife Habitat and Species* section provides:

- A detailed description of source habitat;
- A description and analysis of bighorn sheep core herd home ranges and current population sizes in Hells Canyon and Salmon River Mountain areas;
- An analysis of bighorn sheep long distance movements;
- A quantitative risk analysis to determine the risk of contact between bighorn sheep and domestic sheep; and
- A disease model to assess the likelihood bighorn sheep population persistence under different alternatives.

The analyses in the *Terrestrial Wildlife Habitat and Species* section provide the foundation for estimates of the numbers of animals that can reasonably be harvested by the Tribes

Consistent with 36 CFR §219.20(a), the following paragraphs will replace corresponding paragraphs of the Effects Common To All Alternatives section, page 3-803, of the Chapter 3 Tribal Rights and Interests section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement and will update the DSEIS on pages 3-82 through 3-85.

ENVIRONMENTAL CONSEQUENCES

Effects Common to All Alternatives

General Effects

Species Viability—

Consistent with 36 CFR §219.20(a), the following paragraphs will supplement the Effects Common To All Alternatives section, page 3-803 through 3-805, of the Chapter 3 Tribal Rights and Interests section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement.

The alternatives added in this updated information analysis vary widely in the magnitude of risk for contact between bighorn sheep and domestic sheep that they produce, with subsequent implications for persistence of bighorn sheep populations over time and their potential distribution across the Payette National Forest. All of these effects are discussed in the *Terrestrial Wildlife Habitat and Species* section.

Direct and Indirect Effects to Tribal Resources

***Alternatives* 1B, 2, 3, 4, 5, 6, 7**

These alternatives do not provide for viability in the long-term on the Payette as they produce a very high risk of contact between domestic and bighorn sheep. Tribal trust responsibilities may not be met. The ability to harvest bighorn sheep in culturally important areas may be lost.

Alternatives 7G and 7L

These alternatives may provide habitat to maintain a bighorn sheep population in the short-term, but not in the long-term. The risk for contact remains very high with these alternatives. Tribal trust responsibilities may be provided for in the short-term. Harvest of bighorn sheep in culturally important areas is greatly diminished. There could be significant direct, indirect, or cumulative negative effects expected to the viability of treaty resources or traditional and cultural species of interest to American Indians as a result of National Forest activities. In this case, the negative impacts are tied to domestic sheep grazing in current bighorn sheep source and foray habitat on the Payette National Forest.

Alternative 7E

Alternative 7E completely removes domestic sheep grazing from the Forest and produces less risk of contact between domestic and bighorn sheep than any other alternative: populations of bighorn sheep are most likely to persist on the Payette under this alternative. Alternative E provides for tribal trust responsibilities and allows harvest of bighorn sheep in all or nearly all traditional locations influenced by the Payette National Forest because it remove all risk of contact between bighorn sheep and domestic sheep.

Alternatives 7N and 7O

Among alternatives that maintain some grazing by domestic sheep, Alternatives 7N and 7O leave the greatest amount of source habitat for bighorn sheep, and have the greatest long term probability of allowing viable populations of bighorn sheep to persist on the Payette. Most areas of high risk for contact are removed with these alternatives. Although some contact risk still remains on the landscape, 90% or more of the contact risk in Alternatives 1257 and 346 is eliminated by these alternatives. Tribal trust responsibilities may be met with thorough monitoring for presence of bighorn sheep near active sheep and goat allotments. The areas of harvesting bighorn sheep in culturally important areas is less for Alternative 7N than it is for 7E and 7O.

Alternatives 7M and 7P

Not all areas of high risk for contact are removed with the alternatives. Risk of contact on the landscape remains at levels higher that for Alternatives 7N and 7O. Habitat provided for viable populations may only be effective in the immediate future. Extensive levels of monitoring for the presence of bighorn sheep would be required. The areas of harvest bighorn sheep in culturally important locations is further reduced from Alternatives 7N and 7O.

Cumulative Effects

This information updates the cumulative effects section of the DSEIS. Some alternatives could have considerable negative effects on species viability and thus numbers available for harvest. Ample source habitat is well distributed across the Payette National Forest. However, the habitat is not available to bighorn sheep if domestic sheep are present in or near to the habitat. Current numbers of bighorn sheep are well below historical levels, which also impacts tribal ability to harvest animals. Current uses of the habitat by domestic sheep, adjacent to known populations of bighorn sheep, impact the ability of the depressed populations to foray and contact with other

isolated groups as needed to increase their numbers and preserve genetic variation. The result is a reduced area from which the Tribes can hunt. This reduced area may affect areas that were historically and/or traditionally important to the Tribes for hunting. The *Terrestrial Wildlife Habitat and Species* section contains an in-depth discussion of the effects of each alternative on the potential risk of contact and subsequent implications for population viability.

Alternatives 1B, 2, 3, 4, 5, 6, 7 provide only a small proportion of source habitat for maintenance a viable population of bighorn sheep on the Payette Forest. These alternatives all produce a very high risk of contact between bighorn sheep and domestic sheep on allotments that continue to be grazed within or in close proximity to bighorn sheep core herd home ranges. Because of the proximity to domestic sheep, bighorn sheep are not afforded the opportunity to pioneer, explore, or expand into adjacent source habitat and thus increase the opportunity for tribes to hunt in traditional areas and at greater harvest levels. These alternatives may have a considerable effect on Tribe's ability to harvest bighorn sheep.

Alternatives 7G and 7L provide a reduced but still substantial risk of contact, with bighorn sheep on forays expected to enter occupied domestic sheep allotments once every two years. The high rate of contact makes population persistence under these alternatives very uncertain, with the result that Tribal harvest of sheep is not assured.

Alternatives 7M and 7P halve the risk of contact relative to Alternatives 7G and 7L, and provide a greater opportunity for Tribal harvest. Bighorn sheep populations have some opportunity for pioneering and expanding into areas that tribal members traditionally hunted.

Of the alternatives that maintain some grazing by domestic sheep on the Payette NF, Alternatives 7N and 7O provide the greatest opportunity for bighorn sheep population expansion and tribal harvest. With little or no domestic sheep grazing permitted within source habitat and only limited grazing in foray habitat, contact between the two species is reduced.

Alternative 7E removes all risk of contact between bighorn and domestic sheep on Forest Service allotments, as no domestic sheep grazing is permitted on the Payette National Forest. It allows the greatest potential for future expansion of bighorn populations, and in the long term, it is the alternative most likely to provide the Tribes with the ability to harvest bighorn sheep in all traditional locations influenced by the Payette National Forest.

Socio-Economic Environment

INTRODUCTION

The following information is presented as an update to the Socio-Economic section of the DSEIS to the FEIS for the 2003 Payette Land and Resource Management Plan. This update was generated in response to comments received on the DSEIS and the updated set of alternatives. The socio-economic analysis is split into two topic areas: 1) the economic effects tied to the local agriculture sector; and 2) the economic effects tied to the local recreation sector.

Consistent with 36 CFR §219.20(a), the following paragraphs will supplement the National and International section, pages 3-910 through 3-939, of the Chapter 3 Socio-Economic Environment section of the 2003 Southwest Idaho Ecogroup Land and Resource Management Plans Final Environmental Impact Statement, and pages 3-86 thru 3095 of the DSEIS.

AGRICULTURE SOCIO-ECONOMICS

This updated analysis has several components:

1. Direct economic impacts are displayed for the alternative grazing scenarios being evaluated in this updated information document (Alternatives 1B257, 346, 7E, 7G, 7L, 7M, 7N, 7O, 7P).
2. Economic impacts of the alternative grazing scenarios were analyzed using a new regional model. The results of the regional model are compared to the community model which was used in the DSEIS.
3. Economic impacts of the grazing fee payments to local governments are estimated and compared using both the community and regional models.
4. Economic value of the sheep industry to Idaho and its regional economies is estimated, using secondary data sources.

AFFECTED ENVIRONMENT

Community Economic Profiles

The economic impacts of the sheep allotments on the Payette National Forest under considerations occur in three communities: Riggins, Idaho; Weiser, Idaho; and Wilder Idaho. An economic profile for each community was constructed for this analysis and is presented here to provide baseline information relevant to the discussion of community level effects.

Table 3-22 illustrates the economic profile of Riggins, Idaho. Column one represents the aggregated industrial categories for the North American Industrial Classification System (NAICS). Column two represents the total number of jobs per industry; column three is the percentage of total jobs per industry; column four is labor income (earnings) in thousands of dollars; column five represents the percentage of total earnings per industry; column six represents total sales per industry; column seven represents the percent of sales per industry; and column eight represents earnings per worker (total earnings per industry/workers).

The largest industry is government, providing the community with 175 jobs, $5.7 million in earnings and $25.1 million in sales. The second largest industry is agriculture, forestry, fishing, and hunting category that provides the community with 127 jobs, $1.4 million in earnings and $6.2 million in sales. Of these jobs 103 are in production agriculture (81%). The third biggest industry in terms of employment is accommodation and food service (15.2%) followed by retail trade at 12.6%. Riggins has a diverse economy that has a strong tourist and agriculture sectors. In total, there are 698 jobs, $14.4 million in earnings, and $52 million in sales in Riggins.

Table 3-22. 2006 Economic Profile of Riggins

Industry	Jobs	%	Earnings ($1,000)	%	Sales ($1,000)	%	EPW ($1,000)
Ag., forestry, fishing and hunting	127	18.2%	$1,444	10.0%	$6,169	11.9%	$11
Mining	13	1.9%	$707	4.9%	$2,526	4.9%	$56
Utilities	<10	N/A	$60	0.4%	$230	0.4%	$130
Construction	45	6.4%	$1,016	7.0%	$2,312	4.4%	$22
Manufacturing	<10	N/A	$88	0.6%	$376	0.7%	$39
Wholesale trade	<10	N/A	$78	0.5%	$198	0.4%	$15
Retail trade	68	9.7%	$1,086	7.5%	$2,321	4.5%	$16
Transportation and warehousing	13	1.9%	$379	2.6%	$937	1.8%	$28
Information	<10	N/A	$18	0.1%	$53	0.1%	$23
Finance and insurance	<10	N/A	$168	1.2%	$572	1.1%	$38
Real estate and rental and leasing	56	8.0%	$905	6.3%	$5,201	10.0%	$16
Professional and technical services	<10	N/A	$159	1.1%	$234	0.4%	$47
Management of companies	0	0.0%	$0	0.0%	$0	0.0%	$0
Administrative and waste services	<10	N/A	$71	0.5%	$133	0.3%	$8
Educational services	12	1.7%	$246	1.7%	$444	0.9%	$21
Health care and social assistance	48	6.9%	$1,126	7.8%	$2,000	3.8%	$23
Arts, entertainment, and recreation	15	2.1%	$145	1.0%	$414	0.8%	$9
Accommodation and food services	82	11.7%	$831	5.8%	$2,386	4.6%	$10
Other services, ex.public ad.	17	2.4%	$203	1.4%	$361	0.7%	$12
Government	175	25.1%	$5,707	39.5%	$25,176	48.4%	$54
Total	698	100.0%	$14,440	100.0%	$52,043	100.0%	$18

Source: EMSI

For Weiser (Table 3-23), the largest industry is agriculture, forestry, fishing, and hunting category that provides the community with 1,185 jobs, $17.5 million in earnings and $51.6 million in sales. Of these jobs, 428 are in production agriculture (36%) and 756 jobs (64%) are in agriculture and forestry support services. The second biggest industry in terms of employment is 638 jobs in federal, state, and local government. The third largest industry has 580 jobs in manufacturing (13.2%). Weiser has a diverse economy that has strong wood products and agriculture sectors. In total, there are 4,398 jobs, $106.6 million in earnings, and $406 million in sales in Weiser.

Table 3-23. 2006 Economic Profile of Weiser

Industry	Jobs	%	Earnings ($1,000)	%	Sales ($1,000)	%	EPW ($1,000)
Ag., forestry, fishing and hunting	1185	26.9%	$17,485	16.4%	$51,578	12.7%	$15
Mining	<10	N/A	$45	0.0%	$153	0.0%	$15
Utilities	<10	N/A	$275	0.3%	$1,891	0.5%	$253
Construction	209	4.8%	$5,306	5.0%	$12,071	3.0%	$25
Manufacturing	580	13.2%	$21,983	20.6%	$101,333	25.0%	$38
Wholesale trade	100	2.3%	$3,380	3.2%	$8,606	2.1%	$34
Retail trade	348	7.9%	$7,203	6.8%	$15,388	3.8%	$21
Transportation and warehousing	193	4.4%	$7,274	6.8%	$16,291	4.0%	$38
Information	22	0.5%	$635	0.6%	$2,174	0.5%	$29
Finance and insurance	60	1.4%	$2,345	2.2%	$8,379	2.1%	$39
Real estate and rental and leasing	176	4.0%	$2,564	2.4%	$15,730	3.9%	$15
Professional and technical services	162	3.7%	$3,763	3.5%	$7,893	1.9%	$23
Management of companies	<10	N/A	$52	0.0%	$84	0.0%	$36
Administrative and waste services	61	1.4%	$847	0.8%	$2,084	0.5%	$14
Educational services	<10	N/A	$41	0.0%	$83	0.0%	$27
Health care and social assistance	296	6.7%	$6,121	5.7%	$10,744	2.6%	$21
Arts, entertainment, and recreation	48	1.1%	$933	0.9%	$2,169	0.5%	$19
Accommodation and food services	209	4.8%	$1,740	1.6%	$5,203	1.3%	$8
Other services, ex.public ad.	103	2.3%	$1,573	1.5%	$3,174	0.8%	$15
Government	638	14.5%	$23,001	21.6%	$140,882	34.7%	$36
Total	4398	100.0%	$106,568	100.0%	$405,910	100.0%	$24

Source: EMSI

For Wilder (Table 3-24), the largest industry is agriculture, forestry, fishing, and hunting category that provides the community with 800 jobs, $18.6 million in earnings and $76.8 million in sales. Of these jobs, 704 are in production agriculture (88%). The second biggest industry in terms of employment is 519 jobs in manufacturing (25.3%). The third largest industry has 214 jobs in government (10.4%). Wilder has a diverse economy that has strong food processing and agriculture sectors. In total, there are 2,048 jobs, $59.6 million in earnings, and $281.5 million in sales in Wilder.

Table 3-24. 2006 Economic Profile of Wilder

Industry	Jobs	%	Earnings ($1,000)	%	Sales ($1,000)	%	EPW ($1,000)
Ag., forestry, fishing and hunting	800	39.1%	$18,587	31.2%	$76,802	27.3%	$23
Mining	<10	N/A	$9	0.0%	$23	0.0%	$39
Utilities	0	0.0%	$0	0.0%	$0	0.0%	$0
Construction	111	5.4%	$3,012	5.1%	$6,853	2.4%	$27
Manufacturing	519	25.3%	$20,313	34.1%	$120,672	42.9%	$39
Wholesale trade	63	3.1%	$2,931	4.9%	$7,463	2.7%	$46
Retail trade	36	1.8%	$705	1.2%	$1,507	0.5%	$20
Transportation and warehousing	40	2.0%	$1,365	2.3%	$3,445	1.2%	$34
Information	<10	N/A	$13	0.0%	$40	0.0%	$36
Finance and insurance	<10	N/A	$344	0.6%	$1,367	0.5%	$45
Real estate and rental and leasing	37	1.8%	$558	0.9%	$3,594	1.3%	$15
Professional and technical services	18	0.9%	$307	0.5%	$580	0.2%	$17
Management of companies	0	0.0%	$0	0.0%	$0	0.0%	$0
Administrative and waste services	13	0.6%	$299	0.5%	$539	0.2%	$23
Educational services	<10	N/A	$1	0.0%	$2	0.0%	$8
Health care and social assistance	105	5.1%	$626	1.1%	$1,149	0.4%	$6
Arts, entertainment, and recreation	14	0.7%	$224	0.4%	$694	0.2%	$16
Accommodation and food services	21	1.0%	$278	0.5%	$832	0.3%	$13
Other services, ex.public ad.	49	2.4%	$1,376	2.3%	$3,293	1.2%	$28
Government	214	10.4%	$8,606	14.5%	$52,645	18.7%	$40
Total	2048	100.0%	$59,555	100.0%	$281,500	100.0%	$29

Source: EMSI

Assessment of current levels of grazing occurring on the Payette reveals that 3.95, 24.86, and 8.40 jobs (direct, indirect and induced jobs) are provided to Riggins, Weiser and Wilder communities, respectively (Table 3-29). These contributions make up less than one percent of total employment in these communities however 2.7, 12.9, and 5.8 jobs are directly provided in the livestock industry in Riggins, Weiser and Wilder communities, respectively (Table 3-31) which amount to 2.1, 1.0 and 0.7 percent of the Ag., forestry, fishing and hunting industries in these three communities, respectively.

Income from Sheep and Lamb Production in Idaho

According to the 2009 Idaho Agricultural Statistics: (http://www.nass.usda.gov/Statistics_by_State/Idaho/Publications/Annual_Statistical_Bulletin/2009%20bulletin%20complete%20internet.pdf); gross income from sheep and lamb production was $19,769,000 in 2008 for Idaho State. Idaho State inventory included 235,000 sheep and lambs in 2008 averaging $84.1 price per sheep. There were 2,300 sheep and lambs in Idaho County and 16,000 in Washington County (the only two relevant identifiable county counts in the data). Multiplying by $84.1 yields $193,484 (Idaho County) and $1,345,974 (Washington County). Total estimated

gross income for both counties is $1,539,458 for 2008. Including gross income from wool production, the total yield was $1,691,231 for 2008.

The Southwest Agricultural District includes the counties of Adams, Valley, Washington, Gem, Payette, Boise, Ada, Elmore, Canyon, and Owyhee. There were 52,500 sheep and lambs in the district. Adding in Idaho County (2,300) totals 54,800 sheep and lambs. Multiplying by $84.1 per sheep yields an approximate yearly gross income of $4,609,963. Adding gross income from wool production yields $5,064,453 for 2008 (Table 3-25).

For the State of Idaho, total gross income including wool was $21,718,000 for 2008.

Table 3-25. 2008 Gross Income from Sheep and Lamb Production in Selected Regions

Region	Sheep/Lambs	Meat	Wool	Total
Idaho County	2,300	$193,484	$19,075	$212,559
Washington County	16,000	$1,345,974	$132,698	$1,478,672
Total Two Counties	18,300	$1,539,458	$151,773	$1,691,231
Southwest Agriculture District + Idaho County	54,800	$4,609,963	$454,490	$5,064,453
Idaho State Total	235,000	$19,769,000	$1,949,000	$21,718,000

Source: 2009 Idaho State Agricultural Statistics Bulletin

ENVIRONMENTAL CONSEQUENCES

Methodology for Analysis

Regional Economic Model

A large regional economic model using Economic Modeling Specialists, Incorporated (EMSI) was created to compare the economic impacts of the alternative scenarios with the outputs of the community economic models. The large regional economic model included most of the economy of south-west central Idaho and included the counties of Ada, Adams, Boise, Canyon, Elmore, Gem, Idaho, Payette, Valley, and Washington. A comparison of the totals of the community and regional models in terms of employment and wage/salary (earnings) impacts is presented in Table 3-29.

Head Months per Alternative

The first step in this updated analysis is to calculate head-months (HM) of domestic sheep grazing for each of the subject alternative scenarios (Table 3-26). This was done using forest rangeland inventory of permitted use by allotment and acres suitable for grazing per alternative. Domestic sheep head-months range from 64,385 in Alternatives 1B257 to none in Alternative 7E. These head month estimates were then used to calculate the direct effects (Direct jobs are defined as the actual number of jobs in the sheep production industry dependent on grazing allotments) and total effects (direct, indirect and induced – multiplier effects) of domestic sheep grazing per alternative. Grazing impacts were distributed amongst relevant communities as displayed in Tables 3-27 and 3-28 (the number of head-months of domestic sheep by community for each alternative scenario (Table 3-27), the percent of head-months of domestic sheep by

community (Table 3-28). The direct jobs supported for each alternative scenario are displayed below in Table 3-29.

Table 3-26. Sheep Head-Months by Alternative

Alternative	Total Head Months
1B257	64,385
346	60,704
7E	-
7G	27,534
7L	46,804
7M	35,198
7N	29,599
7O	24,610
7P	36,306

Table 3-27. Number of Head-Months Sheep

City	Current (Alts 1B, 2, 5, 7)	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	8,236	1,390.0	-	1,232	3,201.8	1,734.1	1,385.2	15.4	1,390.0
Weiser	38,650	26,335.4	-	18,529	29,440.4	25,256.3	19,633.2	17,403.4	26,335.4
Wilder	17,499	8,581.1	-	7,773	14,161.5	8,208.0	8,581.1	7,191.4	8,581.1
Total	64,385	36,306.5	-	27,534	46,803.6	35,198.5	29,599.5	24,610.1	36,306.5

Table 3-28. Head-Months Sheep Percentage

City	Current (Alts 1B, 2, 5, 7)	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	12.8%	13.0%	-	4.5%	6.8%	4.9%	4.7%	0.1%	3.8%
Weiser	60.0%	58.2%	-	67.3%	62.9%	71.8%	66.3%	70.7%	72.5%
Wilder	27.2%	28.8%	-	28.2%	30.3%	23.3%	29.0%	29.2%	23.6%
Total	100.0%	100.0%	-	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The forest service establishes permitted limits for HMs on allotments. This is the maximum number of HMs that could be offered under ideal forage conditions. While this analysis uses permitted use levels, actual use of these head months depends on factors such as drought, financial limitations on operators and market conditions. Given an inability to project these other factors this analysis examines permitted use instead of actual use that would occur. Thus employment and earning effects represent the maximum possible effect if all permitted grazing occurred on allotments.

Grazing Fee Impacts

The grazing fee charged in 2009 for domestic livestock (cattle) grazing is $1.35/animal unit month (AUM). The Forest Service uses a factor of 5 (5 sheep = 1 cow) to assess fees for sheep grazing, which puts the fee at $0.27/sheep AUM ($1.35/5 = $0.27) in 2009. For the direct grazing fee totals under the regional model, they range from $0 (Alt 7E) to $15,819.39 (Current Scenario) (Table 3-30).

Effects Common to All Alternatives

Table 3-29 presents the outputs of the new scenarios run in both the community models and the regional model. The economic impacts of the outputs of the regional model were larger in all cases. The net difference in jobs ranged from 0 (Alt 7E) to 8.5 jobs (Current Scenario -- Alt 1B257). For the earnings scenario the differences range from $0 (Alt 7E) to $580,094 (Current Scenario -- Alt 1B257).

Table 3-29. Comparison of Outputs of Community Models to Regional Model

Total Jobs Per Scenario

Includes the direct, indirect, and induced impacts (i.e. multiplier effects)

City	Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	3.95	3.79	0.00	0.59	1.54	0.83	0.66	0.01	0.67
Weiser	24.86	22.72	0.00	11.92	18.94	16.25	12.63	11.20	16.94
Wilder	8.40	8.40	0.00	3.73	6.80	3.94	4.12	3.45	4.12
Community Model Total	37.22	34.9	0.00	16.24	27.3	21.0	17.4	14.7	21.7
Regional Model	45.71	43.1	0.00	19.55	33.2	25.0	21.0	17.5	25.8
Difference	8.5	8.2	0.00	3.3	5.9	4.0	3.6	2.8	4.1

Total Earnings Per Scenario

Includes the direct, indirect, and induced impacts (i.e. multiplier effects)

City	Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	$40,519	$38,866	-	$6,061	$15,753	$8,532	$6,815	$76	$6,839
Weiser	$442,589	$405,253	-	$212,656	$337,889	$289,869	$225,332	$199,740	$302,253
Wilder	$188,527	$188,473	-	$83,745	$152,566	$88,427	$92,447	$77,475	$92,447
Community Model Total	$672,635	$632,592	-	$302,462	$506,208	$386,828	$324,594	$277,291	$401,538
Regional Model	$1,252,729	$1,181,103	-	$535,726	$910,650	$684,851	$575,912	$478,836	$706,409
Difference	$580,094	$548,511	-	$233,263	$404,442	$298,023	$248,318	$201,545	$304,871

Table 3-30 presents the results of the economic impact of grazing fees in both the community models and in the regional model. The grazing fee economic impacts scenarios range from 0 (Alt 7E) to 0.44 jobs (Alt 1B257) for the total of the community economic models. For the

regional model, the grazing fee economic impact scenarios range from 0 (Alt 7E) to 0.40 jobs (Alt 1B257) for the community economic models.

In terms of wage and salary earnings, the grazing fee economic impact scenarios range from $0 (Alt 7E) to $11,704 (Alt 1B257) for the community economic models and $0 (Alt 7E) to $15,819 (Alt 1B257) for the regional economic model .

The earnings impacts rose in the regional model, but the jobs impact fell slightly as compared to the community model. The slight decline in the regional model occurs because the earnings per worker are higher in the regional model due to the inclusion of Ada County and Boise City in the model.

Table 3-30. Economic Impact of Grazing Fees in Both the Community Models and in the Regional Model

Headmonths Sheep

City	Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	8,236	7,900	-	1,232	3,202	1,734	1,385	15	1,390
Weiser	38,650	35,310	-	18,529	29,440	25,256	19,633	17,403	26,335
Wilder	17,499	17,494	-	7,773	14,161	8,208	8,581	7,191	8,581
Total	64,385	60,704	-	27,534	46,804	35,198	29,599	24,610	36,306

Grazing Fees

City	Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	$2,224	$2,133	-	$333	$864	$468	$374	$4	$375
Weiser	$10,436	$9,534	-	$5,003	$7,949	$6,819	$5,301	$4,699	$7,111
Wilder	$4,725	$4,723	-	$2,099	$3,824	$2,216	$2,317	$1,942	$2,317
Total	$17,384	$16,390	-	$7,434	$12,637	$ 9,504	$7,992	$6,645	$9,803

Economic Impacts of Grazing Fees (Community Models)

City		Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	Jobs	0.06	0.05	-	0.01	0.02	0.01	0.01	0.00	0.01
	Earnings	$1,396	$1,339	-	$209	$543	$294	$235	$3	$236
Weiser	Jobs	0.28	0.26	-	0.14	0.21	0.18	0.14	0.13	0.19
	Earnings	$7,326	$6,693	-	$3,512	$5,580	$4,787	$3,721	$3,299	$4,992
Wilder	Jobs	0.10	0.10	-	0.04	0.08	0.05	0.05	0.04	0.05
	Earnings	$2,981	$2,981	-	$1,324	$2,413	$1,398	$1,462	$1,225	$1,462
Total	Jobs	0.44	0.41	-	0.19	0.32	0.24	0.20	0.17	0.25
	Earnings	$11,704	11,013	-	$5,045	$8,536	$6,480	$5,418	$4,526	$6,689

Economic Impacts of Grazing Fees (Regional Models)

	Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Jobs	0.40	0.37	-	0.17	0.29	0.22	0.18	0.15	0.22
Earnings	$15,819	$14,915	-	$6,765	$11,500	$8,648	$7,273	$6,047	$8,921

Alternatives 1B, 2, 5, and 7

Under the Alternatives 1B, 2, 5, 7, 21.5 jobs are directly employed in the sheep production industry (Table 3-31) while 37.2 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 8.5 jobs are supported for a total of 45.7 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $580,094 more than the community model total.

Table 3-31. Direct Jobs per Alternative Scenario

City	Alts 1B, 2, 5, 7	Alts 3, 4, 6	Alt 7E	Alt 7G	Alt 7L	Alt 7M	Alt 7N	Alt 7O	Alt 7P
Riggins	2.7	2.6	0.0	0.4	1.1	0.6	0.5	0.0	0.5
Weiser	12.9	11.8	0.0	6.2	9.8	8.4	6.5	5.8	8.8
Wilder	5.8	5.8	0.0	2.6	4.7	2.7	2.9	2.4	2.9
Total	21.5	20.2	0.0	9.2	15.6	11.7	9.9	8.2	12.1

Alternatives 3, 4 and 6

Under alternatives 3, 4, and 6, 20.2 jobs are supported in the sheep production industry (Table 3-31) while 34.9 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 8.2 jobs are supported for a total of 43.1 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $548,511 more than the community model total of $632,592.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 2.3 locally or 2.6 regionally could occur. In addition, total earnings could decrease by $40,043 locally or $71,626 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7E

Due to the absence of grazing under this alternative neither employment nor income would be supported by grazing. Relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7 this would represent a decrease in total employment of 37.2 locally or 45.7 regionally. In addition, total earnings would decrease by $672,635 locally or $1,252,729 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought,

financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7G

Under Alternative7G 9.2 jobs would be supported in the sheep production industry (Table 3-31) while 16.2 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 3.3 jobs are supported for a total of 19.5 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $233,263 more than the community model total of $302,462.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 21 locally or 26.2 regionally could occur. In addition, total earnings would decrease by $370,173 locally or $717,003 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7L

Under Alternative 7L 15.6 jobs would be supported in the sheep production industry (Table 3-31) while 27.3 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 5.9 jobs are supported for a total of 33.2 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $404,442 more than the community model total of $910,650.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 10 locally or 12.5 regionally could occur. In addition, total earnings would decrease by $166,427 locally or $342,079 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7M

Under Alternative 7M 11.7 jobs would be supported in the sheep production industry (Table 3-31) while 21 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 4 jobs are supported for a total of 25 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $298,023 more than the community model total of $684,981.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 16.2 locally or 20.7 regionally could occur. In addition, total earnings would decrease by $258,807

locally or $567,878 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7N

Under Alternative 7N 9.9 jobs would be supported in the sheep production industry (Table 3-31) while 17.4 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 3.6 jobs are supported for a total of 21 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $248,318 more than the community model total of $575,912.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 19.8 locally or 24.7 regionally could occur. In addition, total earnings would decrease by $348,041 locally or $676,817 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7O

Under Alternative 7O 8.2 jobs would be supported in the sheep production industry (Table 3-31) while 14.7 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 2.8 jobs are supported for a total of 17.5 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $201,545 more than the community model total of $478,836.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 22.5 locally or 28.2 regionally could occur. In addition, total earnings would decrease by $395,344 locally or $773,893 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

Alternative 7P

Under Alternative 7P 12.1 jobs would be supported in the sheep production industry (Table 3-31) while 21.7 total jobs (direct, indirect and induced jobs) are supported in all three communities on an average annual basis. In the regional model an additional 4.1 jobs are supported for a total of 25.8 total jobs (Table 3-29) supported on an average annual basis. Correspondingly total earnings in the sheep production industry are $304,871 more than the community model total of $706,409.

This alternative would support less employment and income relative to the current situation depicted above under Alternatives 1B, 2, 5, and 7. A decrease in total employment of 15.5 locally or 19.9 regionally could occur. In addition, total earnings would decrease by $271,097locally or $546,320 regionally. In order for these decreases to occur permitted use would need to be equal to actual use. As discussed above actual use of forest service grazing is dependent on factors such as drought, financial limitations on operators and market conditions thus these changes reflect a maximum potential effect that do not consider these other factors.

RECREATIONAL SOCIO-ECONOMICS

Introduction

The Southwest Idaho Ecogroup Land and Resource Management Plan Final Environmental Impact Statement (FEIS) was completed in July 2003. However, the Regional Forester received five appeals contending that the decision to implement Alternative 7 threatened the viability of bighorn sheep (*Ovis canadensis*) through disease transmission from domestic sheep (*Ovis aries*) grazing within or near the range of bighorn sheep. On March 9, 2005, the Chief of the Forest Service concurred that the effects analyses and cumulative effects discussion pertaining to bighorn sheep presented in the FEIS did not adequately address viability. To address the issue of bighorn sheep viability, the Regional Forester was instructed to complete a Supplemental Environmental Impact Statement (SEIS) to the FEIS for the Southwest Idaho Ecogroup Revised Land and Resource Management Plans.

This report addresses the potential recreation economic impacts of the update to the Draft SEIS (DSEIS) alternatives (7E, 7G, 7L through 7P) in addition to those analyzed under the FEIS—1B, 2, 3, 4, 5, 6, and 7. The economic impacts estimate effects that Forest Service management may have on local, county, and regional levels. In addition to the economic impacts, the assessment of the Environmental Justice impacts is also included.

Regulatory Framework

Multiple statutes, regulations, and executive orders identify the general requirement for applying economic and social evaluation in support of Forest Service planning and decision making. These include, but are not limited to, the Multiple-Use Sustained Yield Act of 1960 (74 Stat. 215: 16 USC 528-531), National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 USC 4321, 4331-4335, 4341-4347), and the Planning Act of 1974.

Executive Order (EO) 13443 was issued in 2007, directing Federal agencies to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat. EO 13443 also states that Federal agencies shall evaluate the effects of agency actions on trends in hunting participation and, where appropriate, enhance public hunting opportunities. The order also directs Federal agencies to consider the economic and recreational values of hunting in agency actions, as appropriate.

In Addition, EO 12898, issued in 1994, orders Federal agencies to identify and address any adverse human health and environmental effects of agency programs that disproportionately impact minority and low-income populations. EO 12898 also directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish or wildlife.

Overview of Issues Addressed

This analysis furthers compliance with the regulatory framework outlined above and examines effects brought up by cooperators and the general public during the DSEIS comment period. Commenters noted the economic benefits bighorn sheep hunting and viewing bring to the region were not adequately addressed in the DSEIS.

Indicators used in the analysis of economic effects include jobs and labor income. Non-market values, such as the value of recreational experiences associated with bighorn sheep, are difficult to quantify. Direction provided in 40 CFR 1502.23 and Forest Service Handbook 1909.15, (7/6/04) and 22.35 (01/14/05) provides for the use of qualitative analysis to evaluate the effects of these non-market values. The non-market aspects of the alternatives are thus discussed qualitatively where appropriate and will be described in other resource sections of the SEIS and specialist reports.

Economic Impacts (Jobs and Labor Income)

The economic impacts to the local economy affected by the treatments proposed are measured by estimating the employment (full- and part-time jobs) and labor income generated by the alternatives. Direct employment and labor income benefit employees and their families and therefore, directly affect the local economy. Additional indirect and induced multiplier effects (ripple effects) are generated by the direct effects. Together, the direct and multiplier effects comprise the total economic impacts to the local economy. The methods of analysis are described in detail in the Methodology for Analysis section.

Environmental Justice

Environmental Justice effects report what, if any, effects might occur to minority and low-income populations. Of particular concern are patterns of subsistence hunting and fishing relevant when an agency action may affect fish or wildlife used by groups.

Affected Environment

Impact Area

To accurately portray the economic relationship between recreation and the local area, the geographic scope of analysis must be defined. The economic effects from potential changes in the bighorn sheep population extend beyond the immediate vicinity of the Payette National Forest (Payette NF). Thus, the role of the update to the DSEIS, within the larger region, must be addressed while not masking potential change within counties and communities in the area. Therefore, area information is presented at the regional and county level (Figure 3-34).

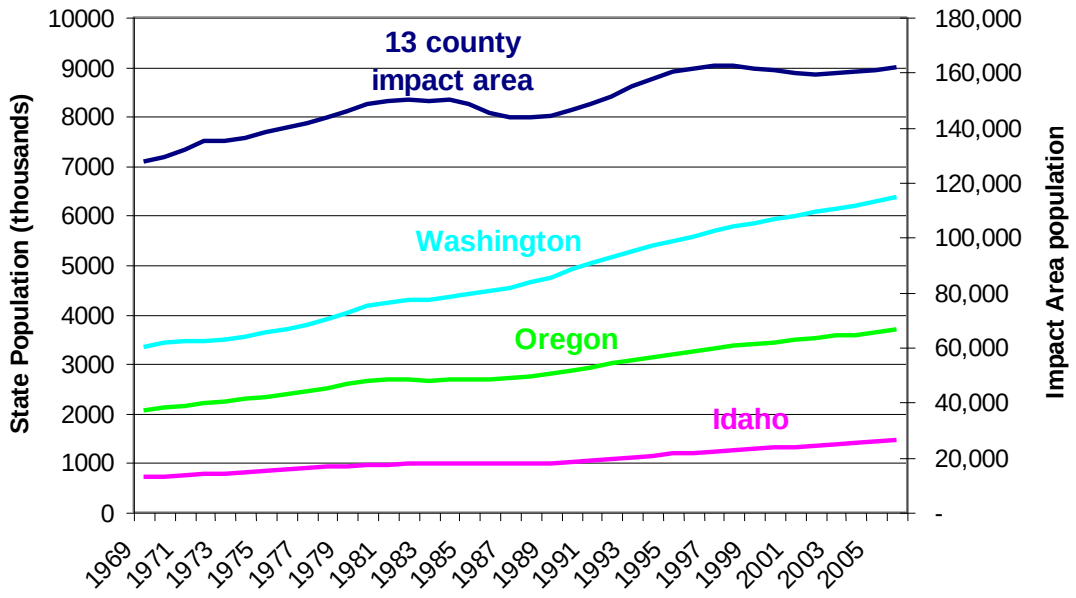
Figure 3-34 below displays counties that could be affected economically by possible direct and indirect disease exposure and connections to bighorn sheep-associated recreation. While bighorn sheep–associated recreation would occur within smaller areas, including the larger 13 county area, will capture spending by recreationists as they travel to, and participate in, bighorn sheep–associated recreation. The extent of the impact area also covers potential effects to Environmental Justice communities in the area.

Figure 3-34. Payette National Forest Impact Area

Population and Demographic Change

According to the U.S. Census Bureau, population growth in the 13 impact area counties was 27 percent between 1969 and 2006. This growth was outpaced by change within Idaho, Oregon, Washington, and the nation, which increased by 107, 79, 91 and 89 percent, respectively. Change in population is depicted below in Figure 3-35 for Idaho, Oregon, Washington and impact area counties.

Figure 3-35. Population Change for Counties within the Impact Area (Source: U.S. Department of Commerce 2006)



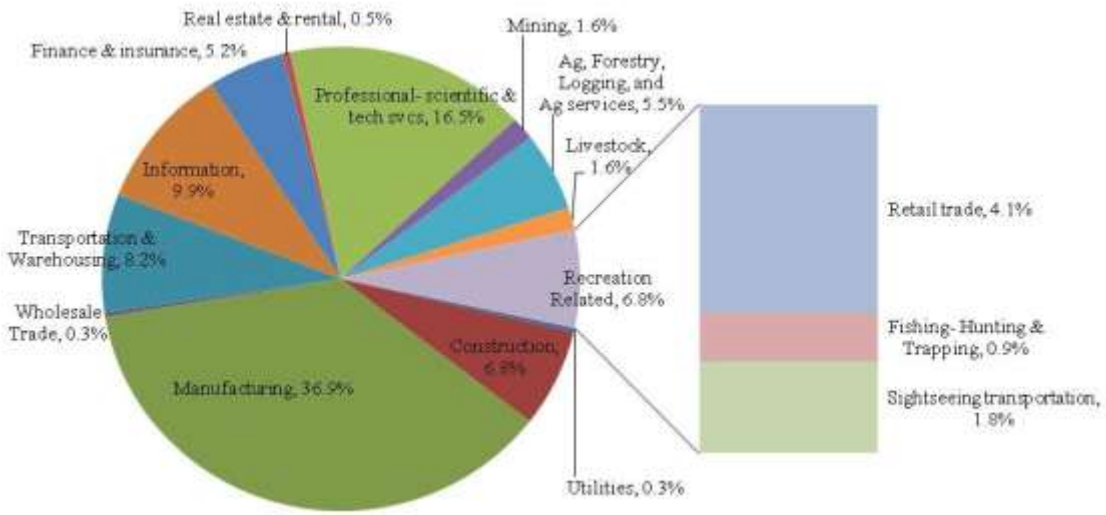
Population density within the impact area was 5.2 persons per square mile in 2006. For individual counties in the impact area, population density ranged from 1.7 persons per square mile in Lemhi County to 45.1 in Nez Perce County (U.S. Department of Commerce 2006). Population density does not indicate if the people living in the area are in more urban or rural areas. The U.S. Census Bureau classifies urban areas and their populations and classified the population of the impact area as 55 percent urban and 45 percent rural. Six impact area counties have at least half of their populations classified as urban: Asotin, Baker, Columbia, Nez Perce, Union, and Washington are, respectively 94, 56, 67, 83, 58 and 55 percent urban. Populations of Adams, Garfield, Lewis, Valley and Wallowa counties were classified entirely as rural while Idaho and Lemhi Counties have at least half of their populations classified as rural (80 and 62 percent, respectively). The urban populations outside of Asotin and Nez Perce Counties are located inside urban clusters (census blocks that have a population density of at least 1,000 people per square mile and surrounding census blocks that have an overall density of at least 500 people per square mile; U.S. Census Bureau 2000), demonstrating the area contains pockets of urban populations across a predominantly rural landscape.

The population in the impact area has aged since 1990; the median age in 2000 was 40.4 years, up from 36.2 years in 1990. The largest age category in the impact area in 2000 was those aged 45 to 49 years. Between 1990 and 2000, the fastest growing age group as a share of total population was those aged 45 to 49, which rose by 2.2 percent (up 4,457 people). Age groups between 40 and 59, which include the baby boomer population, showed increases in their shares' of total population in impact area counties while those aged 25 to 39 saw a decrease in their shares. Thus, the impact area experienced an aging population with decreases in the share of younger age classes between 1990 and 2000. However, counties show slight increases in those aged 15 to 24 (U.S. Census Bureau 2000).

Economic Specialization and Employment

The Interior Columbia Basin Ecosystem Management Project identified communities that were specialized with respect to employment. Their method used the ratio of the percent employment in each industry in the region of interest (counties in the impact area) to an average percent of employment in that industry for a larger area (the reference region; Economic Areas designated by the Bureau of Economic Analysis). For a given industry, when the percent employment in the analysis region is greater than in the reference region, local employment specialization exists in that industry (USDA Forest Service 1998). Using this criterion applied with 2006 data, the impact area can be characterized as specialized with respect to the Professional-scientific & Technical Services, Finance and Insurance, Information and the Retail Trade sectors. Employment within the impact area in 2007 is displayed below (Figure 3-36) (IMPLAN 2006). Contributions from the Payette NF represent only a portion of the economic activity reflected in the recreation-related sectors, seen in Figure 3-36 and Figure 3-37.

Figure 3-36. Economic Impact Area Industry Employment Distribution (IMPLAN 2007)



Income

Total personal income (TPI) and per capita personal income (PCPI) are useful measures of economic well being. From 1970 to 2006, annual TPI in the economic impact area increased from $2.46 billion to $4.46 billion, and annual PCPI increased from $19,059 to $27,578 (all measures adjusted for inflation to 2006 dollars). This translates to a TPI increase of 81 percent (roughly 2 percent annually) and a PCPI increase of 29 percent (less than 1 percent annually) over this time period. Average PCPI in the economic impact area was lower than all three states ($29,920, $33,299, and $38,212, respectively in Idaho, Oregon, and Washington) and the nation ($36,714) in 2006.

While PCPI is a useful measure of economic well being it should be examined alongside changes in real earnings per job. Since PCPI includes income from 401(k) plans as well as other non-labor income sources like transfer payments, dividends, and rent, it is possible for per capita income to rise, even if the average wage per job declines over time. Earnings per job decreased

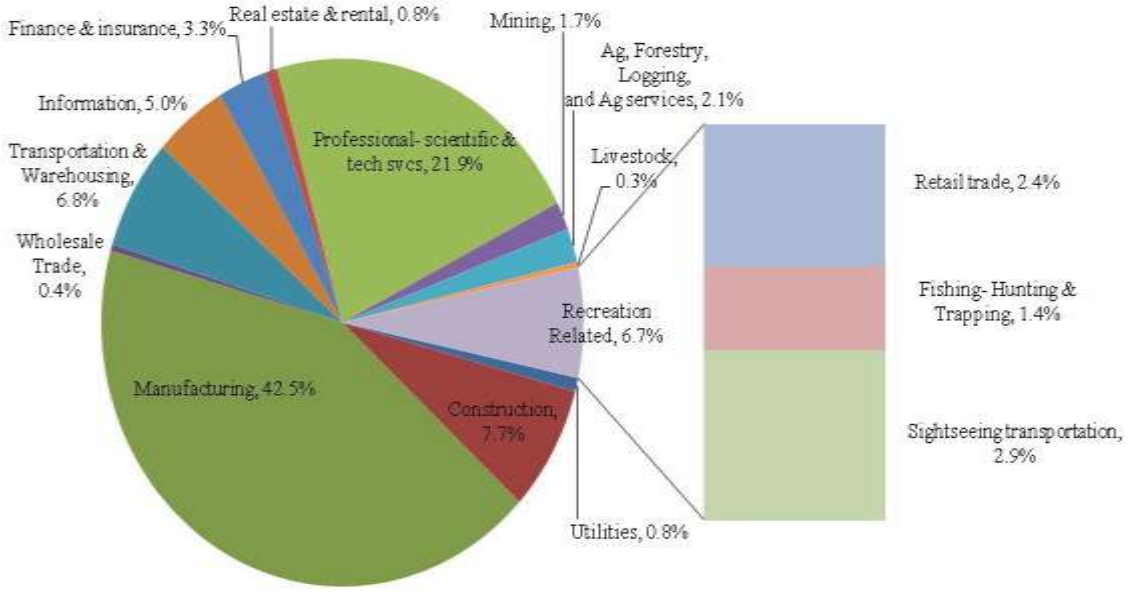
from $34,408 to $27,868 (values adjusted for inflation to 2006 dollars) while PCPI increased, indicating a possible decrease in area economic well being (U.S. Department of Commerce 2006).

Components of Personal Income

Further examination of trends within personal income provides insight into the area's economy and its connection to the lands administered by the Payette NF. There are three major sources of personal income: (1) labor earnings or income from the workplace; (2) investment income, or income received by individuals in the form of rent, dividends, or interest earnings; and (3) transfer payment income or income received as Social Security, retirement, and disability income or Medicare and Medicaid payments.

Within the impact area, labor earnings were the largest source of income, accounting for 57 percent of all income in 2006. For the states of Idaho, Oregon, and Washington, labor earnings made up 67, 65, and 69 percent of TPI, respectively. The Manufacturing and Professional-scientific & Technical Services sectors were the largest components of labor income in 2006 for the economic impact area (Figure 3-37).

Figure 3-37. Economic Impact Area Labor Income Distribution (IMPLAN, 2007)



While labor earning's share of TPI has decreased in the impact area from 1970 to 2006 (from 74 to 56 percent), the share of non-labor income has risen (from 26 to 44 percent). As a share of TPI, investment income and transfer payments rose from 15 to 21 and 11 to 23 percent, respectively. The increase in transfer payments is not entirely due to increases in welfare or unemployment-related payments. Data show age-related transfer payments increased from 57 to 65 percent of total transfer payments while the share of transfer payments from income maintenance benefit payments, or "welfare," actually decreased from 8 to 7 percent. The share of transfer payments from unemployment payments also decreased from 7 to 2 percent.

These patterns may reflect the aging population noted above, which is more likely to have investment earnings than younger adults. As the population of the area continues to age, the share of income from these non-labor sources should continue to rise as long as residents continue to stay in the area after retirement or new retirees move into the area. Rural county population change, the development of rural recreation, and retirement-destination areas are all related to natural amenities (McGranahan 1999). Natural amenities such as bighorn sheep and other wildlife provide recreational opportunities and indirectly contribute to area labor and non-labor income.

Forest Recreation Use

The Payette NF FEIS states that area urban communities will look to Ecogroup National Forests with an increased need and desire to provide recreational and undeveloped areas (USDA Forest Service 2003, p. 3-944). Table SO-18 in the FEIS also states that Forest Service recreation visitor days are projected to increase over time. This growth in recreation use may create additional recreation related jobs in impact area communities (USDA Forest Service 2003, p. 3-955).

From October 2002 through September 2003, the Payette NF and area National Forests participated in the National Visitor Use Monitoring (NVUM) survey process, which was implemented to better understand recreational use occurring on National Forest System lands. NVUM data indicate that 1,855,219 combined visits occurred on the Nez Perce, Payette , and Wallowa Whitman NFs during the survey period from October 2002 through September 2003 (731,535, 619,094, and 504,590 visits, respectively). Table 3-32 presents participation rates by activity over this period. The “Total Activity Participation” column of the table presents the participation rates by activity and the “Main Activity” column presents the participation rates in terms of primary activity. Participation and main activity rates will exceed 100% since visitors can participate in multiple activities and many visitors marked more than one activity as their main reason for their visit. In terms of total participation, the top five recreational activities were viewing natural features, viewing-wildlife, relaxing, hiking/walking, and sightseeing. The top five main activities were hunting, sightseeing, relaxing, viewing natural features, and fishing (Table 3-32).

Table 3-32. Total Activity Participation in the Payette, Nez Perce and Wallowa National Forests (USDA Forest Service 2008)

Activity	Total Activity Participation[5] (% of NF visits)	Main Activity[6] (% of NF visits)
Developed camping	12.9	4.2
Primitive camping	15.7	3.7
Backpacking	7.1	1.4
Resort use	5.6	1.1
Picnicking	18.1	2.7
Viewing natural features	54.6	9.8
Visiting historic sites	17.3	1.3
Nature center activities	9.4	0.2
Nature study	11.7	0.7
Relaxing	41.4	11.0
Fishing	20.5	8.1
Hunting	19.8	15.2
Off-highway vehicle use	10.2	2.3
Driving for pleasure	37.4	3.8
Snowmobiling	5.4	4.7
Motorized water activities	4.2	1.4
Other motorized activity	0.8	0.4
Hiking/walking	39.7	5.8
Horseback riding	2.6	0.2
Bicycling	2.7	0.6
Non-motorized water	4.7	2.1
Downhill skiing	6.1	5.3
Cross-country skiing	4.9	3.3
Other Non-motorized	5.9	1.5
Gathering forest products	11.7	2.7
Viewing-wildlife	41.9	3.4
Sightseeing	37.7	13.4
No activity reported	11.1	15.2
Developed camping	12.9	4.2
Primitive camping	15.7	3.7
Backpacking	7.1	1.4

[5] Survey respondents could select multiple activities so this column may total more than 100 percent.

[6] Survey respondents were asked to select just one of their activities as their main reason for the forest visit. Some respondents selected more than one, so this column may total more than 100 percent.

While visitation in many of the categories in Table 3-32 may be peripherally connected to bighorn sheep populations, a portion of the hunting and viewing-wildlife category can be directly attributable to bighorn sheep; thus activity participation in just the hunting and viewing-wildlife categories are distinguished for area forests and displayed below in Table 3-33. On the Nez Perce and Payette NFs hunting had the second most main activity visits, and on the Wallowa Whitman NF it was the most popular main activity visit. Viewing-wildlife was the sixth most popular main activity on the Wallowa Whitman NF and the fourteenth on the Payette NF.

Table 3-33. Activity Participation on the Payette, Nez Perce, and Wallowa National Forests (USDA Forest Service 2008)

Activity	Total Activity Participation[5] (% of NF visits)	Total Activity Participation[7] (number)	Main Activity[6] (% of NF visits)	Main Activity[8] (number)
Nez Perce National Forest				
Hunting	20.5	41	14.2	28
Viewing-wildlife	0	0	0	0
Payette National Forest				
Hunting	15.1	126	13.2	112
Viewing-wildlife	33.4	240	1.9	14
Wallowa Whitman National Forest				
Hunting	24.6	47	19.3	39
Viewing-wildlife	52.4	348	5.3	14

In addition to visitation data, the NVUM effort included a separate economics survey administered to roughly one-fourth of those sampled in order to gather spending information for use in developing spending profiles for forest visitors. Analyses of expenditures reported by National Forest visitors show the primary factor determining the amount spent by a visitor was the type of trip taken not the specific activity or forest visited (Stynes and White 2005). Thus, recreation visits were distinguished for local and non-local visitors. If the user reported living within 30 miles of the forest boundary, they were considered local and if over 30 miles away, they were considered non-local. Results for the Payette NF indicated that approximately 48 percent of recreation visitors were from the local area while 40 percent were non-locals. The remaining 12 percent were classified as non-primary visitors, or those who indicated that recreating on the National Forest was not their primary purpose (Stynes and White 2006).

Local and non-local visitors were further divided by those staying overnight and those on day trips. The five trip type segments are listed below:

- Visitors who reside greater than 30 miles from the visited forest:
  1. Non-local residents on day trips
  2. Non-local residents staying overnight

[7] The number in this column is the number of survey respondents who indicated participation in this activity.

[8] The number in this column is the number of survey respondents who indicated this activity was their main activity.

- Visitors who live within 30 miles of the visited forest:
  3. Local residents on day trips
  4. Local residents staying overnight
  5. Non-primary visitors

NVUM economic data sample sizes were too small at the individual forest level to reliably portray visitor spending profiles on individual forests. In order to account for spending differences, spending profiles were estimated by grouping forests with above or below average spending. Forest with above or below average spending were identified by comparing spending averages for each forest with the national average[9]. Of the forests sampled, 48 had visitor spending averages that were not significantly different from the national average, 44 forests had below average spending, and 28 had above average spending. The Nez Perce and Payette NFs were identified as average spending forests while the Wallowa Whitman NF was above average (Stynes and White 2006). These expenditures per visit are displayed in Table 3-34 for segment shares of hunting and viewing-wildlife activity types[10].

Between all activities on the Nez Perce and the Payette NFs, non-local hunters staying overnight spend the fourth most per visit ($116.32), while non-local hunters staying overnight on the Wallowa Whitman NF spend the third most of all activity types ($151.05) (USDA Forest Service 2008). While expenditures per visit give some comparison between activity emphases, the economic impacts of these activities depend on the economic characteristics of the impact area discussed above.

Table 3-34. Expenditures by Activity and Trip Type (USDA Forest Service 2008)

	Expenditures ($ per visit)				
	Non-local Day Use	**Non-local Overnight**	**Local Day use**	**Local Overnight**	**Non-Primary**
Nez-Perce National Forest					
Hunting	$38.10	$116.32	$30.00	$79.47	$25.50
Viewing -wildlife	$20.80	$82.59	$10.80	$53.75	$10.00
Payette National Forest					
Hunting	$38.10	$116.32	$30.00	$79.47	$25.50
Viewing -wildlife	$20.80	$82.59	$10.80	$53.75	$10.00
Wallowa Whitman National Forest					
Hunting	$48.10	$151.05	$33.53	$96.32	$28.50
Viewing -wildlife	$26.40	$99.26	$12.00	$65.00	$11.11

[9] Day and overnight visitor spending averages (excluding non-primary visitors) were estimated based on the sample of visitors on each forest. To control for differences in visitor mix across forests, a standardized average was computed for each forest, assuming a fixed mix of 60 percent for day trips and 40 percent for overnight trips. The standardized average for each forest was compared to the national standardized average.

[10] Expenditures per visit were obtained by dividing average expenditures per party trip by average party size. Party sizes by primary activity are reported in Appendix A of Stynes and White, 2006.

Response Coefficients for Hunting and Viewing Wildlife

Table 3-35 displays the estimated employment and labor income response coefficients (employment and labor income per 1,000 visits) by activity types for the three National Forests. The response coefficients indicate the number of full and part-time jobs and dollars of labor income generated per thousand visits by activity type. The response coefficients are useful for understanding the economic effects tied to a given use level,) understanding projected employment effects for various use scenarios (sensitivity analysis) and understanding the differences in employment and labor income effects by activity type (per 1,000 visits). These response coefficients are unique to the impact area discussed previously in this document. It is important to remember that while response coefficients may be greater for certain activity types, the economic effects to the impact area also depend on the number of visitors participating in the activity types.

Table 3-35 illustrates the following:

- Local hunting and viewing-wildlife generates lower employment and labor income effects per 1,000 visits since local visitors spend less per visit compared to non-local visitors (see Table 3-34).
- Economic effects vary across hunting and viewing-wildlife activity types. The lowest employment and labor income contribution is tied to local day users participating in viewing-wildlife and the largest contribution is associated with non-local wildlife viewers who stay overnight.

It should be noted that these response coefficients reflect an economic structure that is a snapshot in time and thus, are not applicable to visitation numbers that are dramatically different from current recreation levels. If recreational activities and/or visits were to change radically, there would be a structural shift in the economy as spending patterns changed and these response coefficients would no longer reflect underlying economic processes.

Table 3-35. Employment and Labor Income Response Coefficients by Activity Type

		Employment (Jobs per 1,000 Party-Trips)		Labor Income (2008 dollars) ($ per 1,000 Party-Trips)	
		Direct Effects	Indirect & Induced Effects	Direct Effects	Indirect & Induced Effects
Hunting	Local Day	0.420	0.148	$9,861	$4,338
	Local OVN	1.325	0.481	$30,372	$14,250
	Non-local Day	0.660	0.233	$15,493	$6,815
	Non-local OVN	2.273	0.749	$47,882	$21,587
	Non-Primary	0.420	0.148	$9,861	$4,338
Viewing-wildlife	Local Day	0.258	0.085	$5,834	$2,351
	Local OVN	1.616	0.485	$30,413	$13,872
	Non-local Day	0.598	0.176	$11,701	$4,860
	Non-local OVN	2.871	0.889	$56,969	$25,136
	Non-Primary	0.258	0.085	$5,834	$2,351

Hunting and Viewing-Wildlife Contributions

Table 3-36 displays the estimated employment and labor income contributions for current use levels reported by NVUM for local and non-local hunting and viewing-wildlife activities on the three area National Forests. Table 3-37 expresses these employment and labor income contributions for each activity as a percent of the total employment and income contributed from current use levels. The response coefficients displayed in Table 3-35 along with the visits in Table 3-33 were used to estimate the economic contributions for these tables.

Table 3-36 indicates that hunting visitation on the three area National Forests was responsible for approximately 161.1 of the total average annual jobs (direct, indirect, and induced; full-time; temporary; and part-time) and $4 million total labor income (direct, indirect, and induced) in the impact area. The total direct, indirect, and induced contributions from viewing-wildlife activity accounted for 103.7 jobs and $2.4 million in labor income within the impact area.

Table 3-36. Total Employment and Labor Income Effects

		Employment (full & part time jobs)	Labor Income (2008 dollars)
Hunting	Local	84.7	$2,173,837.50
	NonLocal	76.4	$1,828,451.90
Viewing-wildlife	Local	24.8	$578,313.00
	NonLocal	78.9	$1,784,611.50
	Total	264.8	$6,365,213.90
	Total Rec Use	524.0	$12,407,297.40
Total for Area		**89,942**	**$3,039,108,000.00**

Contributions from both hunting and viewing-wildlife account for <1 percent of total employment and labor income in the impact area. All jobs and the income attributable to recreation on the three forests contribute <1 percent of total employment and labor income in the impact area (Table 3-37). These estimates indicate that while hunting and viewing-wildlife activities contribute to the attractiveness, lifestyles, and customs of many local residents and visitors, actual economic contributions to the overall impact area are quite small. However, these job and income contributions can be more important at the local level. For example the FEIS shows that Forest Service recreation could account for between 6 and 7 percent of all jobs and between 4 and 5 percent of income for 2000, 2005, and 2010 in all communities analyzed (USDA Forest Service 2003, p. 3-956). Further, only a portion of these contributions can be attributable to bighorn sheep hunting and wildlife viewing activities.

Table 3-37. Percent of Total Area Employment and Total Area Labor Income Effects

		Employment (% of full & part time jobs)	Labor Income (% of total income)
Hunting	Local	0.094	0.072
	NonLocal	0.085	0.060
Viewing-wildlife	Local	0.028	0.019
	NonLocal	0.088	0.059
	Total	0.294	0.209
	Total Rec Use	0.583	0.408
Total for Area		**89,942**	**$3,039,108,000**

Economic Values and Trends for Viewing-Wildlife and Hunting

Viewing, photographing, or otherwise observing nature has been the fastest-growing type of nature-based recreational activity for Americans. New technologies like digital cameras and cell phones with cameras may be fueling these increases. Across the nation there was a 21 percent increase between 2000 and 2007 in the number of participants viewing or photographing wildlife other than birds (Cordell 2008). A 2006 report from the U.S. Fish and Wildlife Service (USFWS) shows that in 2006 hunting had 187,000 participants that spent $259,718,000 in Idaho with an average trip per day expenditure of $47, and wildlife watching had 754,000 participants who spent $265,383,000 in Idaho with an average trip per day expenditure of $37 (Table 3-38). While Table 3-38 shows that the average trip per day expenditure for hunters is greater than wildlife watchers in Oregon and Idaho, the total trip associated expenditures are greater for wildlife watchers in all states. Hunters may spend more per day, but wildlife watchers spend more overall (U.S. Department of Interior and Department of Commerce 2006).

Table 3-38. State Level Expenditures and Visitation for Wildlife Watching and Hunting

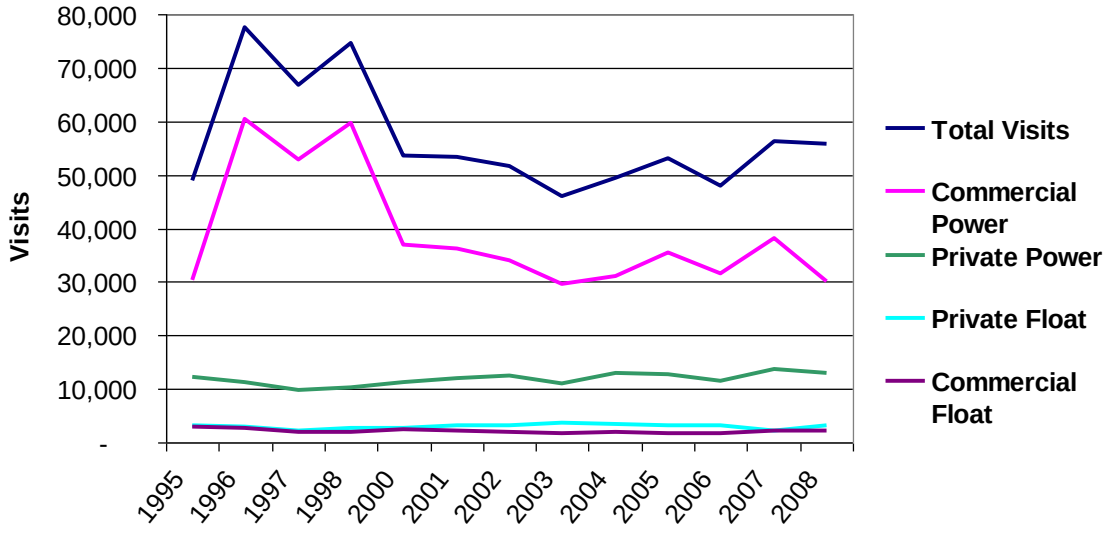
	Idaho	Oregon	Washington
Wildlife-watching			
Total Wildlife-watching expenditures	$265,383,000	$776,414,000	$1,502,311,000
Trip related expenditures (food, lodging, transportation, and other)	$193,468,000	$262,425,000	$441,652,000
Wildlife watching participants	754,000	1,484,000	2,331,000
Percent of wildlife associated recreation participation	75%	81%	85%
Total days wildlife watching	5,165,000	8,162,000	9,104,000
Average trip per day expenditure	$37	$32	$49
Hunting			
Total Hunting expenditures	$259,718,000	$373,613,000	$313,134,000
Trip related expenditures (food, lodging, transportation, and other)	$100,218,000	$116,690,000	$74,233,000
Total hunting participants	187,000	237,000	182,000
Percent of wildlife associated recreation participation	19%	13%	7%
Total days hunting	2,117,000	2,759,000	2,126,000
Average trip per day expenditure	$47	$42	$35

(Source: U.S. Department of Interior and Department of Commerce 2006)

While expenditures specific to bighorn sheep viewing or the value of the experience are not available, trends in boating activities provide insight on their importance in the area. Commercial outfitters for jet and private boating portray bighorn sheep in their marketing material. Boater activity participation occurs for a variety of reasons, but examination of their role in the area provides insight on its importance to the impact area economy.

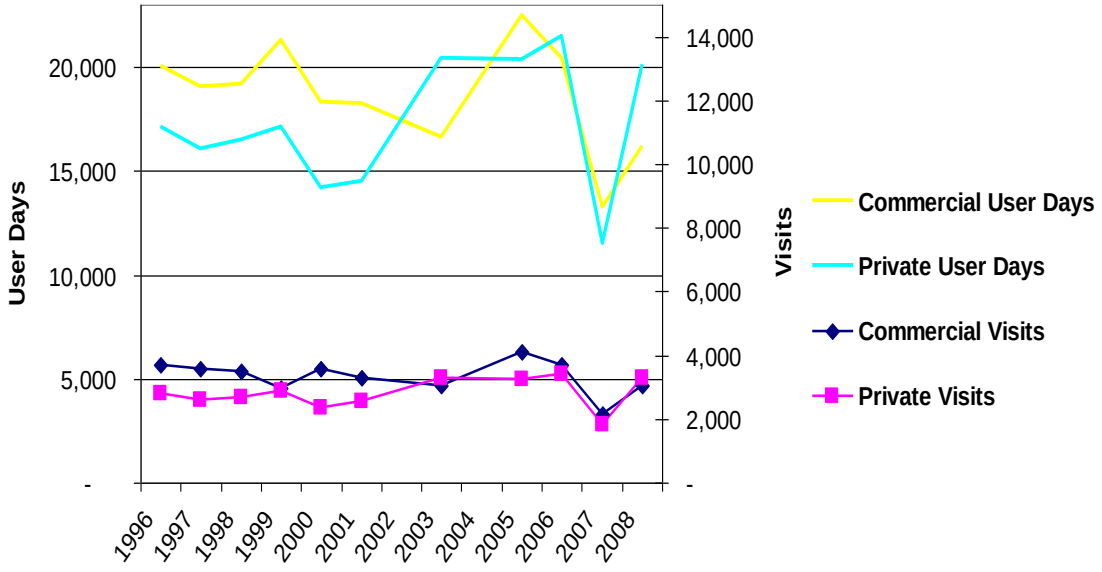
The Hells Canyon National Recreation Area (NRA) is managed by the Wallowa Whitman NF, and provides wildlife viewing opportunities for bighorn sheep and other wildlife. These activities are an important part of the boating experience and provide local economic revenue. Boating visits between 1995 and 2008 are displayed below in Figure 3-38. While visit numbers are down for most boating types, the length of stay per visit has increased which means visitor use days may be stable or decreasing (personal communication with Hells Canyon NRA staff).

Figure 3-38. Number of Boater Visits in Hells Canyon National Recreation Area (Source: HCRNA 2008)



The value of experience for many users on the Salmon River similarly depends on bighorn sheep and other wildlife viewing opportunities. From June 20 to September 7, a controlled boating season exists on the Salmon River. During this time, boaters enjoy private and commercially operated trips on rafts and jet boats. Commercial and private floatboating use on the Salmon River is depicted in Figure 3-39below and has been steady with a brief decrease in 2007 due to a large fire in the area. Jet boating is a big draw, and area businesses laud the importance of seeing bighorn sheep (personal communication with Nez Perce NF staff). Use days for commercial jet boat trips from 2003 to 2006, issued by the Nez Perce and Salmon Challis NFs, indicate use has remained stable over this period (Nez Perce and Salmon Challis National Forests 2009).

Figure 3-39. Number of Float-Boater Visits and User Days on the Salmon River during the Controlled Boating Season (Source: Salmon Challis National Forest 2008)



Bighorn sheep Hunting Trends and Expenditures

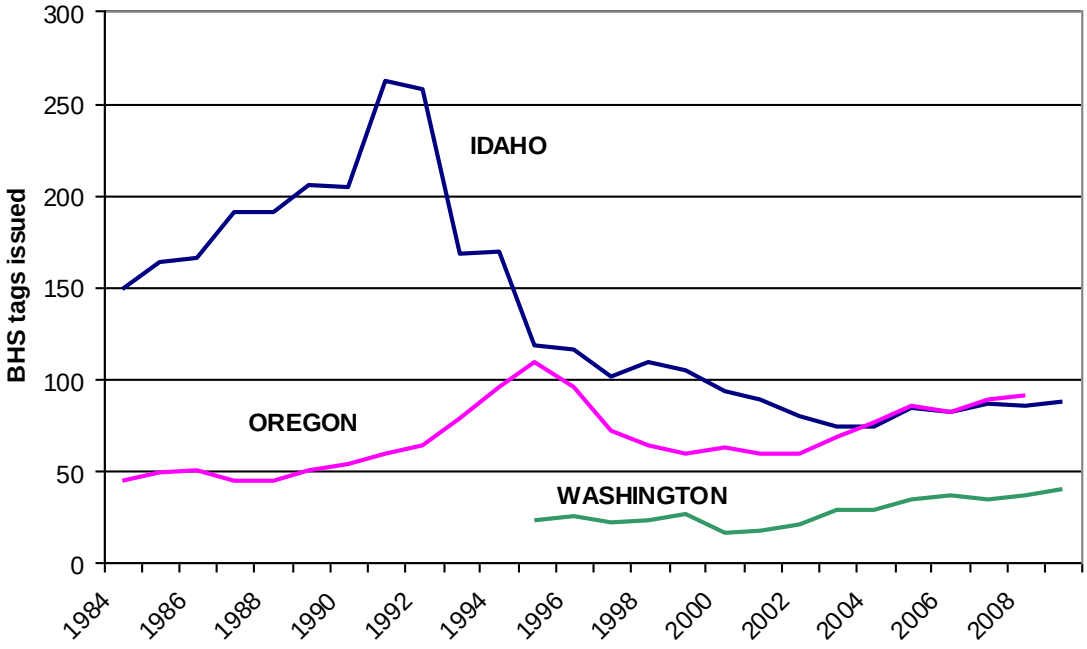
The information presented thus far on hunting provides a useful frame of reference for the general role of hunting in the area. However, only a portion of the activity participation presented in Table 3-33 can be attributable to bighorn sheep opportunities. Distinguishing bighorn sheep hunts makes sense since these hunts are considered a once in a lifetime opportunity (given the small likelihood of drawing a tag) and are particularly unique hunts. Bighorn sheep hunts often cost more than general hunting and involve a different set of expenditures which provide a different economic contribution to the area. Thus, the unique nature of a bighorn sheep hunt and its role in the impact area should be distinguished.

The value of a bighorn sheep hunt is significant since it is considered a once-in-a-lifetime opportunity. Auction costs of bighorn sheep permits gives insight into the unique value of these hunts. Cost of an auctioned Hells Canyon bighorn sheep tag between 1989 and 2009 ranged from $40,000 in 1997 to $193,000 in 2005 and has averaged $74,000[11] (State of Idaho 2009). Cost of an auctioned bighorn sheep permit by the Oregon Department of Fish and Wildlife (ODFW) ranged from $36,500 in 1997 to $139,500 in 2005 and averaged $91,00011 (State of Oregon 2009). Tags are limited and demand exceeds supply due to the limited populations of bighorn sheep; in 2008, 374 hunters applied for 2 tags in Hells Canyon Hunt Area 11 (USDA Forest Service 2008p. 3-99). For the Mt. Hull, Wenaha, and Asotin hunts in Washington, 3,587 residents applied for 4 tags and 749 non-residents applied for 4 tags. Statewide in Oregon, 32,045 applicants applied for 85 tags and 620 non-residents applied for 5 tags. Statewide in Idaho, 1,037 residents applied for 54 tags while 631 non-residents applied for 7 tags.

[11] All values adjusted for inflation to 2009 dollars.

The annual number of bighorn sheep tags issued in the three impact area states correspond to disease outbreaks that occurred in the late 1980s and early 1990s. The largest statewide decrease of 72 percent occurred in Idaho between 1991 and 2003 (from 262 to 73 tags issued), while Oregon's number of tags issued decreased by 46 percent between 1995 and 2002 (from 109 to 59 tags issued). Though data are not available statewide for Washington in the late 1980s and early 1990s, information for game units that overlap the bighorn sheep population range depicted in Figure 3-40 Error! Reference source not found.suggests that the peak in number of tags issued ccurred in 1992.

Figure 3-40. Bighorn Sheep Tags Issued in Oregon, Idaho and Washington



According to Idaho Department of Fish and Game (IDFG), Washington Department of Fish and Wildlife, and ODFW 78 Rocky Mountain bighorn sheep permits were issued in 2006 for units that overlap the bighorn sheep population range depicted in Figure 3-34. While the number of permits issued depends on herd size and state policy, 2006 use levels represent hunting levels within the affected population and are used to estimate current contributions. Sixty-four of these hunts occurred in Idaho, 12 in Oregon, and 2 in Washington. Based on the number of hunters who applied for these permits, the number of annual hunts could increase if bighorn sheep populations increased.

Information from the ODFW suggests that in 2006 these hunters spent an average of $1,530 per trip on lodging, restaurants, and other incidentals and miscellaneous gear. This amount is more than ten times the general hunting expenditures reported in Table 3-34 above. According to the Draft SEIS, many bighorn sheep hunters hire local outfitters at charges ranging from $6,100 to $8,600 per hunter (USDA Forest Service 2008, p. 3-100), with occasional trips costing almost $25,000 (personal communication with IDFG staff). This difference in expenditures suggests differentiation is appropriate during analysis in order to accurately portray the role bighorn sheep hunting plays in the impact area. ODFW data on bighorn sheep hunter expenditures allows

examination of the contributions made specifically by bighorn sheep hunters in the impact area. Using this ODFW information, response coefficients were generated for the impact area (Table 3-39). Compared to response coefficients for general hunting, bighorn sheep effects from bighorn sheep hunting are far greater than any of the effects for general hunting per 1,000 party trips in any visitor segment presented in Table 3-35. The largest visitor segment response coefficients for general hunting are non-local overnight hunters who generate 2.3 and 0.7 direct and indirect/induced jobs and $47,882 and $21,587 in direct and indirect/induced labor income in the impact area. Bighorn sheep–specific response coefficients are far greater than these effects per 1,000 party trips. While response coefficients are greater per 1,000 visits, only 78 bighorn sheep hunts occurred in hunting units that overlap the bighorn sheep population range depicted in Figure 3-34. Thus, employment and labor income associated with current levels of bighorn sheep hunting are small compared to general hunting contributions in the impact area (Table 3-40).

Table 3-39. Employment and Labor Income Response Coefficients for Bighorn Sheep Hunting and Management

	Employment (full and part-time jobs)		Labor Income (2009 dollars)	
	Direct Effects	Indirect & Induced Effects	Direct Effects	Indirect & Induced Effects
	(Jobs per 1,000 Party-Trips)		(Labor Income per 1,000 Party-Trips)	
Bighorn Sheep Hunts	47.4	88.5	$655,548	$1,949,307
	(Jobs per $1,000,000)		(Labor Income per $1,000,000)	
Bighorn Sheep Management	38.0	6.7	$762,199	$180,342

Table 3-40. Employment and Labor Income Effects for bighorn sheep Hunting and Management

	Employment		Labor Income (2008 dollars)	
	Direct Effects	Indirect & Induced Effects	Direct Effects	Indirect & Induced Effects
Bighorn Sheep Hunts	3.7	6.9	$51,133	$152,046
Bighorn tag revenues	12.1	2.4	$264,421	$67,519
Total BHS	25.1		$535,119	
General Hunting	119.8	41.4	$2,756,753	$1,249,561
Viewing—wildlife	79.1	24.5	$1,639,919	$715,721
Total for Area	89,942		$3,039,108,000	

In addition to expenditures made by bighorn sheep hunters in the area, revenues from the sale, auction, and raffle of bighorn sheep tags provide further contributions to the impact area. For example, the total 2006 revenues from raffle sales in Washington and Idaho were $101,250 and $86,246, respectively. Given the high degree of interest in these tags, their auction provides

significant revenues as discussed above. Along with the revenues from the general sale of tags and the raffle of tags, these revenues are used for bighorn sheep research and management in the area. Activities such as habitat improvement, population monitoring, and disease control efforts are funded in part from these dollars. Given the high degree of industries in the impact area that support these activities, response coefficients for bighorn sheep management are high[12] (Table 3-39). Associated bighorn sheep management contributes 14.5 jobs (direct, indirect and induced) and $331,940 (direct, indirect and induced) in labor income on an average annual basis within the impact area (Table 3-40).

While total contributions from bighorn sheep hunting and management (25.1 jobs and $535,119 in labor income from direct, indirect and induced contributions) are small relative to total employment and income in the impact area, these contributions may be more important for communities within the impact area that depend more on hunting-related activities. In addition, increased populations of bighorn sheep under the alternatives could accommodate more hunting opportunities and generate greater contributions to the impact area economy.

Economic Efficiency and Non-Market Economic Value

The value of resource goods traded in a market can be obtained from information on the quantity sold and market price. However, markets do not exist for some resources, such as recreational opportunities, environmental services, or the value some place on wildlife such as bighorn sheep. Recognizing their value is important, since without estimates, these resources may be implicitly undervalued, and decisions regarding their use may not accurately reflect their true value to society. Because these recreational and environmental values are not traded in markets, they can be characterized as non-market values.

Non-market values can be broken down into two categories: use and non-use values. The use value of a non-market good is the value to society from the direct use of the asset; within the planning area this occurs through activities such as recreational fishing, hunting, boating, and bird watching. The use of non-market goods often requires consumption of associated market goods; such as lodging, gas, and fishing equipment.

Non-use values of a non-market good reflect the value of an asset beyond any use. These can be described as existence, option, and bequest values. Existence values are the amount society is willing to pay to guarantee that an asset simply exists. An existence value of bighorn sheep might be the value someone places on knowing they exist in the Hells Canyon NRA even though that person may never see them. Other non-use values are thought to originate in society's willingness to pay to preserve the option for future use; these are referred to as option values and bequest values.

Non-market use and non-use values can be distinguished by the methods used to estimate them. Use values are often estimated using revealed preference methods or stated preference methods, while non-use values can only be estimated using hypothetical methods. While use and non-use values exist for the planning area, evaluation is not always feasible during the planning process. However this does not preclude their consideration. Direction in 40 CFR 1502.23 and the Forest Service Handbook 1909.15 and 22.35 provides for the use of qualitative analysis to evaluate non-

[12] For example, the direct employment response coefficient for general government operation is 4.5 jobs per $1,000,000.

market effects. Therefore, non-market values are thus discussed qualitatively where appropriate, and are also described in other resource sections of the Final SEIS and specialist reports.

Comments received on the DSEIS demonstrate relevant non-market values exist and should be considered:

"I know that you are trying to manage these forests in the best ways you know how, but please know that there are many of us who love wild sheep. If my children and grandchildren are to ever have the opportunity to experience these wonderful animals, managers like you will need to take these protective actions now."

In addition, the bighorn sheep values held by area tribes can be characterized as non-market values. For example, bighorn sheep have been highly valued by members of the Nez Perce Tribe for traditional and cultural purposes. Nez Perce and other tribal hunters craft distinctive bows made from sections of their curled horns. Accounts of the Medicine Tree also demonstrate value held by the Nez Perce Tribe associated with bighorn sheep. The Medicine Tree was a large pine tree in the Bitterroot Valley in which a large horn of a bighorn sheep was embedded. The tree has served as a source of spiritual power to the Nez Perce Tribe and other tribal people for generations (Josephy 1997).

Environmental Justice

EO 12898 requires Federal agencies to "identify and address the disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." EO 12898 also directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish or wildlife. According to the Council on Environmental Quality's (CEQ) Environmental Justice Guidelines for NEPA (1997) "minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis…..a minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above stated thresholds."

Thus, the ethnic and racial composition of the impact area (Figure 3-34) is of interest. Between 2000 and 2008, estimates show that the shares of all non-white races increased in all counties in the impact area, while the share of the population identified as White Alone decreased. Estimates of 2008 county population by race and ethnicity are displayed in Table 3-41[13]. The shares of the population described as Black or African American, Asian Alone, and Native Pacific Islander was greater in Washington County than the state of Idaho in 2008. Shares of the American Indian and Alaska Native population were greater in Idaho, Lewis, Nez Perce and Washington Counties than the state of Idaho. In addition, Garfield County's share of those of Hispanic Origin was greater than the state of Washington (U.S. Census Bureau 2008). While the difference in shares between the counties and their states is sometimes small and may not be considered "meaningful" as defined by the CEQ, larger concentrations of these groups likely exist at smaller scales within each county. Thus, it is safe to say that populations in the impact area can likely be defined according to the CEQ's definition of minority populations. Given the

[13] Race and ethnicity shares do not add to 100 percent because Hispanics can be of any race.

likely presence of these populations, potential impacts to their patterns of resource and other subsistence uses are relevant. In addition, tribal interest in subsistence uses is of interest to Nez Perce, Shoshone Bannock, and Shoshone Piute Tribes and Confederated Tribes of the Umatilla Indian Reservation.

Table 3-41. Population by Race and Ethnicity in 2008

	White Alone (%)	Black or African American Alone (%)	American Indian and Alaska Native Alone (%)	Asian Alone (%)	Native Hawaiian and Other Pacific Islander Alone (%)	Two or More Races (%)	Hispanic Origin (%)
Impact Area	**94.4**	**0.4**	**2.5**	**0.8**	**0.2**	**1.7**	**10.2**
Idaho	**94.6**	**0.9**	**1.5**	**1.1**	**0.1**	**1.7**	**10.2**
Adams County	96.9	0.1	1.6	0.2	0.0	1.2	9.8
Idaho County	93.9	0.2	3.8	0.4	0.0	1.6	4.0
Lemhi County	97.4	0.1	0.8	0.2	0.0	1.5	3.3
Lewis County	92.2	0.4	5.3	0.5	0.1	1.6	2.8
Nez Perce County	90.9	0.6	5.6	1.0	0.1	1.9	3.9
Valley County	97.1	0.5	0.8	0.3	0.1	1.3	7.6
Washington County	84.3	3.7	1.7	6.7	0.5	3.1	9.8
Oregon	**90.1**	**2.0**	**1.4**	**3.6**	**0.3**	**2.5**	**11.0**
Baker County	96.3	0.3	1.3	0.5	0.0	1.6	3.0
Union County	94.0	0.7	1.0	1.4	1.1	1.9	3.1
Wallowa County	97.3	0.1	0.9	0.3	0.0	1.5	2.6
Washington	**93.4**	**4.1**	**1.9**	**7.4**	**0.5**	**3.4**	**3.2**
Asotin County	95.6	0.4	1.5	0.7	0.0	1.8	4.2
Columbia County	95.4	0.3	1.3	0.8	0.1	2.2	2.8
Garfield County	97.3	0.0	0.6	0.4	0.0	1.6	17.7

Source: US Census Bureau, 2008

In addition to race, concentrations of people living under the poverty level are of interest when considering the Environmental Justice implications of the SEIS. CEQ guidance on identifying low-income populations states "agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect." The share of the population living below the poverty level was greater in all counties than their respective states except Valley County (Table 3-42), and was greater for the impact area as a whole than shares in these states. The Census data indicates that low-income populations, as defined by CEQ, likely exist within the impact area. In addition, poverty levels amongst minority populations are greater than the white shares for the impact area as a whole. All counties had American Indian & Alaska Natives shares of those living below poverty greater than white shares. Shares of Hispanic or Latinos living below the poverty level were greater than shares of whites for all counties except Adams County in Idaho. All counties

except Columbia County in Washington had at least one minority group whose share of those living below the poverty level was greater than the state (U.S. Census Bureau 2000).

Table 3-42. Population Living Below Poverty by Race and Ethnicity

	Share Below Poverty	White	Black or African American	American Indian & Alaska Native	Asian	Native Hawaiian & Other Pacific Islander	Some Other Race	Two or More Races	Hispanic or Latino
Impact Area	**13.8**	**13.2**	**25.2**	**26.4**	**22.0**	**43.4**	**18.5**	**21.6**	**23.0**
Idaho	**11.9**	**10.9**	**18.6**	**25.2**	**10.5**	**20.4**	**24.3**	**17.6**	**24.2**
Adams County	15.1	14.8		26.3		100.0		14.9	3.3
Idaho County	16.3	15.8		27.6			13.7	23.0	32.1
Lemhi County	15.3	14.8					41.5	35.2	38.8
Lewis County	12.0	11.4	66.7	25.0		0.0	4.5	15.3	19.6
Nez Perce County	12.2	11.1	25.6	25.5	32.6	78.6	12.4	19.9	20.6
Valley County	9.3	8.7		66.7	8.3		50.8	2.6	27.1
Washington County	13.3	13.1	100.0	26.9	2.8		16.6	10.3	21.8
Washington	**10.9**	**9.2**	**19.2**	**24.0**	**12.8**	**15.8**	**26.7**	**16.6**	**24.8**
Asotin County	15.4	14.9	23.8	25.5	46.2		7.2	29.2	15.7
Columbia County	12.6	12.6			12.2		17.9	14.5	20.4
Garfield County	14.2	13.5		66.7		100.0	37.5	47.1	40.9
Oregon	**11.6**	**10.2**	**24.1**	**22.2**	**12.5**	**18.2**	**26.8**	**18.1**	**24.9**
Baker County	14.7	14.1	7.3	40.0	17.1	100.0	33.1	23.9	29.0
County	13.8	13.3	24.3	20.9	16.2	35.4	17.6	24.9	24.2
Wallowa County	14.0	13.8		15.4		100.0		23.6	33.3

Source: US Census Bureau, 2000

Environmental Consequences

Methodology for Analysis

The analysis of economic effects considers job and labor income. Market values such as the value of sheep grazing and costs of implementation to government and allottees are important considerations. However, site specific information that is not available at this scale of analysis makes assessment impractical. Regardless, changes in values associated with the alternatives are discussed relative to non-market values. Non-market values, such as the value of recreational experiences and ecological services, are difficult to quantify. Direction provided in 40 CFR 1502.23 and Forest Service Handbook 1909.15 and 22.35 provides for the use of qualitative analysis to evaluate the effects of these non-market values. However, the fact that no monetary value is assigned to these values does not lessen their importance in the decision-making process. Helpful inferences can still be made from estimated effects on available bighorn sheep tags and acres of suitable bighorn sheep habitat under the alternatives. These consequences allow determination of how the alternatives potentially degrade, maintain, or perhaps enhance non-market values associated with affected bighorn sheep. In addition, other non-market aspects of each alternative are described in other resource sections of the SEIS and specialist reports.

This analysis offers a consistent measure for comparison of alternatives; however, it should not be viewed as a complete answer. Considering these impacts alongside additional social, ecological, or other non-market values provide a complete comparison of the SEIS alternatives.

Economic impacts are used to evaluate potential direct, indirect, and induced effects on the economy. The analytical technique used by the Forest Service to estimate employment and income impacts is "input-output" analysis using the IMPLAN Pro software system (IMPLAN 2006). Input-output analysis (Miernyk 1965) is a means of examining relationships within an economy between businesses, and between businesses and final consumers. The direct employment and labor income resulting from recreation purchases first benefit employees and their families, and therefore directly affect the local economy. Additional indirect and induced multiplier effects (ripple effects) are generated by the direct activities. Together, the direct and multiplier effects comprise the total economic impacts to the local economy. In this manner, input-output analysis captures all monetary market transactions for consumption in a given time period. The resulting mathematical representation estimates the effect of a change in one or several activities on the economy of an area. This analysis depicts effects of possible changes in bighorn sheep hunting use within the impact area.

The expenditure and use information collected by the ODFW survey are crucial elements in the economic analysis. As discussed above, the NVUM survey collected expenditure information from bighorn sheep hunters in spending categories. The reported expenditures in each of the spending categories are allocated to the appropriate industry within the IMPLAN model. The total economic impact over all industries for each activity type provides a response coefficient generated for 1,000 visits. The response coefficient gives the economic effect specific to the designated impact area for bighorn sheep hunting. These response coefficients are then combined with the visitation estimates to give economic impacts of hunting in the area. Economic impacts associated with viewing bighorn sheep are discussed qualitatively because information on recreation associated specifically with bighorn sheep viewing is unavailable. Effects to these uses are thus discussed qualitatively under the section on non-market values. The value of these other bighorn sheep associated recreational experiences cannot be characterized solely on the basis of their market transactions, and thus the section on non-market values is the most appropriate place for their consideration.

Incomplete and Unavailable Information

Insufficient information exists to project changes that may result in viewing wildlife or other activities associated with bighorn sheep following implementation of the proposed action or alternatives analyzed in this report. Such predictions would be highly speculative and would likely be minimized by regional and national recreational trends. Estimated economic contributions presented in the affected environment are calculated for existing viewing-wildlife use levels and include all watchable wildlife opportunities in addition to bighorn sheep. The analysis of the impacts of the alternatives will focus on changes in opportunities and the potential direction of change from the No Action Alternative, but not the size of economic impacts relative to those changes.

While the costs of implementation to government and allottees may vary between the alternatives, information is unavailable for a complete cost comparison. Changes in other associated costs, such as enforcement and allotment maintenance, are unavailable, making

assessment impractical at this programmatic level of analysis. Future site-specific planning under this document will assess costs associated with management actions.

Effects Common to All Alternatives

Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. EO 12898 further stipulates that agencies conduct their programs and activities in a manner that does not have the effect of excluding persons from participation in, denying persons the benefits of, or subjecting persons to discrimination because of their race, color, or national origin.

While alternatives are expected to result in small changes in employment and labor income relative to current conditions, these changes would be spread throughout the population and would not disproportionately affect minority and low-income populations. These contributions will likely remain a small share of total employment and labor income within the planning area, but may be more important for smaller communities within the planning area.

Access to bighorn sheep habitat would be accommodated under all alternatives. This access would continue to provide uses valuable to communities within the planning area; sustaining lifestyles, traditions, and ceremonies.

Actions under the alternatives have potential effects on the area bighorn sheep population, and could affect Environmental Justice populations within the impact area identified above. Harvest ability depends on areas with disease free habitat and the population available for hunting. Since the effect on harvest ability would be spread between all segments of the general population, tribal, other minority, or low-income communities would not be disproportionately affected. Thus, disparate effects to Environmental Justice populations within the impact area are not anticipated. Effects to harvest ability are discussed further as they relate to tribal interests in the Tribal Rights and Interests section.

Additionally, public involvement efforts for this project have been inclusive, and the agency has considered input from persons or groups regardless of race, color, national origin, income, or other social and economic characteristics.

Alternatives 1B, 2, 5, and 7

Alternatives 1B, 2, 5, and 7, do not designate any acres on the Payette National Forest as unsuitable for grazing by domestic sheep and all trailing routes would remain open.

Employment and Income

Since grazing use would not change the available bighorn sheep tags (Table 3-43) and viewing wildlife opportunities currently experienced would likely decrease as disease would continue to spread at rates greater than the other alternatives with the greater risk of contact (Table 3-5). Thus, decreased contributions to local economies is anticipated relative to the current situation; from 6.5 to 8.1 jobs and $124,000 to $150,000 in labor income would be provided (Table 3-44) while 10.6 and $203,000 in labor income are currently provided (Table 3-40).

Table 3-43. Potential Bighorn sheep tag availability at 10 and 100 percent effective contact

Alternative	100 percent effective contact	10 percent effective contact
1b, 2, 5, 7	48	60
3, 4, 6	50	61
7E	78	78
7G	56	69
7L	55	69
7M	57	71
7N	61	74
7O	64	75
7P	59	72

Table 3-44. Employment and labor income effects per alternative (IMPLAN 2007)

	100 percent effective contact		10 percent effective contact	
Alternative	Employment	Labor Income	Employment	Labor Income
1b, 2, 5, 7	6.5	$118,395	8.1	$146,976
3, 4, 6	6.8	$123,847	8.3	$150,307
7E	10.5	$191,311	10.5	$191,311
7G	7.6	$137,655	9.3	$169,236
7L	7.5	$135,959	9.3	$169,248
7M	7.8	$141,052	9.7	$175,325
7N	8.3	$151,213	10.1	$182,768
7O	8.7	$158,681	10.2	$185,311
7P	8.0	$144,907	9.8	$178,539

Similarly, decreased employment and labor income changes from other bighorn sheep–associated recreation, such as wildlife viewing, are anticipated since the population would likely decrease over time with continued disease spread.

Role of Non-market Values

The economic analysis assesses the economic effects of the direct use of resources in terms of jobs and income. This type of analysis does not include other types of economic value often referred to as non-market values, as discussed above. Non-market values are difficult to quantify, and insufficient data exist to assess the effects of management actions. However, the fact that no monetary value is assigned to these values does not lessen their importance in the decision-making process. Helpful inferences can still be made from estimated effects on available bighorn sheep tags (Table 3-43) and acres of suitable bighorn sheep habitat (Table 3-4) under the alternatives.

With no changes in designation of acres on the Forest as unsuitable for grazing by domestic sheep and maintenance of all trailing routes as open the bighorn sheep population and associated non-market values would likely decrease. Thus, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced

by visitors and area residents. In addition, non-market values associated with this alternative would be lower than the other alternatives given their lower risk of bighorn sheep contact with domestic sheep (Table 3-5) higher tag availability (Table 3-43) and higher levels of disease free habitat (Table 3-4).

Alternatives 3, 4 and 6 – Smith Mountain Allotment and MA #1 Unsuitable

Alternatives 3, 4 and 6 designate suitable rangeland portions of the Smith Mountain Allotment overlapping current bighorn sheep habitat as unsuitable for domestic sheep grazing. MA #1 outside of grazing allotments was also determined to be unsuitable for domestic sheep grazing and no trailing routes are closed.

Employment and Income

Changes in domestic sheep grazing on the Smith Mountain Allotment and within MA#1 provide less risk of contact (Table 3-5) and potentially higher availability of bighorn sheep tags than would be experienced under Alternatives 1b, 2, 5 and 7. Consequently more domestic sheep permits would be issued than these alternatives (Table 3-43) and some increase in other bighorn sheep associated recreation would be anticipated relative to these alternatives. As a result 6.8 to 8.3 jobs (direct, indirect and induced full and part-time jobs) and $124,000 $150,000 in labor income (2009 dollars) would be provided. Similarly, employment and labor income increases, relative to these alternatives, would be anticipated as other bighorn sheep associated recreation opportunities were enhanced. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7G through 7P.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under these alternatives would support slightly greater bighorn sheep associated non-market values than alternatives 1B, 2, 5 and 7. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than alternatives 7G through 7P with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of tags (Table 3-43) and greater area of disease free habitat (Table 3-4).

Alternatives 7E – Entire PNF Unsuitable

Alternative 7E designates no area within the Payette National Forest as suitable for domestic sheep grazing, and leaves no trailing routes open.

Employment and Income

Elimination of domestic sheep grazing on the PNF provides no risk of contact and the highest estimated bighorn sheep population of all the alternatives. Consequently current levels of

hunting permits and other bighorn sheep associated recreation would be maintained and could potentially increase. As a result current employment and labor income contributions associated with hunting and bighorn sheep management would remain (Table 3-40). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. The employment and labor income supported by bighorn sheep associated recreation under this alternative would be greater than all the other alternatives.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7E would support the highest level of bighorn sheep associated non-market values of all the alternatives. This alternative would provide levels of bighorn sheep associated non-market values closest to past perceived levels however, does not account for effects on the bighorn sheep population that would occur from contact off of the PNF analyzed below under Cumulative Effects. Non-market values associated with this alternative would be the highest of all the alternatives with its lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Alternative 7G – Agency Preferred Alternative in the DSEIS

Alternative 7G designates all land within the Hells Canyon and Salmon River GPRs as unsuitable for domestic sheep grazing and closes all trailing routes within these areas.

Employment and Income

Changes in domestic sheep grazing under Alternative 7G imply less risk of contact and higher population levels than alternatives 1 through 7 and Alternative 7L however greater risk of contact and fewer bighorn sheep than alternatives 7E, 7M, 7N, 7O and 7P. Consequently fewer hunting sheep permits would be issued than these alternatives (Table 3-43). As a result 7.6 to 9.3 jobs (direct, indirect and induced full and part-time jobs) and $138,000 to $169,000 in labor income (2009 dollars) would be provided (Table 3-44). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced relative to alternatives 1 through 7 and Alternative 7L. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7E, 7M, 7N, 7O and 7P.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7G would support slightly greater bighorn sheep associated non-market values than alternatives 1 through 7 and Alternative 7L. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than alternatives 7E, 7M, 7N, 7O and 7P with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Alternative 7L

Alternative 7L was designed to remove only the very highest risk areas from domestic sheep grazing and keeping as much suitable range land open.

Employment and Incomes

Changes in domestic sheep grazing under Alternative 7L imply similar risk of contact and population levels as 7G which suggest less risk and higher population levels than alternatives 1 through 7 however greater risk of contact and fewer bighorn sheep than alternatives 7E, 7G, 7M, 7N, 7O and 7P. Consequently fewer hunting permits would be issued than these alternatives (Table 3-43). As a result 7.5 to 9.3 jobs (direct, indirect and induced full and part-time jobs) and $136,000 to $169,000 in labor income (2009 dollars) would be provided (Table 3-44). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced relative to alternatives 1 through 7. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7E, 7G, 7M, 7N, 7O and 7P.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7L would support greater bighorn sheep associated non-market values than alternatives 1 through 7. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than alternatives 7E, 7G, 7M, 7N, 7O and 7P with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Alternative 7M

Alternative 7M was designed to remove more risk from the landscape and keep grazing outside of the herd home range areas.

Employment and Income

Changes in domestic sheep grazing under Alternative 7M imply less risk and higher population than alternatives 1 through 7 and Alternative 7L however greater risk of contact and fewer bighorn sheep than alternatives 7E, 7G, 7N, 7O and 7P. Consequently fewer hunting permits would be issued than these alternatives (Table 3-43). As a result 7.8 to 9.7 jobs (direct, indirect and induced full and part-time jobs) and $141,000 to $175,000 in labor income (2009 dollars) would be provided (Table 3-44). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced relative to alternatives 1 through 7 and Alternative 7L. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7E, 7G, 7M, 7N, 7O and 7P.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7M would support greater bighorn sheep associated non-market values than alternatives 1 through 7 and Alternative 7L. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than alternatives 7E, 7G, 7N, 7O and 7P with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Alternative 7N

Alternative 7N was designed to remove most of the high risk area and also attempting to add grazing areas of lower risk back in.

Employment and Income

Changes in domestic sheep grazing under Alternative 7N imply less risk and higher population than all alternatives except 7E and 7O. Consequently fewer hunting permits would be issued than these alternatives (Table 3-43). As a result 8.3 to 10.1 jobs (direct, indirect and induced full and part-time jobs) and $151,000 to $183,000 in labor income (2009 dollars) would be provided (Table 3-44). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced relative to all alternatives except 7E and 7O. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7E and 7O.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7N would support greater bighorn sheep associated non-market values than all alternatives except 7Eand 7O. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than alternatives 7E and 7O with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Alternative 7O

Alternative 7O 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.

Employment and Income

Changes in domestic sheep grazing under Alternative 7O imply less risk and higher population than all alternatives except 7E. Consequently fewer hunting permits would be issued than these alternatives (Table 3-43). As a result 8.7 to 10.2 jobs (direct, indirect and induced full and part-time jobs) and $159,000 to $185,000 in labor income (2009 dollars) would be provided (Table 3-44). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced relative to all alternatives except 7E. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7E.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7O would support greater bighorn sheep associated non-market values than all alternatives except 7E. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than Alternative 7E with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Alternative 7P

Alternative 7P was designed to keep many of the high risk area as unsuited but add in area that are of a lower risk. In addition an effort was made to maximize bighorn sheep protection and maximize the amount of suitable range land.

Employment and Income

Changes in domestic sheep grazing under Alternative 7P imply less risk and higher population than all alternatives except 7E, 7N and 7O. Consequently fewer hunting permits would be issued

than these alternatives (Table 3-43). As a result 8 to 9.8 jobs (direct, indirect and induced full and part-time jobs) and $145,000 to $179,000 in labor income (2009 dollars) would be provided (Table 3-44). Similarly, employment and labor income increases would be anticipated as other bighorn sheep associated recreation opportunities were enhanced relative to all alternatives except 7E, 7N and 7O. For example, Table 3-35 above shows that employment would increase by less than one job for every 1,000 wildlife viewing trips made by local day users and could increase by almost 4 jobs for every 1,000 visits made by non-local visitors staying overnight. Similarly, labor income would increase from $8,185 to $82,105 for every 1,000 wildlife viewing visits made by local day users and non-local overnight visitors, respectively. Regardless of these increases in area economic activity the risk of contact and subsequent bighorn sheep population levels would support less bighorn sheep associated recreation than alternatives 7E, 7N and 7O.

Role of Non-market values

Population and acres of disease free habitat (Table 3-4) under Alternative 7P would support greater bighorn sheep associated non-market values than all alternatives except 7E, 7N and 7O. However, the past level of values associated with bighorn sheep experienced at higher population levels in the absence of disease would not be experienced by visitors and area residents. In addition, non-market values associated with this alternative would be lower than alternatives 7E, 7N and 7O with their lower risk of bighorn sheep contact with domestic sheep (Table 3-5), higher availability of hunting permits (Table 3-43) and greater acres of disease free habitat (Table 3-4).

Cumulative Effects

The economy can be affected by a variety of factors, including population growth, changes in interest rates, location of new magnet industries, recession, growth of new sectors, tax policy, and State economic policy. When compared to these kinds of variables, managing bighorn sheep on the National Forest has a relatively small regional effect, as discussed previously. Because any changes in economic activity from changes in use would be unnoticeable, there should be no cumulative economic effects across the region. However, for smaller areas within the impact area cumulative effects are noteworthy.

Cumulative effects from management on other lands (private, Bureau of Land Management) on bighorn sheep populations will cause larger degrees of change in associated bighorn sheep economic effects than presented above. Changes to the bighorn sheep population from domestic sheep management on these other lands could potentially affect other forms of bighorn sheep–associated recreation such as wildlife viewing and boating use. While it is reasonable to assume some change in these recreation types, the magnitude of these effects is beyond reasonable assumption.

Summary of Effects

The employment and labor income impacts associated with bighorn sheep hunting and other associated recreation would likely continue to represent a very small proportion of the analysis area economy. However, predicting if wildlife viewing recreationists would change their activities as a result of the alternatives is difficult, since there is little evidence to suggest that one species would cause recreationists to reduce their visitation or choose not to participate in that activity. Continued population growth in the area will lead to more recreation visitation on the

Payette NF, and it is likely the regional area will not experience a significant economic effect from the alternatives. For smaller areas within the impact area, changes could occur from the alternatives. If bighorn sheep populations are maintained, the unique nature of these hunts, demand for bighorn sheep permits, and increasing popularity of nature-based tourism suggest that the role bighorn sheep play in local recreation economies could remain stable or increase.

Chapter 4
Preparation and Consultation

Consistent with 36 CFR §219.20(a), the following pages will update the List of Preparers section, page 4-1, of the 2008 DSEIS.

List of Preparers

The following Forest Service Employees and Federal Contractors comprised the Interdisciplinary Team (IDT) which prepared the environmental analysis for this update process:

Patricia Anderson Soucek	Payette National Forest
Christine Bradbury	Clearwater National Forest
Pete Grinde	Payette National Forest
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Darcy Pederson	Nez Perce National Forest
Tim Schommer	Wallowa-Whitman National Forest
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Contractor Support

The following individuals assisted the Payette National Forest with meeting facilitation, meeting documentation and/or document preparation:

Susan Hayman	North Country Resources, Inc., Boise, ID
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Jeff Pearson	Peak Science Communications, LLC, Boise, ID
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Loren Roberts	Peak Science Communications, LLC, Boise, ID
James Parker	McCall, ID

Cooperators

The States of Idaho, Washington and Oregon acted as Cooperators in this update process along with the tribal governments of the Nez Perce and Shoshone-Bannock Tribes. Following are the individuals that participated as technical representatives for the update:

Steven Goodson	State of Idaho—Governor's Office
Cal Groen	Idaho Department of Fish and Game
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Brooklyn Baptist	Nez Perce Tribe
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Curt Mack	Nez Perce Tribe
Leander Watson	Shoshone-Bannock Tribes
Claudeo Broncho	Shoshone-Bannock Tribes
Yvette Tuell	Shoshone-Bannock Tribes
ChadColter	Shoshone-Bannock Tribes

Tribal Consultation

Formal tribal consultation has been requested and has occurred with the updated process with the following tribes:

Nez Perce Tribe
Shoshone-Bannock Tribes
Shoshone-Paiute Tribes

Glossary

Consistent with 36 CFR §219.20(a), the following pages update the Glossary section, page G-1, of the 2008 DSEIS.

Big Game Management Unit—Units designated by the Idaho Department of Fish and Game for big game management purposes, including setting population and demographic objectives, hunting recommendations, etc.

Core Herd Home Range—The area within which most individuals of a herd spend most (95%) of their time.

Core Herd Home Range Analysis—Analysis used to estimate core herd home ranges from telemetry observations of individual bighorn sheep. First, fixed kernel analyses are used to estimate the home ranges of all observed individuals in a herd, and then those estimates were aggregated. The core home range is the area lying within the 95th volume contour of the aggregated home range estimates.

Disease Model—A simulation model that uses the estimated rate of contacts between bighorn sheep and domestic sheep allotments to estimate the populations dynamics of bighorn sheep herds in the Salmon River and Hells Canyon metapopulations. The model incorporates estimates of current population sizes as well as demographic and disease impact parameters drawn from the literature on bighorn sheep biology.

Effective Contact—Any contact between domestic and bighorn sheep that results in the transmission of disease from the domestic sheep to the bighorn.

Fixed Kernel Analysis—A method of mapping the home range of an individual on the landscape which uses a standard bivariate normal (i.e., Gaussian) kernel density estimator (i.e., utilization distribution). Polygons are calculated from the volumes of the curve under different portions of the utilization distribution. Polygons are also calculated using a fixed kernel approach which assumes the width of the standard bivariate normal kernel placed at each observation is the same throughout the plane of the utilization distribution.

Herd—A group of bighorn sheep that remain together as a loose group with a tighter group of breeding ewes as the core. Most of the herds in Hells Canyon are named and identified based on the group of reintroduced animals from which they descend.

Foray—A movement of a bighorn sheep outside of the core herd home range. Rams in particular make occasional long distance foray movements.

Foray Analyses—Analyses of the frequency and pattern of foray movements. For animals of each sex, and during each season ("Summer" = May to October, "Winter"= November to April), telemetry observations are used to determine the probability of a foray movement and the distribution of distances traveled in those forays.

Metapopulation—A collection of populations that interact with each other as a result of occasional movement of animals between the populations.

Population—Used interchangeably with the term "herd". (See above).

Risk of Contact Model—Model for predicting contact between bighorn sheep and domestic sheep expressed either as the expected number of contacts per year, or as the percent probability of at least one contact per year. Model uses the Source Habitat, Core Herd Home Range, and Foray Analyses results to generate the output.

Sensitive Species— "Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trend in population numbers, or habitat capability that reduce a species existing distribution." (2670.5). Objectives for sensitive species include "special management emphases to ensure viability and to preclude trends toward endangerment that would result in the need for Federal listing" (FSM 2672.1).

Source Environment—The composite of all environmental conditions occurring in a specified area and time that result in stationary or positive population growth.

Source Habitat—Those characteristics of macrovegetation and topography that contribute to positive population growth for a species in a specified area and time. Distinguished from habitats associated with species occurrence: such habitat may or may not contribute to long-term population persistence. Source habitats contribute to source environments.

Source Habitat Capacity—All acres with the potential to provide habitat for bighorn sheep, based only on their requirement for escape terrain.

Source Habitat Model—GIS modeling, validated with telemetry observations, used to map areas of winter and summer bighorn source habitat. The model uses vegetation cover type and structure, along with topological variables (elevation, slope and aspect) to identify areas qualifying as bighorn source habitat.

Volume Contour—A component of a Fixed Kernel Analysis that depicts the level of activity (i.e., 50 percent contour means that half of the herd activity falls within that contour).

Viability—Relative to Forest Service regulations (Code of Federal Regulations, Title 36, Section 219.19): Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area.

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Appendix A

Alternative Maps

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

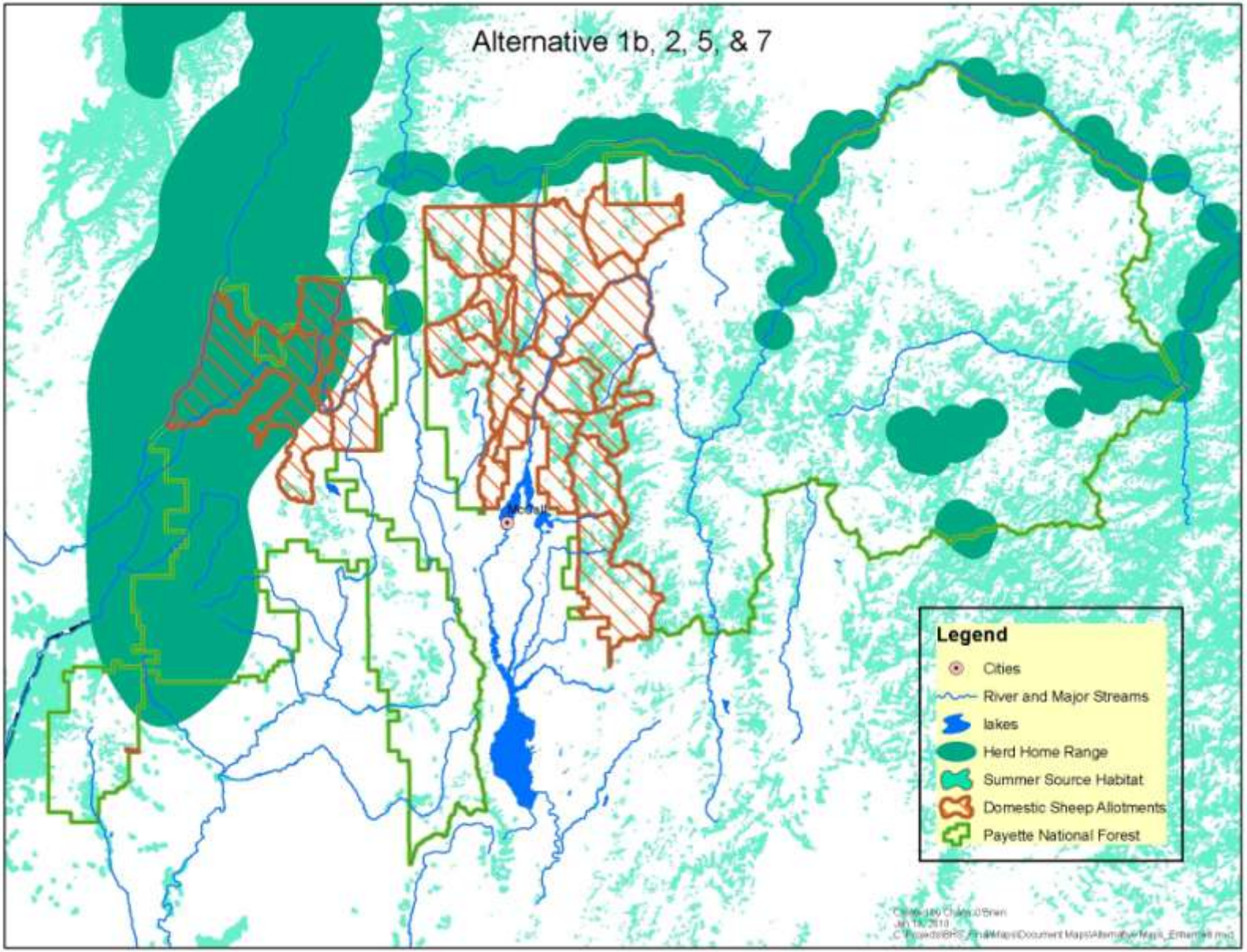


Figure 2. Payette National Forest - Alternatives 3, 4 and 6

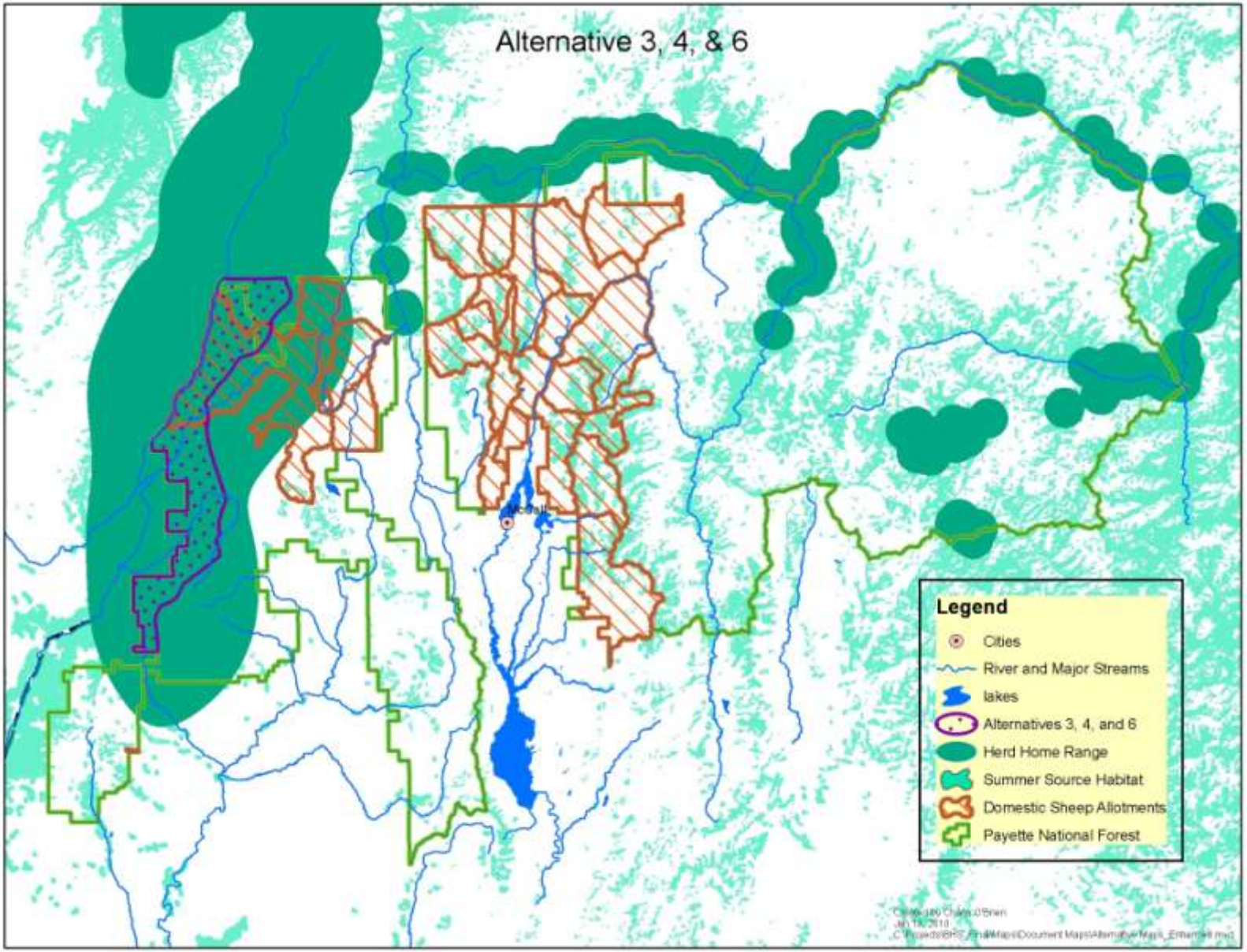
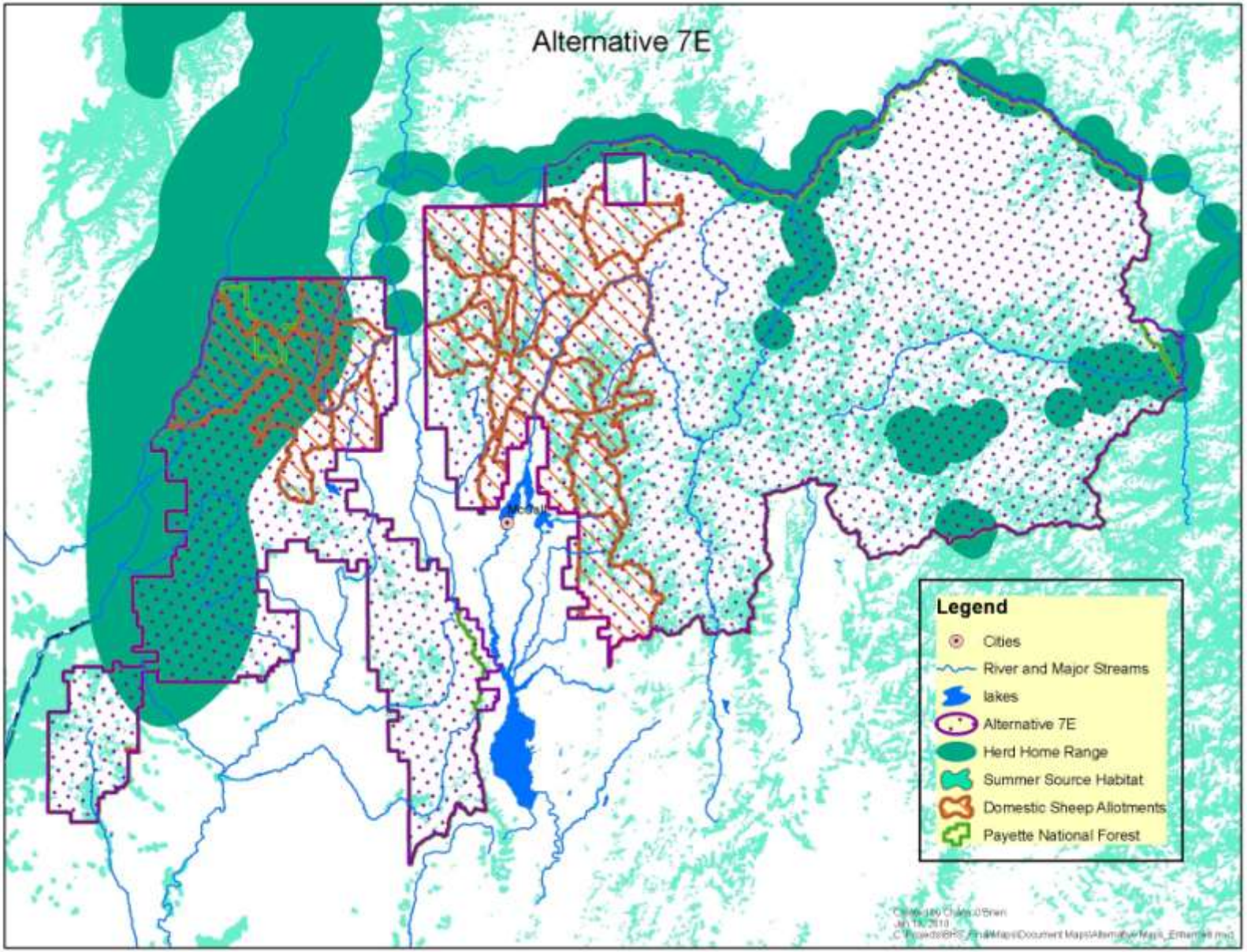


Figure 3. Payette National Forest - Alternative 7E



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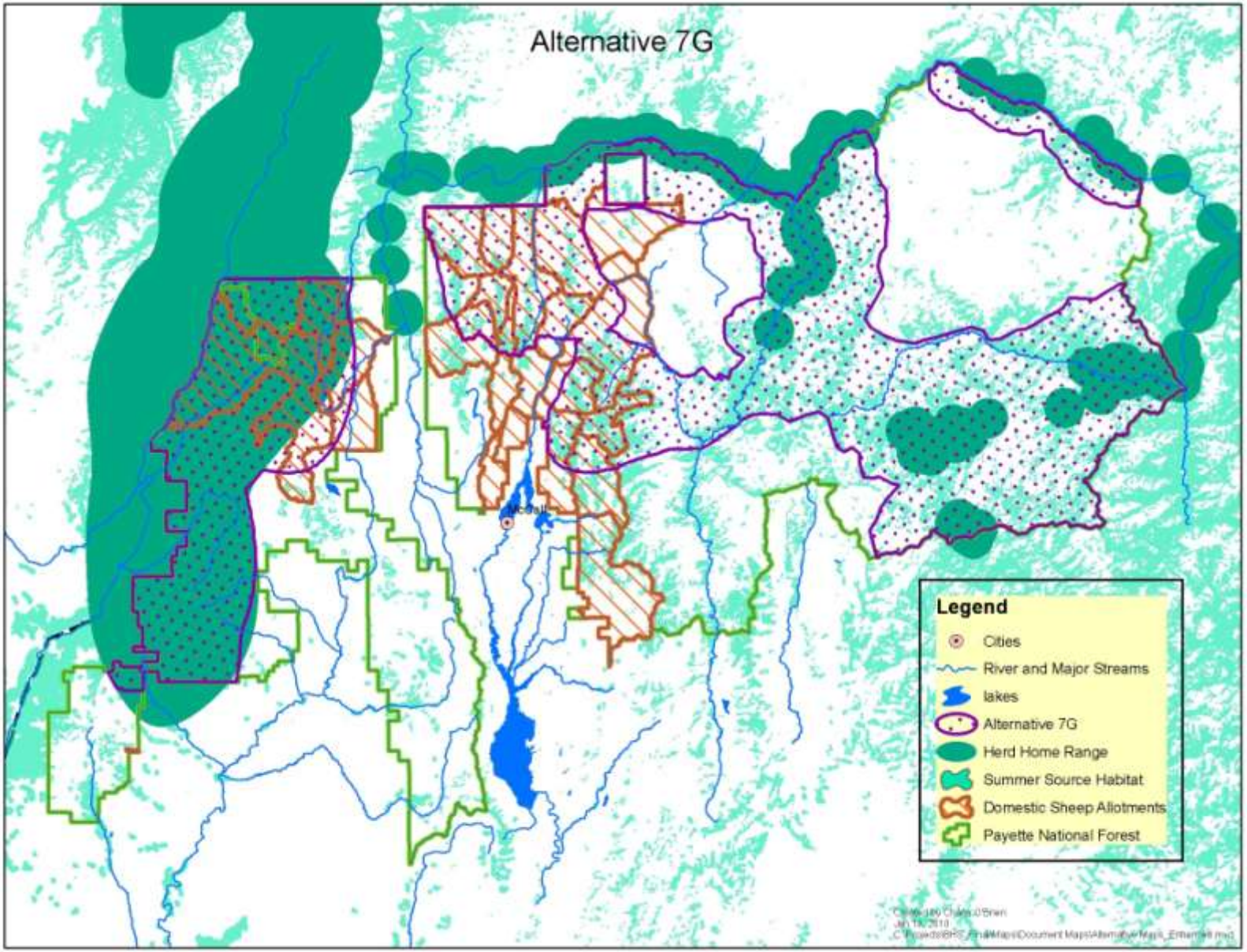


Figure 5. Payette National Forest - Alternative 7L

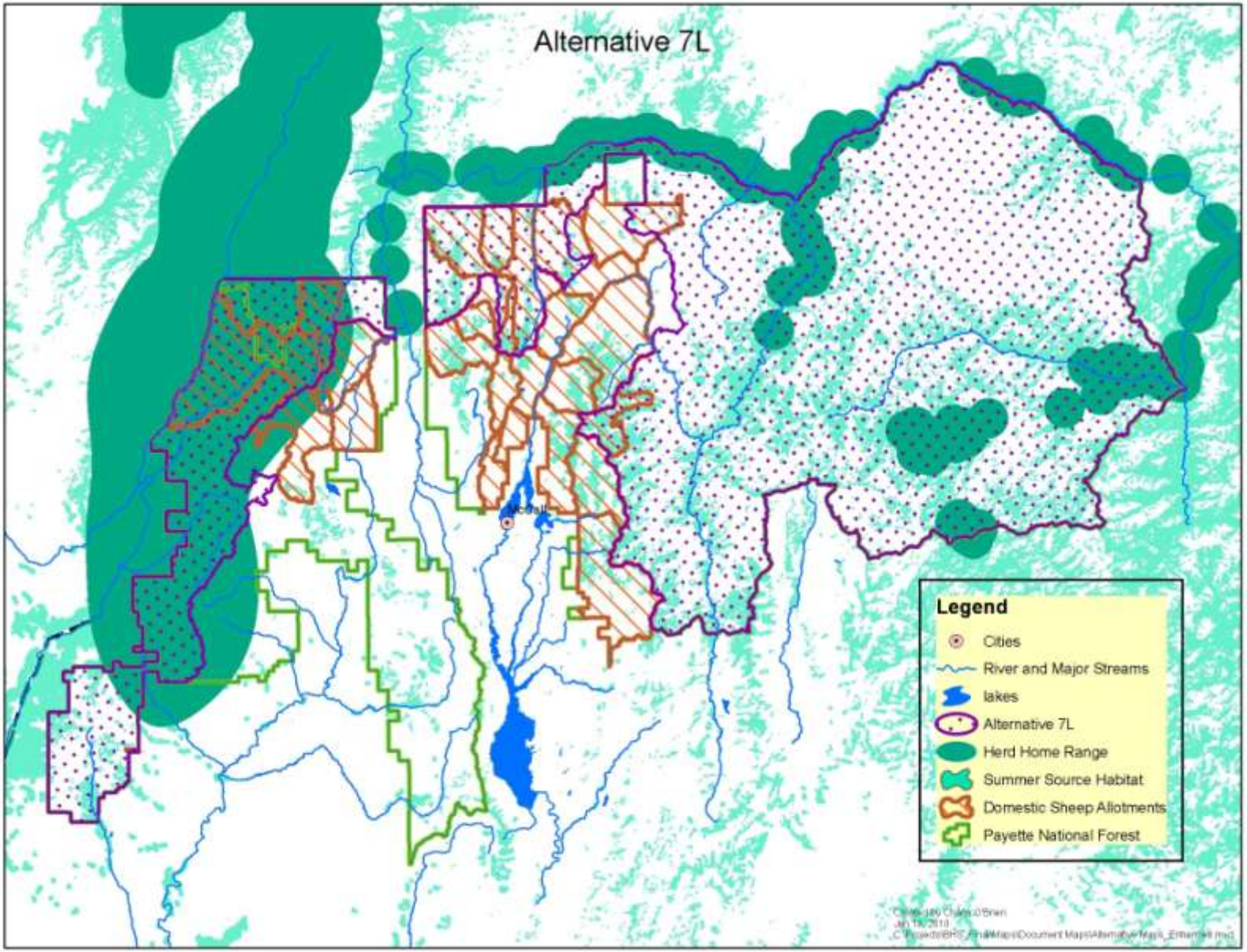


Figure 6. Payette National Forest - Alternative 7M

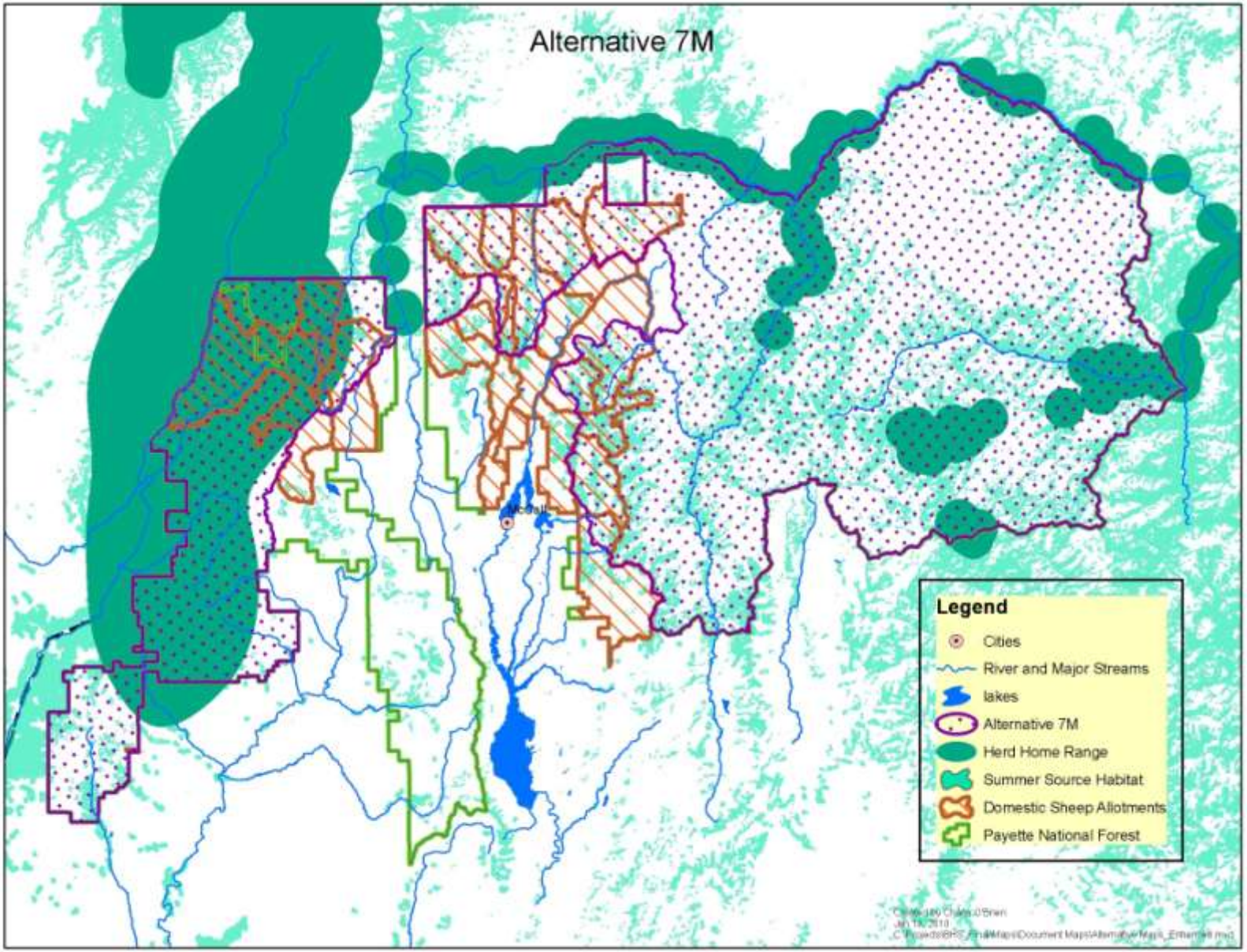


Figure 7. Payette National Forest - Alternative 7N

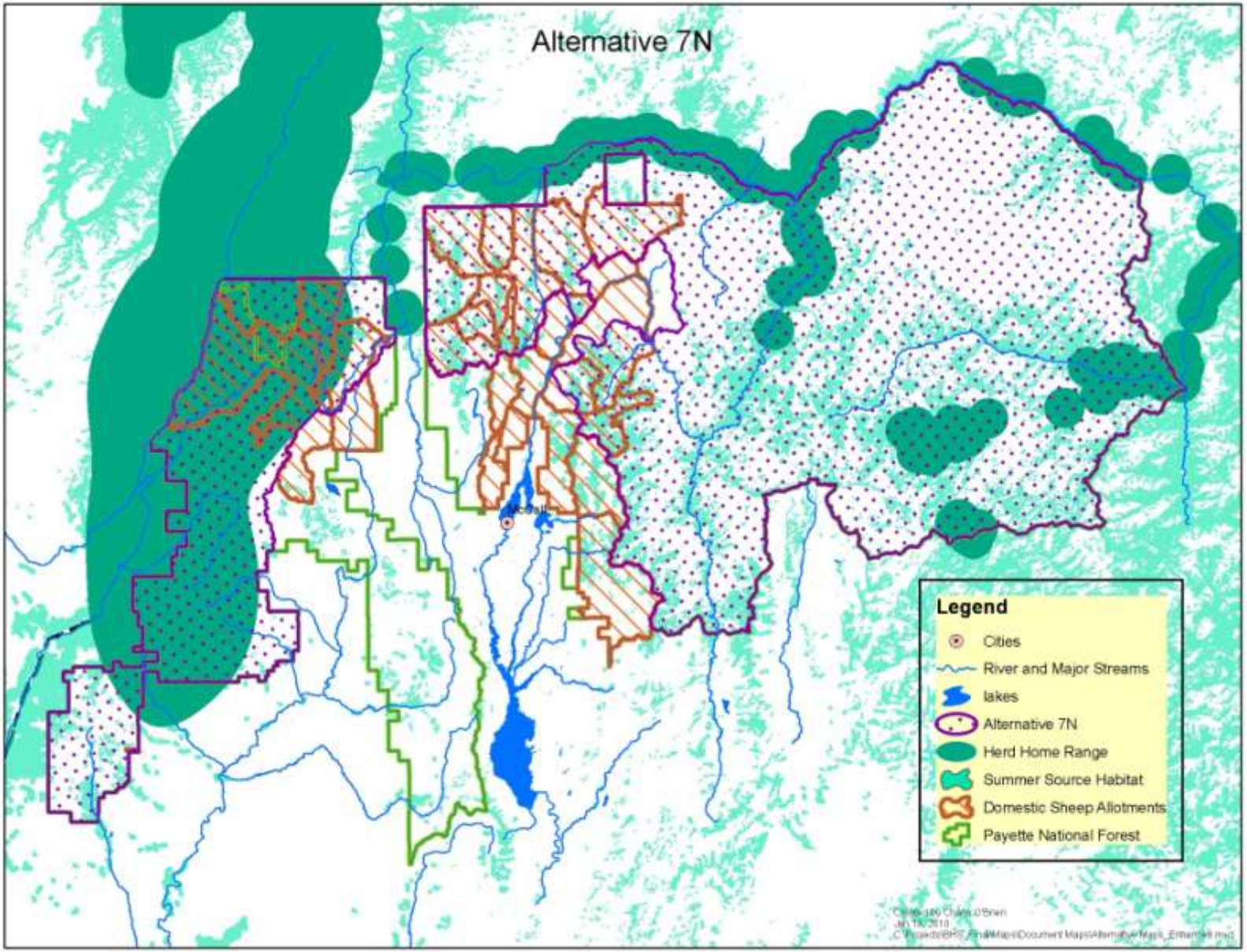


Figure 8. Payette National Forest - Alternative 7O

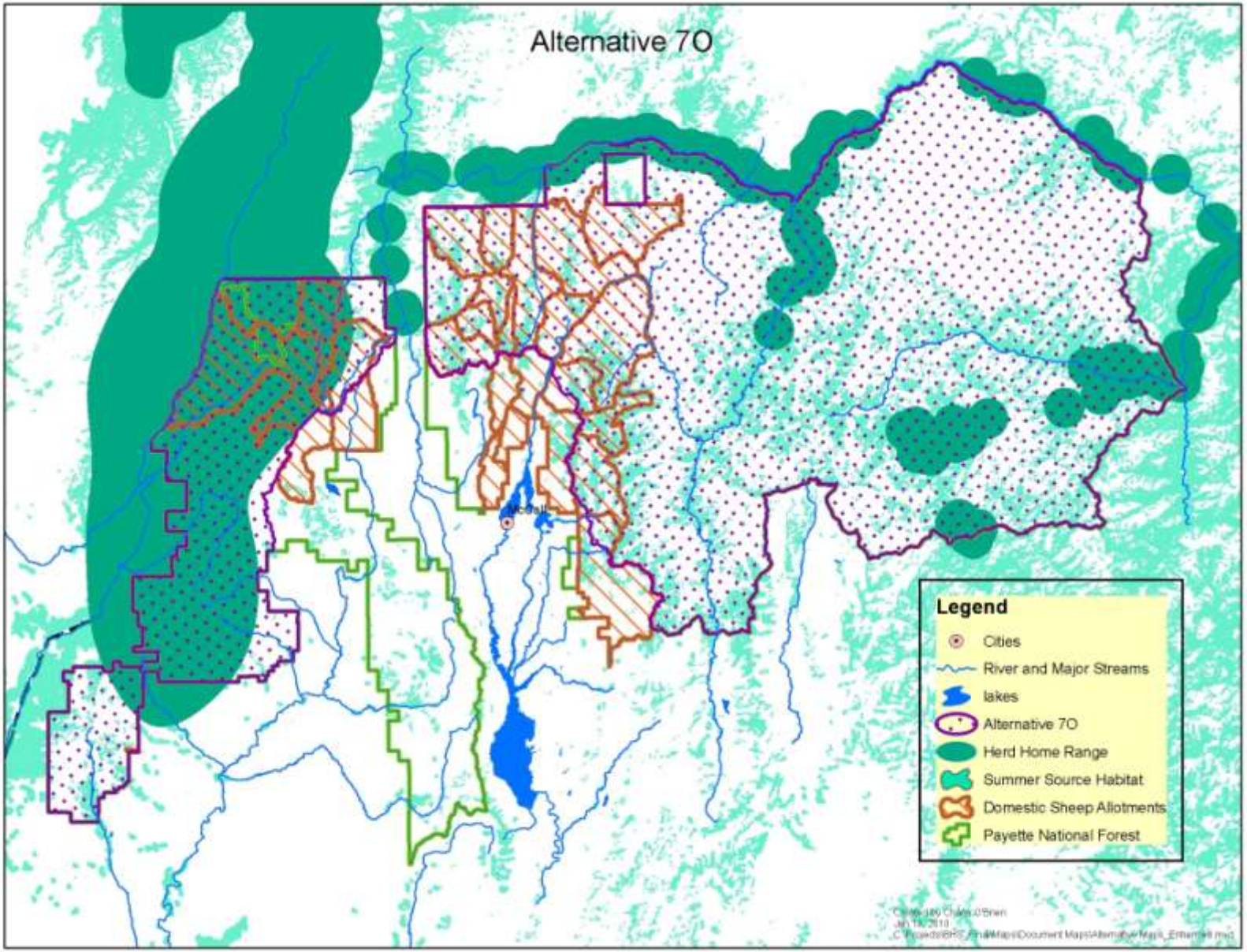
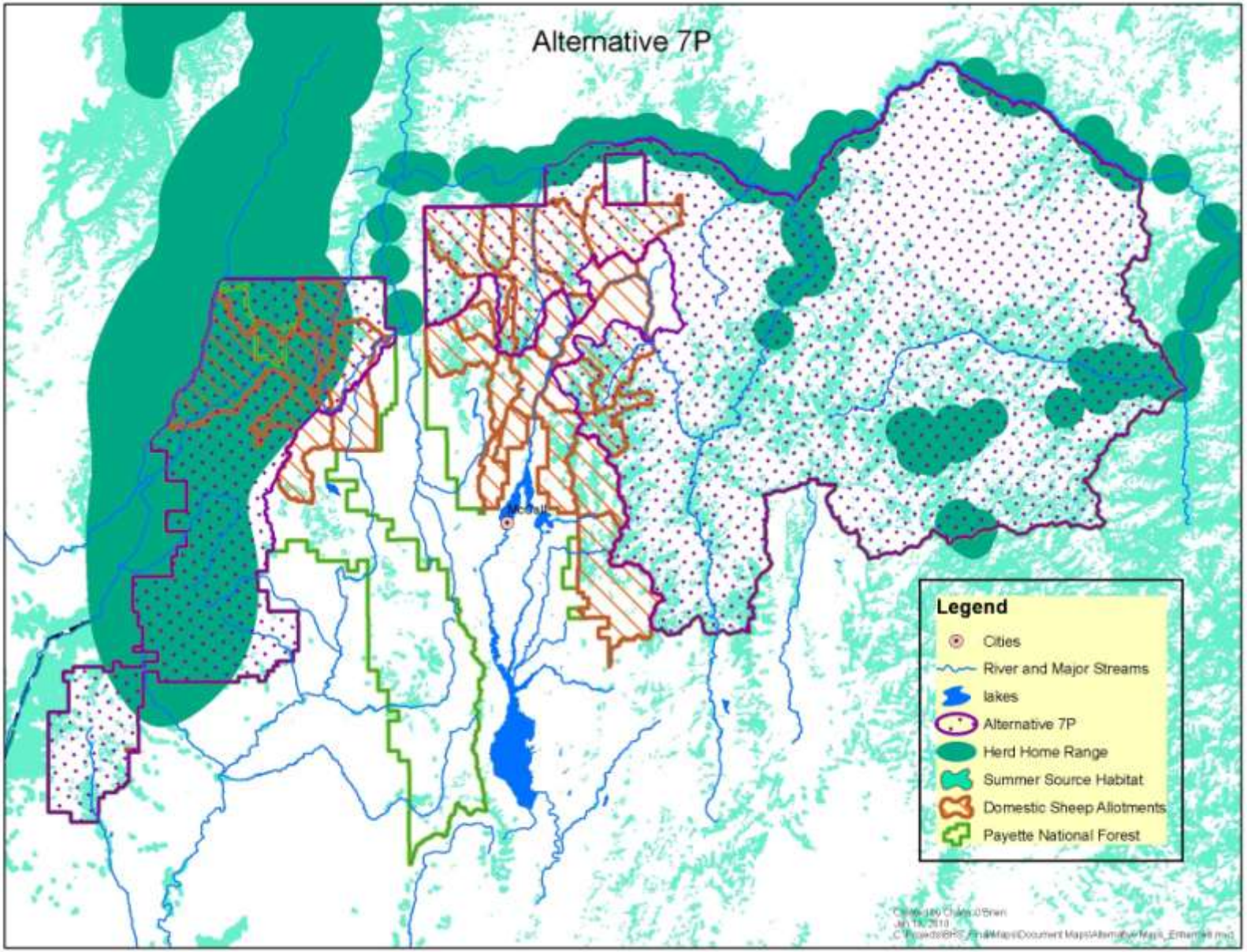


Figure 9. Payette National Forest - Alternative 7P



Appendix B

Modeling and Analysis Technical Report

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

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4. 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.

5. 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
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

No.	Type of Vegetation
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
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

No.	Type of Vegetation
2228	Larix occidentalis Forest Alliance
2232	Abies grandis Forest Alliance

6. 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.

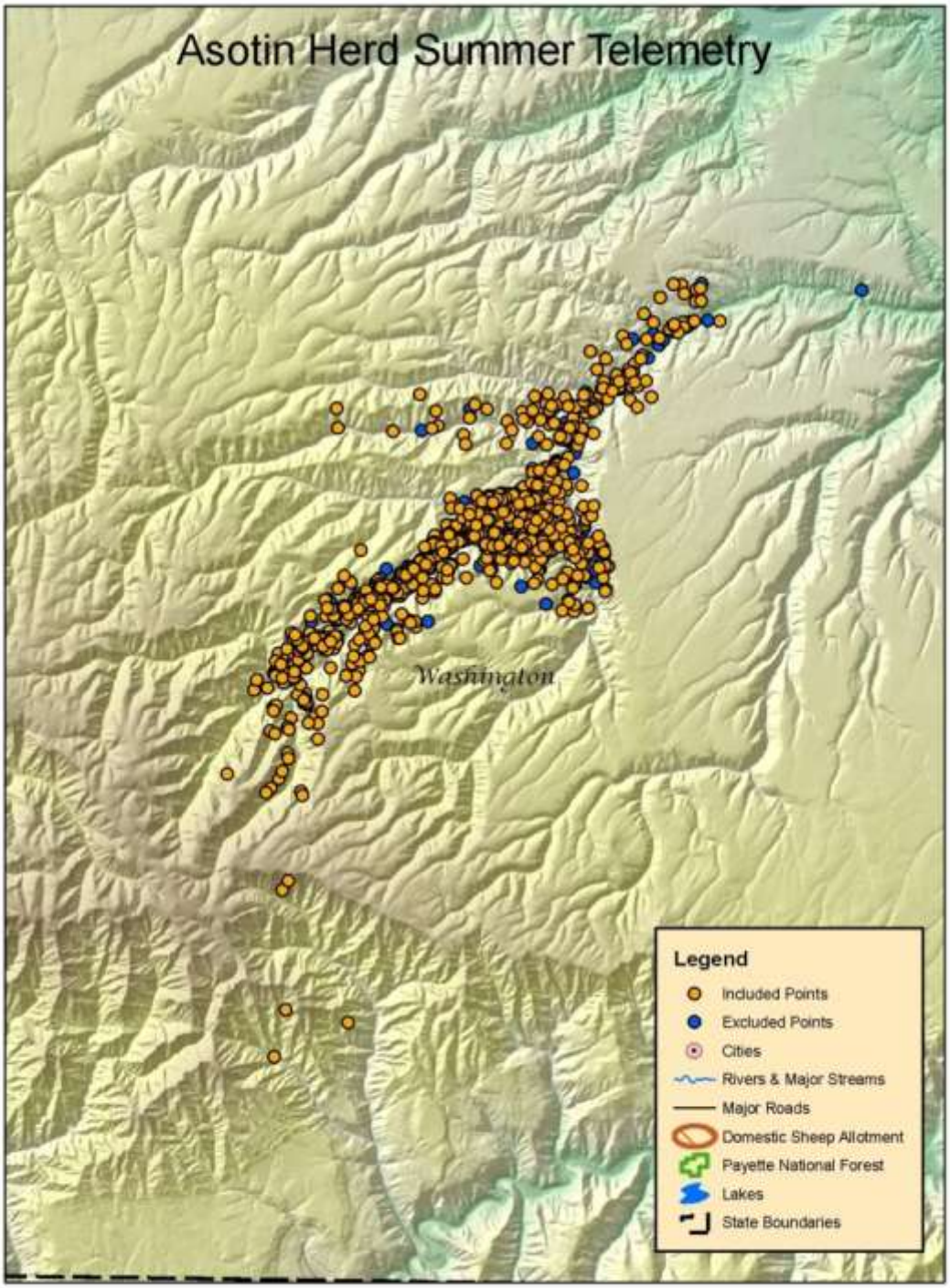


Figure 3-1. Asotin herd telemetry points

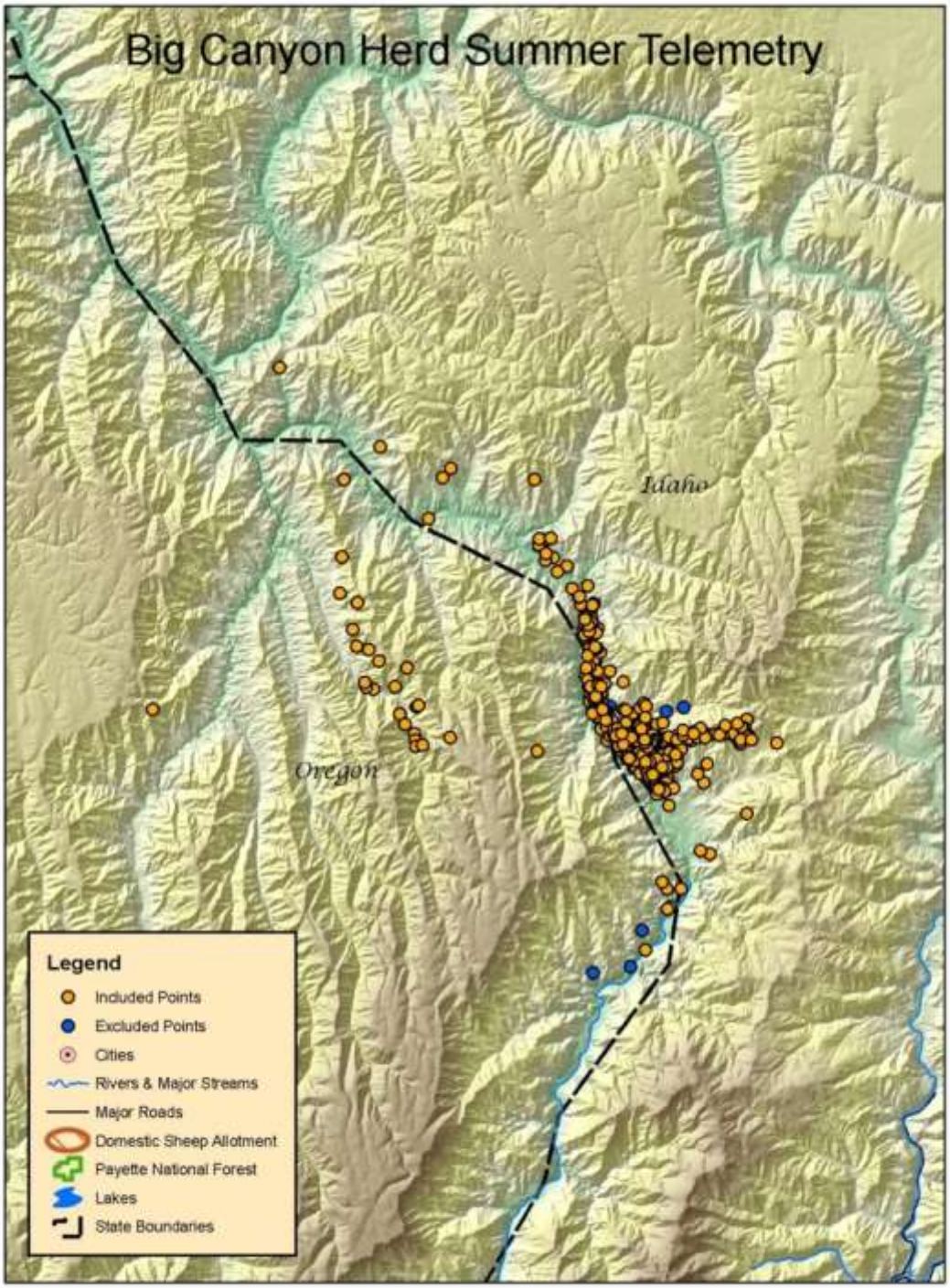


Figure 3-2. Big Canyon herd telemetry points

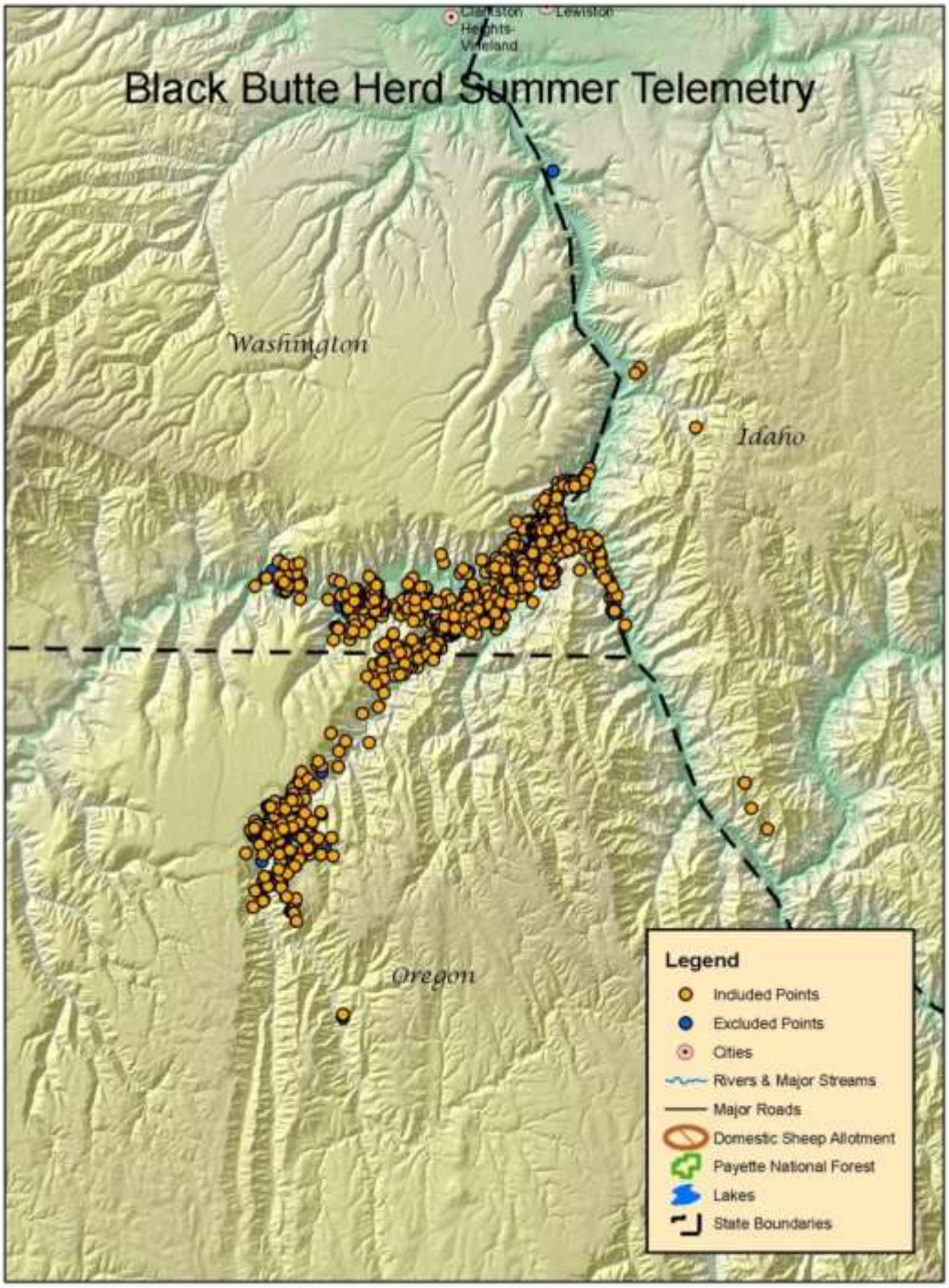


Figure 3-3. Black Butte herd telemetry points

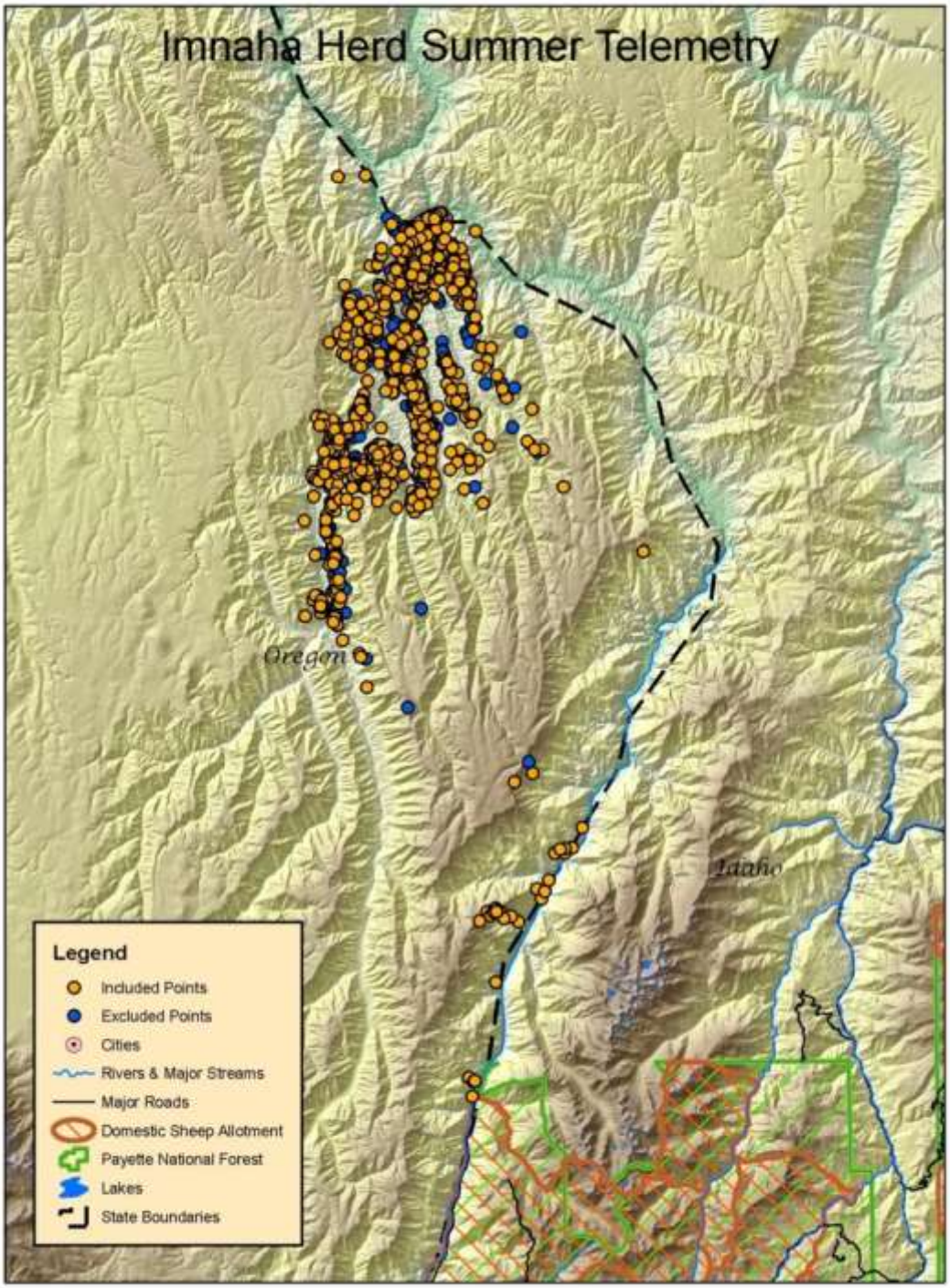


Figure 3-4. Imnaha herd telemetry points

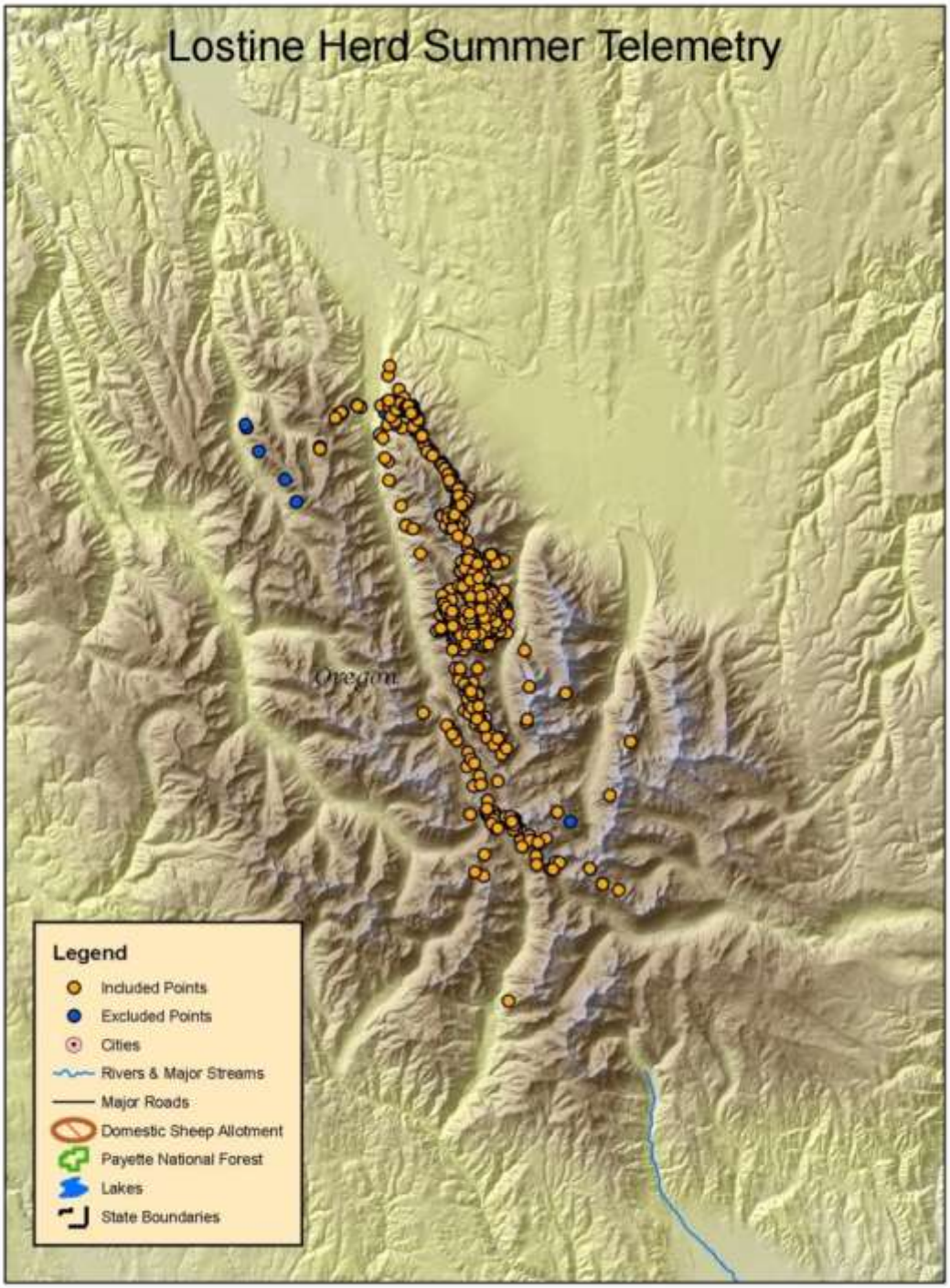


Figure 3-5. Lostine herd telemetry points

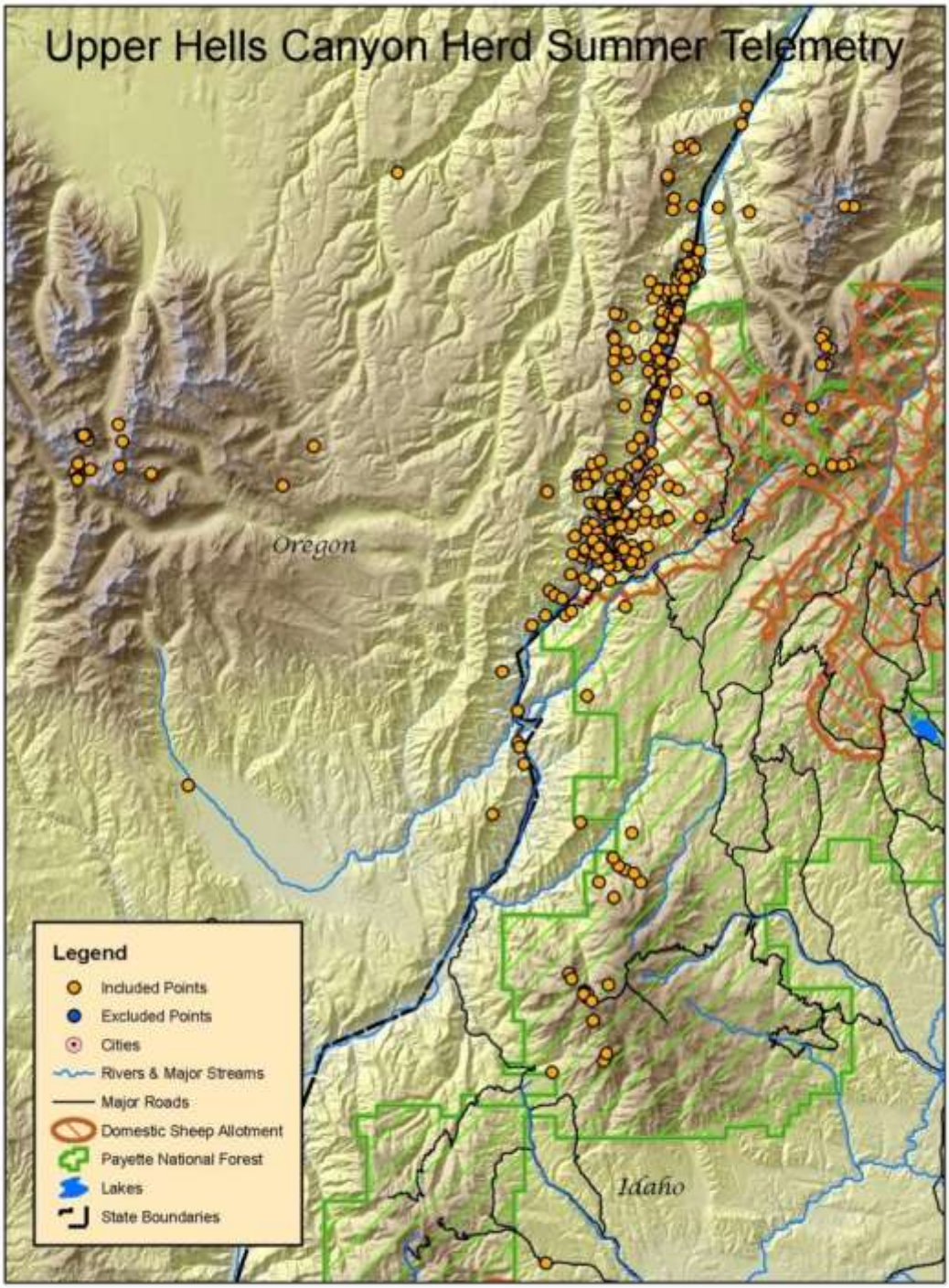


Figure 3-6. Upper Hells Canyon herd telemetry points

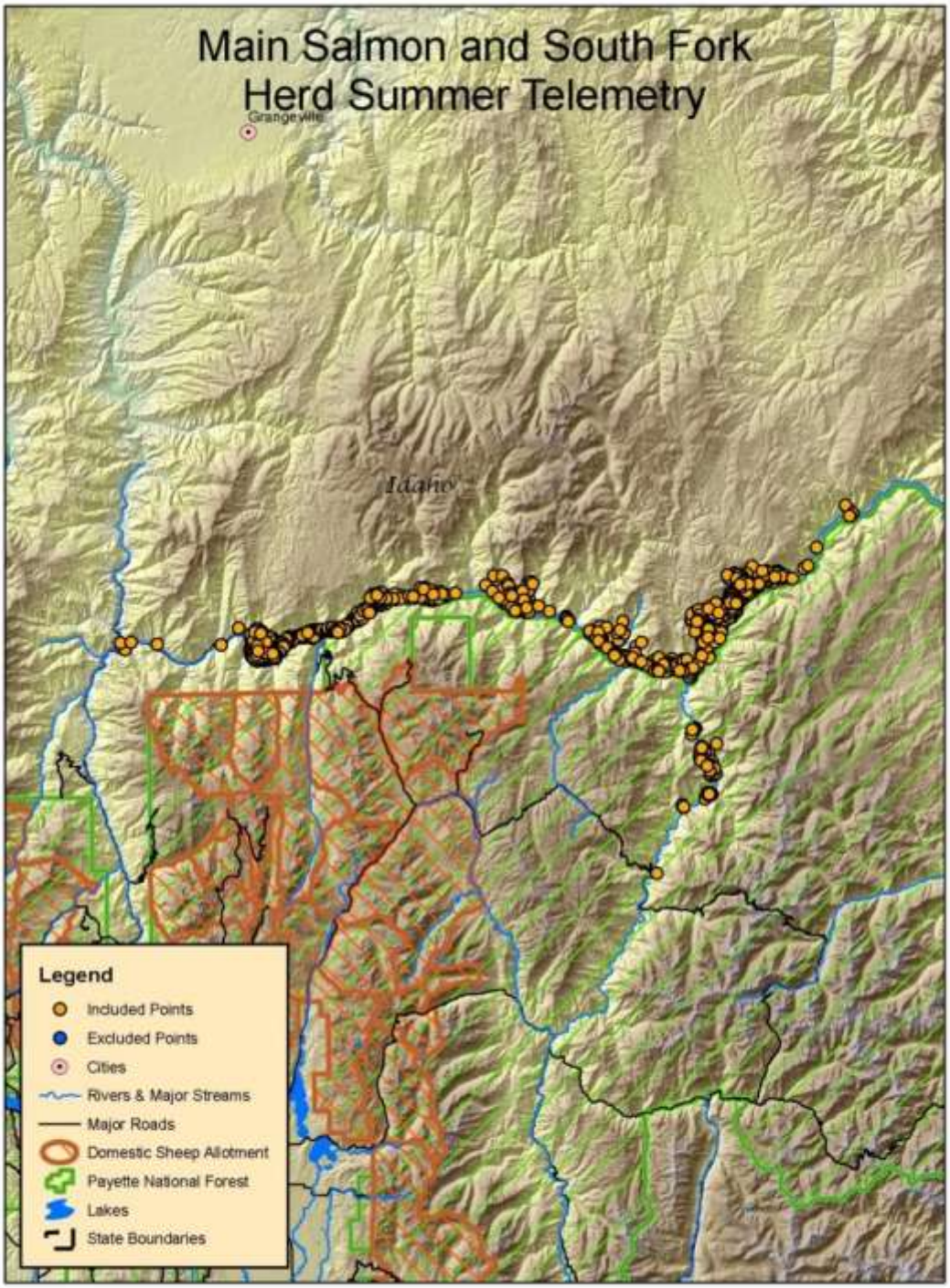


Figure 3-7. Main Salmon/South Fork herd telemetry points

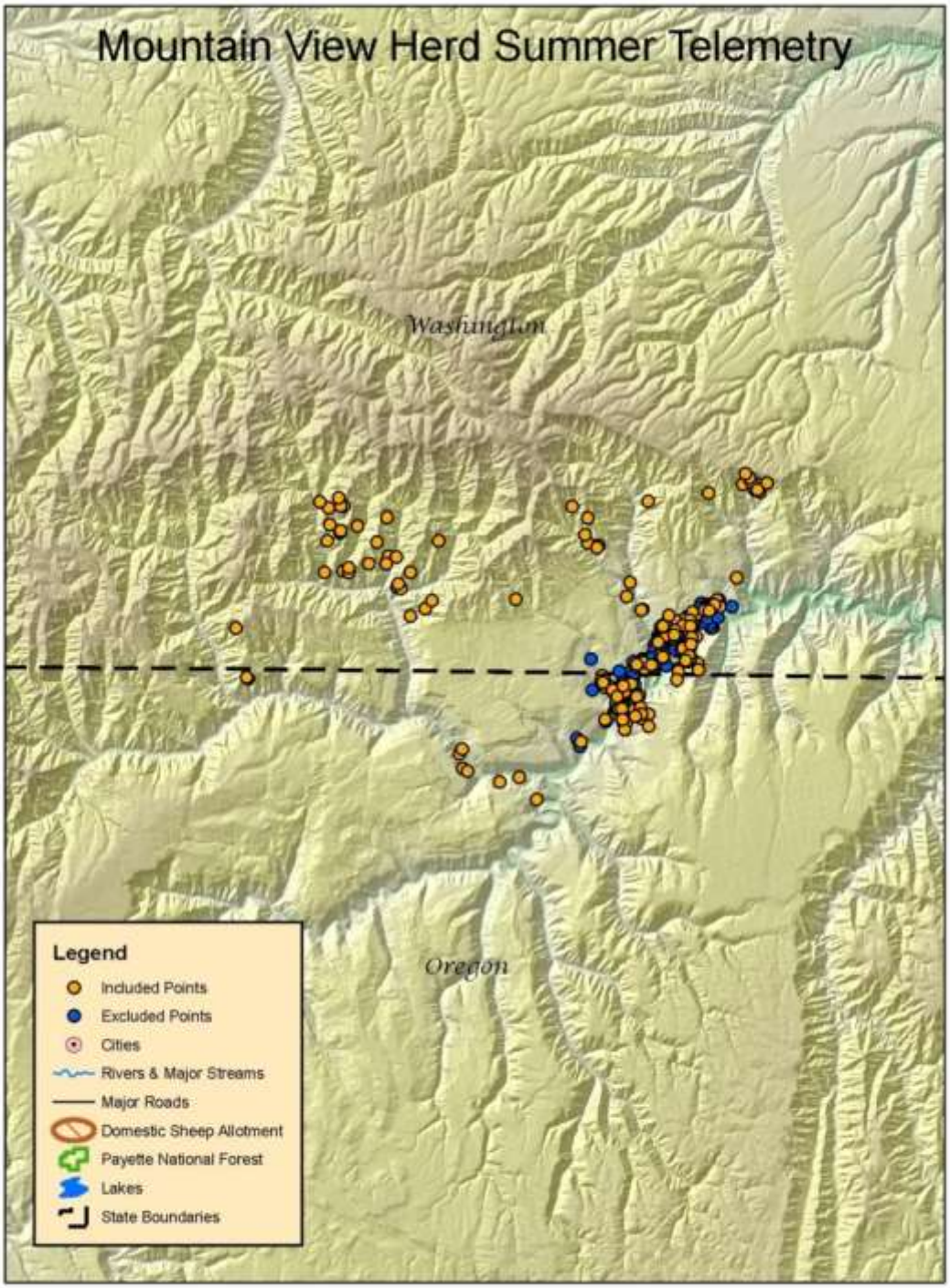


Figure 3-8. Mountain View herd telemetry points

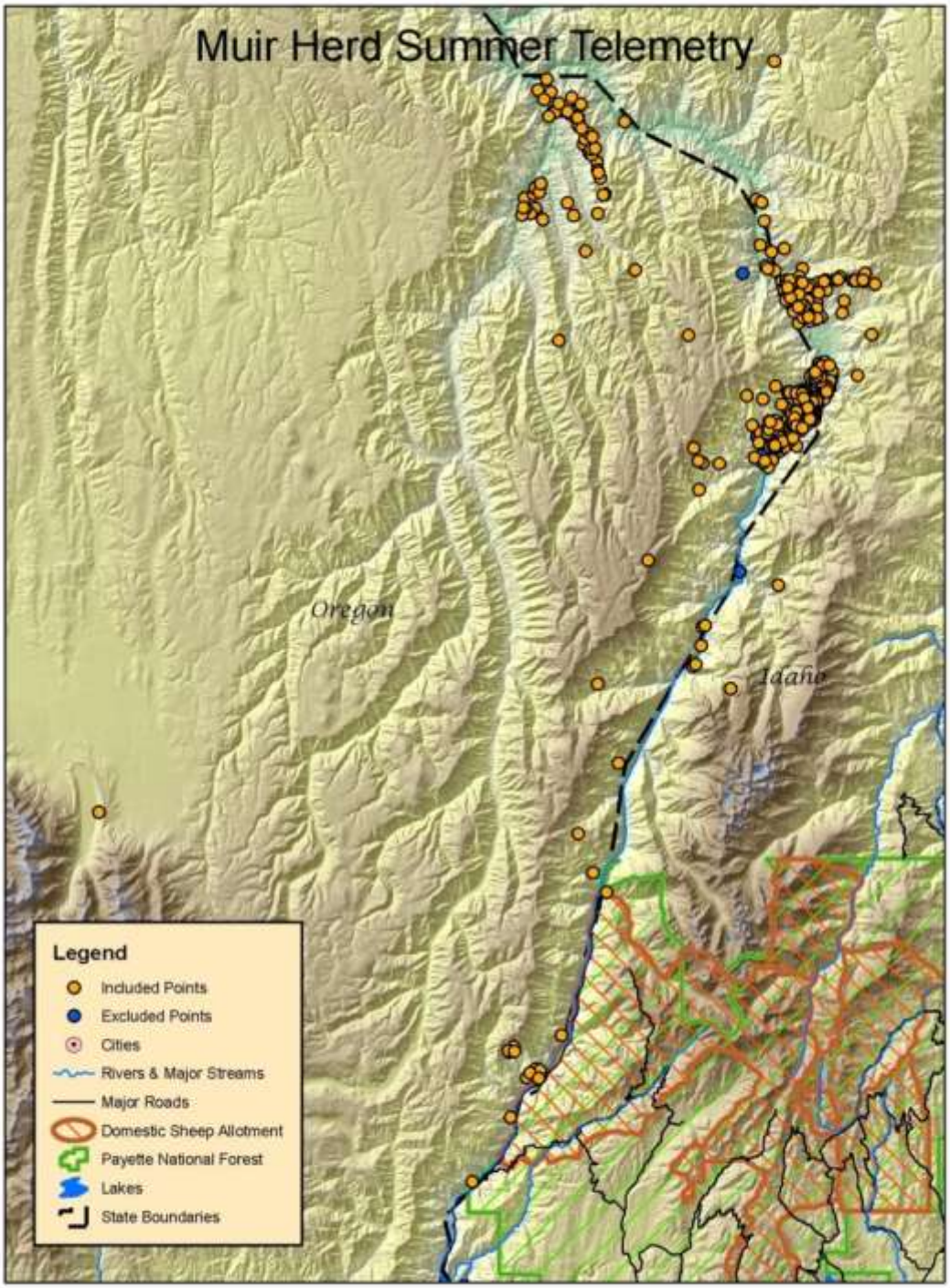


Figure 3-9. Muir herd telemetry points

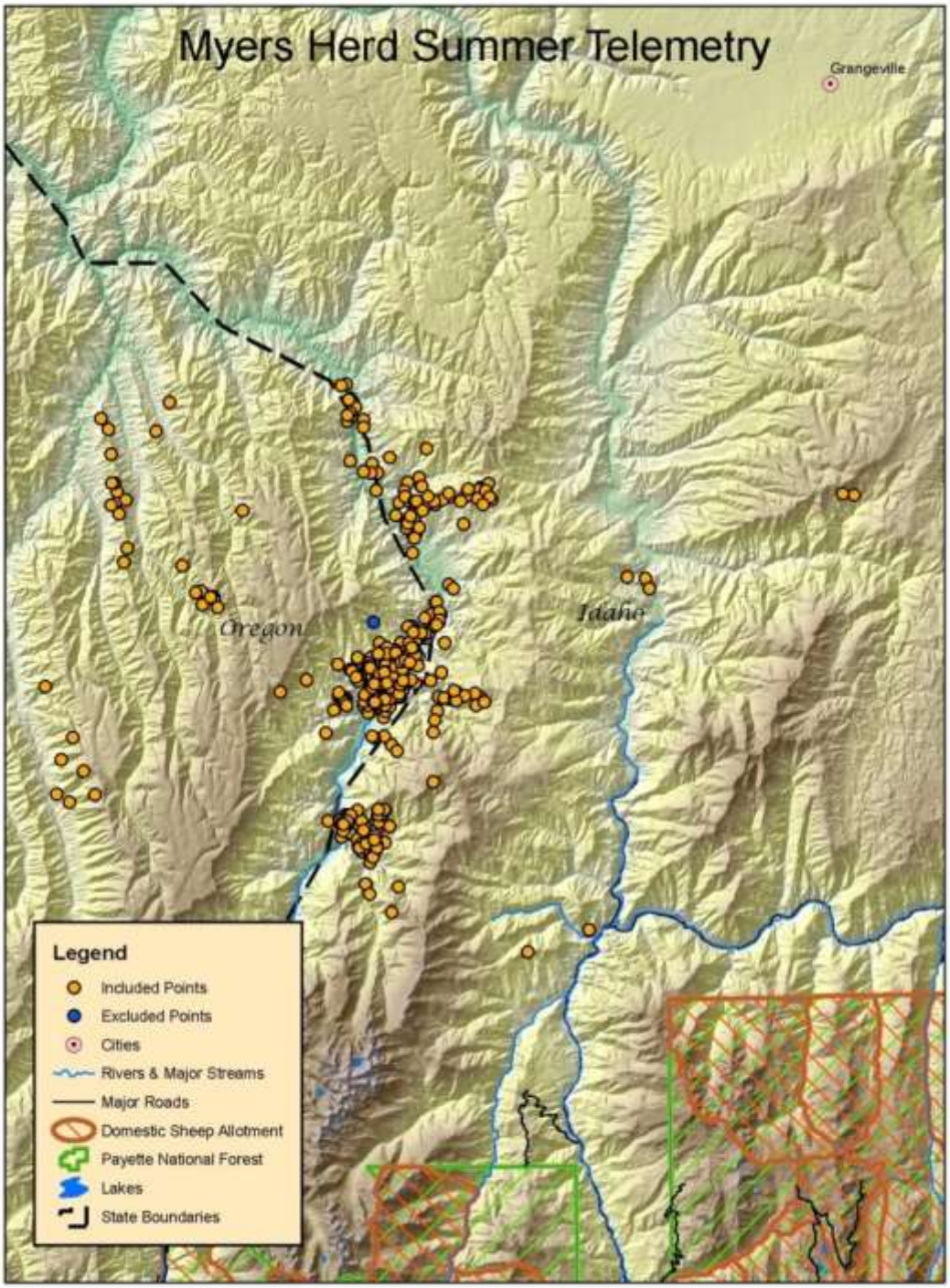


Figure 3-10. Myers herd telemetry points

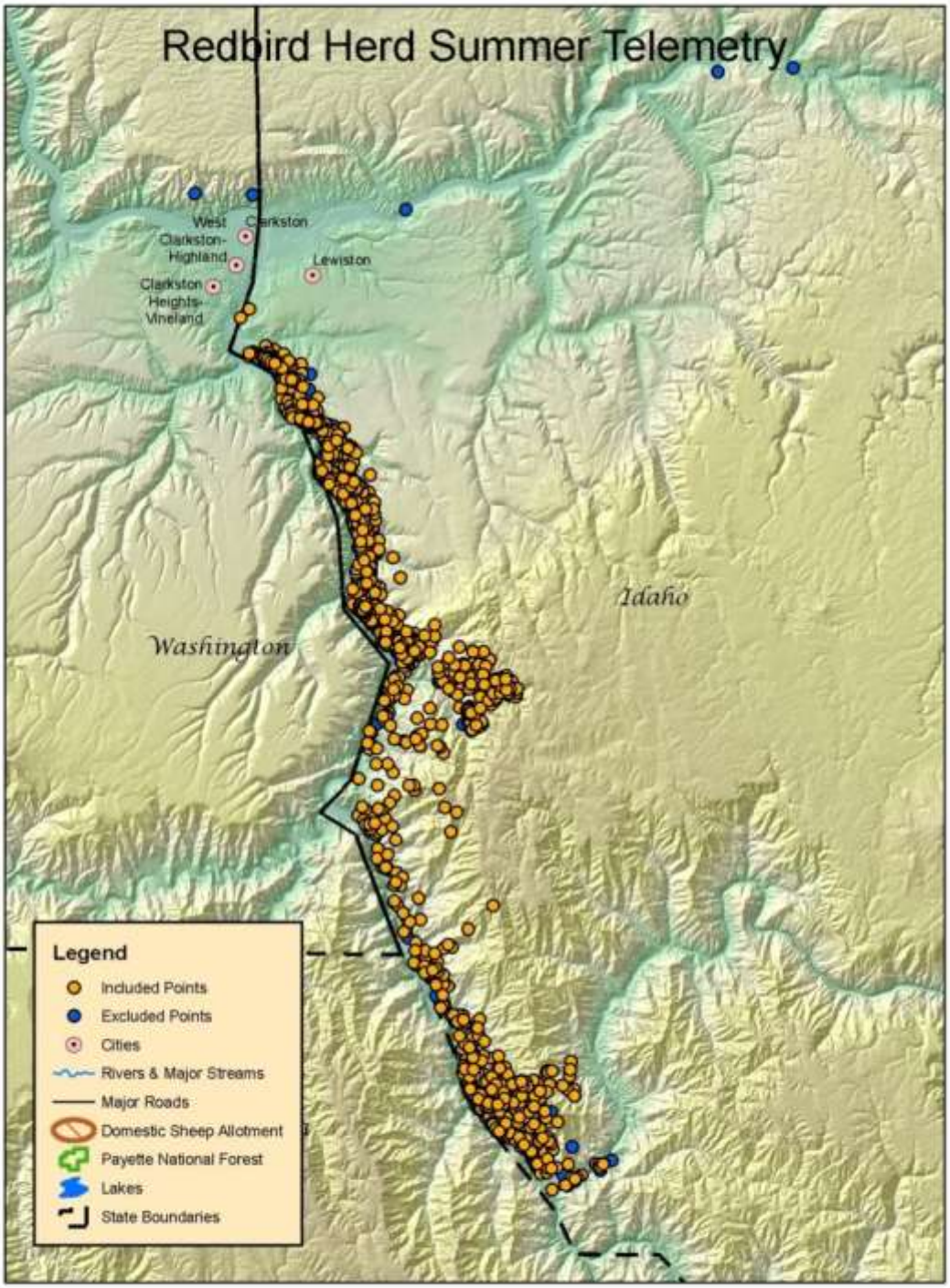


Figure 3-11. Redbird herd telemetry points

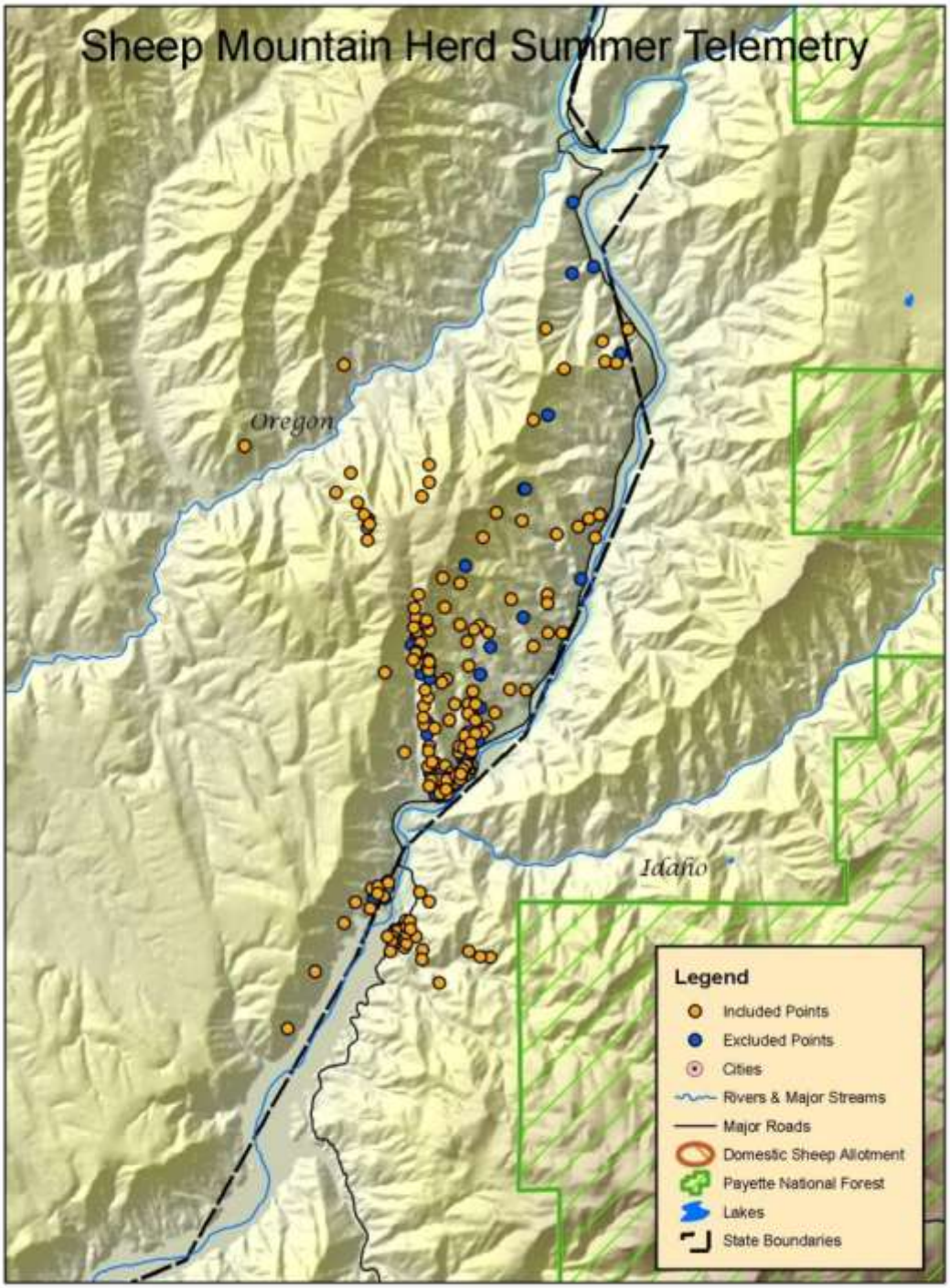


Figure 3-12. Sheep Mountain herd telemetry points

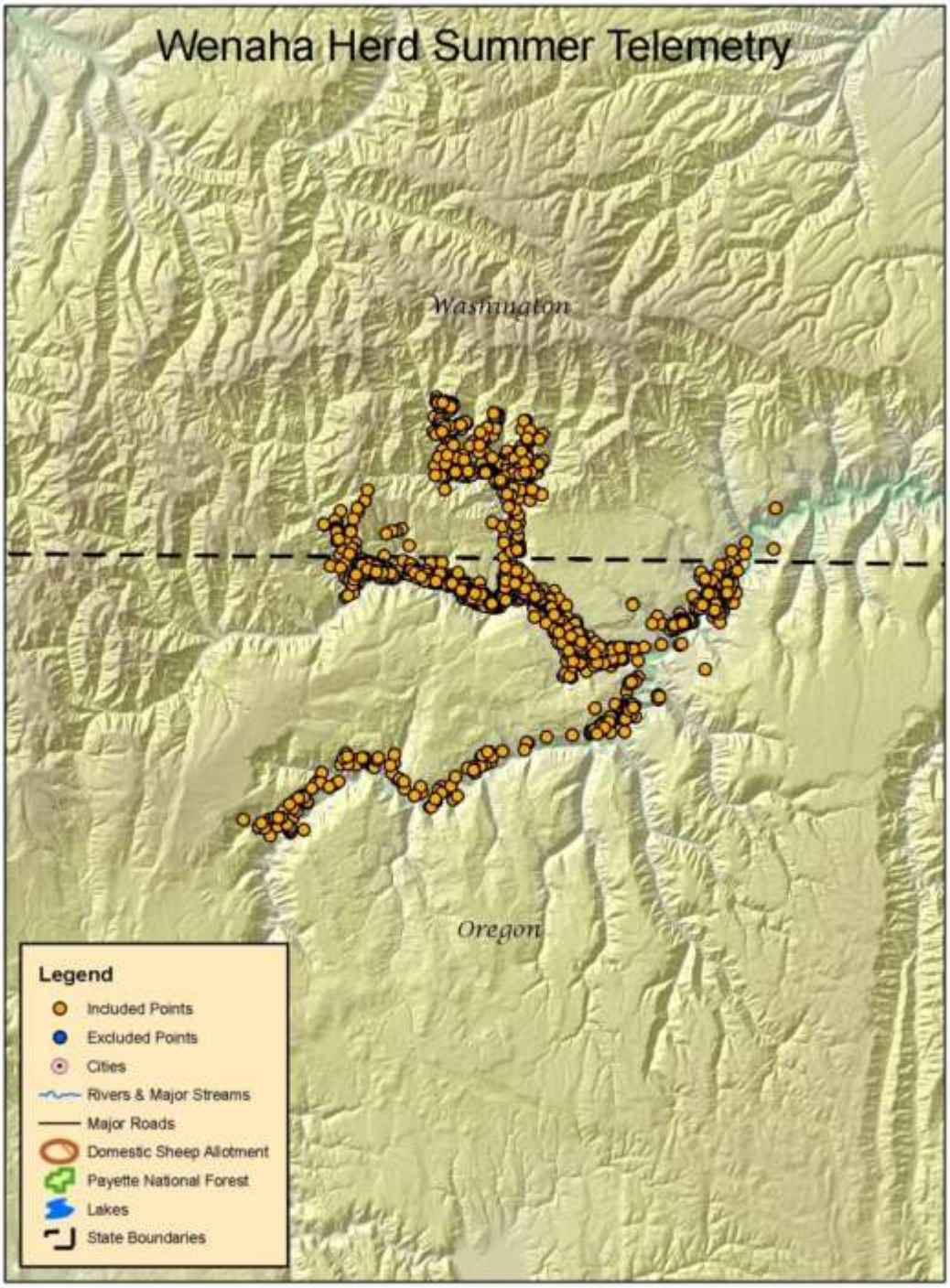


Figure 3-13. Wenaha herd telemetry points

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).

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

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.

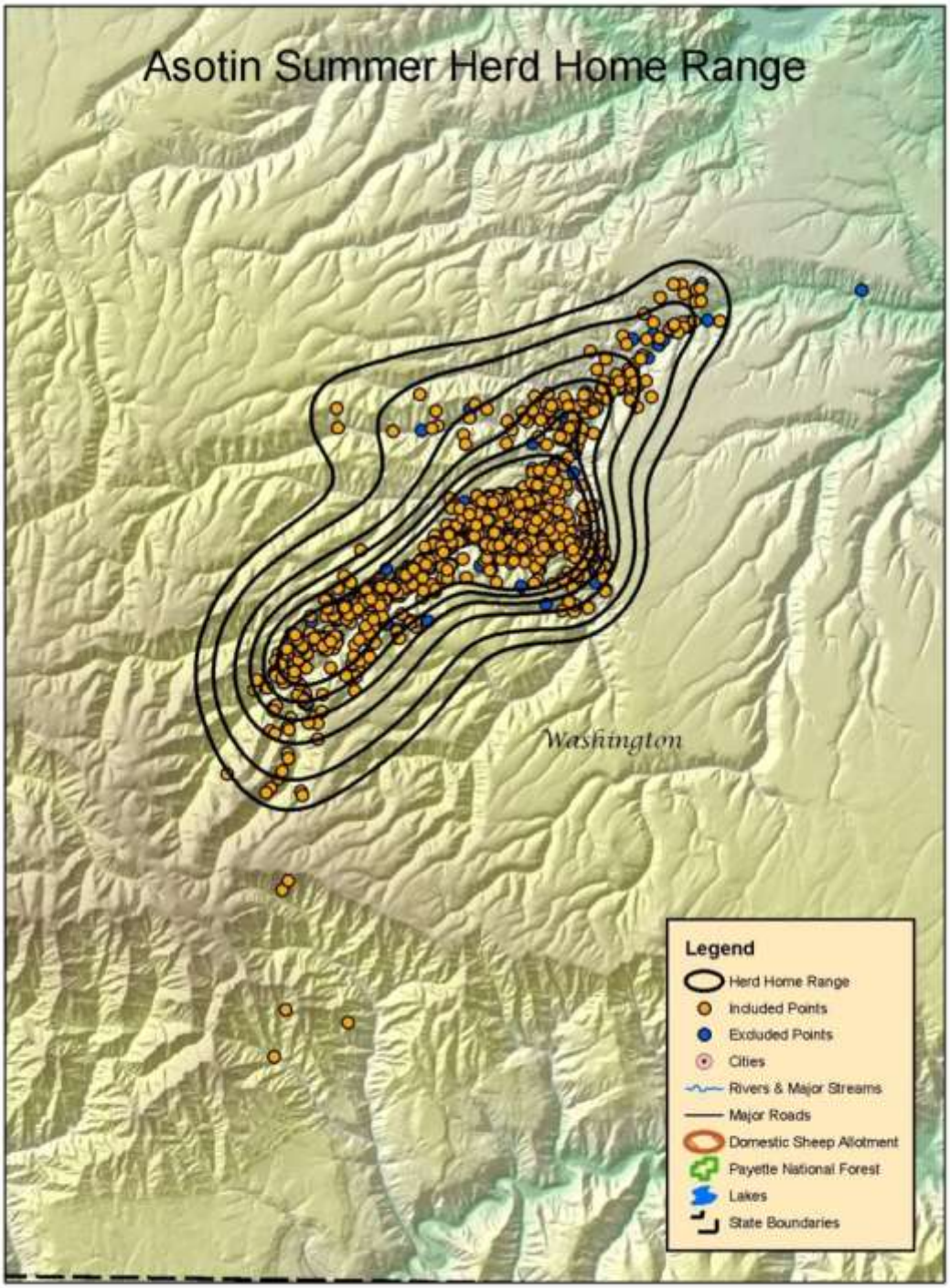


Figure 3-14. Asotin home range

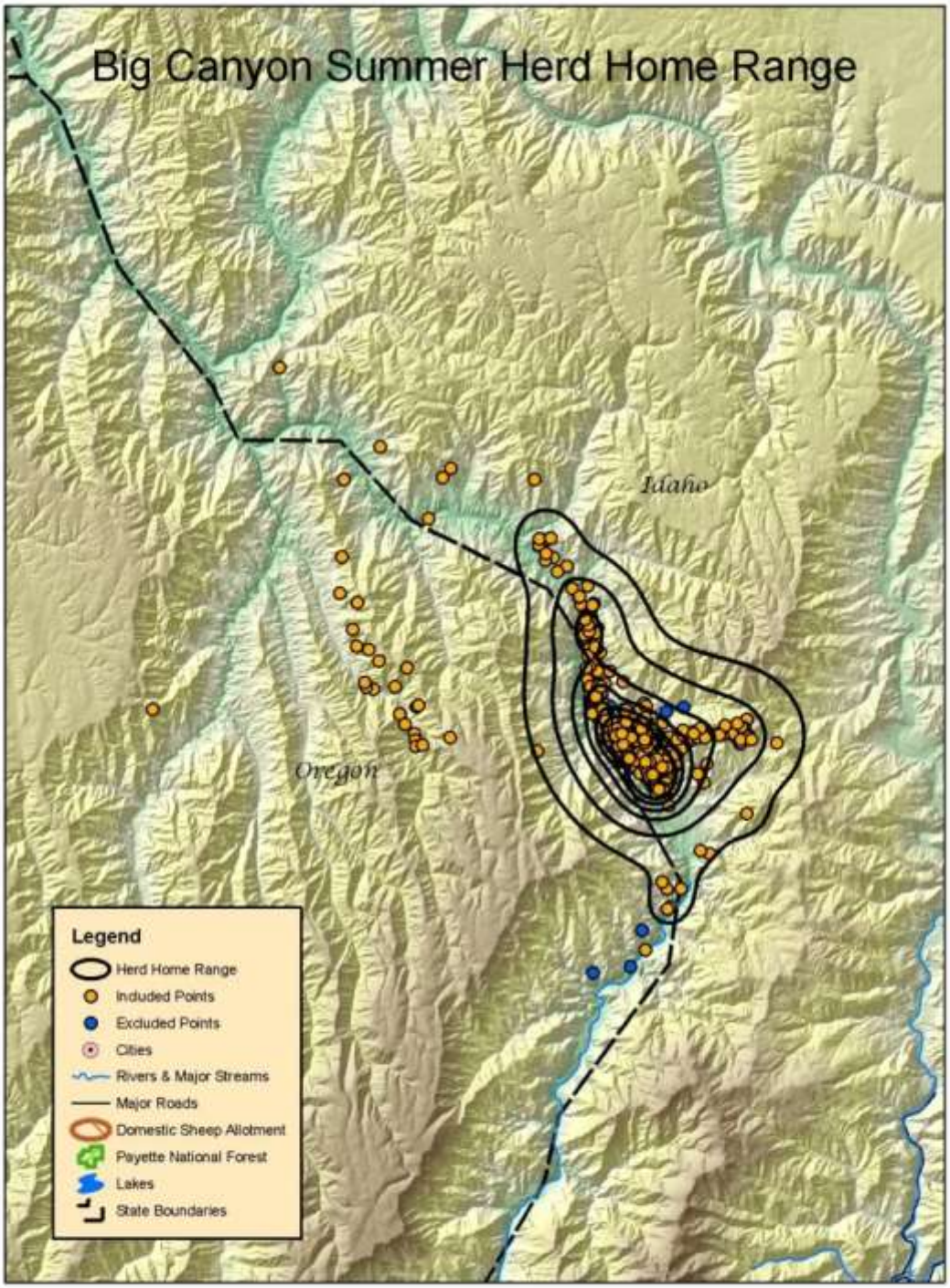


Figure 3-15. Big Canyon herd home ranges

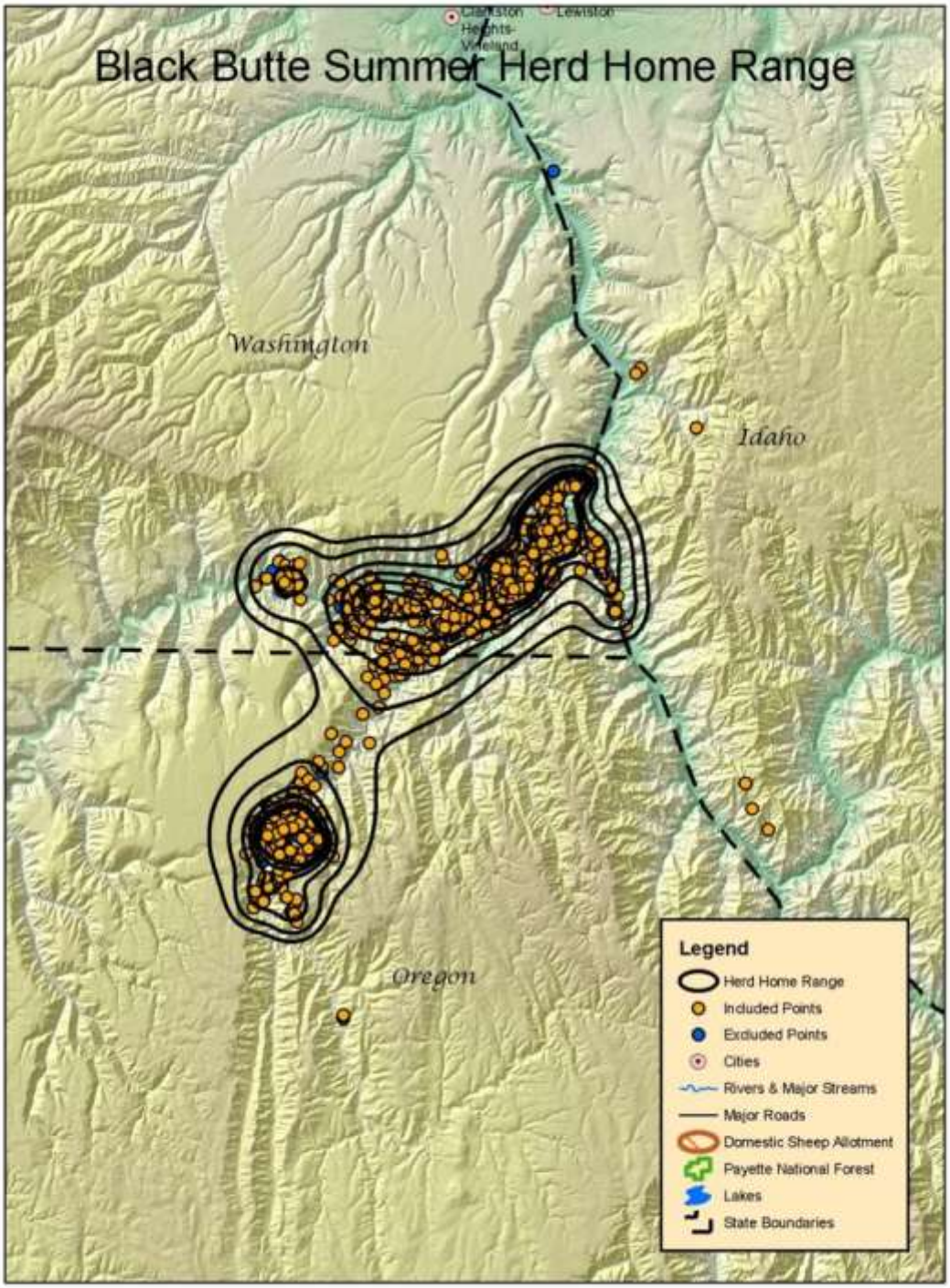


Figure 3-16. Black Butte herd home range

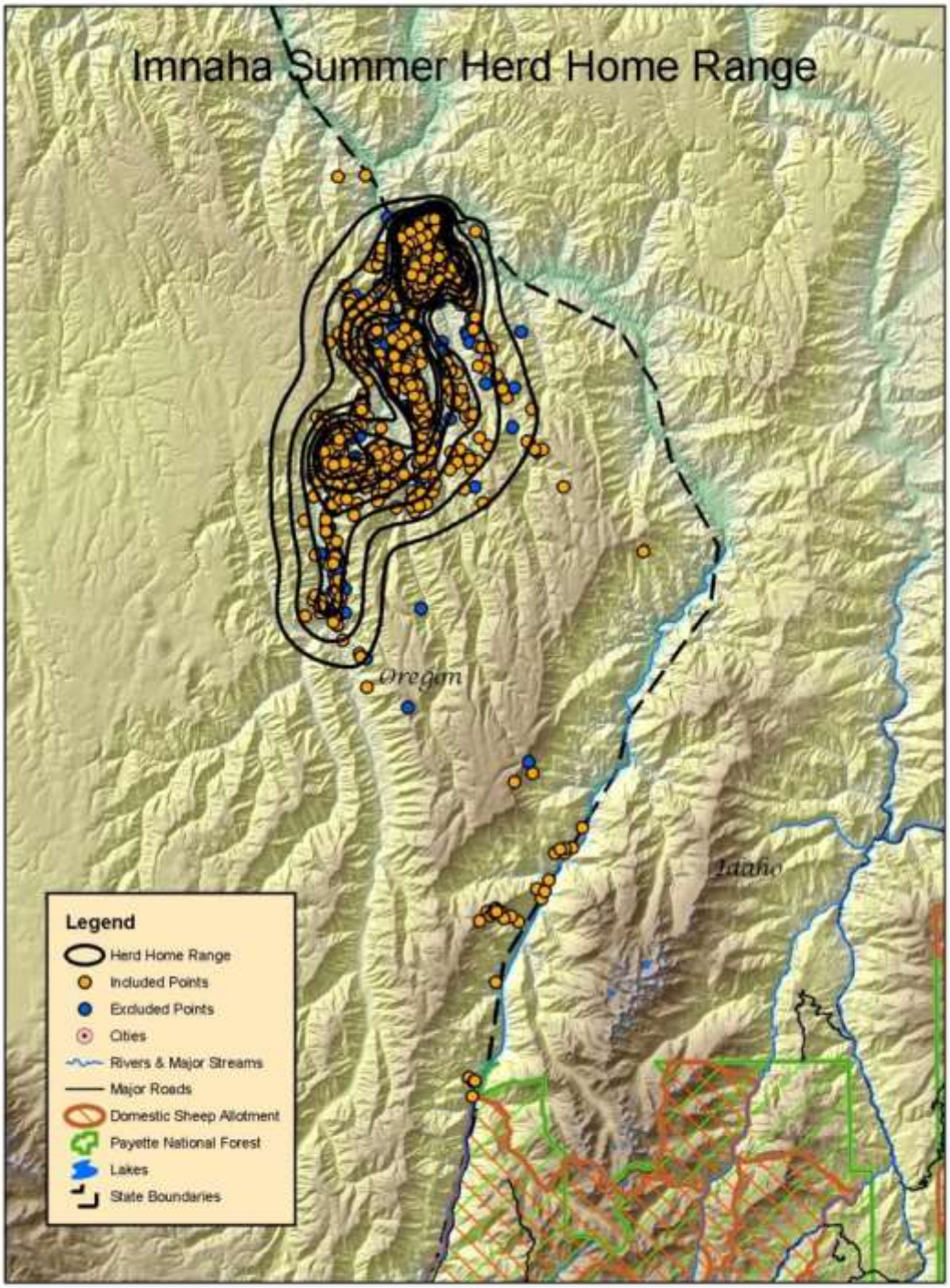


Figure 3-17. Imnaha herd home range

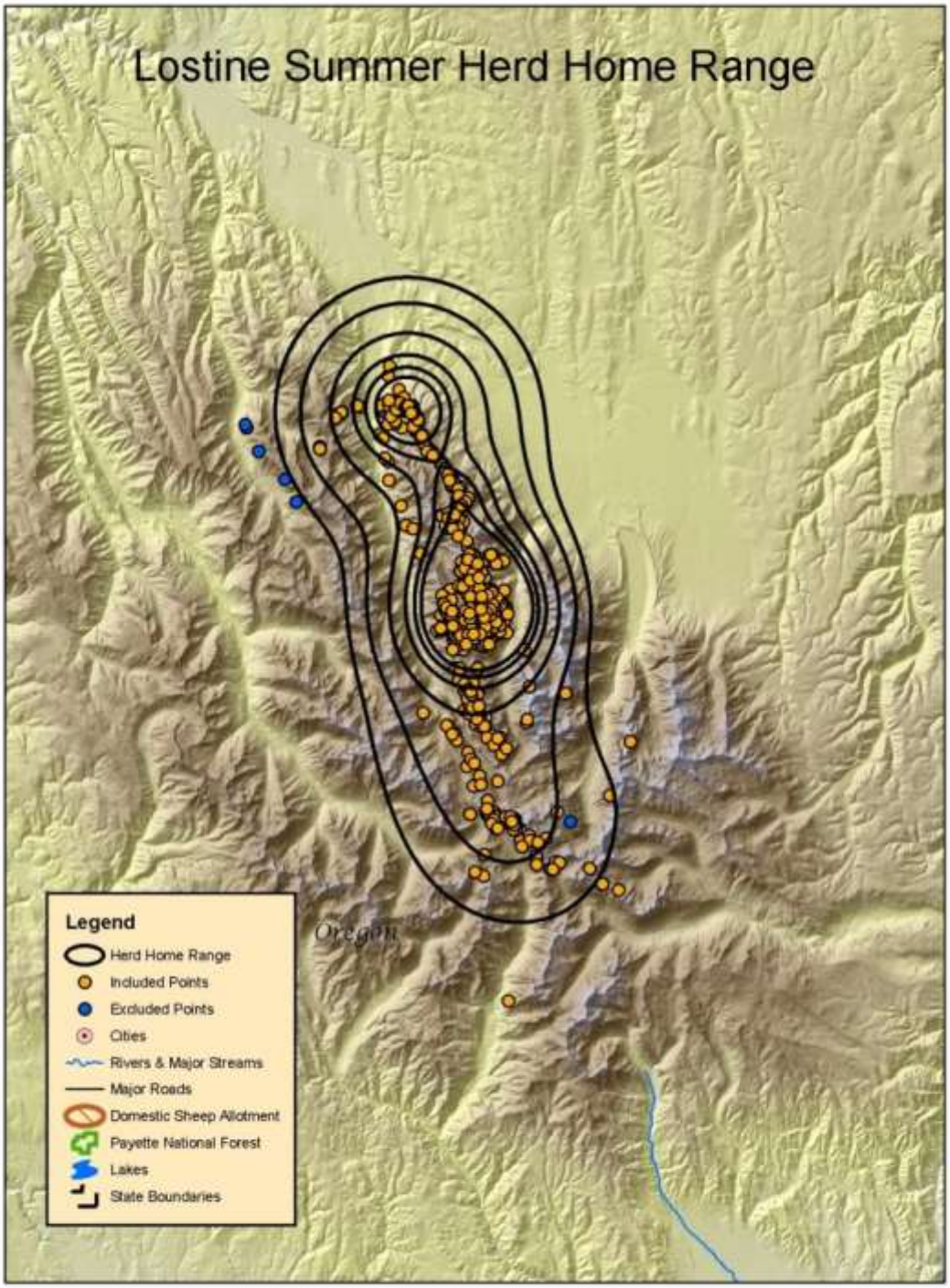


Figure 3-18. Lostine herd home range

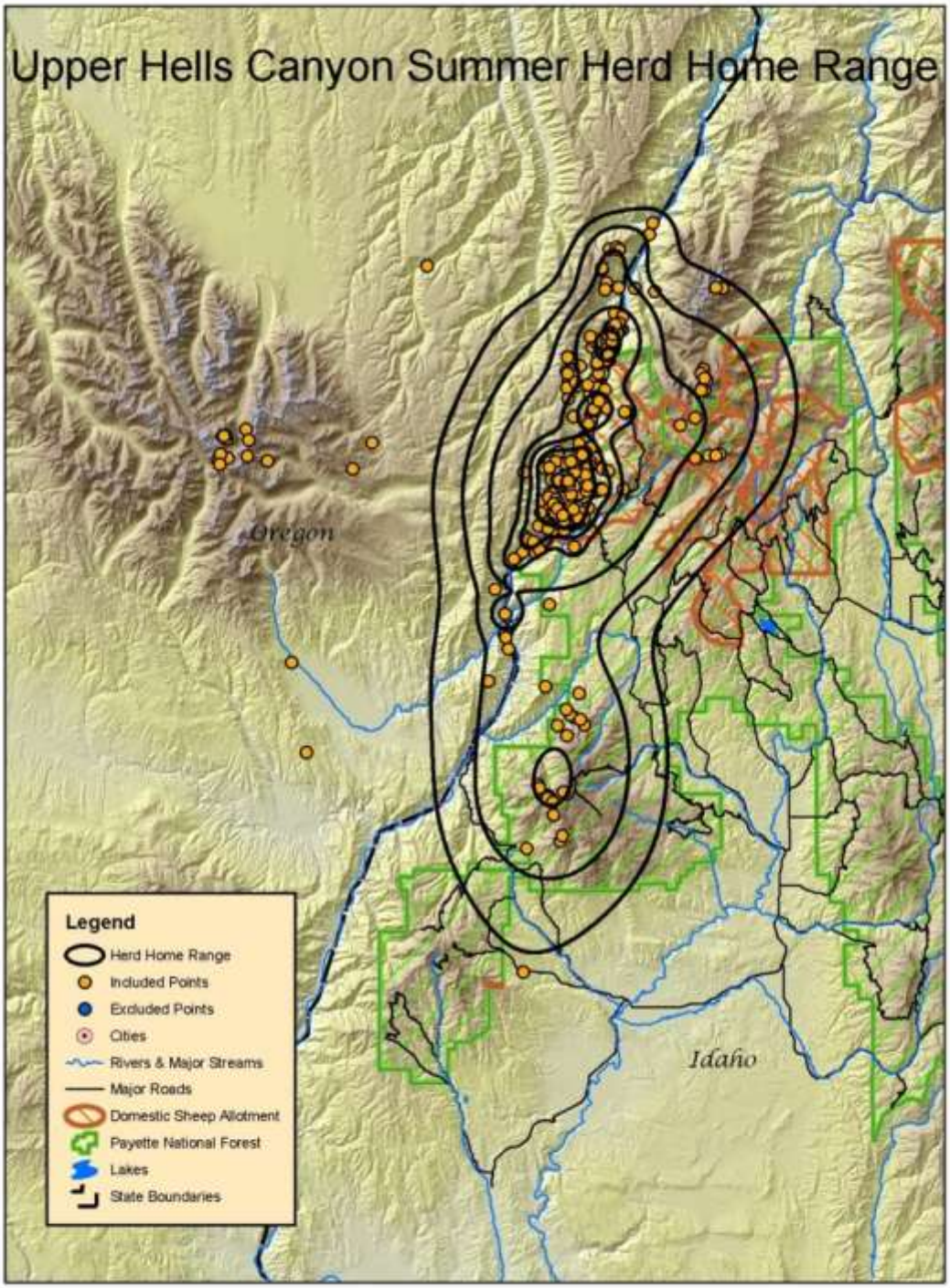


Figure 3-19. Upper Hells Canyon herd home range

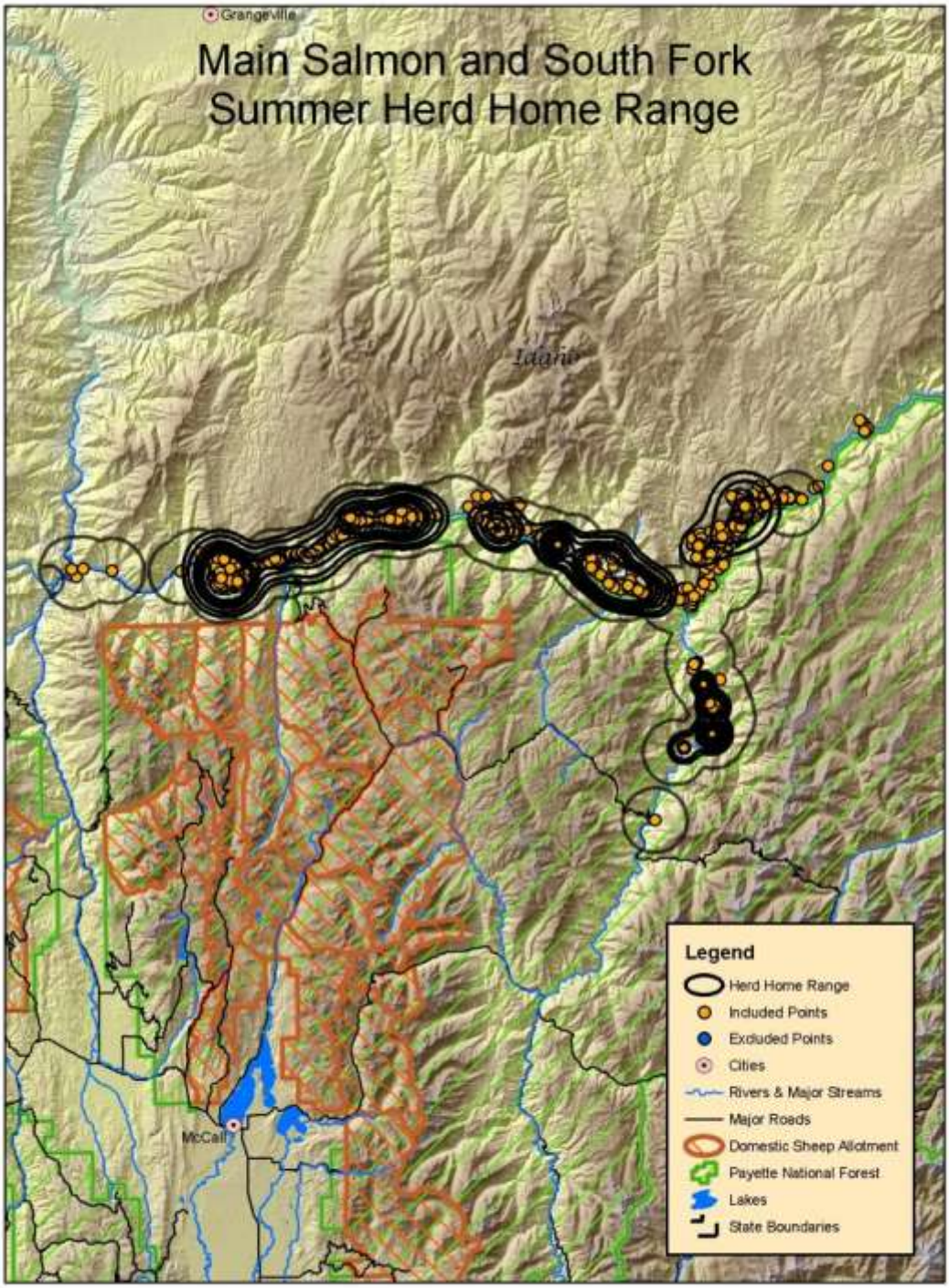


Figure 3-20. Main Salmon/South Fork herd home range

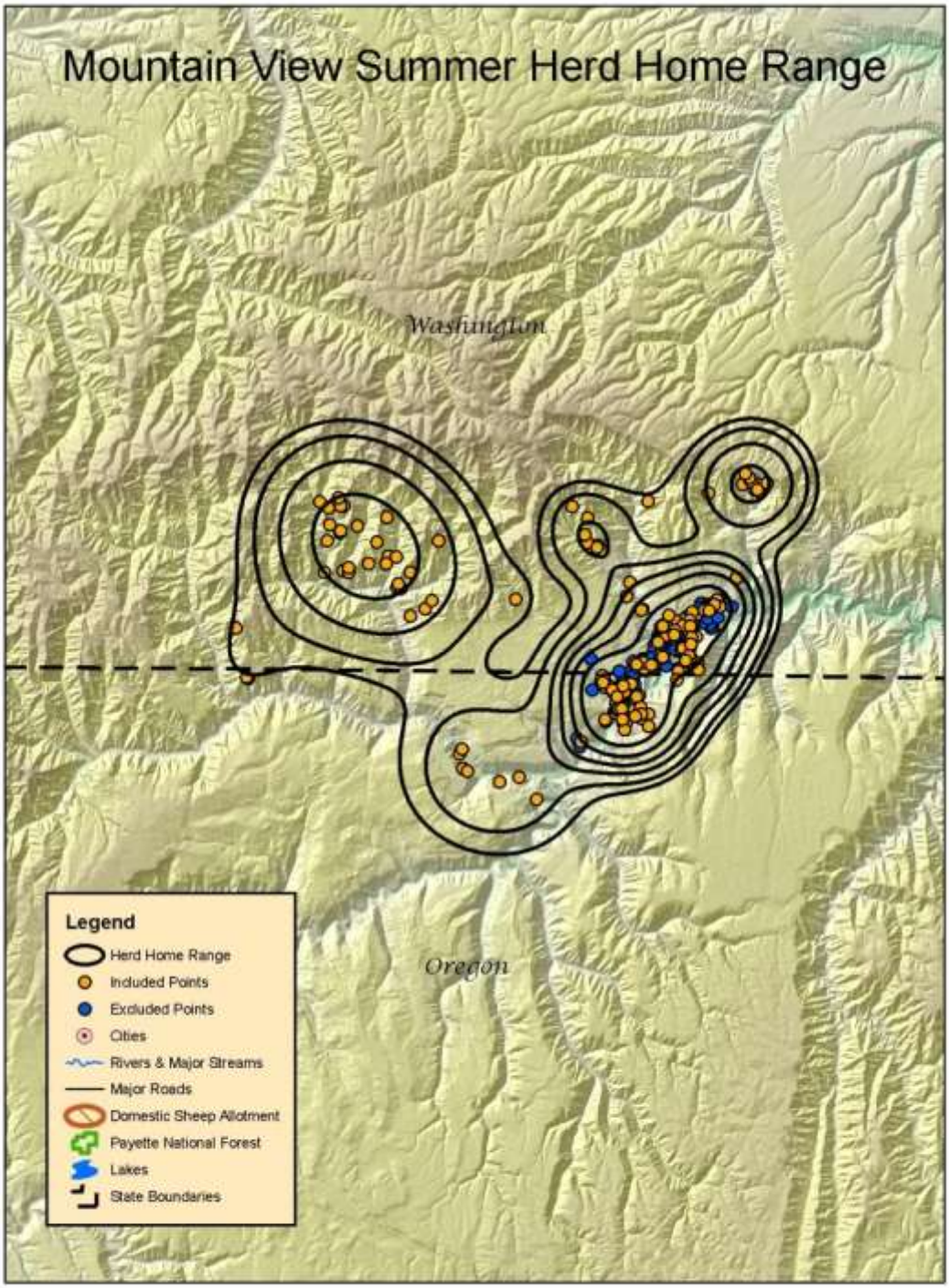


Figure 3-21. Mountain View herd home range

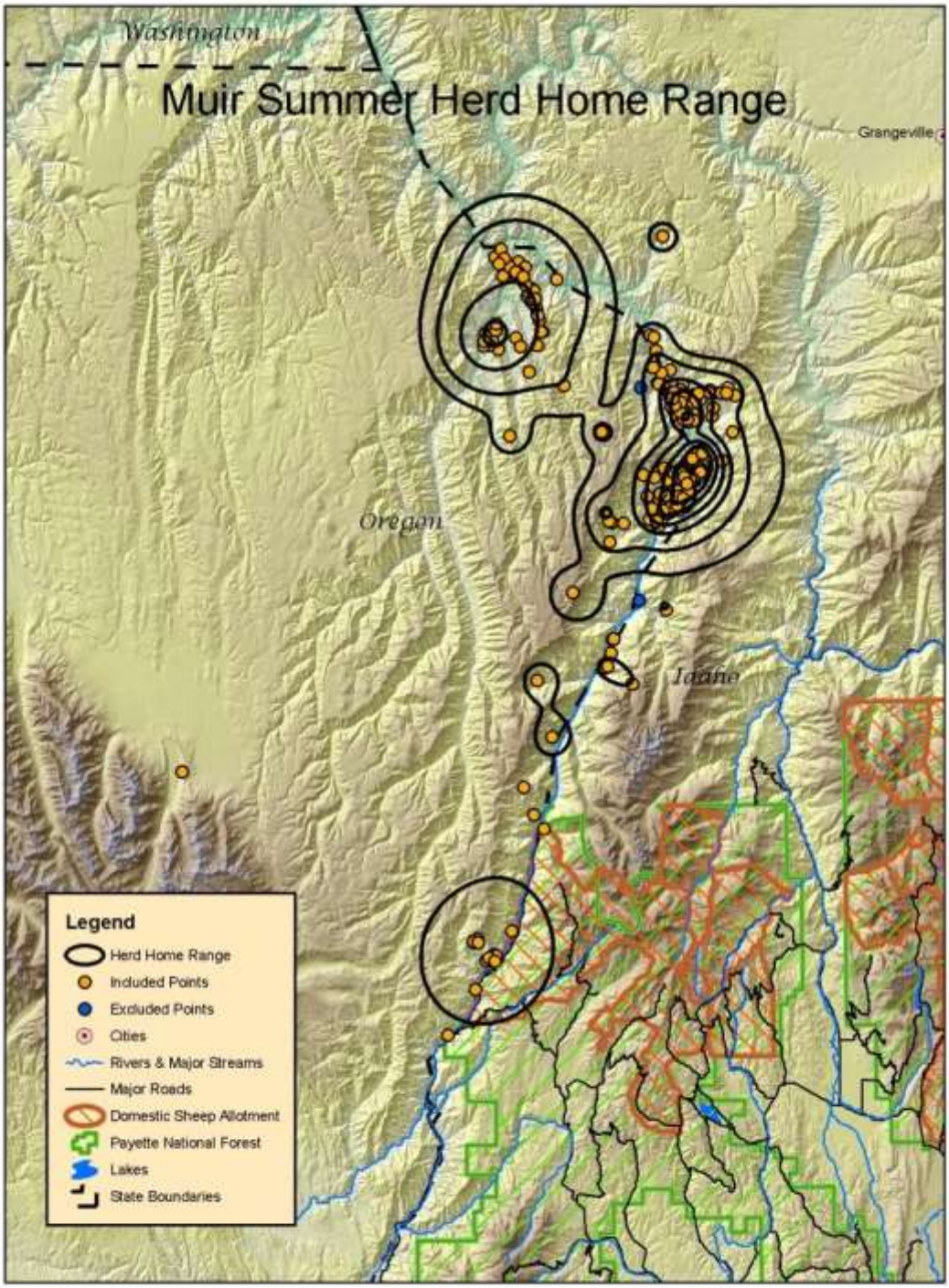


Figure 3-22. Muir herd home range

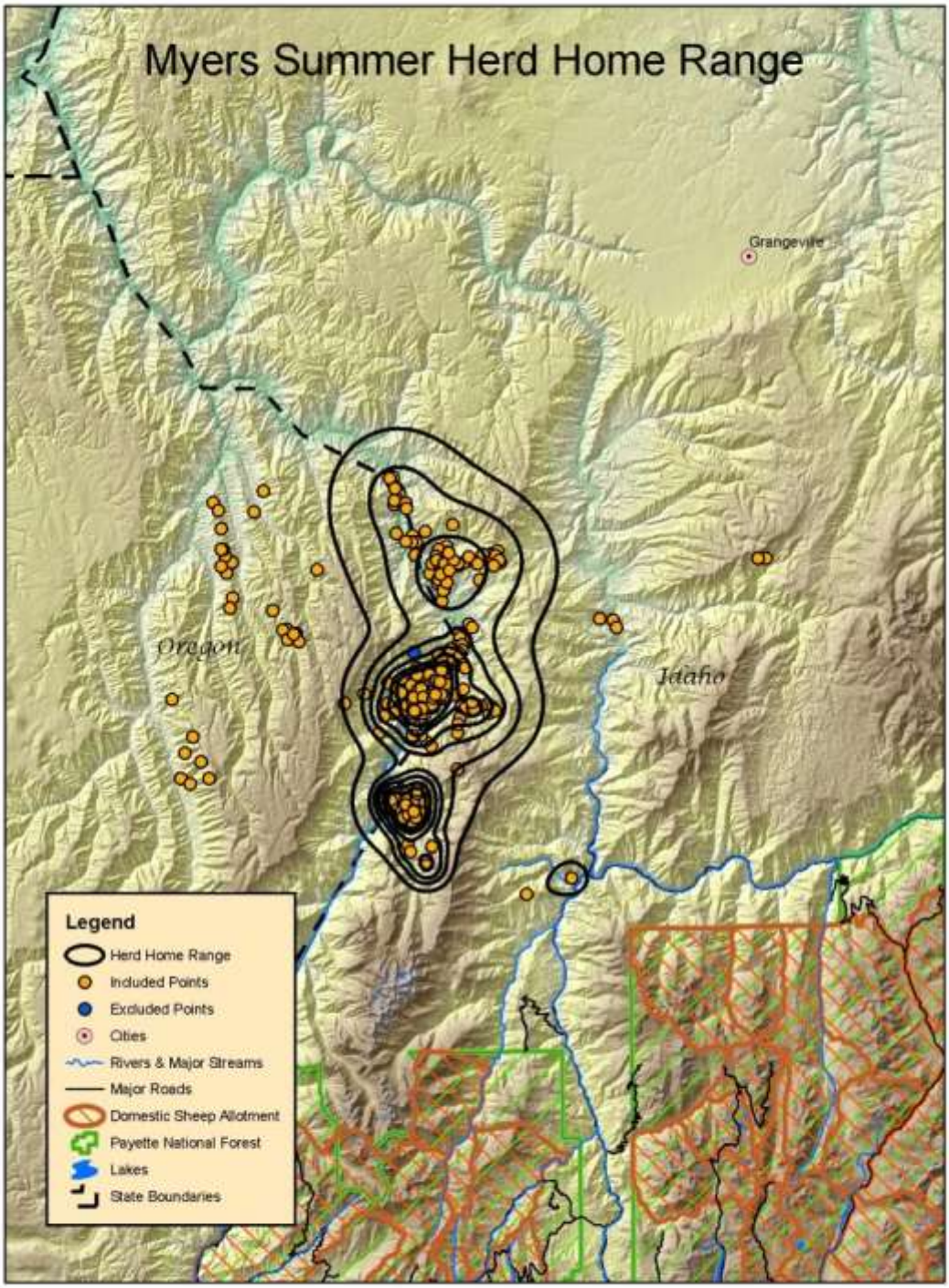


Figure 3-23. Myers herd home range

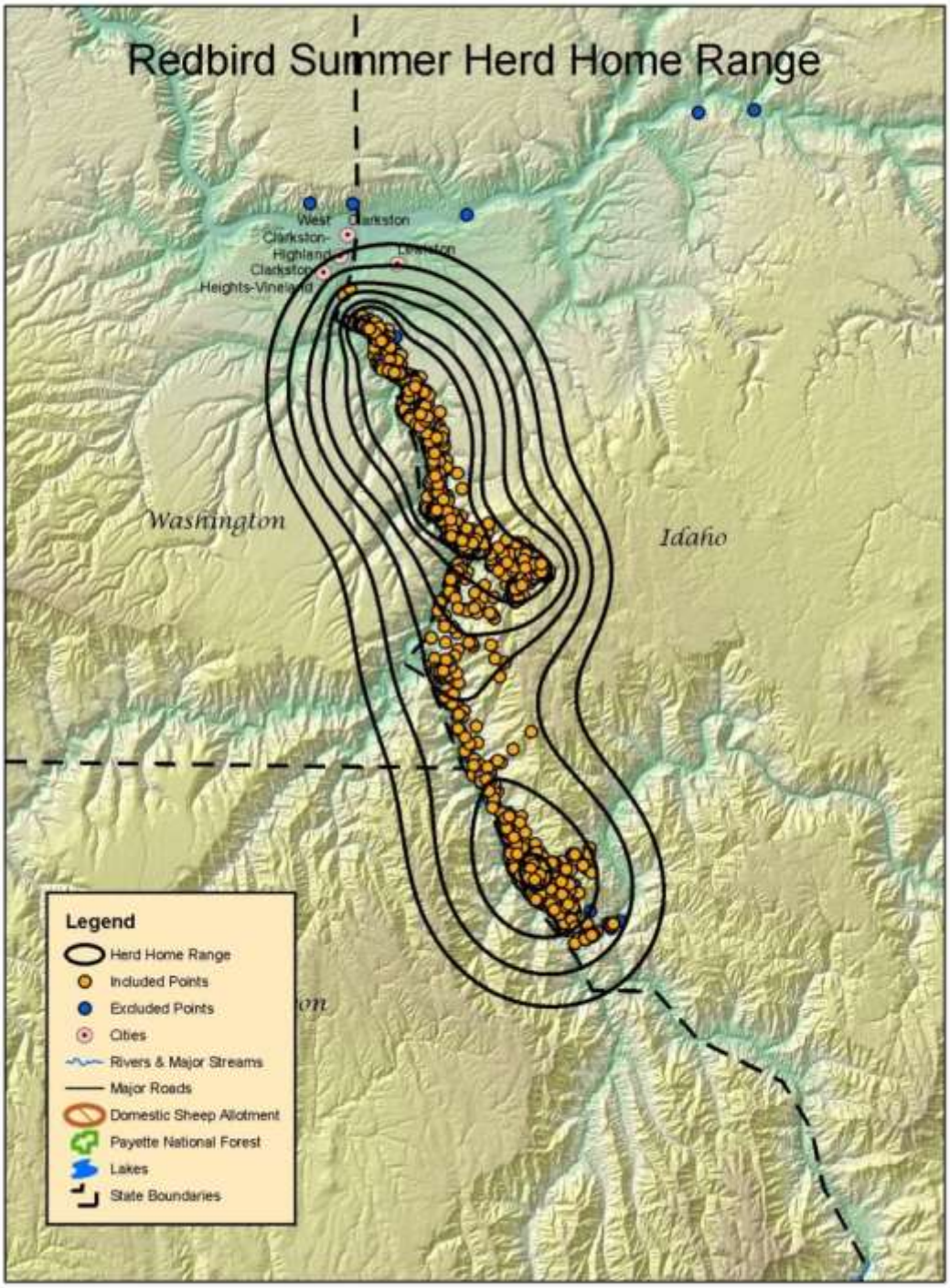


Figure 3-24. Redbird herd home range

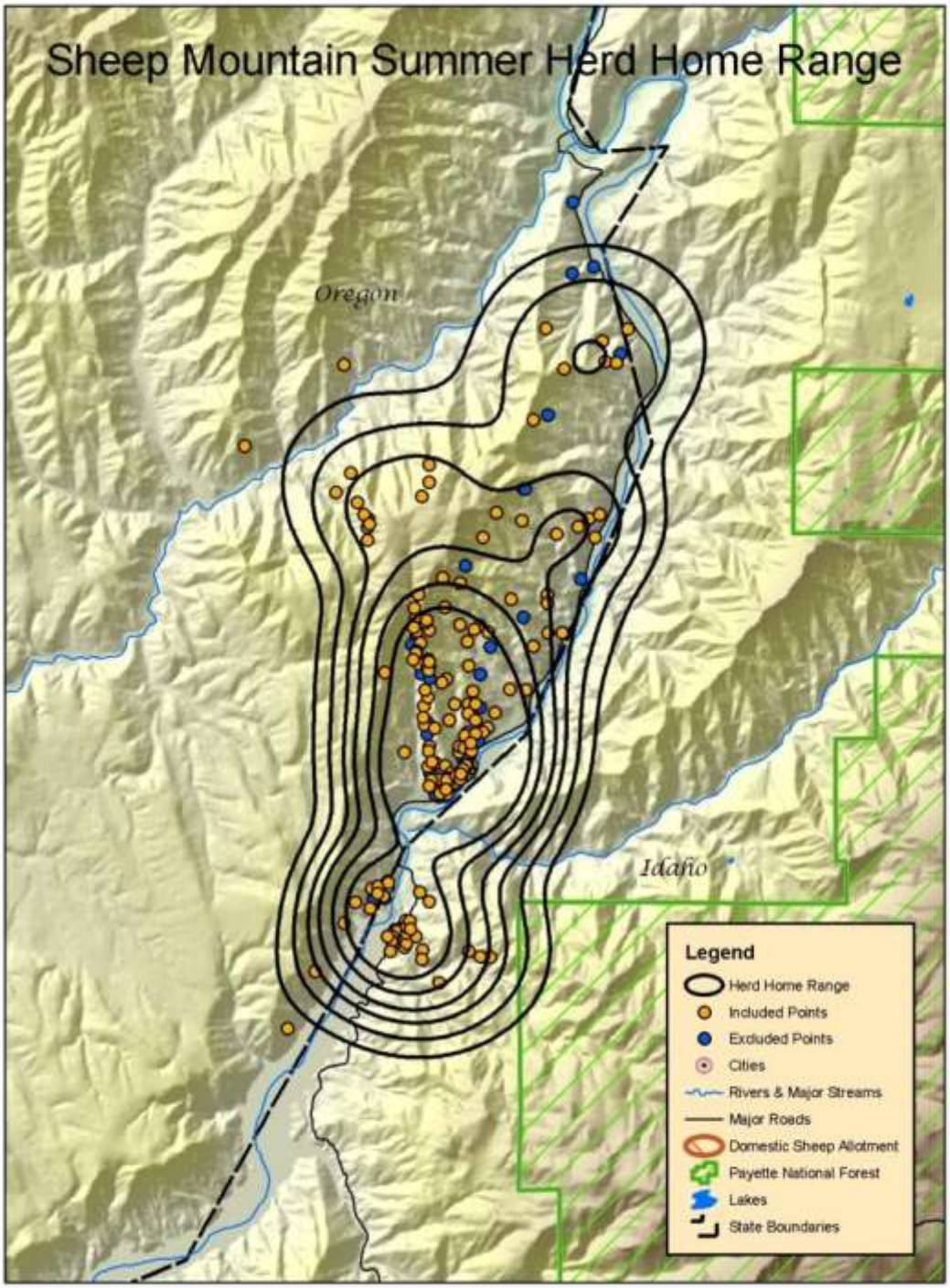


Figure 3-25. Sheep Mountain herd home range

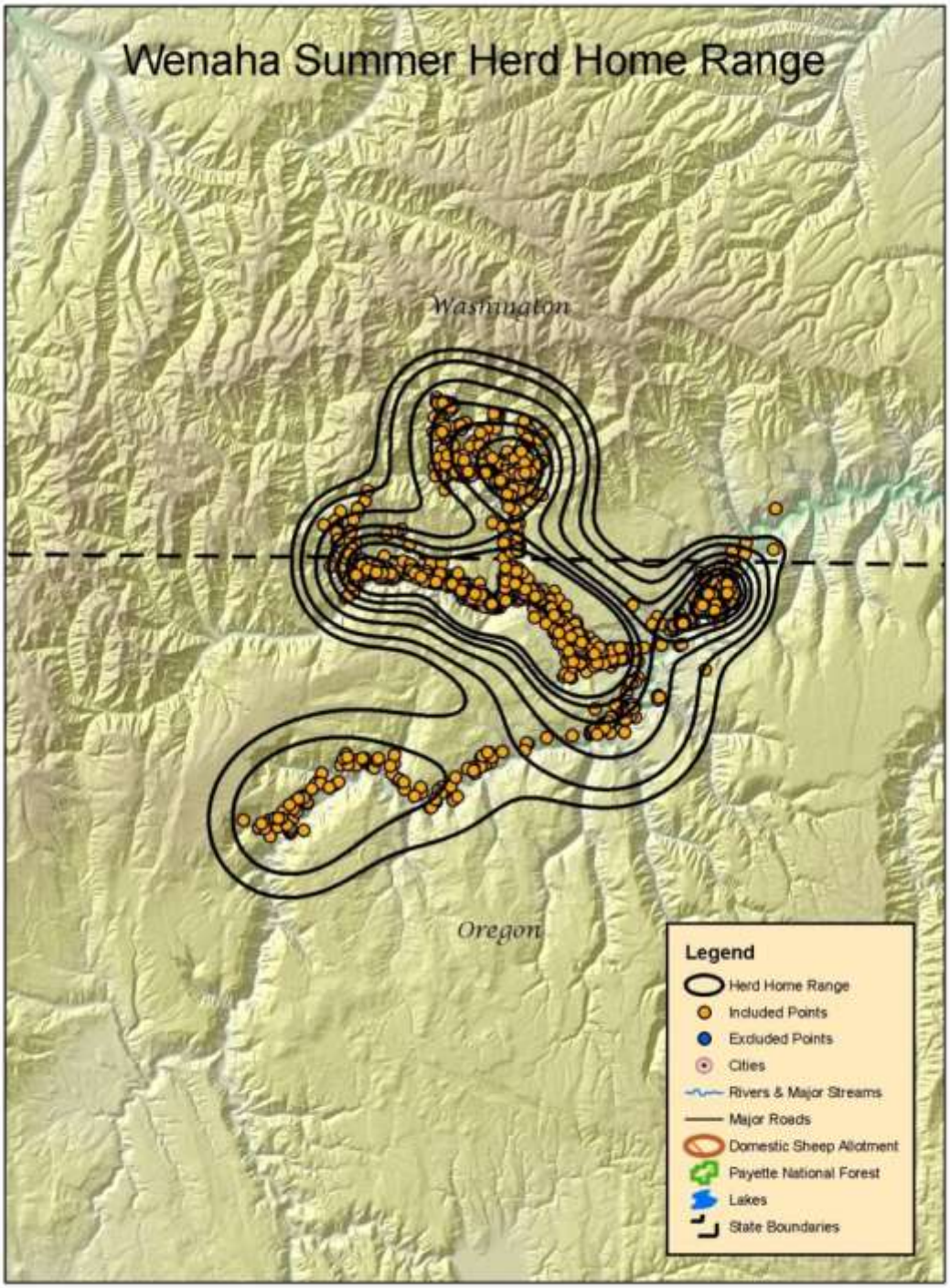


Figure 3-26. Wenaha and Mountain View herd home range

7. 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:

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

8. 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

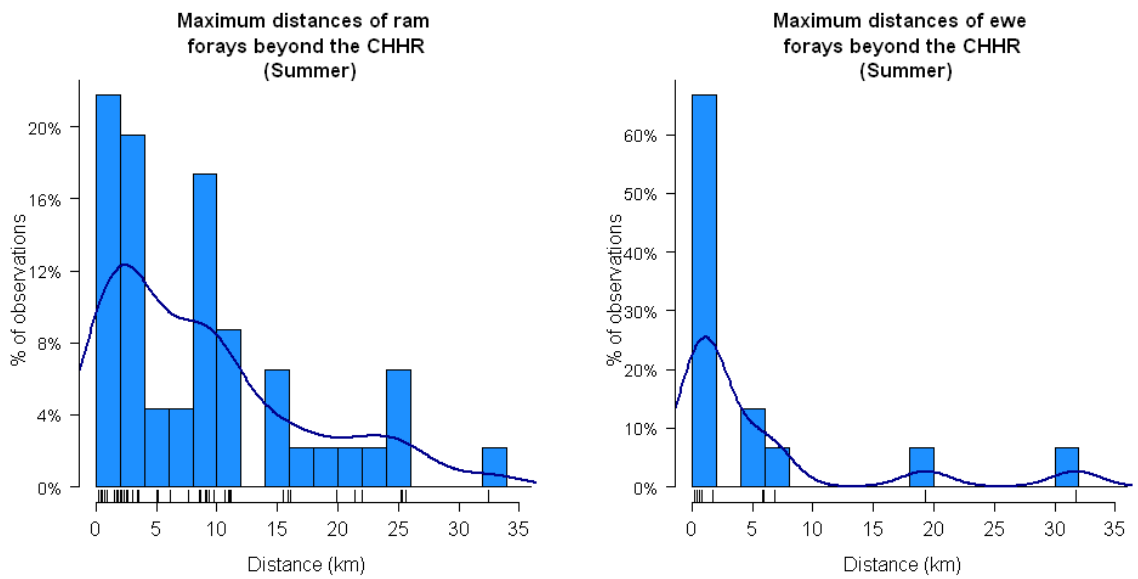
	Ewes		**Rams**	
Summer—May to October	**Percent (%)**	**Number**	**Percent (%)**	**Number**
Animals located beyond CHHR[a] at least once during period of observation	**6.50**	(14/215)	**28.80**	(30/104)
Animal-years with at least one foray	**1.50**	(15/985)	**14.10**	(44/311)
Telemetry points outside 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

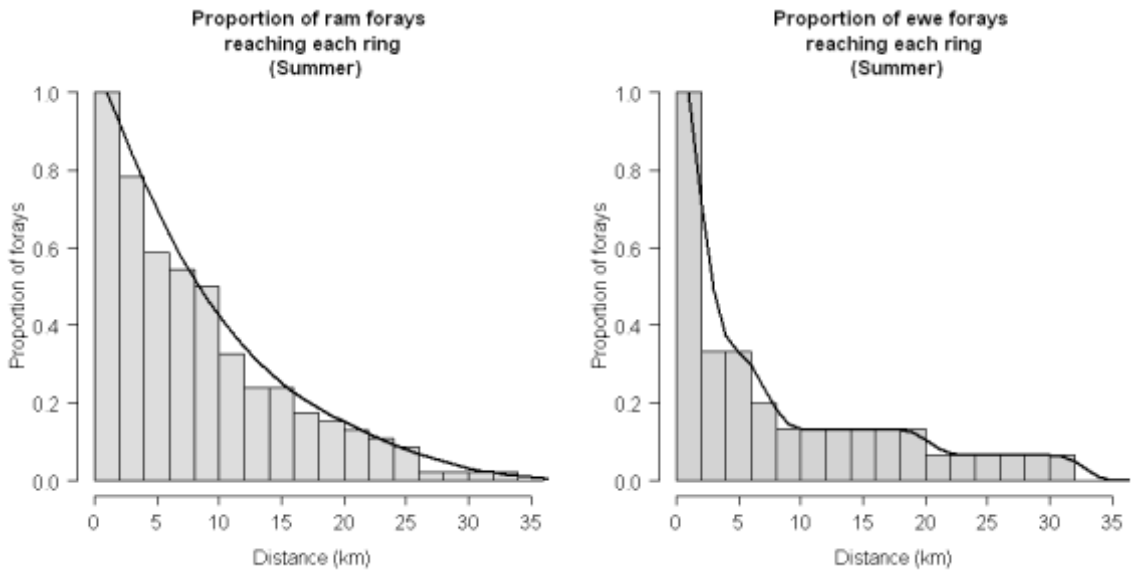
9. Distance from Core Herd Home Range Travelled on Typical Forays—*P*(Animal reaches ring$_k$ | Foray)

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.

10. 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:

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

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).

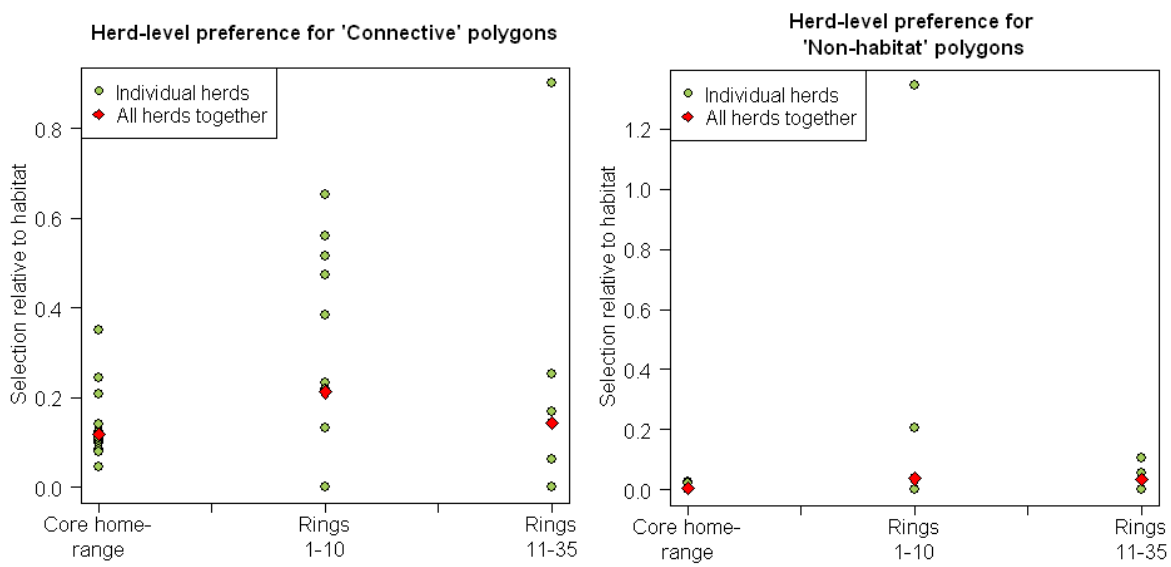


Figure 4-3. Observed herd-level preferences for connectivity area and non-habitat, relative to source habitat.

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:

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

11. 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%.

12. 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.

13.5.1Inputs

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.

14. 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.

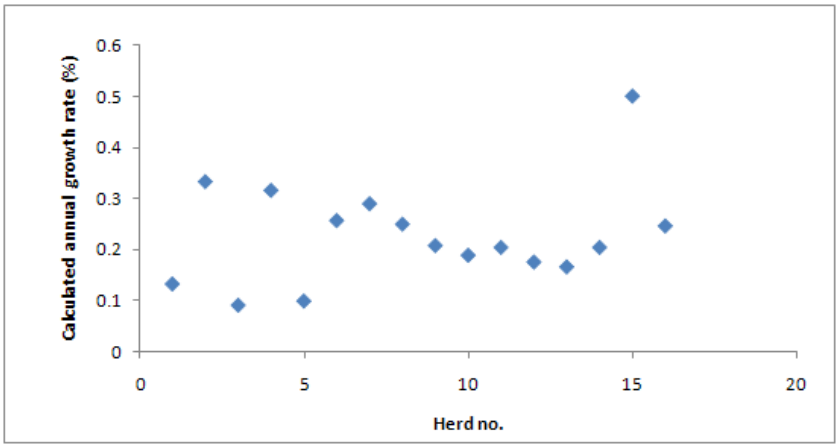
Nonviable Herd Numbers (NVN)—Modelers believed that a minimum population size exists—referred to here as the NVN—at or below which a population would not continue to grow at a disease-free rate and would in fact decline. Based on expert opinion of the IDT and Cooperating Agency experts, the model uses 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.

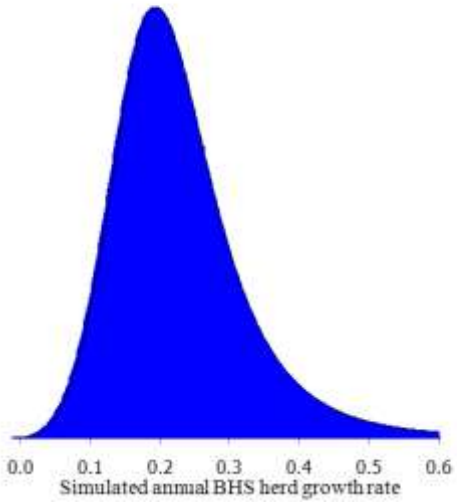


Figure 5-4. Probability density function (pdf) of growth rate without disease input

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.

15.5.1.2 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*BT28)*(1-$AV63*$BU$4)^($FY63*BU28)*(1-$AY63*$BV$4)^($GF63*BV28)*(1-$BB63*$BW$4)^($GM63*BW28)

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*BF28)

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.

16.5.2Stochastic 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.)

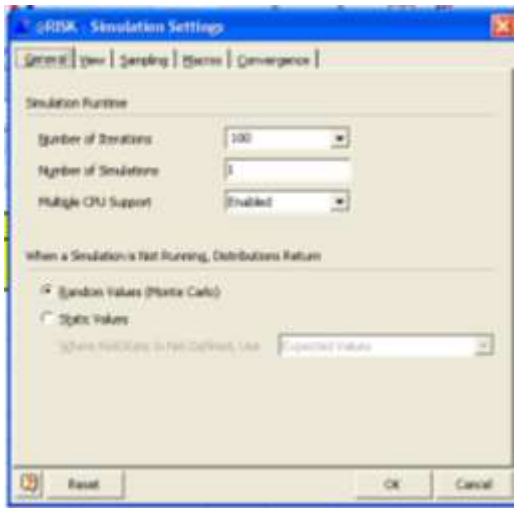


Figure 5-12. @RISK "Simulation Settings" menu, "General" tab settings

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.

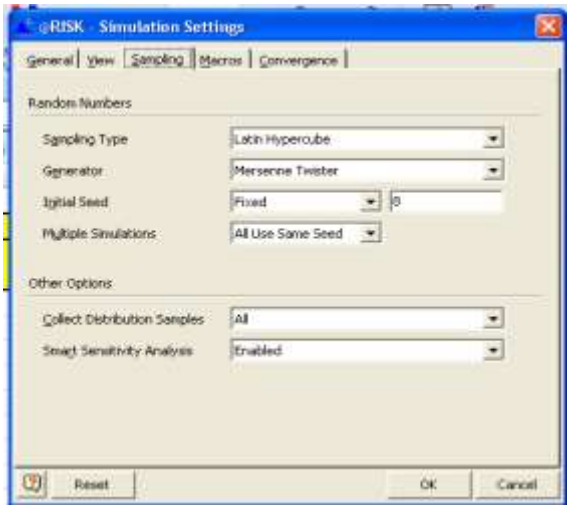


Figure 5-13. @RISK "Simulation Settings" menu, "Sampling" tab settings

17.5.3Outputs

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.

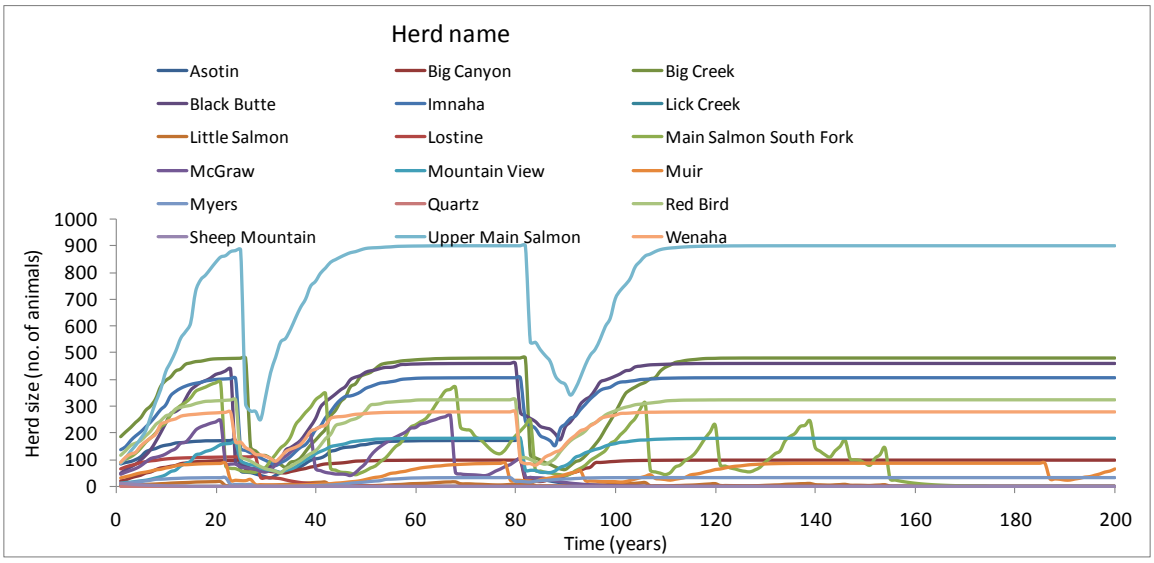


Figure 5-14. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 10 herds surviving

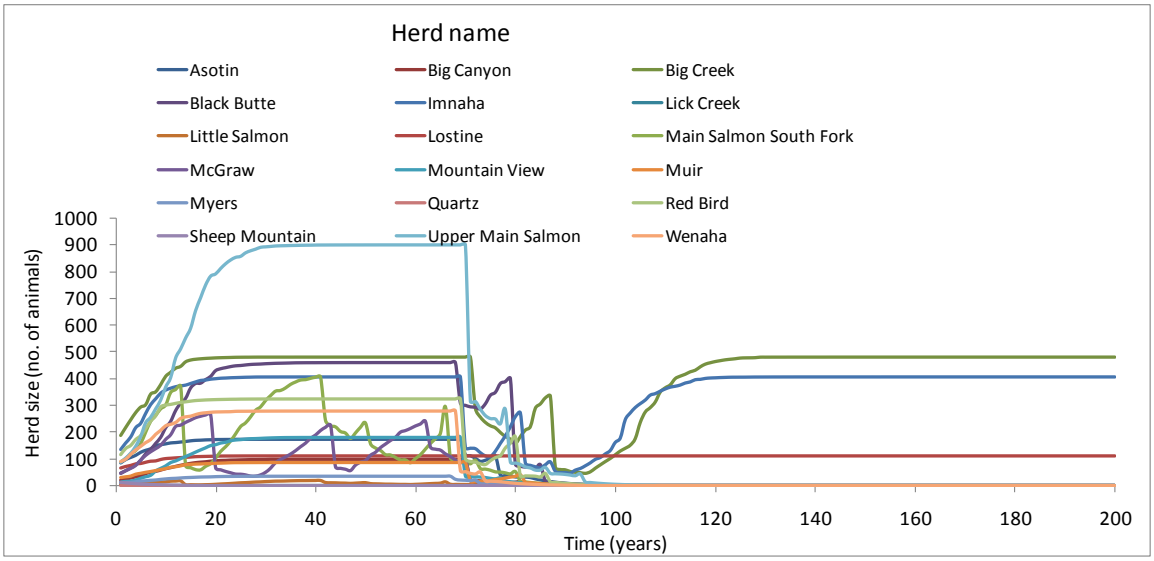


Figure 5-15. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 3 herds surviving

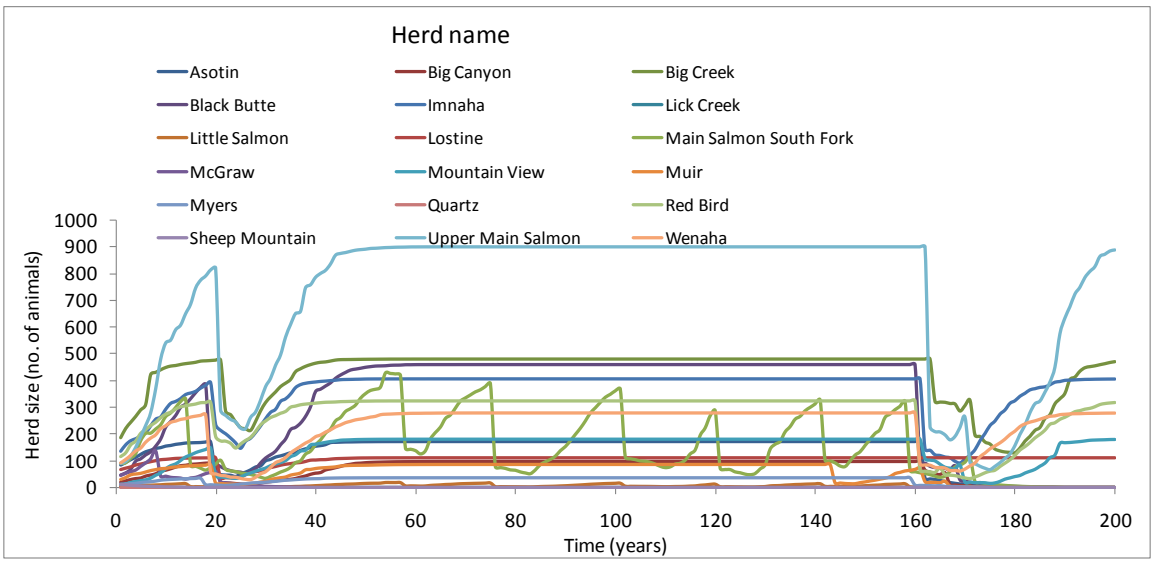


Figure 5-16. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 7 herds surviving

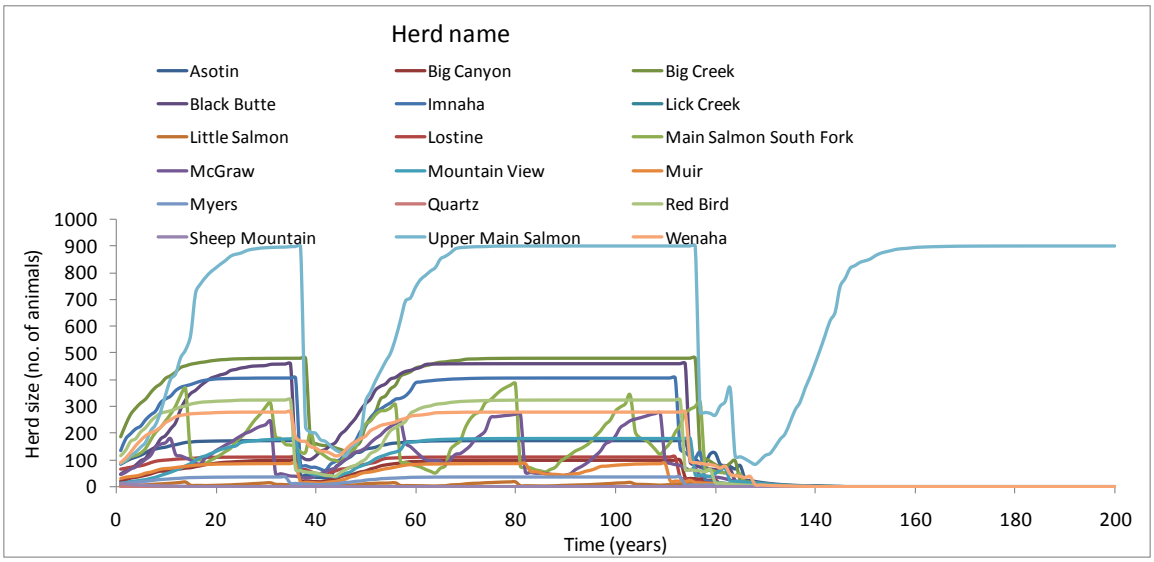


Figure 5-17. Epidemic curves for 18 bighorn sheep herds over a 200-year period showing 1 herd surviving

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.

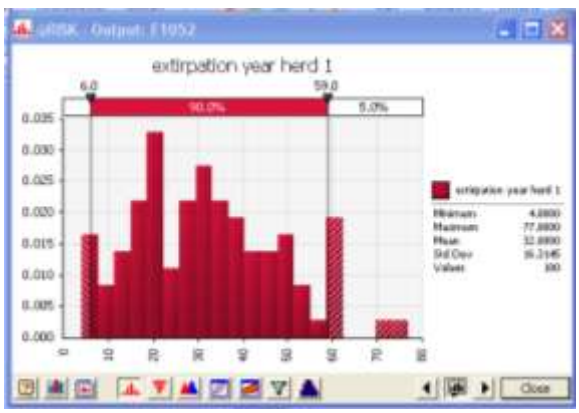


Figure 5-19. Example simulation output distribution of extirpation year for herd 1

18.5.3Running 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.

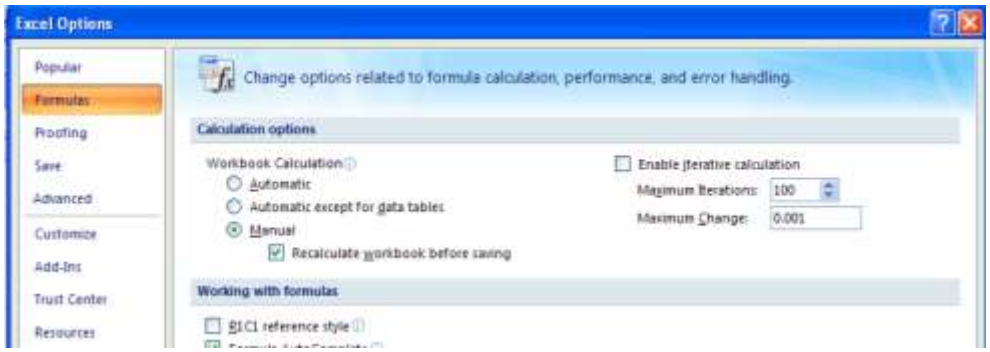


Figure 5-20. Illustration of proper settings to avoid extensive recalculations when modifying the model

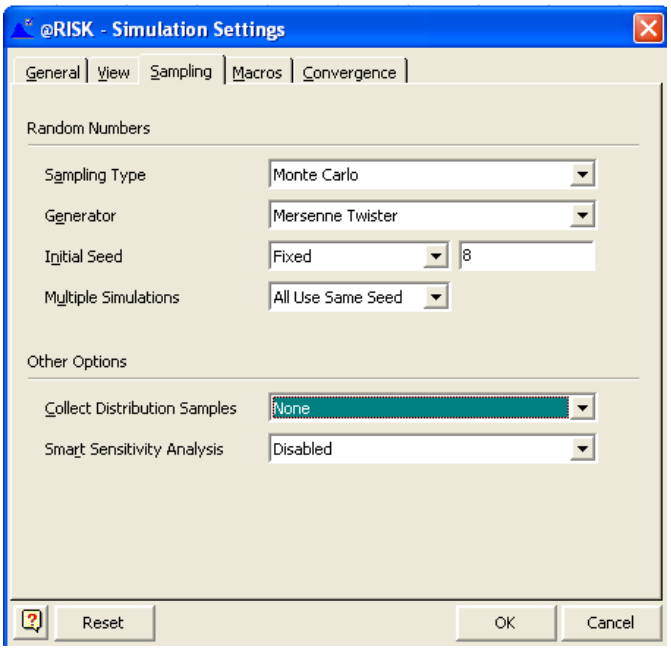


Figure 5-21. Illustration of proper settings to avoid extensive data collection when running the model

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).[14] 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).

[14] 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).

20.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.

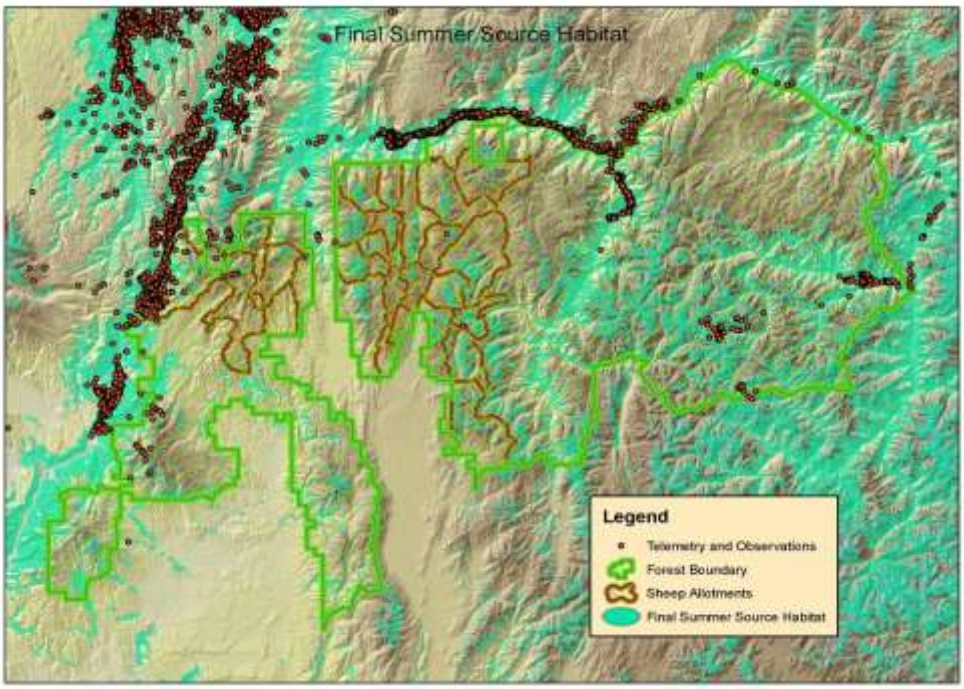

Figure 1. Summer source habitats for bighorn sheep on and adjacent to the Payette National Forest, with telemetry locations of radiocollared bighorn sheep

21. 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.

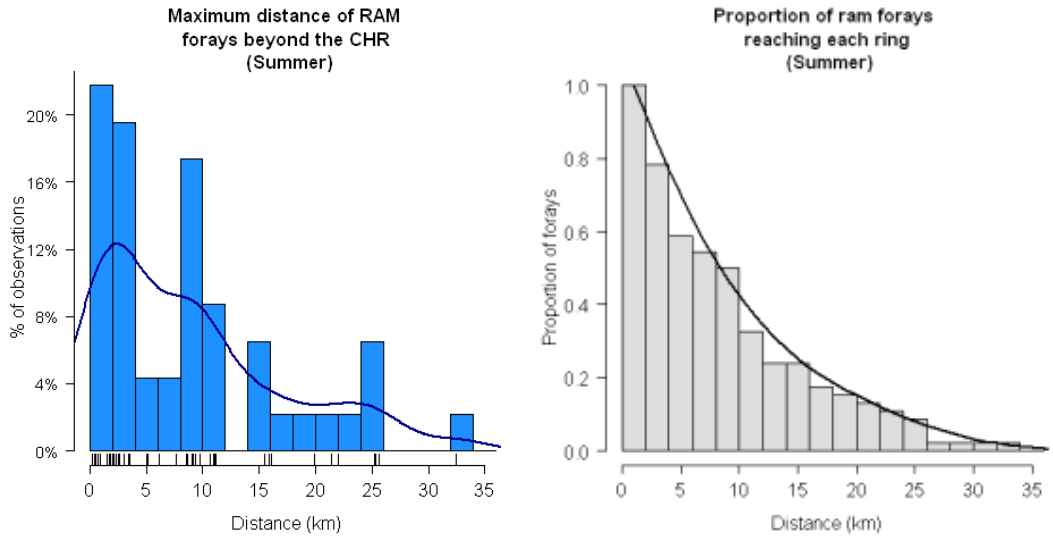

Figure 2. Maximum distance of ram summer forays beyond the core home range and proportion of ram summer forays reaching each ring. (Source: USDA Forest Service 2010)

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.

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

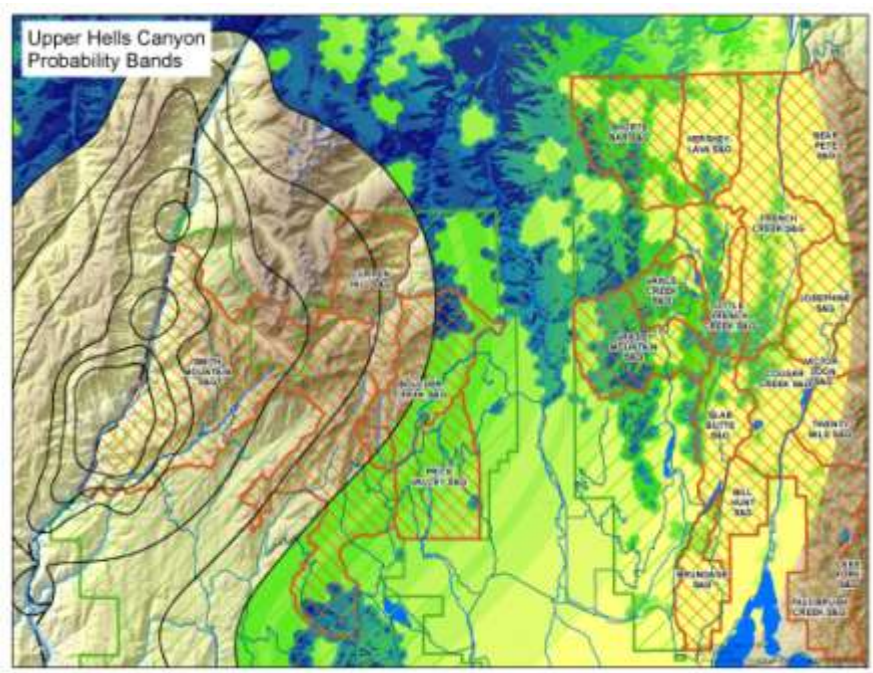

Figure 3. Example of probability of contact in the Upper Hells Canyon herd,where dark blue is the highest probability and light yellow is the lowest probability, based on source habitats in 1-kilometer rings outside of core herd home ranges (from 1 to 35 kilometers) and domestic sheep grazing allotments

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.

22.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:

23. Viability of bighorn sheep at the planning-unit scale
24. Compliance with the Hells Canyon National Recreation Area (HCNRA Act [PL 94-199])
25. Compliance with 36 CFR 292.48 (Domestic Livestock Grazing Activities on Other Lands, Wild and Scenic Rivers, and Wilderness Lands in the HCNRA)
26. Compliance with the National Forest Management Act (NFMA)
27. 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.

28. 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.

29. 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

30. 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.

31. 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.

32. 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.

33. 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.

34. 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.

35. 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.

36. 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.

37. 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.

38. 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.

39. 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.

40. 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.

41. 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.

42. 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.

43. 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.

44. 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.

45. 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.

46. 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.

47. 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.

48. 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.

49. 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.

50. 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.

51. 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.

52. 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.

53. 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.

54. 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.

55. 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.

56. 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.

57. 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.

58. 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.

59. 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.

60. 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.

61. 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.

62. 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.

63. 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.

64. 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.

65. 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.

66. 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.

1. 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.

2. 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.

3. 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).

4. 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.

5.
6. */s/Timothy S. Schommer* Date: 12/21/2009
7.
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

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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 III
Management Direction

2. 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 IV
Implementation of the Forest Plan

3. Monitoring and Evaluation

4. 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

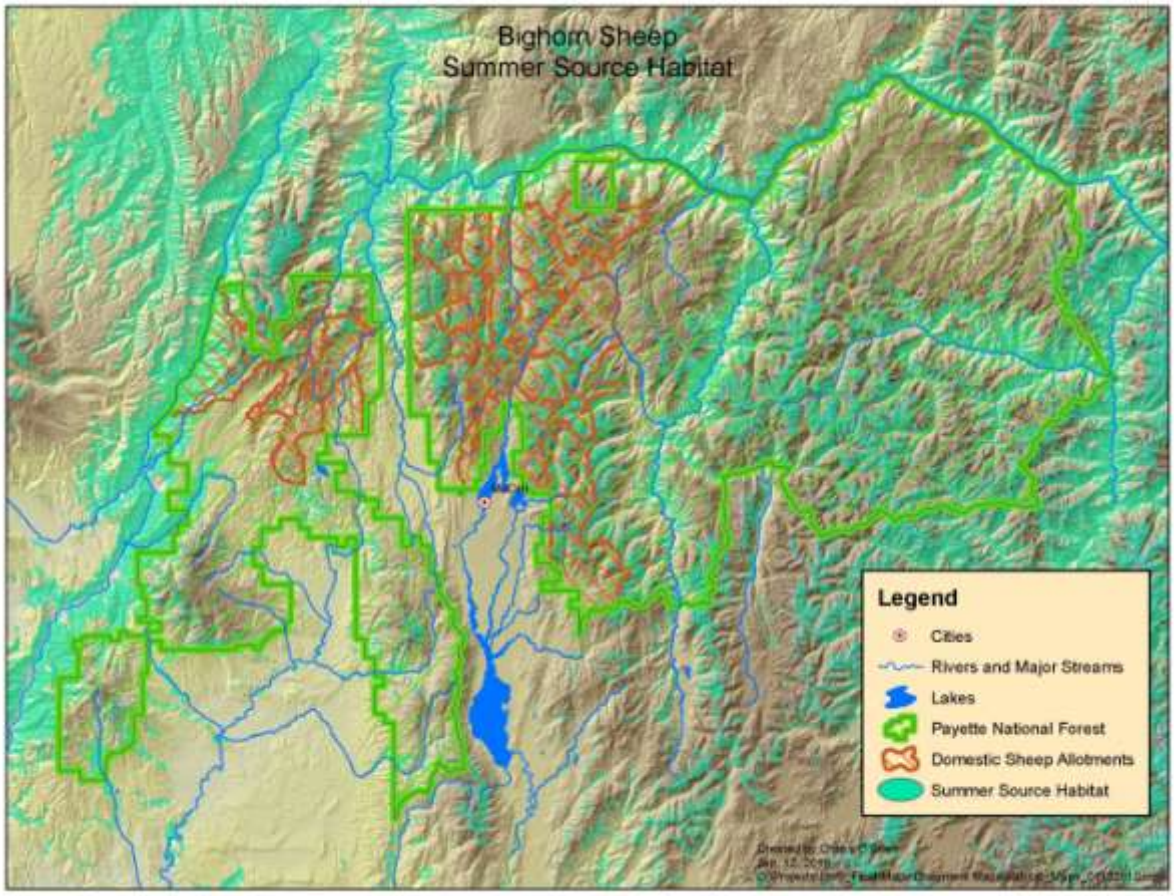
USDA Forest Service, 2003, *Southwest Idaho Ecogroup Land and Resource Management Plans: Final Environmental Impact Statement*. Ogden, Utah: USDA Forest Service, Intermountain Region

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.

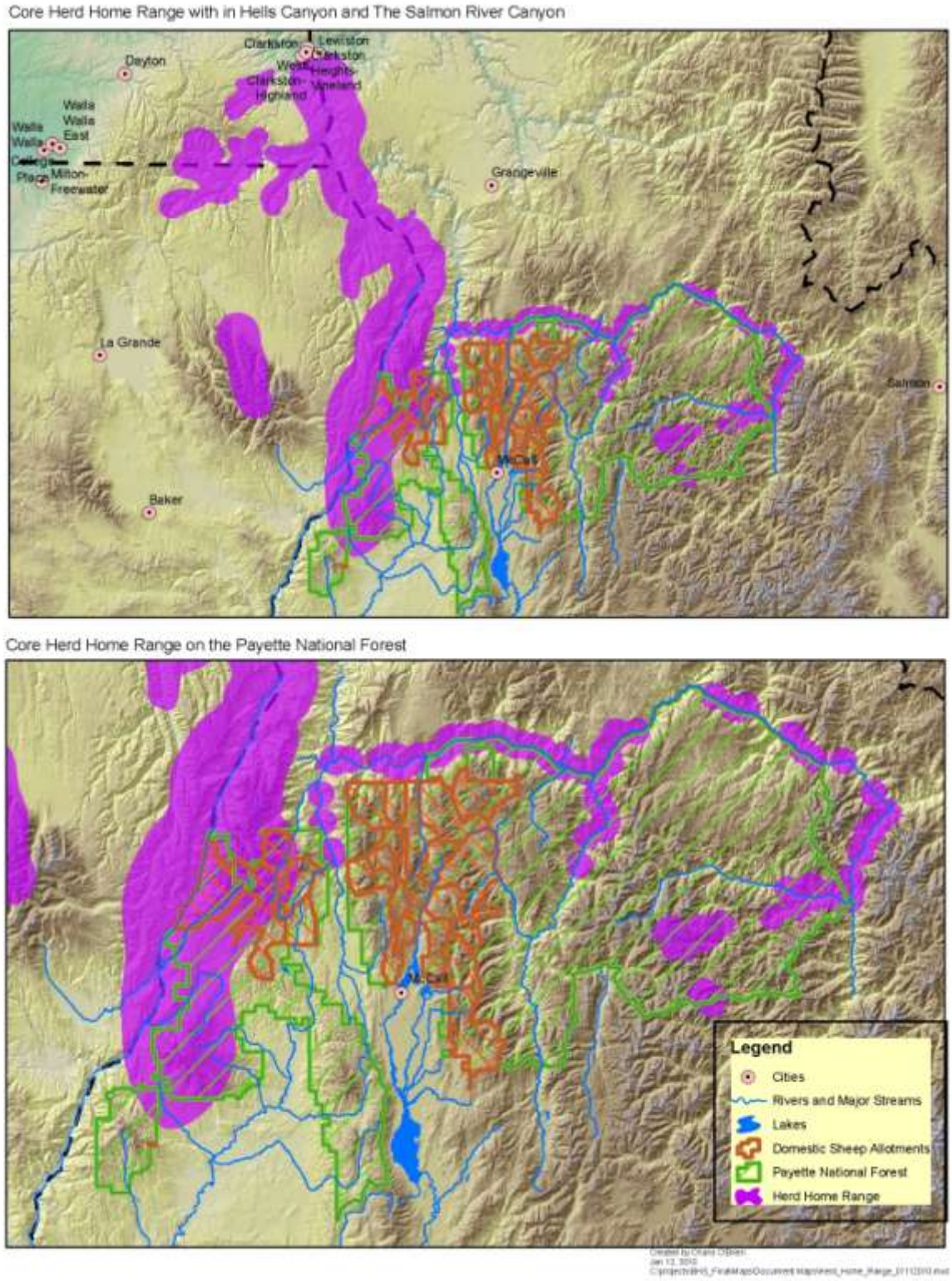
5. Changes in Source Habitat for Selected Species

Figure E-0. Bighorn Sheep Summer Source Habitat



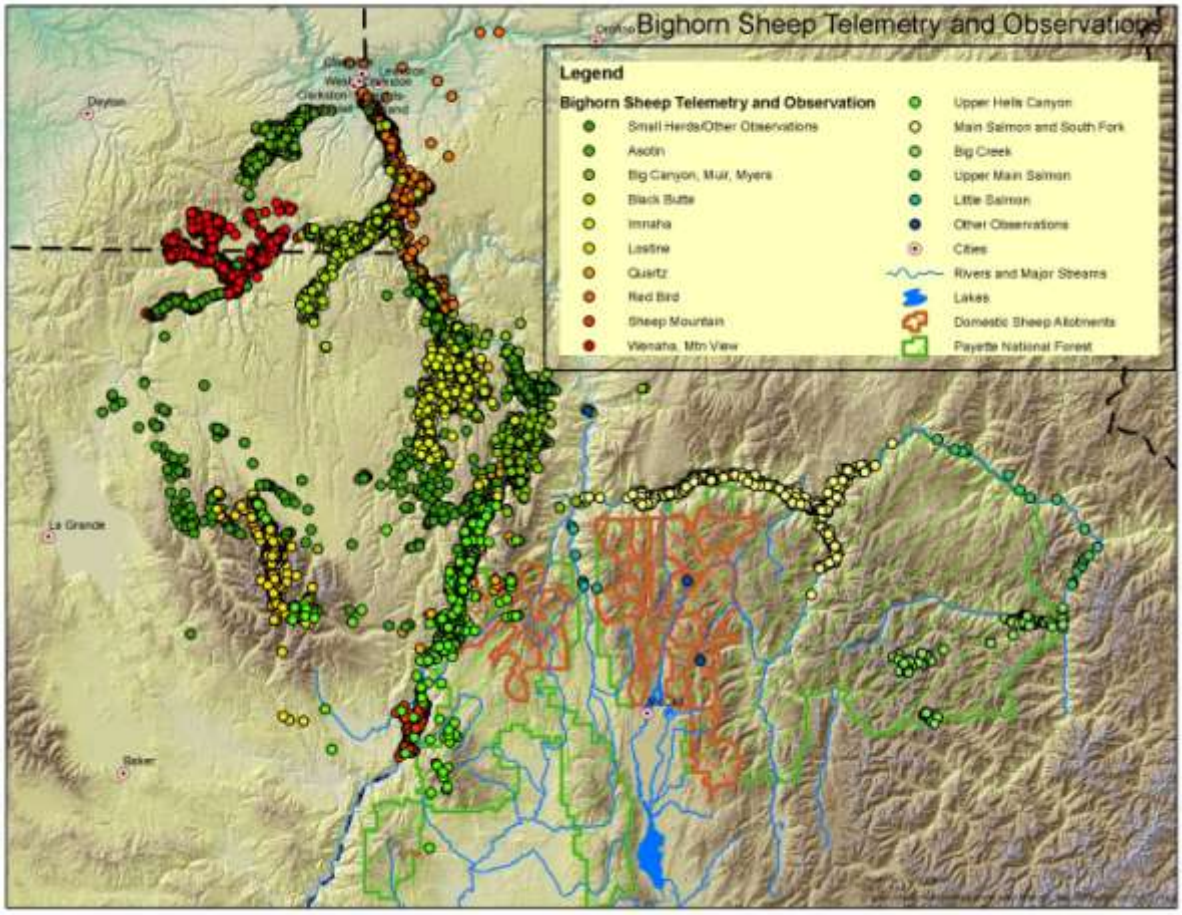
6. Core Herd home range for bighorn sheep

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



7. 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.

8. Legal and Administrative Framework by Resource

9. 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.