

# Idaho



## Bighorn Sheep Management Plan

# 2010



600 South Walnut

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### **Suggested Citation**

Idaho Department of Fish and Game (IDFG). 2010. Bighorn sheep management plan 2010.  
Idaho Department of Fish and Game, Boise, USA.

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Approved 10/2010 Commission Meeting. Updated January 2011. 200 final revised plans printed 3/2011/pca41918*

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# CONTRIBUTORS

This document represents contributions from many people and a wide variety of experience and perspectives regarding bighorn sheep and their management. This plan benefitted from the input of a wide range of people from outside of the Department. Many sportsmen shared their opinions as a result of Department questionnaires. Others, including many non-hunters, provided input through Idaho's Bighorn Sheep-Domestic Sheep Working Group convened by Governor Otter and comments on earlier drafts of this document. The input and contributions of these people and many others resulted in a document that provides greater detail of discussion and rationale for decisions than might have been presented without such participation.

Within the Department, those directly involved in the analyses and the task of writing and editing the plan, developing the maps, and developing the design are named alphabetically below, with their job titles as of the time the plan was written. In addition to wildlife managers and biologists, this effort benefitted from input of those folks whose training and specialties include veterinary science, wildlife research, law enforcement, social science, and public communication.

As Statewide Trophy Species Manager, I especially commend Hollie Miyasaki, who volunteered to lead the team assigned to this task and whose leadership and dedication contributed significantly to the quality of this document.

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## We Also Acknowledge and Thank the Following Support Personnel and Others for Their Contributions

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# EXECUTIVE SUMMARY

## Introduction

The Idaho Department of Fish and Game (IDFG) was established to preserve, protect, perpetuate, and manage fish and wildlife in the state. Statewide species planning documents provide an overview of current status and set statewide management direction to help fulfill that mission. The most recent bighorn sheep management plan was completed in 1990 and this plan updates that document. Bighorn sheep management has become significantly more complex in the intervening period, and that is reflected in the current plan.

This plan was developed by a team of Department personnel using the best biological information available. Public input was solicited during development of the plan and professionals from other jurisdictions were also consulted. The document provides an overview of current and historical bighorn sheep distribution and abundance statewide. It also describes the current distribution of potential habitat, and it discusses management issues including disease, predation, hunting, law enforcement, and public education. Future statewide management direction is identified in the context of these issues.

## Restoring Populations

Archaeological evidence and reports by early explorers indicate that bighorn sheep were widely distributed and abundant in Idaho until the late 1800s. As occurred throughout the West, drastic population declines followed the arrival of homesteaders and other settlers in the late 1800s and early 1900s. Declines were caused by a combination of unregulated hunting, competition with livestock for forage, and disease. By 1920, the Idaho bighorn sheep population was estimated at 1,000 animals, mostly within the Salmon River watershed. As a result of restoration efforts, including strict hunting regulations, habitat protection, and translocations of bighorn sheep to historically occupied habitat, by 1990 numbers increased to about 5,000. However, starting in the late 1980s and continuing through the 1990s, population declines, primarily associated with disease, reduced statewide numbers to an estimated 2,900 bighorn sheep today.

Currently, bighorn sheep occupy about 15% of the state. They are distributed from north-central Idaho to the southern border, but are restricted to rugged canyon and mountain terrain and adjacent habitats within this area. Bighorn sheep select habitats that provide forage, water, and steep open terrain where they can evade predators. Landscape modeling indicates that there are approximately 28,000 km<sup>2</sup> of potential bighorn sheep habitat in the state, of which about a third (9,500 km<sup>2</sup>) is currently occupied.

In Idaho, bighorn sheep exist in both small isolated populations and in interconnected metapopulations. For management purposes these populations and metapopulations have been divided into 22 Population Management Units (PMUs). In south-central and southwestern Idaho about 1,000 California bighorn sheep occur in 6 PMUs. Bighorn sheep were completely extirpated from this part of the state, and current populations are the result of 11 translocations from outside Idaho and 18 in-state translocations between 1963 and 2004. Rocky Mountain bighorn sheep occur in 16 PMUs in central and southeastern Idaho. Eighteen translocations from out of state and 17 in-state translocations were conducted between 1969 and 2005 to restore Rocky Mountain bighorn sheep populations to historically occupied habitat. Translocations have successfully expanded the distribution of bighorn sheep, but the largest populations are still native Rocky Mountain bighorn sheep that were never extirpated in the Salmon River drainage. Overall, average population density within the species distribution is 0.3 bighorn sheep/km<sup>2</sup> of potential habitat, which is considered very low. The primary limiting factor is disease, although other factors including predation and habitat degradation can also be important.

## Managing Limiting Factors

### Habitat

Idaho contains abundant habitat for bighorn sheep. However the quality of that habitat can be diminished by noxious weeds, conifer encroachment, roads and urban development, human disturbance, competition with livestock or other wild ungulates, and other factors. The focus of bighorn sheep habitat management in Idaho is to maintain healthy native plant communities in proximity to rugged escape terrain, and to minimize negative effects of human

activities. This includes preventing the introduction and spread of noxious weeds, minimizing human disturbance, and avoiding management activities that can facilitate introduction and transmission of diseases. Restoration activities in degraded habitats include using fire or logging to reverse conifer encroachment, controlling noxious weeds, reducing human disturbance, and decreasing the potential for competition with domestic or wild ungulates where appropriate. Most bighorn sheep habitat and populations occur on lands managed by the U.S. Forest Service and Bureau of Land Management. However, private landowners, local, county, and state governments, and other federal agencies can also play an important role in managing habitats for bighorn sheep.

## Disease

Disease was a significant factor in the historic decline of bighorn sheep and is a key factor limiting recovery. Pneumonia is the disease that has the greatest impact on bighorn sheep populations. Bighorn sheep are vulnerable to organisms carried by healthy domestic sheep and goats and once these organisms are transmitted there is no effective treatment in bighorn sheep. Therefore, the most important management direction to reduce the impact of disease on bighorn sheep populations is to minimize or eliminate contacts between bighorn sheep and domestic sheep and goats that could result in disease transmission. The Department will work with private individuals and public land managers to develop best management practices that can be implemented in areas where interactions are likely to occur to keep the domestic and wild animals separate. We will also collaborate with agricultural agencies and industries to develop and distribute information to educate domestic sheep and goat owners and the general public about this issue. Finally, the Department will continue to conduct and collaborate on research to better understand and control disease in bighorn sheep and modify management as appropriate.

Ultimately, preventing contact with domestic sheep and goats is critical to successfully managing disease in bighorn sheep. However, when this strategy fails, a protocol will be followed to remove bighorn sheep that are in contact with domestic flocks and/or stray domestic sheep and goats in contact with bighorn sheep to prevent further disease transmission.

Wildlife managers can also inadvertently facilitate disease transmission through movement of animals. Some disease agents can persist in bighorn sheep

populations and mixing populations through translocations poses a risk of infecting naïve animals. In addition, translocating bighorn sheep to areas where they may contact domestic sheep or goats is counterproductive and poses a high risk to bighorn sheep. Therefore, while translocation can be a valuable tool for restoring bighorn sheep populations, we will carefully evaluate the potential risks and benefits of proposed bighorn sheep translocations. When translocations occur, the best, most current, monitoring and health testing protocols will be followed.

## Predation

Bighorn sheep have developed successful strategies to elude predators, including gregarious behavior and use of rugged escape terrain. As a result, most predators have difficulty capturing bighorn sheep. For example, wolf predation is generally not a factor for bighorn sheep, probably in part because bighorn sheep can usually out run wolves in steep terrain. However, mountain lions are more effective predators on bighorn sheep because their hunting strategy is better suited to rugged habitats. While mountain lion predation on bighorn sheep is widespread, it usually does not limit populations. Predation typically only has population-level effects on small bighorn sheep populations that are struggling due to other factors, such as disease or drought. Populations can also be affected if predators, particularly mountain lions, switch to preying on bighorn sheep when their primary prey species (such as deer) decline. Mountain lions can also be effective at preying on newly translocated bighorn sheep. When these situations occur, focused, short term predator removal may be implemented to ensure the long term survival of bighorn sheep populations.

## Providing Hunting and Viewing Opportunities

### Hunting

Bighorn sheep hunting tags are few and highly sought after. In 2009, only 3.9% of 2,179 applicants were awarded 1 of 85 bighorn sheep tags. Hunters are only able to harvest 1 California and 1 Rocky Mountain sheep in Idaho in their life if they draw these tags. Demand has been increasing over time, and the chance of drawing a tag has declined. Obtaining special tags offered annually (1 auction and 1 lottery) that raise funds for bighorn sheep research and management and for wildlife health monitoring has also become increasingly competitive over time.

Hunters will likely see few changes in regulations under the guidelines in this plan. Tag numbers are limited by allowing harvest of at most 20% of the mature rams in a population. Due to low population densities, hunting ewes is not currently allowed and is unlikely to occur in the foreseeable future. Limited hunting opportunity is maximized by allowing hunters to harvest any ram, allowing them to choose any weapon for their hunt, and not allowing hunting during the breeding season when rams are more vulnerable. Additional ram hunting opportunity could also be offered in populations at high risk for contact with domestic sheep and goats. There are a variety of sheep hunting opportunities in the state and the department will work to better inform prospective hunters about the diversity of experiences available in different hunt areas.

### Wildlife Viewing

Wildlife-related recreation is important to Idaho's economy and culture. About 3/4 million people spent 265 million dollars while participating in wildlife viewing in Idaho in 2006. Many people who have no interest in hunting bighorn sheep are very interested in learning more about them and observing bighorn sheep in the wild. The outdoor recreation industry capitalizes on this interest. For example, river rafting and jet boat touring companies frequently use the opportunity to view bighorn sheep to promote their trips. Bighorn sheep are among Idaho's most treasured wildlife species and there is widespread fascination with this majestic animal. The Department has partnered with agencies, nongovernmental organizations, and private donors to develop bighorn sheep viewing interpretive sites. We will continue to look for additional opportunities to enhance bighorn sheep viewing experiences and to provide information about bighorn sheep.

### Enforcement

The high demand for bighorn sheep and the illegal market value of ram horns provides incentive for illegal harvest or poaching. Poaching in small bighorn sheep populations can have significant impacts on public hunting and wildlife viewing opportunities. Enforcement of bighorn sheep harvest regulations has resulted in successful prosecution in a number of recent bighorn sheep cases. The Department will continue to adopt and implement regulations to ensure that illegal harvest is minimized and opportunities for legal hunting and viewing are maintained.

### The Future

Our goal for the future is to manage for viable bighorn sheep populations at ecologically sustainable densities while minimizing conflicts with other resource users.

We recognize that this can be a difficult and controversial task. Although wildlife is legally property of the state under our jurisdiction, we are only one of many entities involved in the management of bighorn sheep in Idaho. We want and need to achieve this goal collaboratively with other public agencies, tribes, private organizations, the agriculture industry, and individual stakeholders.

This plan provides a road map to help us get there.



# INTRODUCTION

## History

Historically, bighorn sheep (*Ovis canadensis*) ranged widely in Idaho (Fig. 1) and are believed to have been a common game animal in the state until the late 1800s (Smith 1954, Buechner 1960). Archeological evidence from Idaho suggests the species was important to Native Americans for subsistence, tools, and ceremonial purposes. West-wide, these uses date back  $\geq 7,000$  years (Demarchi et al. 2000).

Early Idaho settlers and explorers reported seeing thousands of bighorn sheep in their historic range (Merriam 1891, Seton 1929, Smith 1954). However, beginning in the 1870s, Idaho's bighorn sheep populations declined drastically. Smith (1954) estimated there were 1,000 bighorn sheep in Idaho in the early 1920s, mostly in the Salmon River drainage. In 1925, the last bighorn sheep in Hells Canyon was reported killed and by 1940 bighorn sheep were extirpated from the Owyhee River area (IDFG 1990). Ultimately, native bighorn sheep populations only persisted along the Salmon River. As elsewhere in the West, the primary factors believed responsible for the decline of bighorn sheep in Idaho were unregulated hunting, competition with domestic livestock for forage, and disease.

The Department began to restore bighorn sheep populations in the 1960s. Bighorn sheep from British Columbia were translocated to the East Fork Owyhee River drainage in 1963 and bighorn sheep from the Salmon River in central Idaho were translocated to the Lost River Range near Mt. Borah in 1969. Since then, 811 bighorn sheep have been moved into and within Idaho from 6 states and provinces to reestablish populations in historic habitat. The most recent translocation was to the Lost River Range in eastern Idaho in 2005 (Appendix B). As populations have increased, Idaho also contributed 307 bighorn sheep to restoration of bighorn sheep populations in other states.

## Value

Today, bighorn sheep are an important wildlife resource in the state of Idaho. Wildlife and outdoor enthusiasts, hunters, photographers, and the general public value the opportunity to view bighorn sheep as well as to hunt them as one of Idaho's premier big game species. Although there are no estimates specifically for bighorn sheep, consumptive and nonconsumptive wildlife activities are an important

contributor to the economy in Idaho. Estimates for annual hunting and wildlife viewing participation in Idaho were 187,000 and 754,000 individuals in 2006 (USFWS 2007). Gross expenditures related to hunting were \$259,718,000. Gross expenditures attributed to wildlife viewing were \$265,383,000.

Using information extrapolated from a Wyoming willingness to pay study, O'Laughlin and Cook (2010) estimated 1 typical bighorn sheep unit with 5 tags to be worth \$482,100 total economic value in 2008 dollars. The sale and price of resident and non-resident bighorn sheep tags, including special auction and lottery tags, can be attributed directly to bighorn sheep hunting opportunities. Bighorn sheep tag sales for the 2009 season included 85 controlled hunt permits/tags, 1 auction tag, and 1 lottery tag. Resident tags sell for \$166.75 and non-resident tags for \$2,101.75. Eight non-resident and 77 resident tags were allocated in 2009. The auction tag sold for \$120,000 in 2009, and has averaged \$82,450 per year over the last 10 years.

Total direct revenue was \$207,635. The lottery tag raised \$57,982 in 2009 and has averaged \$62,031 per year over the last 10 years. Indirect income generated from sheep hunting activities includes monies spent by hunters on travel, food, lodging, outfitters and guides, and possibly taxidermists. Estimates for guided bighorn sheep hunts in Idaho range from \$6,100 to \$8,600 (USFS 2010). Though the economic value of bighorn sheep has not been studied or quantified specifically for Idaho, we expect that benefits similar to those identified by O'Laughlin and Cook (2010) occur for direct and indirect revenues and other economic indicators.

## Laws and Policies

Idaho Code (36-103) defines the state's wildlife policy and the mission and role of Idaho Fish and Game:

*"All wildlife, including all wild animals, wild birds, and fish, within the state of Idaho, is hereby declared to be the property of the state of Idaho. It shall be preserved, protected, perpetuated and managed. It shall be only captured or taken at such times or places, under such conditions, or by such means, or in such manner, as will preserve, protect, and perpetuate such wildlife, and provide for the citizens of this state, and as by law permitted to others, continued supplies of such wildlife for hunting, fishing and trapping."*



**Figure 1.** Probable historic distribution of bighorn sheep in the United States prior to European settlement (Buechner 1960). Published with permission from The Wildlife Society, Bethesda, MD.

The Department serves as a trustee to protect and manage wildlife resources for all Idaho citizens. This “public trust doctrine” defines the role of all states relative to their natural resources and is an integral responsibility of state governments. As trustees for natural resources owned in common among all citizens, state governments take actions that preserve and protect public ownership to provide for continued consumptive and nonconsumptive uses of their valuable resources.

Through time, the management of wildlife in general and bighorn sheep in particular has become increasingly complex. This is evident from the number of specific references to bighorn sheep that have been added to Idaho Code Title 36-106 since 1995. These include mandates associated with translocations and in 2009, a requirement that the department develop a plan to ensure a viable, self-sustaining population of bighorn sheep in Idaho and work with domestic sheep (*Ovis aries*) producers to develop “Best Management Practices” to help

implement a state policy of separation between bighorn and domestic sheep.

However, although IDFG has primary jurisdiction over fish and wildlife in the state, other executive agencies have a similar scope of jurisdiction over other interests of the state, such as agricultural activities, and each has its own chapter of pertinent laws in Idaho Code. In addition, laws passed by the U.S. Congress apply to federal agencies such as the U.S. Forest Service (USFS), Bureau of Land Management (BLM), and National Park Service that have a stewardship responsibility for public lands (i.e., habitat). In deference to state ownership of wildlife, federal agencies are not required to restore native wildlife populations, but they must ensure that the required habitat is maintained to support those populations whether the species actually occurs or not. The federal government also entered into treaties with Native American tribes (e.g., Nez Perce Treaty of 1855, Fort Bridger Treaty of 1868) prior to Idaho statehood. Those treaties include agreements about traditional or cultural uses of that wildlife that must be recognized by federal land management agencies including the USFS and the BLM.

## Management Planning and Accomplishments

Smith may have written the first defacto bighorn sheep management plan for the state in Idaho Fish and Game Bulletin No. 1 “The Bighorn Sheep in Idaho” published in 1954, but Idaho Fish and Game’s first official statewide Bighorn Sheep Management Plan was completed in 1985. The most recent plan (1990) provided direction for bighorn sheep management and research in the state for the period spanning 1991 through 1995. The plan had 7 goals:

1. Increase Idaho’s current bighorn sheep population and allow a corresponding increase in harvest and recreational opportunity;
  - a. increase Rocky Mountain bighorn sheep (*O. c. canadensis*) by 10 % (3,850 estimated Rocky Mountain bighorn sheep in 1990);
  - b. increase California bighorn sheep (*O. c. californiana*) by 20% (1,185 estimated California bighorn sheep in 1990);
  - c. increase bighorn sheep statewide by 10% (5,035 estimated bighorn sheep in 1990)

2. Establish new herds by translocating bighorn sheep;
3. Recognize and promote nonconsumptive values of bighorn sheep;
4. Cooperate in bighorn sheep disease research efforts;
5. Survey all bighorn sheep populations with a helicopter at least every 5 years;
6. Establish special hunts in Regions 3 and 6 where female bighorn sheep can be harvested;
7. Revamp the season framework for Rocky Mountain bighorn sheep.

The plan achieved some, but not all of these goals.

1. By 1990, population declines affected a number of bighorn sheep populations in Idaho.
  - a. Rocky Mountain bighorn sheep herds in Panther Creek and nearby main Salmon River were affected by a disease-related die-off in 1989, followed by similar die-offs in the upper Salmon River herds in 1990-91. Bighorn sheep in Granite Creek (a tributary to the Snake River in Hells Canyon) were affected in 1991, and bighorn sheep in the main Salmon River (Game Management Units [GMUs] 19 and 20) were affected in 1992-1993. By 1998, when most statewide herds were once again surveyed, the statewide population was estimated at 1,710, a decline of more than 55% among Rocky Mountain bighorn sheep statewide.
  - b. California bighorn sheep were less affected, although a major decline was noted in GMU 42 where the number of bighorn sheep observed declined from 669 (in 1993) to 334 (in 1994), a decline of 50% in a single year. By 1997, when California herds were re-surveyed, the population was estimated at 1,460, a 15% increase over 1990 estimates.
2. Between 1990 and 1995 there were 7 translocations of bighorn sheep within Idaho (Appendix B).

3. Numerous efforts were made to identify and promote bighorn sheep viewing statewide. The Idaho Wildlife Viewing Guide (Carpenter 1990), published cooperatively with several entities, features bighorn sheep viewing and was published soon after the 1991-1995 Bighorn Sheep Plan was completed.
4. An IDFG Wildlife Veterinarian position was created in 1990 to head the IDFG's Wildlife Health Laboratory. Pens were modified to allow for the holding of a herd of captive bighorn sheep at the Wildlife Health Laboratory. A major emphasis of the Laboratory was investigation of bighorn sheep diseases. In addition, IDFG personnel worked closely with the University of Idaho Caine Veterinary Teaching Center on bighorn sheep disease investigations.
5. The Department surveyed all bighorn sheep herds during 1991-1995, many repeatedly, to monitor the toll of all-age die-offs on populations. Other populations were surveyed during surveys for other ungulates such as mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*).
6. Hunting seasons for bighorn ewes were offered in Region 3 (GMU 41) in 1993 and 1994, with 5 tags offered annually, and a total of 5 ewes harvested. Hunts were curtailed immediately after discovery of all-age die-offs among some of Idaho's bighorn sheep herds.
7. The season framework for bighorn sheep hunting was re-designed in 1991, with California bighorn sheep hunts separated from Rocky Mountain bighorn sheep hunts. Standard opening dates of 30 August (early seasons) and 21 October (late seasons) for Rocky Mountain bighorn sheep hunts replaced former opening dates scattered in September. Late seasons were extended and all closed 5 November (as opposed to October 28). California bighorn sheep hunts adopted the 30 August opening date for early hunts (formerly 1 September), and the second hunt in open units continued with a 22 September opening date. A new hunt for California bighorn sheep was opened in GMU 46.

Since 1995, there have been few changes in management direction and new projects have generally been in line with existing goals. In 1997, the states of Idaho, Oregon, and Washington; BLM; USFS; and the Wild Sheep Foundation, along with other private partners began, and still continue, a major restoration and research project on bighorn sheep in Hells Canyon (Cassirer et al. 2001, Cassirer and Sinclair 2007). Since 2006, the Department has also collaborated with the USFS, BLM, and Nez Perce tribe on bighorn sheep research and monitoring in the Salmon River above Riggins (Mack and Robinson 2009). Restoration efforts were also underway in southern and eastern Idaho. The Department conducted 12 translocations, moving a total of 216 bighorn sheep into Hells Canyon, the Lost River Range, and the Magic Valley region during this period (Appendix B). Two master's projects were completed in southern Idaho (Fowles 2002, Berkley 2005). Research into diseases also continued in collaboration with the University of Idaho Caine Veterinary Teaching Center (Rudolph et al. 2003, Frey 2006, Safaee et al. 2006, Kelley et al. 2007, Rudolph et al. 2007) and most recently with the College of Veterinary Medicine at Washington State University (Besser et al. 2008; Dassanayake et al. 2009, 2010). All bighorn sheep populations have been surveyed since 1995, most at approximately 3-year intervals, varying from annually in Hells Canyon to as much as 6 years between surveys. The hunting season framework has remained unchanged, but in 2007 hunting regulations were changed from restricting hunting to mature rams to allowing harvest of any ram.

## Current Planning Process

In 2008, the department assembled a team to update and revise the previous plan to reflect changes since 1995 and develop management directions and strategies necessary to meet the goals of Idaho Fish and Game's 2005 strategic plan: "*The Compass*." The current plan also provides substantial background information and broad management objectives that will be used to set annual work plan activities and to establish funding priorities.

## Public Involvement

In 2008, at the start of developing the plan, the team sent out a scoping letter explaining the planning process and requesting input on important issues that should be included. Fifty recipients included representatives of state and federal



resource management agencies, county and tribal governments in Idaho, as well as agriculture, hunting and conservation organizations. We also sent the letter to wildlife departments in other western states with bighorn sheep. Also in 2008, we mailed questionnaires on bighorn sheep hunting to a random sample of hunters and posted the questionnaire on the IDFG web site. The questionnaire and responses are contained in Appendix F. In 2009 and 2010, the team leader made 3 formal presentations to the Idaho Governor's advisory group on bighorn and domestic sheep jointly chaired by Idaho Fish and Game and the Idaho Department of Agriculture. Written comments on the draft plan from the advisory group members were incorporated into this document.

## Relevant Planning Documents

*The Compass*, IDFG strategic plan (IDFG 2005a)

Idaho Comprehensive Wildlife Conservation Strategy (IDFG 2005b)

Interim Strategy for Managing Separation Between Bighorn Sheep and Domestic Sheep in Idaho (IDFG and ISDA 2007)

Policy for Avian and Mammalian Predation Management (IDFG 2000)

Idaho Mule Deer Management Plan 2008-2017 (IDFG 2008)

We also reviewed and used ideas from current bighorn sheep management plans from the states of Arizona, California, Colorado, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, and the provinces of Alberta and British Columbia.

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# POPULATION MANAGEMENT

## Distribution, Classification, and Population Structure

Bighorn sheep currently occur from north-central Idaho south to the state boundary, however, within this range, distribution is generally centered on rugged mountains and steep river canyons that are preferred habitat for bighorn sheep (Fig. 2). For the purposes of this document, distribution is considered a general delineation of the area regularly or periodically occupied by bighorn sheep. Bighorn sheep distribution includes both core use areas and space used for movements that does not have sufficient suitable habitat to support persistent populations. Bighorn sheep can and do occasionally travel outside this area and distribution can change over time as a consequence of changes in population density, habitat, or other factors. Bighorn sheep that occur outside the mapped distribution will be managed on a case-by-case basis.

As defined by the map in Figure 2, bighorn sheep currently occupy 15.7% of the state. Not surprisingly, given the rugged nature of the terrain, a disproportionate amount of this area is in federally designated wilderness. Nearly one-third (31.5%) of Idaho bighorn sheep distribution is in wilderness while only 8.4% of Idaho is designated as wilderness.

Idaho Department of Fish and Game refers to bighorn sheep south of Interstate 84 as California bighorn sheep and manages them as a “trophy type” (Mitchell and Frisina 2007) separate from the Rocky Mountain bighorn sheep in the rest of the state. Although all bighorn sheep in Idaho are considered to be a single subspecies (Rocky Mountain bighorn sheep, *O. c. canadensis*) based on the most recently accepted taxonomy (Wehausen and Ramey 2000), California and Rocky Mountain bighorn sheep display differences in physical appearance and they offer different hunting opportunities within the state. California bighorn sheep generally occupy canyon and desert habitat whereas Rocky Mountain bighorn sheep occupy canyons and rugged mountainous terrain. Currently, there are approximately 1,900 Rocky Mountain bighorn sheep and 1,000 California bighorn sheep in Idaho.

Within these trophy type designations, bighorn sheep tend to occur in groups of interacting populations (also called herds) often referred to as metapopulations and these metapopulations are

divided into Population Management Units (PMU). The PMU and the population, are the levels at which many management activities occur. Based on current knowledge of connectivity within and among populations, there are 22 PMUs in Idaho. About a quarter of these PMUs (6) comprising 45% of the statewide population, are native (never extirpated). The remaining PMUs are reintroduced populations in historic habitat. Population Management Units are described individually in more detail in the last section of the plan.

In most instances PMUs are fairly well defined, but in some cases PMU boundaries are somewhat arbitrary. Interaction among PMUs is not well understood. Additional information on population structure and connectivity would be beneficial for population management. Understanding population structure has direct implications for evaluation of population persistence (viability).

## Population Monitoring

The goal of a good population monitoring plan is to provide wildlife managers with the information needed to evaluate management goals and make informed decisions. This information should include a minimum known population count and herd composition data. Surveys should be conducted frequently enough to establish population trends.

Monitoring bighorn sheep in Idaho is difficult. Bighorn sheep in Idaho exist at low to extremely low densities and often in remote, rugged areas including federally designated wilderness. Bighorn sheep generally move between summer and winter home ranges and are a gregarious species that exhibit sexual segregation except during the rut (Geist 1971). This movement between areas of use and sexual segregation can complicate monitoring. Many of Idaho’s bighorn sheep herds have not been studied intensely and spatial and temporal habitat use is not well understood. Furthermore, because of hunting seasons for other species, aerial surveys are usually not practical during the rut. Timing surveys when bighorn sheep are in smaller, sexually segregated groups increases the likelihood of missing groups which can impact observed ram:ewe and lamb:ewe ratios as well as the population estimate.

Bighorn sheep in much of Idaho exist as a metapopulation. In Idaho, metapopulations span hunt areas, Game Management Units (GMUs),

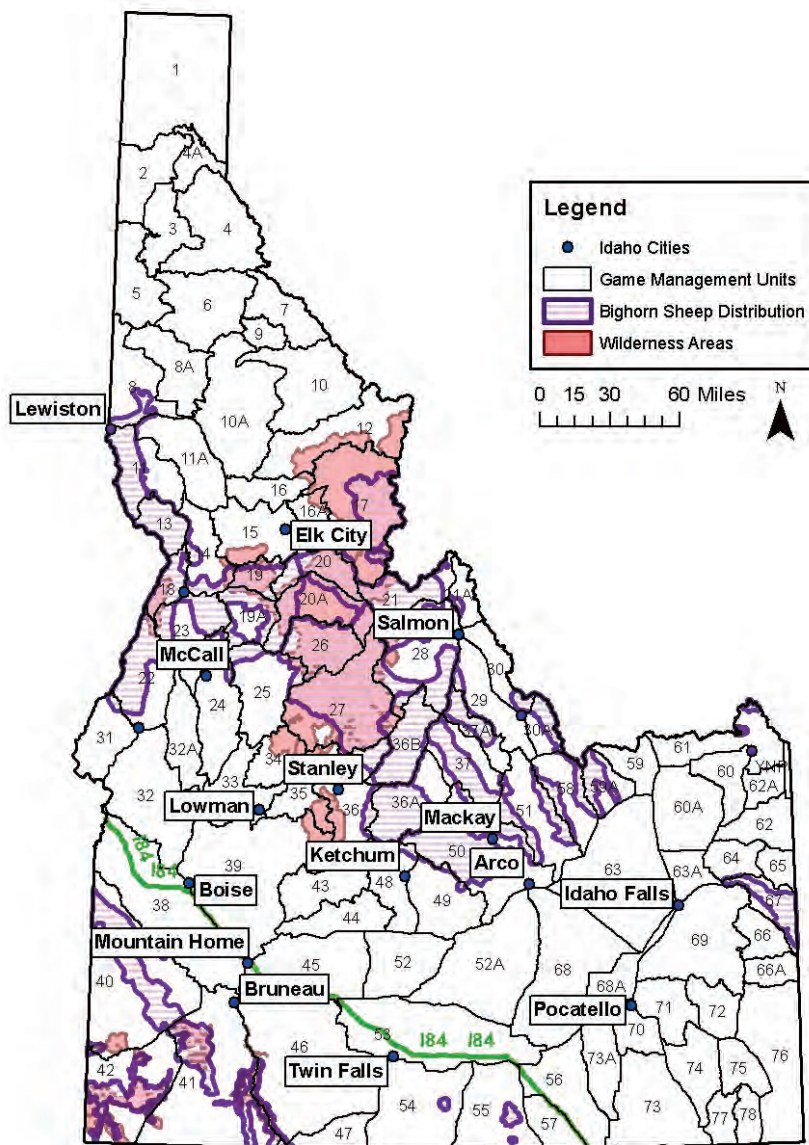


Figure 2. Current distribution of bighorn sheep in Idaho.

and regional boundaries. This results in a patchy network of populations of bighorn sheep that may have varied population trends (stable, increasing, or decreasing) across a large area of contiguous habitat that may make up a metapopulation. In many areas this metapopulation structure has not been delineated or is not well understood. This makes it possible for individual populations or parts of individual populations to be missed, affecting survey results.

Challenges associated with monitoring a species that occurs at low density, has a patchy distribution, and exhibits varied population trends will require a different approach than monitoring techniques applied to more common large ungulates. Deploying radiocollars on a few individuals in populations

where movement patterns are not known may help delineate summer and winter ranges. Radiocollared bighorn sheep will also help biologists stratify areas for sheep surveys and provide data for sightability models. Ultimately, this strategy should lead to reducing flight survey hours and generating better population data.

Currently, Idaho does not survey all populations of sheep. Survey activities are prioritized in areas where hunts are offered. Most surveys are conducted in a helicopter where a minimum count and demographic information is obtained. The frequency of surveys varies from annually to once every 5 years. Most surveys are conducted during surveys for other species (deer [*Odocoileus* spp.] or elk) to

save money. This may be cost effective, but likely reduces the quality of the surveys for both species. Concurrent surveys also dictate the timing of the survey; most deer and elk surveys are conducted from December through March.

Current factors that affect survey quality are primarily driven by financial limitations (frequency, timing, and conducting a sheep-only survey), but are also impacted by knowledge of distribution and range. Given the rising cost of aerial surveys, Idaho will have to secure additional funding to maintain the current level of monitoring, much less expand it. Additional data could be collected by conducting ground counts on populations that are not currently monitored or that are surveyed infrequently.

Idaho does not currently have a robust sightability model for all bighorn sheep populations. Bodie et al. (1995) developed a sightability model for bighorn sheep populations in canyon habitats. This model is used to generate bighorn sheep population estimates for this type of habitat in southern Idaho. Another sightability model is currently being developed by IDFG staff for use in other bighorn sheep habitat types. Sightability models are needed to generate bounded population estimates which can be evaluated to determine statistically significant changes in populations.

## Population Management Direction

Management Direction - The Department will continue to recognize Rocky Mountain and California bighorn sheep as unique “trophy types,” with Rocky Mountain bighorn sheep north of Interstate 84 and California bighorn sheep south of Interstate 84.

**Strategy: The Department will continue to manage Rocky Mountain and California bighorn sheep translocations and harvest separately.**

Management Direction - The Department will manage native Rocky Mountain sheep populations as a unique and irreplaceable resource.

**Strategy: No bighorn sheep from outside the 6 native population management units will be released into native populations.**

Management Direction - The Department will seek to improve understanding of metapopulation structure and interaction.

**Strategy: The Department will use telemetry, genetic analysis, and other suitable techniques to study movements, interactions, and gene flow.**

Management Direction - The Department will use historic documented population levels or densities consistent with suitable range availability to establish a baseline for management objectives. The Department will strive to allow populations to grow to ecologically sustainable densities as determined by habitat and range conditions unless conflicts with other uses of the habitat have been documented that would require management intervention to maintain bighorn herds at some lower population level.

Management Direction – The Department will improve the quality of bighorn sheep population data to better evaluate population trend and viability.

**Strategy: The Department will develop a monitoring plan for aerial surveys that provides for periodic assessments of population status and distribution.**

**Strategy: The Department will continue to develop and refine bighorn sheep sightability models for Idaho’s differing types of habitat and terrain.**

**Strategy: The Department will radiocollar bighorn sheep (or use bighorn sheep collared for other projects) to help delineate distribution and increase survey efficiency.**

**Strategy: The Department will use other means when possible, such as radiocollaring bighorn sheep and ground observation, to monitor population size composition, and status.**

**Strategy: The Department will develop ground count protocols to standardize data collection.**

**Strategy: The Department will attempt to secure additional funding for bighorn sheep monitoring.**

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# HABITAT MANAGEMENT

## Background

Habitat, in its simplest sense, is where an animal lives. It includes all the resources an animal needs as part of its daily life: food, water, shelter, and space distributed appropriately across the landscape. Bighorn sheep are uniquely adapted to exploit particular habitats, and therefore have specialized habitat needs, such as escape terrain.

In Idaho, bighorn sheep habitat consists of rugged mountains dominating the central part of the state and steep rocky canyons in the south and west. Because they have somewhat narrowly defined habitat requirements, the quality and quantity of bighorn sheep habitat is one of the primary factors potentially limiting the distribution and number of bighorns Idaho can support. Habitat management is therefore a key component of bighorn sheep conservation.

The vast majority of bighorn sheep habitat occurs on lands managed by the USFS and the BLM. Long-term success of bighorn sheep management and conservation will depend on close coordination between IDFG and federal and state land management agencies. Although private lands comprise only a small portion of bighorn sheep habitat in Idaho, private landowners, as well as local, county, and state governments, make decisions and conduct activities which may affect bighorn sheep and their habitat.

Accurate mapping of important habitats is a critical factor in facilitating habitat management. Mapping suitable bighorn sheep habitat will be a dynamic process as habitat conditions will change through time. Understanding the extent and spatial distribution of habitat facilitates management, including developing population goals and prioritizing threats. For bighorn sheep, these threats include conifer encroachment, noxious weeds, interspecific competition, domestic livestock grazing, and human recreation. Migration corridor protection, mineral requirements, and water developments are auxiliary issues that are also important to bighorn sheep habitat management. Each of these threats and issues warrant discussion and specific management objectives to mitigate their impacts on the quality and quantity of bighorn sheep habitat. It should be noted, however, that for the foreseeable future disease risk is the single

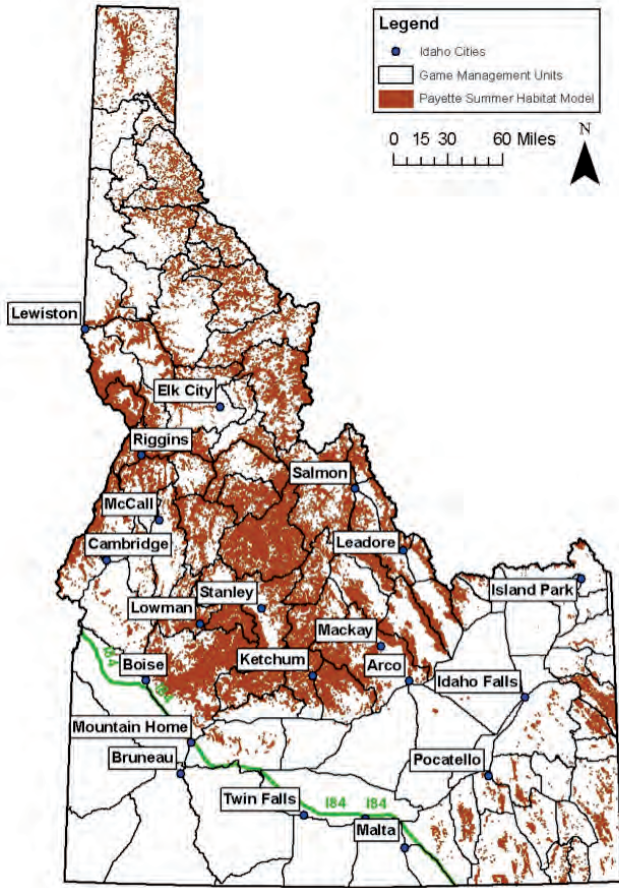
most important issue driving bighorn sheep habitat management in Idaho.

## Mapping of Bighorn Sheep Habitats

Mapping bighorn sheep habitat is neither simple nor static. One common process for describing suitable habitat is based on actual animal locations. Habitat features, such as slope, aspect, elevation, and vegetative characteristics are recorded at known locations used by bighorn sheep. These variables are then used to develop a model of habitat characteristics, and that model is applied to a larger geographic area to predict areas of potentially suitable habitat. This allows biologists to evaluate habitat suitability in areas not currently occupied by a given species, or to identify habitat factors that may play a role in a species success or failure in a given location.

However, modeling is imperfect. In fact, habitats are generally neither completely suitable nor completely unsuitable, and probability of use varies along a continuum. Therefore, modeling suitable habitat based on features used most frequently may not account for areas that animals use only occasionally, such as travel corridors between areas of “suitable habitat.” Animals in different geographical locations may select different habitat features, which may mean that a model developed in one area may or may not be applicable to other areas. Models may over- or under-predict habitat; some assessment of parsimony is required to strike a balance between these 2 errors.

For bighorn sheep, several habitat models have been developed through time. Some are appropriate only to specific locales (e.g., Fowles 2002, Fowles and Merrick 2003), whereas others are intended for wider state or region-wide use (Payette National Forest 2010, Bosworth 2008). For this plan, we assessed the different models available and elected to use a model of summer bighorn sheep habitat developed by the Payette National Forest (Fig. 3). This model accounts for slope, minimum area of habitat features, vegetation, and escape terrain components. Because bighorn sheep in southern Idaho use habitat with noticeably different characteristics, and because biologists observed that the Payette model appeared to vastly under-predict habitat south of the Snake River, we applied a 500m



**Figure 3.** Predicted bighorn sheep habitat (Payette summer model) north of Interstate 84.

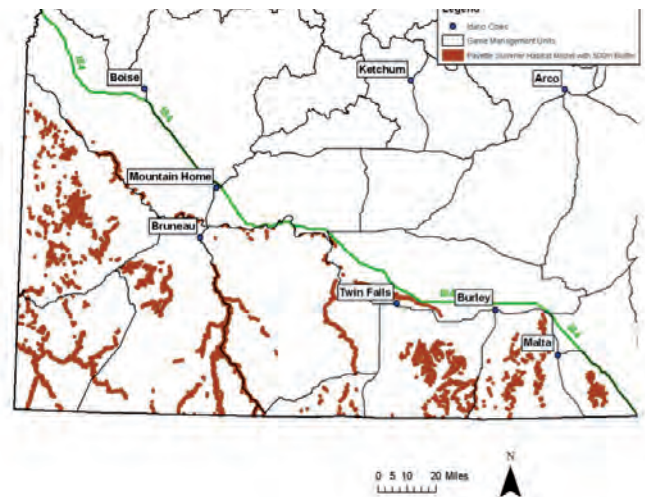
buffer to modeled habitat south of the Snake River (Fig. 4). Modeled potential habitat north and south of the Snake River includes 12.8% of Idaho.

For all populations, we assessed accuracy and parsimony of the habitat model by evaluating the proportion of points (actual known bighorn locations) that fell within predicted habitat. Results, as we expected, varied by population. The Payette National Forest reported that 90% of summer bighorn sheep locations on the forest fell within modeled habitat. Because the model was developed for this population, we regarded 90% as a benchmark for adequate accuracy (i.e., many of the bighorn sheep point locations fell within predicted habitat) and parsimony (i.e., the model did not vastly over-predict bighorn sheep habitat). Results of the point-in-habitat analysis are reported in Table 1.

It is important to note that bighorn sheep distribution does not exhibit perfect correspondence with modeled bighorn sheep habitat. Although most areas within distribution are modeled as habitat, there are some areas within distribution that are not suitable

habitat. This is a result of several factors, including any model is an imperfect predictor of bighorn sheep habitat, bighorn sheep occasionally use areas not typically considered “bighorn sheep habitat” for migratory or dispersal movements, and the model may perform better in some areas of the state (i.e., areas similar to where it was developed) than in others. Conversely, there is substantial predicted habitat (as determined by the model) well outside current bighorn sheep distribution.

Once habitat is depicted within a given area, it is possible to calculate potential bighorn sheep populations based on observed bighorn sheep densities in similar areas. Described densities vary by location, study, habitat and other factors, and therefore should only be used as a relative index of the number of bighorn sheep habitat may be able to support in a given area. For example, Smith et al. (1991) describe densities of 1.9-3.9 bighorn sheep/km<sup>2</sup> of habitat. Bighorn sheep densities vary widely across North America. Van Dyke (1983) suggested a density of 1.9/km<sup>2</sup> for some habitats averaged over a herd range. These densities may be affected by habitat quality, seasonal movements to more limiting winter habitat, or other factors that limit habitat suitability. For this plan, we quantified the amount of predicted habitat within bighorn sheep distribution for both Rocky Mountain and California bighorn sheep (Figs. 5 and 6), and described this by Population Management Unit (PMU). Approximately 38% of modeled habitat is within bighorn sheep distribution; therefore, <4.9% of Idaho is considered potential habitat for the purposes of developing population objectives. We then used Van Dyke’s (1983) recommended density of 1.9 bighorn sheep/km<sup>2</sup> to estimate the total number of



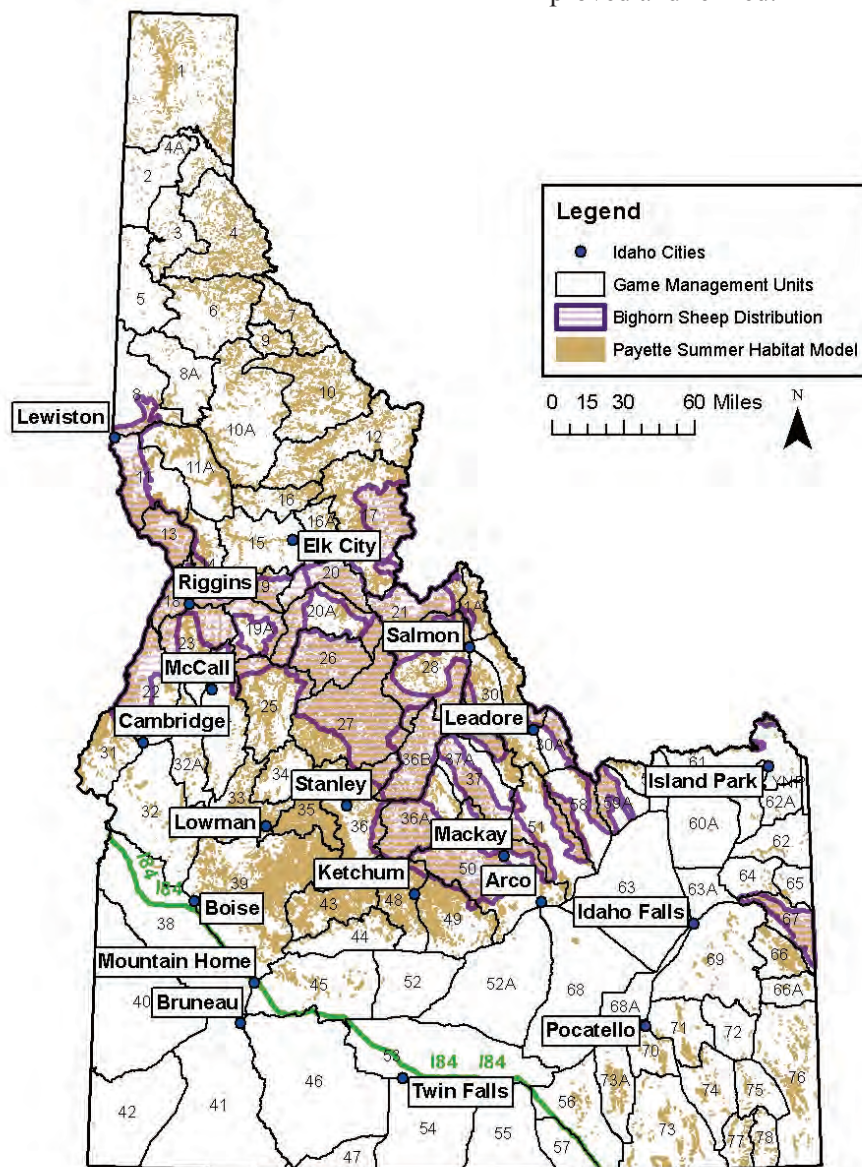
**Figure 4.** Predicted bighorn sheep habitat (Payette summer model, buffered) south of Interstate 84.



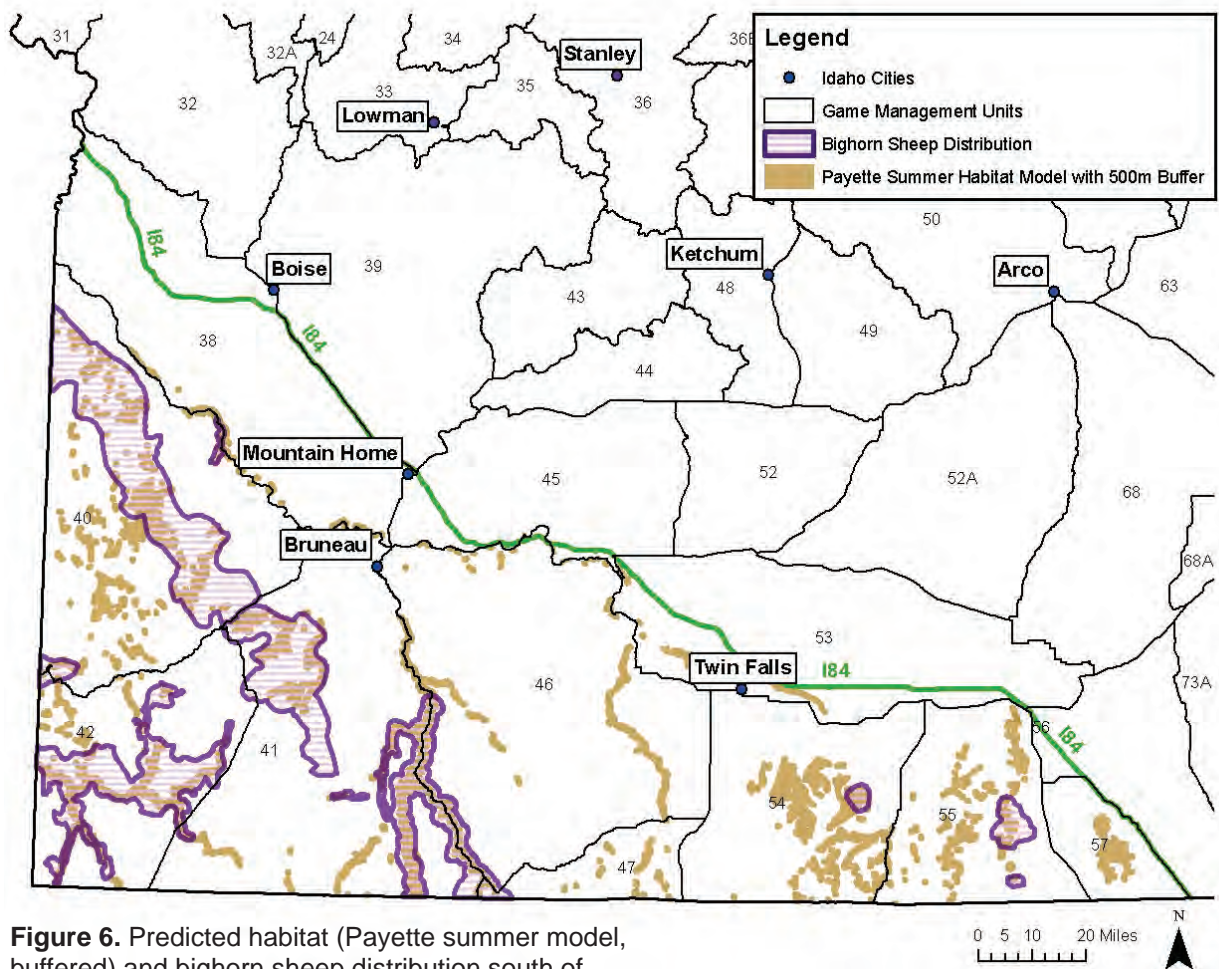
bighorn sheep that might be able to occupy this habitat within each PMU (Table 2). This number does not account for local variation in habitat quality or other site-specific factors and should be treated as a relative index to the potential population that could exist based solely on potential habitat. To account for potential conflict with domestic livestock, we also removed private lands and public land domestic sheep and goat (*Capra hircus*) grazing and trailing allotments from total available predicted habitat and used the resulting area to calculate the total number of bighorn sheep supportable by the remaining habitat (Table 2).

As indicated in Table 1, the Payette summer model does not perform equally well across all PMUs; while it works well (and has acceptable point-

in-habitat agreement) for most Rocky Mountain bighorn sheep populations in the west and central parts of the state, it is a poorer predictor of habitat (lower point-in-habitat agreement) for Rocky Mountain bighorn sheep populations in some parts of eastern Idaho. Using the 500m buffer with the Payette summer model increased point agreement to >80% for California bighorn sheep in all PMUs for which there were sufficient (>100) data points for robust analysis (Table 1). Furthermore, for most populations, winter habitat is likely more limiting to Rocky Mountain bighorn sheep than summer habitat. Population estimates derived from densities acceptable on relatively spacious summer range may overestimate numbers for sheep populations that become more crowded during the winter. Because of these factors, efforts at mapping and describing sheep habitat throughout the state need to be improved and refined.



**Figure 5.** Predicted habitat (Payette summer model) and bighorn sheep distribution north of Interstate 84.



**Figure 6.** Predicted habitat (Payette summer model, buffered) and bighorn sheep distribution south of Interstate 84.

## Potential Threats to Bighorn Sheep Habitat

### Domestic Sheep and Goats

Domestic sheep and goats are grazed throughout portions of bighorn sheep distribution in Idaho. Direct competition with these domestic sheep and goats may result in many of the issues described below in the competition discussion. However, the more urgent concern with overlapping populations of bighorn sheep and domestic sheep or goats is the possibility of disease transmission from contact between bighorn sheep and domestic sheep and goats. A more detailed discussion of disease issues can be found in the Health Assessment and Management section. In recent years, IDFG and the Idaho State Department of Agriculture (IDFG and ISDA 2008) and the Western Association of Fish and Wildlife Agencies (WAFWA 2007) have recommended preventing contact between bighorn sheep and domestic sheep and goats. For this reason, calculations in Table 2 exclude domestic

sheep grazing and trailing allotments and private lands from potential bighorn sheep habitat in order to manage bighorn sheep populations at levels that minimize contact between bighorn sheep and domestic sheep and goats. It is acknowledged that ongoing and future management direction and policy for domestic sheep and goat grazing on public lands (USFS and BLM) may be curtailed to reduce or eliminate risks of disease transmission.

### Conifer Encroachment

Bighorn sheep, particularly ewes with lambs, use open habitats with good visibility near rugged escape terrain to detect and evade predators. Encroachment and maturation of forest and tall shrub stands can degrade and fragment habitat (Wakelyn 1987) and interfere with migration corridors. Stand manipulation via logging, prescribed fire, or wildfire can produce increased bighorn use of treated areas and at least short-term gains in nutrition and population performance (Elliot 1978, Peek et al. 1979, Smith et al. 1999, Holl et al. 2004, Dibb and

**Table 1.** Analysis of what proportion of recorded bighorn sheep locations fall within habitat predicted by the Payette National Forest’s summer habitat model, by PMU. Grey highlighting in the “Proportion of points in habitat” column indicates PMUs with <0.80 point-in-habitat agreement. Asterisks in the “Total points analyzed” column indicate a low (<100 points) overall sample size of points for analysis.

PMU	Total Points Analyzed	Total Points in Habitat	Proportion of Points in Habitat
Hells Canyon	16,749	14,648	0.87
Lower Salmon River	160	130	0.81
Selway	21*	4	0.19
Middle Fork Salmon River	297	243	0.82
Lower Panther-Main Salmon River	157	115	0.73
Tower-Kriley	5*	5	1.00
North Beaverhead	28*	14	0.50
South Beaverhead	83*	69	0.83
North Lemhi	88*	77	0.88
South Lemhi	443	237	0.53
Lost River Range	2,896	1,744	0.60
East Fork Salmon River	96*	76	0.79
Middle Main Salmon River	188	130	0.69
Lionhead	2*	2	1.00
Owyhee Front	36*	18	0.50
Owyhee River	369	318	0.86
Jacks Creek	242	197	0.81
Bruneau-Jarbidge	104	101	0.97
South Hills	12*	10	0.83
Jim Sage	25*	23	0.92
Totals	21,999	18,159	0.83

Quinn 2008), and may be used to improve migration corridors (Dibb et al. 2008).

In large portions of central Idaho, conifer maturation and encroachment since the advent of modern fire suppression have probably decreased bighorn habitat quality and fragmented migration corridors, particularly those connecting high elevation summer ranges to low elevation winter ranges.

### Noxious Weeds

Noxious weeds can significantly degrade bighorn habitat by reducing the variety and density of more palatable and nutritious native forage species. In addition, a less diverse plant community may have a more abbreviated period of highly nutritious green forage. Idaho currently has 57 species designated as noxious weeds (<http://www.agri.state.id.us>). Several of these, such as yellow starthistle (*Centaurea solstitialis*), leafy spurge (*Euphorbia esula*), rush skeletonweed (*Chondrilla juncea*), and knapweed

(*Centaurea spp.*), pose significant threats to bighorn sheep habitat. Land managers should be encouraged to adopt habitat management practices aimed at maintaining healthy native plant communities resistant to weed invasion. Department staff should also work closely with land management agencies to ensure that habitat restoration and rehabilitation efforts focus on native species. Where noxious weeds have become established, appropriate control measures should be implemented. However, the use of domestic sheep and goats for weed control in bighorn habitat should not be used because of the risk of disease transmission to bighorn sheep (Giacometti et al. 2002, Jansen et al. 2006a).

### Recreation

In recent decades, human population growth, improved access to remote areas, and increases in human recreational activity in and near bighorn sheep habitats have led to more frequent interactions

**Table 2.** Predicted bighorn sheep supportable by habitat within bighorn sheep distribution, by PMU. Based on a density of 1.9 sheep/km<sup>2</sup> (Van Dyke 1983).

PMU	Total km <sup>2</sup> of predicted habitat within bighorn sheep distribution (A)	Bighorn sheep population supportable by (A)	Total km <sup>2</sup> of private land within (A)	Total km <sup>2</sup> of domestic sheep grazing or trailing allotments within (A)	Bighorn sheep population supportable by (A) without private land and allotments
Hells Canyon	1,474	2,802	580	77	1,555
Lower Salmon River	792	1,504	57	239	942
Selway	290	552	0	0	552
Middle Fork Salmon River	1,867	3,546	10	0	3,527
Lower Panther-Main Salmon	576	1,094	6	0	1,083
Tower-Kriley	24	46	6	0	35
North Beaverhead	137	261	0	0	261
South Beaverhead	212	402	2	58	287
North Lemhi	324	615	12	0	592
South Lemhi	322	612	2	24	565
Lost River Range	773	1,468	2	93	1,289
East Fork Salmon River	591	1,122	14	18	1,060
Middle Main Salmon River	595	1,130	28	0	1,077
Lionhead	27	51	0	0	51
Owyhee Front	526	999	48	14	880
Owyhee River	388	738	4	0	731
Jacks Creek	261	496	10	0	476
Bruneau-Jarbidge	410	779	10	0	759
South Hills	35	66	0	5	56
Jim Sage	56	107	3	0	102
Totals	9,679	18,390	794	528	15,880

between humans and bighorn sheep. Bighorn sheep were resilient to human disturbance and recreation under certain circumstances (Jansen et al. 2006b). When bighorns are exposed to people at predictable locations and times, they are often able to tolerate some level of disturbance (Hicks and Elder 1979, Goodson et al. 1999, Papouchis 2001). Power boaters and river rafters on the Snake and Salmon Rivers frequently see bighorns along the shoreline. Bighorn sheep are commonly seen along the Salmon River Road below Shoup, along Highways 75 and 93 near Challis and Salmon, and along roadsides in several national parks. In these situations, bighorn sheep are often able to tolerate onlookers. However, when bighorn sheep are approached closely, at random times or in irregular locations, even sheep that are habituated to humans may flee and vacate the area (Papouchis et al. 2001).

Bighorn sheep may respond to human disturbance by a temporary or permanent abandonment of

the area (Wilson et al. 1980, DeForge 1981, Legg 1998, Papouchis et al. 2001, Keller and Bender 2007). These movements may displace bighorns to less optimal habitats, thereby decreasing foraging efficiency (Horejsi 1976, Hicks and Elder 1979, Legg 1998, Bailey 1999), increasing energy expenditures (MacArthur et al. 1982, Legg 1998), and increasing their risk of predation (DeForge 1981, Papouchis 2001). Human disturbance may also increase stress levels in bighorns (Legg 1998) and lower the resistance of sheep to disease (Spraker 1977, Foreyt and Jessup 1982, Spraker et al. 1984, Schwantje 1986). Disturbance can also interfere with breeding activities (Legg 1998, Papouchis et al. 2001). The net impacts of human disturbance could result in a decrease in survival and reproduction of bighorns (Campbell and Remington 1981, Miller and Smith 1985, Cassirer et al. 1992, Caslick 1993, Papouchis et al. 2001, Keller and Bender 2007). Because fitness of individual bighorn sheep often decreases with increased disturbance levels, it is

important to limit potential negative impacts of recreation and human disturbance during critical times of the year (e.g., lambing season; Boyle and Samson 1985, Papouchis et al. 2001). Disturbance from developments along migration corridors or near winter range may decrease the already limited habitat available for bighorn sheep (Legg 1998).

There is little specific research into the effects of off-road vehicle (ORV) use on bighorn sheep; most literature defines “human disturbance” broadly and assesses effects based on the distance between humans and bighorn sheep and the extent of bighorn response. However, research into the effects of motorized vehicle use on other ungulates suggests that animal responses differ among disturbance types (Wisdom et al. 2000, Johnson et al. 2000, Boyle and Samson 1985). Furthermore, OHVs better enable humans to access remote places, which may increase disturbance levels and/or harvest vulnerability of bighorn sheep in these areas. Given the variety of negative responses exhibited by bighorn sheep to any type of human disturbance, and given recent increases in OHV ownership and participation in Idaho (Idaho Department of Parks and Recreation 2010), restrictions on vehicle traffic in areas with bighorn sheep populations are likely warranted.

Helicopter overflights are a particular form of disturbance with potential to negatively impact bighorn sheep. Unlike many other forms of human activity, bighorn sheep have not been found to habituate to helicopter overflights (Horejsi 1976, MacArthur et al. 1982, Legg 1998, Frid 1999a). Fixed-wing aircraft cause less disturbance to bighorn sheep than helicopters (Frid 1999b). In some places in Idaho, there are frequent U.S. Air Force training exercises in bighorn sheep habitat. Research into the effects of frequent flight activities is limited (Lawler et al. 2004) and potential effects warrant further investigation.

Eliminating some of the disturbance associated with human activity may require seasonal or permanent closures of critical bighorn habitats (Goodson et al. 1999). Disturbance may also be minimized by limiting human activities to roads or trails (Papouchis et al. 2001) and requiring that domestic dogs be leashed. The integrity of migration corridors should be protected. Special protection during critical periods, such as breeding, lambing, or winter, may be required in some areas to ensure long-term viability of bighorn sheep populations.

Bighorn sheep share habitat with many wild ungulates and domestic livestock. Other species may limit bighorn sheep populations by exploiting resources (often food) and thereby reducing the supply of that resource available to bighorns, or by directly interfering with bighorn access to the resource. One critical element of competition is that the resource in demand be of limited quantity or quality. For example, 2 individuals or species living in the same area during springtime could have an identical diet. However, if nutritious green spring forage is abundantly available to both, competition may not exist. A second critical component of competition is harm to one or both species, such as a negative impact on reproduction, survival, or population growth rate. If no harm occurs to an individual or species, competition is not present. Many studies have documented considerable overlap in resource use between coexisting species, including bighorn sheep; very few field studies of wildlife competition have gone the exponentially more demanding and difficult step of showing actual harm. For bighorn sheep, Marshal et al. (2008) demonstrated a negative relationship between wild feral burro (*Equus asinus*) abundance and desert bighorn sheep (*O. c. nelsoni*) population growth rates, particularly during the driest years. The paucity of complete evidence for competition does not imply that other species do not compete with bighorns, only that competition is exceedingly difficult to demonstrate in the field.

Interference between bighorn sheep and other species has occasionally been documented. Mountain goats (*Oreamnos americanus*) may dominate and displace bighorn sheep at mineral licks (George et al. 2009). Other native ungulates (elk, mule deer, and pronghorn [*Antilocapra americana*]) show no clear dominance pattern over bighorns, but feral horses (*Equus caballus*) are almost always dominant over native wildlife, including bighorns (Berger 1985). Dunn and Douglas (1982) saw bighorn displacement by feral burros at water sources but Seegmiller and Ohmart (1981) could find no evidence of interference between burros and bighorns for either water or forage. Wilson (1969) reported bighorn avoidance of cattle (*Bos taurus*) in Utah, as did Bissonette and Steinkamp (1996) and Taylor (2001) in Idaho. However, King (1984) detected no social intolerance between bighorns and cattle, and one study reported a positive association between bighorns and cattle in an Alberta park (Brown et al. 2010).

In the northerly parts of their range, bighorn sheep are generally considered to subsist primarily on grasses (Geist 1971), whereas the diet of desert bighorns is dominated by browse (Ginnett 1982, King and Workman 1984, Dodd 1986). However, the forage preferences of bighorn sheep are quite elastic, varying considerably dependent upon relative species composition, palatability, and nutrient content of forages available at a particular time. Within a specific area, bighorns may shift seasonally from diets dominated by grasses to ones dominated by browse or forbs (Todd 1975, Wagner and Peek 2006). Given their dietary elasticity, considerable overlap is possible between bighorn diets and those of most other native and introduced grazers, including mule deer, elk, mountain goats, pronghorn, bison (*Bison bison*), burros, horses, cattle, domestic sheep, and domestic goats (Lawson and Johnson 1982, Shackleton 1985). The effects of dietary overlap and competition are likely intensified on shared ranges during winter and when availability of high-quality forage is restricted by forage desiccation. Based on dietary overlap, many authors have inferred forage competition between bighorn sheep and other species, sometimes buttressing the inference with evidence of intense forage utilization or poor range condition (Buechner 1960, Constan 1972, Wilson 1975, Gallizioli 1977).

Bighorn sheep seek out landscapes that offer abundant forage in close proximity to steep rugged slopes. Generally, this tends to spatially separate bighorn sheep from many other ungulates (Constan 1972, Hudson et al. 1976, Ganskopp and Vavra 1987). Fire in or near bighorn habitat may create nutritious forage that attracts other grazers and intensifies competition with bighorns (Spowart and Hobbs 1985, Easterly and Jenkins 1991). Cattle, bison, and pronghorn all have food habits similar to bighorn, but tend to prefer much gentler terrain. However, they may sometimes use forage adjacent to bighorn escape terrain, particularly if drawn there by water or mineral licks. Burros, horses, and domestic sheep will use somewhat rougher terrain and have strong dietary overlap with bighorns, so significant competitive potential exists. Mule deer usually have different dietary and habitat preferences, but may on occasion compete with bighorn sheep (Mackie 1976). Elk have similar diets throughout the year and can use bighorn habitat, but may do so only under special circumstances such as severe winters (Oldemeyer et al. 1971). Unfortunately, severe winters may be when competitive impacts on bighorns are strongest. In some areas, intensive elk browsing on shrubs

such as mountain mahogany (*Cercocarpus* spp.) can permanently remove virtually all the foliage within reach of bighorn sheep. Finally, domestic goats and mountain goats can readily use bighorn habitat and may have extensive dietary overlap with bighorns. Mountain goats were introduced into Colorado in 1948. Their subsequent increase and expanding range led to concerns about competition with and negative impacts on bighorn sheep, in part because the introduced goats ventured unusually far from cliffy escape terrain (George et al. 2009). Colorado intends to limit expansion of mountain goats where there may be possible negative impacts on bighorn sheep. In strong contrast to Colorado, mountain goats and bighorn sheep are both native to Idaho and coevolved in areas north of the Snake River Plain. Distributions in Idaho overlap in the White Cloud, Lemhi, and Beaverhead Mountains; along the Salmon River and several of its tributaries; and in Hells Canyon. In these areas, goat populations are often at low densities and seem to exhibit somewhat different habitat preferences than bighorn sheep. Competitive interactions have not been noted.

## Water Development

Desert bighorn sheep are known to use man-made water developments (Broyles 1995), and the presence of permanent water has been shown to influence the distribution of desert bighorns (Turner et al. 2004). Some authors argue that water developments may be important in maintaining small isolated populations threatened by disease, climate change, habitat fragmentation, etc. (Dolan 2006). However, there is scant evidence that water developments actually produce population benefits (Broyles 1995, Krausman and Etcheberger 1995, Broyles and Cutler 1999). Some desert bighorns persist in the absence of permanent water (Broyles and Cutler 1999). An experimental removal of water sources in Arizona failed to document negative impacts on desert bighorn sheep (Cain et al. 2008). Potential adverse aspects of water development include disease transmission, toxic water quality, increased predation risk, and introduction and expansion of nonnative species (Dolan 2006).

Desert bighorns in the most arid parts of their range rarely travel more than 2-3 km from permanent surface water during summer months (Turner et al. 2004). Idaho's bighorns exist in much cooler, moister environments where a natural source of water is virtually always nearby. At least 89% of Idaho is within 3 km of year-round water (Stream Order 2 and larger streams) and >56% is within 1

km. Even in the most arid sheep habitats in Idaho (Owyhee County), 98% of the area is within 3 km of water. Over 50% of that area is within 1 km of water. Additional water developments in these circumstances produce negligible benefits to bighorn sheep. Water has not been identified as a limiting resource in Idaho, nor is there supportive literature to suggest that water developments benefit Rocky Mountain or California bighorn sheep.

Because disease risk is a critical management concern for bighorn sheep, proposals that may increase disease risk must carry substantial potential benefits. Man-made water and mineral sources have not been demonstrated to benefit Rocky Mountain or California bighorn sheep, but they may increase predation and disease risks. For these reasons, such developments should be discouraged (Giacometti et al. 2002).

## Nutrition

Research into bighorn sheep nutrition has generally been divided into 2 categories: forage and mineral requirements. Bighorn sheep are generally grazers, and forbs and grasses comprise the majority of their diets (Van Dyke et al. 1983). Both Rocky Mountain and California bighorn sheep diets have been described as “cosmopolitan;” they seem to eat almost every plant available to them at some time or another (Shackleton et al. 1999). It is unknown whether selection for individual plant species is driven by nutritive quality or some other factor, and some analyses suggested bighorn sheep graze opportunistically, rather than seeking specific plant species or forage nutrients (Shackleton et al. 1999). However, availability of green forage may seasonally limit bighorn sheep (Goodson et al. 1991).

In addition to forage, bighorn sheep may consume soil or use mineral licks to meet trace mineral requirements. Mineral composition in forage may vary with changing climate conditions (Goodson et al. 1991, Hnilicka et al. 2002, McKinney et al. 2006). This variation increases the importance of mineral licks or nutrient-rich soil (Mincher et al. 2008). Specifically, researchers speculated that deficiencies in minerals such as selenium, sodium, potassium, calcium, and magnesium may affect bighorn sheep fitness (Dean et al. 2002, Hnilicka et al. 2002, Mincher et al. 2008). Placement of mineral blocks has alleviated nutrient limitations in some studies (Hnilicka et al. 2002), but may have the same negative impacts as artificial water sources (artificial congregations of animals may promote disease

transmission and predation), so such activities should be considered only if mineral deficiencies have been identified as a primary limiting factor for a bighorn sheep population.

## Urban Development

In some areas, urban development near bighorn sheep habitat has been associated with population declines or extirpations (Krausman et al. unpublished report). Among the issues associated with urban development near bighorn sheep populations are habitat fragmentation, habitat loss, increased human activity, vehicle collisions, and increased likelihood of parasite and disease transmission (Krausman et al. unpublished report, Armentraut and Boyd 1994, Rubin et al. 2002). Furthermore, some aspects of developments may attract bighorn sheep as they seek forage and water resources, thereby bringing bighorn sheep into closer contact with humans (Rubin et al. 2002). Krausman et al. (unpublished report) recommended limiting development near bighorn sheep populations to minimize potential negative effects.

## Migration Corridor Protection

Although not all populations exhibit seasonal migrations, many do in an attempt to make optimal use of plant resources and minimize energy expenditures (Valdez and Krausman 1999). Urban development, roads, habitat conversion, and conifer encroachment in bighorn sheep habitat may all have the unintended consequence of interrupting seasonal migration patterns. Disturbance from developments along migration corridors or near winter range may decrease the already limited habitat available for bighorn sheep (Legg 1998). Where possible, migration corridors should be identified, and efforts should be made to conserve or improve habitats within these areas.

## Habitat Management and Restoration

In general, habitat management for bighorn sheep should be directed toward minimizing deleterious human disturbances and maintaining healthy native plant communities in proximity to suitable escape terrain. Where plant community maturation patterns tend toward closed shrub or conifer overstories, logging or fire may be used to produce earlier successional stages with more open overstories favored by bighorn sheep. Particular emphasis should be on maintaining or improving transitional migration corridors between seasonal ranges.

Carefully considered prescribed fire may also be used short-term to improve forage nutrition, to attract bighorns into new areas, or to lure them away from hazardous locations such as highways.

## Habitat Management Direction

Management Direction - The Department will engage with land management agencies and other land users and groups to improve the quality and quantity of bighorn sheep habitat throughout Idaho.

**Strategy:** Improve communication and coordination between IDFG and land management agencies (USFS, BLM, Idaho Department of Lands) regarding issues that may affect bighorn sheep habitats.

**Strategy:** Where succession and conifer encroachment have significantly affected bighorn sheep habitats, IDFG will work closely with land managers and encourage them to adopt fire and habitat management practices to benefit bighorn sheep.

**Strategy:** Department staff will work closely with land managers to identify infestations of noxious weeds and develop strategies for removing noxious weeds from bighorn sheep habitat.

**Strategy:** The Department will work with land managers to maintain suitable escape terrain, winter range, and lambing habitats.

**Strategy:** The Department will discourage management activities (such as water development or fencing) that may focus interspecific competition in important seasonal bighorn sheep habitats.

**Strategy:** The Department will discourage establishment of artificial water sources in bighorn sheep habitat unless bighorns are primarily utilizing habitat >3 km from a perennial water source. In areas where bighorn sheep spend a significant amount of their time in areas >3 km from a perennial water source, IDFG staff will evaluate the status of the bighorn sheep population relative to management objectives and assess potential factors limiting the success of that bighorn sheep population prior to considering establishment of artificial water sources.

**Strategy:** The Department will be involved in restoration and rehabilitation efforts within bighorn sheep habitat to ensure that these efforts focus on restoring native plant communities in proximity to escape terrain and natural water sources.

Management Direction - The Department will work with other land and resource management agencies to ensure that critical areas of habitat are protected from inadvertent disturbance associated with recreational activities such as hiking, off-road vehicle use, low-altitude aerial activity, rock climbing, or trail riding.

**Strategy:** The Department will support investigations into the effects of different types and levels of human activities on bighorn sheep.

**Strategy:** In areas where recreation is considered to be a factor limiting the success of a bighorn sheep population, IDFG will work with land managers and the public to mitigate the effects of disturbance associated with recreation.

Management Direction - In areas where elk are suspected to compete with bighorn sheep for limited resources, IDFG will closely monitor both elk and bighorn sheep numbers and will adapt management practices to move numbers of both species towards IDFG population objectives.

Management Direction - The Department will continually refine efforts at mapping occupied, unoccupied, potential, and suitable bighorn sheep habitat statewide.

**Strategy:** Develop population-specific seasonal habitat models in PMUs where the existing summer model performs poorly. These areas include the Lost River Range, South Lemhi, Middle Main Salmon River, and all California bighorn sheep populations.

**Strategy:** Develop a statewide winter habitat model, and consider using the area of winter habitat to calculate supportable population sizes to better account for changes in density and narrower habitat requirements during winter in some populations.

**Strategy:** Improve data collection on sheep locations in some PMUs (e.g., Lionhead, Selway, South Beaverhead, East Fork Salmon River) to be better able to assess performance of habitat models applied in those areas.



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# HEALTH ASSESSMENT AND MANAGEMENT

## Background

Population health is an essential component of bighorn sheep restoration and management. Disease was an important factor contributing to the extinction of bighorn sheep in much of their range in the 1800s (Buechner 1960) and disease continues to limit bighorn sheep numbers today.

Respiratory disease is the most serious disease affecting bighorn sheep. As in livestock, the epidemiology likely includes interactions between various pathogens including bacteria, viruses, or macroparasites (Miller 2001)

Of the many pathogens that may contribute to the respiratory disease complex in bighorn sheep, bacteria of the family Pasteurellaceae are the most common pathogens associated with morbidity and death and the disease is sometimes referred to as pasteurellosis. Currently, there are 13 known genera (<http://www.bacterio.cict.fr/index.html>) and  $\geq 61$  species (<http://www.the-icsp.org/taxa/Pasteurellaceaelist.htm>) of Pasteurellaceae. In general, *Pasteurella* spp. are commensal organisms in the upper respiratory tract of ruminants and usually do not cause disease (Jaworski et al. 1998). Three species of Pasteurellaceae appear to be associated with disease in bighorn sheep: *Pasteurella multocida* (Spraker et al. 1984, Weiser et al. 2003, Rudolph et al. 2007), *Mannheimia* (formerly *Pasteurella*) *haemolytica* (Onderka et al. 1988, Silflow et al. 1993, Foreyt et al. 1994), and *Bibersteinia* (formerly *Pasteurella*) *trehalosi* (Miller et al. 1991). *B. trehalosi* is also generally considered to be part of the normal, commensal respiratory flora of bighorn sheep. Within each species, there are also subtypes (serotypes, biotypes, and subspecies, Jaworski et al. 1998), some of which differ in virulence or ability to cause disease.

*Mycoplasma ovipneumoniae* is also significantly associated with pneumonia in bighorn sheep and may be the primary pathogen that allows normally commensal Pasteurellaceae to invade the lungs (Besser 2008, Dassanayake et al. 2010).

Other contributing pathogens associated with respiratory diseases in bighorn sheep may include bacteria such as *Corynebacterium pyogenes* (Spraker et al. 1984) or viruses including Parainfluenza-3 (PI3), Bovine Respiratory Syncytial Virus (BRSV), Bovine Viral Diarrhea Virus (BVD) or Infectious Bovine Rhinotracheitis (IBR).

Lungworms, *Protostrongylus stilesi* and *P. rushi*, are native lung parasites of bighorn sheep with a 2-host life cycle (Uhazy et al. 1973, Robb and Samuel 1990). *P. stilesi* have been implicated in pneumonia in bighorn sheep, especially in lambs (Forrester 1971, Spraker et al. 1984). However infecting lambs with lungworms did not reduce survival (Samson et al. 1987), provision of anthelmintic blocks did not increase lamb survival (Miller et al. 2000), and no consistent associations of lungworm infection with respiratory disease events have been shown in field investigations (Festa-Bianchet 1991, Jones and Worley 1994, Cassirer et al. 1996, Aune et al. 1998).

Bighorn sheep are host to other pathogens and parasites that may cause morbidity or mortality independently of pneumonia. Some populations of bighorn sheep are infested with mites (*Psoroptes ovis*) that cause psoroptic mange. Psoroptic mange can have significant individual animal effects or, can cause substantial mortality in naïve populations (Welsh and Bunch 1983, Lange et al. 1980, Sandoval 1980). The mite can be relatively easily transmitted within and among bighorn sheep populations (Lange et al. 1980, Foreyt et al. 1990). The mite causes lesions including alopecia (hair loss) and thickening of the skin and can lead to secondary skin infections. Extensive crusting and debris accumulation can occur in the ear canals. Infestations can be associated with hypothermia, deafness, and loss of balance which may increase vulnerability to predation and death (Lange et al. 1980, Foreyt et al. 1990, Boyce and Weisenberger 2005).

Contagious ecthyma is a relatively common viral disease of bighorn sheep and other free-ranging and domestic ruminants and is caused by a poxvirus (Samuel et al. 1975). Contagious ecthyma tends to occur in sporadic outbreaks in which naïve animals, especially lambs, develop blisters on mucus membranes of the face and mouth. Severe infections can cause morbidity and mortality in lambs due to inability to nurse or feed (Blood 1971, Merwin and Brundige 2000, Douglas 2001).

Several protozoan parasites of blood cells, including *Babesia* spp. (Goff et al. 1993a) and *Anaplasma ovis* (Goff et al. 1993b, Jessup et al. 1993) are well documented in bighorn sheep. Bacterial sinusitis (Allen and Bunch, 1982) can cause chronic changes in the frontal bones and horns. Bighorn sheep are susceptible to orbiviruses, especially bluetongue

(Robinson et al. 1967, Castro et al. 1989). A number of gastro-intestinal parasites are known in bighorn sheep, most of which do not impact individuals or populations (Capelle, 1966, Beckland and Senger, 1967, Uhazy and Holmes 1971).

Many pathogenic organisms found in bighorn sheep are similar to those in livestock and do not have serious effects on populations. However, bighorn sheep differ in important ways from domestic sheep in their responses to bacteria associated with respiratory disease. Experimental exposure to leukotoxin-producing *M. haemolytica* causes disease and death in bighorn sheep, but not in domestic sheep (Foreyt et al. 1994, Dassanayake et al. 2009). On a cellular level, pulmonary macrophages and neutrophils in the blood of bighorn sheep are much more susceptible to destruction by leukotoxin from *M. haemolytica* than those of domestic sheep (Silflow et al. 1989, 1991, 1993; Silflow and Foreyt 1994; Sacco et al. 2006; Herndon et al. 2010).

## Population Effects and Epidemiology

Respiratory disease is uniquely important in the population dynamics of bighorn sheep. The effects on populations can take several forms, including acute all-age mortality events, high rates of mortality restricted to lambs, especially during summer, and chronic, low level, sporadic adult mortality. Some populations recover relatively quickly from disease events, while disease can recur chronically or sporadically for long periods in others (Ryder et al. 1992, 1994; Hnlika et al. 2002; Cassirer and Sinclair 2007). Pathogens associated with the respiratory disease complex appear to spread among interconnected populations over a period of years, resulting in morbidity and mortality of numerous individuals in multiple populations over time (Onderka and Wishart 1984, George et al. 2008).

Overall, these dynamics can chronically limit numbers and distribution of bighorn sheep in areas where respiratory disease occurs. Consequently, disease, especially recurring events, can drive populations to extinction directly or indirectly by predisposing small fragmented, surviving populations of bighorn sheep to extinction from stochastic events unrelated to disease, such as weather, predation, genetic drift, or inbreeding (Berger 1990, Gross et al. 2000, deCastro and Bolker 2005).

The serious impact of respiratory disease on bighorn sheep populations has led to the investigation of multiple causal hypotheses. Most of these

hypotheses are derived from causes known or suspected to be associated with pasteurellosis pneumonia, or “shipping fever” in domestic livestock, including density-dependence or crowding, nutrition, weather, stress, genetics or inbreeding, and introduction of novel pathogens. The applicability of these factors to free-ranging populations of bighorn sheep is uncertain. Although some of these factors can be practically managed in a free-ranging population, others cannot (e.g., weather).

## Density-Dependence

Transmission rates of many infectious diseases are density-dependent: the higher the population density, the more likely the pathogen will be maintained and spread within a population. Density-dependent diseases are unable to persist in host populations below a threshold host population density (Anderson and May 1978, Swinton 2002). Thus, if populations are managed to remain below this density threshold, disease outbreaks are less likely to, or will not, occur. The assumptions associated with density-dependence of directly transmitted organisms include:

- spatially homogenous mixing
- a linear or proportional relationship between population size and density. In the case of pathogens with direct transmission, density, contact rates, and transmission events are assumed to increase as population size increases.

In fact, in free-ranging social ungulates these assumptions are rarely met. A nearly constant number of intraspecific contacts may occur regardless of population size, and local densities may remain fairly stable due to herd behavior (Conner et al. 2008). Therefore, disease transmission in free-ranging, gregarious species may more commonly be frequency-dependent. Transmission rates are determined by the relative proportions of the population that are infected, infectious, and those that are naïve or susceptible to infection, not by the total population size (Hobbs and Miller 1992, Dobson and Meagher 1996, McCallum et al. 2001). Reducing population size is not an effective management tool for dealing with frequency-dependent pathogens.

There is also limited and equivocal empirical evidence for a relationship between bighorn sheep population size and the occurrence of pneumonia outbreaks. Monello et al. (2001) found that most

reported epizootics in bighorn sheep occurred within 3 years of peak population size and interpreted this to indicate that epizootics were density-dependent, but no density-related differences, such as population size or growth rates, were found between bighorn sheep populations that suffered pneumonia epizootics and those that did not. Other investigators have found no evidence for density effects or population size on pneumonia outbreaks (Jorgenson et al. 1997, Aune et al. 1998).

Whereas maintenance and spread of directly-transmitted respiratory pathogens is likely not related to population size in bighorn sheep, animals likely move more widely and extend their range of occupied habitat if numbers increase (Fuller et al. 2007). This is desirable for management and persistence of populations and metapopulations (Bleich 1990), but in some cases may increase the likelihood of contacts and transmission of infectious pathogens among adjacent bighorn sheep populations and between bighorn sheep and livestock. Density and contact rates can also be artificially increased by concentrating animals at feeding stations and salt blocks (Blood 1971).

## Nutrition

Poor nutrition can predispose animals to disease. Immune function can be compromised by inadequate total caloric intake or by deficiency or imbalance in specific nutritional components, such as trace elements including selenium and vitamin E.

Habitat changes and sedentary populations have been proposed as factors that may predispose bighorn sheep to diseases (Risenhoover et al. 1988, Enk et al. 2001) however, the evidence for a nutritional predisposition for bighorn sheep pneumonia outbreaks is equivocal. Most pneumonia outbreaks start in late fall and early winter when bighorn sheep are usually in excellent physical condition. Adjacent populations in similar habitats on a similar nutritional plan can have quite different disease histories (Cassirer and Sinclair 2008, George et al. 2008). Also, no relationship has been demonstrated between fecal nitrogen (an index to dietary quality) and occurrence of disease (Cassirer 2005).

Selenium, vitamin E, and zinc are micronutrients that play important interacting roles in immune function. Deficiency or toxicity can have clinical or subclinical effects on animal populations. Many bighorn sheep populations occur in areas that are considered low or deficient in selenium for livestock

(Robbins 1993, Mincher et al. 2008) and it is not uncommon for whole blood and serum levels to be borderline or deficient based on livestock standards (Samson et al. 1989, Hein 1994, Lemke and Schwantje 2005). Hnilika (2002) investigated the possibility of an association of selenium deficiency with poor bighorn lamb survival. However, selenium requirements even by domestic sheep are highly variable in part due to interactions among micro-nutrients. A deficiency in one nutrient can be offset by another. Also, there are no established levels for deficiency in bighorn sheep and it is not unreasonable to assume the species may have evolved compensatory mechanisms that reduce their requirements relative to livestock.

In fact, bighorn sheep have inhabited ranges with selenium deficient soils with no evidence of respiratory disease (Samson et al. 1989), disease has not been induced in captive bighorn sheep kept on a low selenium diet (Dean et al. 2002), and supplementation with selenium has not been shown to prevent pneumonia related mortality in free-ranging adults or outbreaks in lambs (Coggins 2006). Likewise, in domestic sheep, selenium supplementation can increase productivity and lamb survival but effects of supplementation on immune function are mixed (Rooke 2004). As with other ecological factors, current data show no straightforward causal relationship of micronutrient deficiency with disease in bighorn sheep.

## Weather

Dynamics of bighorn sheep populations have been shown to be correlated to weather conditions, especially to precipitation in desert environments (Douglas 2001, Holl et al. 2004, Bender and Weissenberger 2005). However, there is little evidence that supports weather as a predisposing factor for disease events in bighorn sheep (Douglas 2001, Monello et al. 2001).

## Stress

Stress refers to a non-specific response of the body to any factor that could overcome its ability to maintain homeostasis. In all animals, stress is a normal part of life and by itself, is not considered to be negative. The physiological responses induced by stress, generally the release of stress hormones (e.g., adrenalin), are those that enable an animal to respond to its environment and survive. However, response to chronic stress can be maladaptive and can disrupt physiological function including suppression of the immune system.

While it has been postulated that chronic stress can predispose bighorn sheep to pneumonia (e.g., Spraker et al. 1984), experimentally-imposed stress has failed to induce pneumonia in captive bighorn sheep (Belden et al. 1990, Miller et al. 1991). Kraabel and Miller (1997) found that in vitro exposure of bighorn sheep neutrophils to adrenocorticotrophic hormone (ACTH) caused mild increases in neutrophil death rates following exposure to leukotoxin producing strains of *Pasteurella* bacteria. Because treatment with ACTH primarily affected survival of neutrophils exposed to highly virulent *Pasteurella* strains, and did not affect survival of neutrophils exposed to low virulence strains of *Pasteurella*, they concluded that the pathogenicity of the agent (*Pasteurella*) was likely more important than environmental stressors in respiratory disease epizootics.

While stress is a natural part of life for free-ranging bighorn sheep, some management activities such as capture and translocation, impose artificially high levels of stress on wild animals. In these situations the potential negative stress-related effects are recognized and all efforts will be made to minimize factors associated with stress (Appendix E). However, it should be noted that the most significant stress effect associated with handling bighorn sheep is capture myopathy (Kock et al. 1987). We are not aware of any pneumonia outbreaks in bighorn sheep associated with capture.

## Introduction of Pathogens

Diseases introduced by domestic sheep and goats contributed to population reductions and extinction of bighorn sheep throughout much of their range coincident with the arrival of early settlers and homesteaders (Grinnell 1928, Buechner 1960). Captive experiments have consistently shown that co-pasturing bighorn sheep and domestic sheep results in fatal pneumonia in bighorn sheep, but has no effect on domestic sheep (Foreyt and Jessup 1982; Onderka and Wishart 1988; Foreyt 1989, 1994; Callan et al. 1991; Lawrence et al. 2010). For nearly a century naturalists and wildlife managers have also observed that disease outbreaks in free-ranging bighorn sheep seem to be associated with contact with domestic sheep (George et al. 2008). Disease outbreaks can occur in the absence of known direct contact with domestic sheep. However, pneumonia outbreaks have not been recorded in bighorn sheep in northern Alberta or in thimhorn sheep (*O. dalli*), where there is no possibility for contact with domestic sheep (Garde et al. 2005).

There is less information on the effects of domestic goats and experimental evidence for disease risk from contact between the 2 species is not as conclusive as for domestic sheep (Foreyt 1994). However, infectious keratoconjunctivitis from domestic goats caused significant morbidity and mortality in free-ranging bighorn sheep (Jansen et al. 2006). In addition, pathogens can be shared between apparently healthy feral domestic goats and bighorn sheep and these pathogens have been shown to cause respiratory disease in bighorn sheep (Rudolph et al. 2003).

Experimental contact of bighorn sheep with cattle, horses, mule deer, elk, mountain goats, and llamas (*Lama glama*) did not result in epidemic mortality of bighorn sheep (Foreyt 1992, 1994; Foreyt and Lagerquist 1996).

## Disease Risk Management

### Domestic Sheep and Goats

While much remains to be learned about the respiratory disease complex in bighorn sheep, the evidence is clear that introduction of pathogens into bighorn sheep populations should be avoided. Effects can be serious and long-lasting, there are no effective preventive vaccines, and once pathogens are introduced, there is currently no effective treatment. The most likely sources of pathogen introduction into bighorn sheep populations are domestic sheep, domestic goats, and other bighorn sheep (USFS 2006, WAFWA 2007, CAST 2008, Schommer and Woolever 2008).

Idaho Code 36-106(e)5(E) requires IDFG to develop Best Management Practices (BMP) agreements with willing domestic sheep permittees who operate in proximity to bighorn sheep. Recommendations developed by IDFG and the Idaho State Department of Agriculture (IDFG and ISDA 2008) and the Western Association of Fish and Wildlife Agencies (WAFWA 2007) to prevent contact between bighorn sheep and domestic sheep and goats will be followed as appropriate by IDFG in collaboration with other resource management agencies and domestic sheep and goat owners. These recommendations briefly include:

1. Identify and map statewide distribution of potential bighorn sheep habitat and existing or potential use areas of domestic sheep and goats.
2. Identify and map current documented and potential bighorn sheep use areas.



3. Identify and map interface areas with risk of contact among bighorn sheep and domestic sheep and goats.
  4. Focus population-level disease risk monitoring and management efforts on those bighorn and domestic sheep and goat populations that are in risk of contact.
  5. Adopt a protocol for managing individual incidents of suspected or known contact between domestic sheep and goats.
- ◆ Trucking domestic sheep rather than trailing them to and from allotments.
  - ◆ Counting sheep more frequently to better detect strays and gather them.
  - ◆ Not turning sick domestic livestock out on allotments.
  - ◆ Spatial or temporal separation of habitat use by bighorn sheep and domestic sheep and goats. This could include not grazing domestic sheep or goats during certain times of the year, moving domestic sheep or goats to other portions of allotments or to different allotments to avoid bighorn sheep, or not restoring bighorn sheep in areas with potential conflicts with domestic sheep and goats.
  - ◆ Conservation easements on private land that promote separation between bighorn sheep and domestic sheep or goats and conservation of bighorn sheep habitat.

Maps of current bighorn sheep habitat and population distribution (Figs. 5 and 6) and domestic sheep grazing areas (Figs. 7 and 8) have been developed and provide a basis to prioritize population and health monitoring and translocation activities (recommendation 4). Agreements for implementing BMPs have or will be developed for bighorn sheep populations that are in risk areas where domestic sheep producers are willing to participate in creating a BMP agreement. These plans should be proactive and focus on preventing interaction between species. Currently there has been no measure of compliance from producers or evaluation of how effective these BMP's are at maintaining separation, but IDFG would support these efforts in the future. Plans should be modified as needed based on changing conditions and can include but are not limited to:

- Maps of bighorn and domestic sheep and goat use areas.
- An assessment of where interactions are likely to occur.
- Best management practices that can be used to achieve separation including, but not limited to:
  - ◆ Creating barriers such as double fencing.
  - ◆ Using additional guard dogs and extra herders, propane cannons, and night penning of domestic sheep and goats.
  - ◆ Providing herders with communication devices such as a cell phone, satellite phone, or satellite messaging device.
  - ◆ Additional educational materials including bighorn sheep identification cards in multiple languages.

- Response procedures if bighorn and domestic sheep or goats are observed to be in contact or likely to come into contact.

## Response Plan

When proactive management techniques to maintain separation between bighorn sheep and domestic livestock fail and bighorn and domestic sheep or goats are observed to be in contact or likely to come into contact, the bighorn sheep or domestic sheep or goats should be either captured alive and removed, or removed lethally in a timely manner, preferably within 48 hours. Bighorn sheep removed alive from interaction situations will not be released into any area of the state that other bighorn sheep currently occupy. Response plans will be developed by IDFG regional and bureau personnel and appropriate public land managers, private landowners, and domestic sheep and goat owners (Fig. 9). Response plans should include a map of zones where management actions should occur if bighorn sheep and domestic sheep or goats are observed to be in proximity and instructions on whom to contact with such observations.

Management actions must be conducted in a timely manner. However, where possible, the following

scenario should be implemented. At a minimum, the IDFG regional supervisor or designee must be contacted prior to any removals. No removals will be conducted on private land without notification and permission of the landowner. A record will be kept by IDFG regional personnel of all Watch and Removal management actions and summarized annually.

### Watch zone

- Defined as an area where bighorn sheep and domestic sheep or goats may be present, but in which it is unlikely that an interaction will occur.
- If no contact can be documented, bighorn sheep should be captured, sampled (Appendix C), marked with radiocollars (preferably GPS collars) and ear tags, and released on site or in safer locations, if such capture is practical and possible.
- Animals should be monitored as feasible, recognizing that monitoring unmarked individuals is difficult and time consuming.
- Attempts may be made to haze animals towards less risky locations.
- If monitoring is not feasible, animals (domestic or wild) could be removed.

### Removal zone

- Defined as an area where bighorn sheep or domestic sheep or goats are likely to have contact and within which bighorn sheep should not be allowed to remain if they are observed.
- Bighorn or domestic sheep or goats observed in this area should be removed, either lethally or captured alive.
- If a suitable captive facility has been identified in advance, the bighorn sheep could be captured alive and transported to the facility.
- In the event of lethal removal, the carcass or portions of the carcass will be retrieved as possible and submitted for complete diagnostic testing, as identified in Appendix D.

## Capture

Bighorn sheep will be captured (Appendix E) using safe, accepted techniques, for example Foster (2005), and animals will be handled to minimize stress and injury to animals and people. Any bighorn sheep that is captured will undergo health screening (Appendix C).

## Translocations

Mixing populations of bighorn sheep through translocations may contribute to introduction of pathogenic organisms and the onset of respiratory disease. Bringing together populations with differing health histories poses risks to both resident and translocated individuals. Potential risks and benefits of translocations will be assessed as outlined in the translocation section. Health screening will be conducted and evaluated for all translocations in advance of translocation projects.

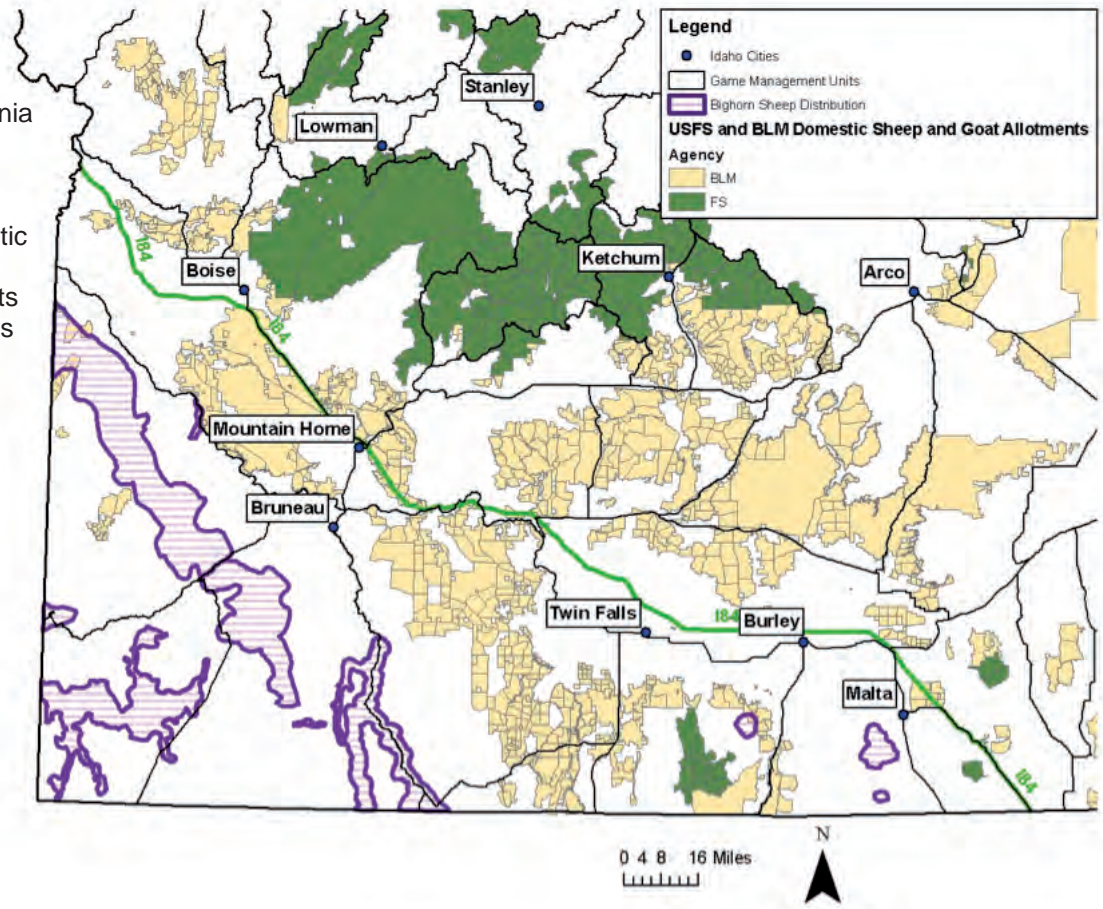
## Information Needs

Much remains to be learned about causes and management of respiratory disease in bighorn sheep. Additional information would benefit disease management, improve precision and accuracy of risk assessments (USFS 2006, Clifford et al. 2007), and ultimately increase management success.

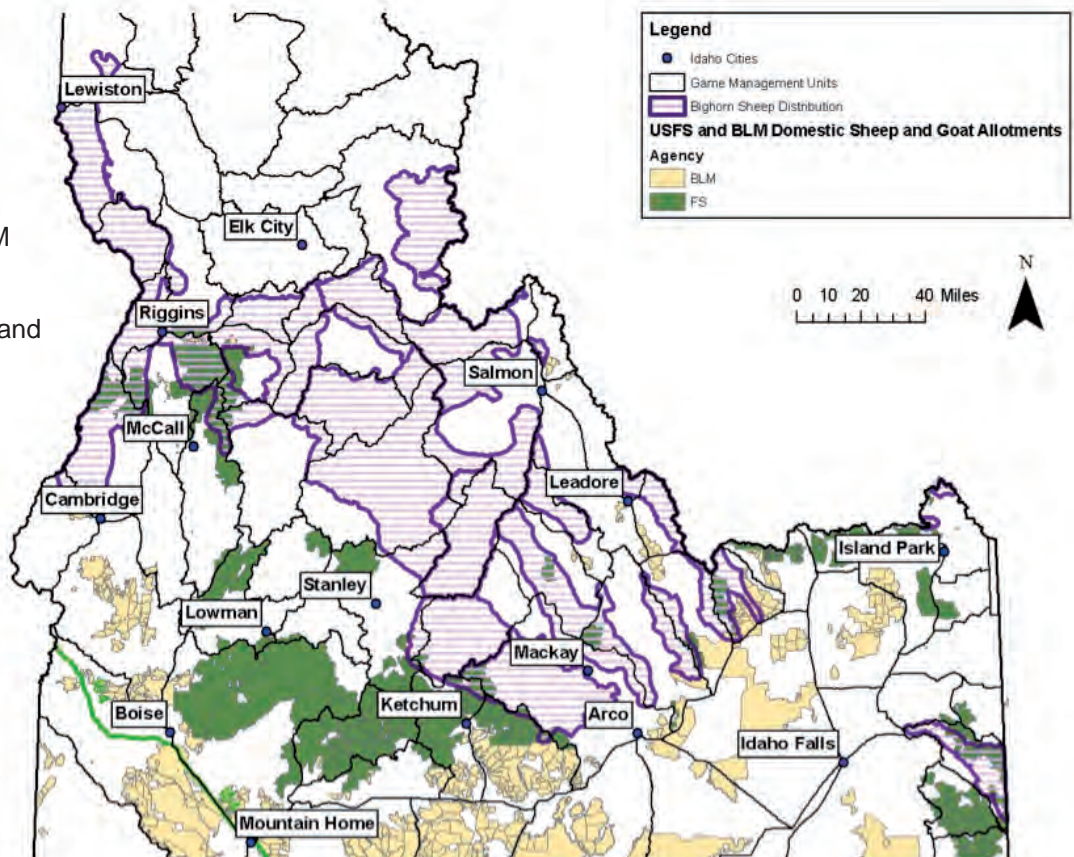
Not all contacts between bighorn sheep and domestic sheep and goats result in disease. Key questions are: what conditions are necessary for association of bighorn sheep and domestic sheep and goats and contacts among bighorn sheep to result in disease in free-ranging conditions? How much contact is necessary? What pathogens must be present and what contributing factors are important in order for disease to occur?

Additional information that would be useful for management includes a better understanding of bighorn sheep movements across the landscape, the degree of exchange of pathogens among bighorn sheep populations, routine disease status assessment, and effects of changes in population size and environmental factors (e.g., fire and weather conditions) on distribution and population dynamics.

**Figure 7.** California bighorn sheep distribution and USFS and BLM permitted domestic sheep and goat grazing allotments and trailing routes



**Figure 8.** Rocky Mountain bighorn sheep distribution and USFS and BLM permitted domestic sheep and goat grazing allotments and trailing routes.



## Disease Surveillance and Outbreak Investigation

Biological samples should be taken from all animals captured and handled by IDFG personnel whenever possible. The samples need to be collected and handled in an appropriate manner to yield interpretable results that can be applied to management decisions.

The WAFWA Wildlife Health Committee recently (2009) developed wild sheep herd health monitoring recommendations for the Wild Sheep Working Group [http://www.wafwa.org/documents/wswg/WAFWA\\_WS\\_Herd\\_Monitoring\\_9\\_09.pdf](http://www.wafwa.org/documents/wswg/WAFWA_WS_Herd_Monitoring_9_09.pdf). These recommendations include both field and laboratory monitoring. No standard set of diagnostic samples is recommended. The limitations of some laboratory techniques are discussed, as well as the importance of proper sample collection and handling.

As part of disease surveillance, where possible, bighorn sheep found dead in the field or that die during capture or transport activities should undergo a complete necropsy (Appendix D). Response to a disease outbreak will be evaluated on a case by case basis and will include using or where necessary developing a standardized protocol for sampling and testing. Where possible, bighorn sheep that are exhibiting signs or symptoms of illness deemed to be potentially detrimental to the population should be promptly removed and disease assessment conducted through necropsy and laboratory tests.

## Health Monitoring and Management

Management Direction - The Department will continue to emphasize studies pertinent to resolving bighorn sheep disease issues.

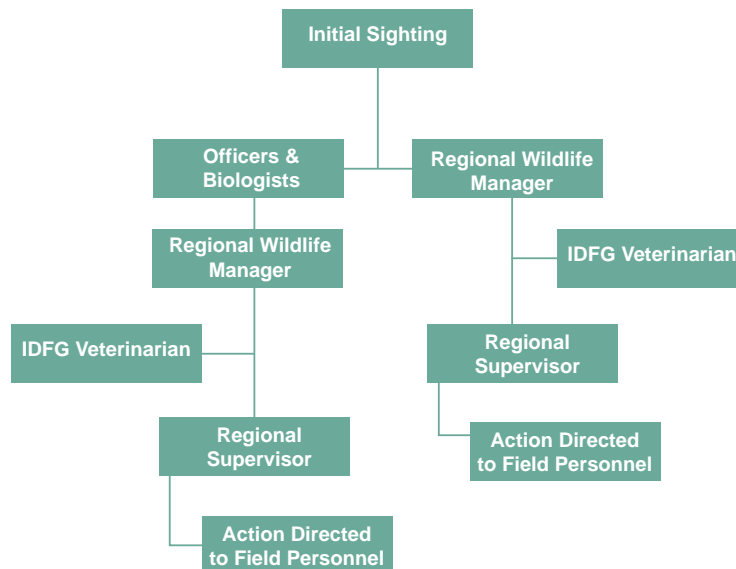
**Strategy:** The Department will work to reduce the effects of disease on populations.

**Strategy:** The Department will continue to obtain biological samples from all bighorn sheep handled, to determine exposure to pathogens, and to develop individual herd health histories of bighorn sheep in Idaho.

**Strategy:** The Department will conduct investigations of known disease events and their impacts on individual herds.

**Strategy:** The Department will continue to maintain close working relationships with universities and other wildlife management agencies to share information on mechanisms of disease development in bighorn sheep and impacts on bighorn sheep populations.

**Strategy:** The Department will continue to work with the ISDA and appropriate universities to monitor diseases that may potentially affect livestock production in Idaho.



**Figure 9.** Flow chart for IDFG personnel responding to contact or potential contact between domestic and bighorn sheep.

**Strategy: The Department will continue to collaborate with others to develop vaccines and treatments for pathogens to prevent transmission of disease among domestic sheep and bighorn sheep.**

Management Direction - The Department will use standard procedures to safely capture and handle bighorn sheep.

## Bighorn Sheep and Domestic Sheep Separation

Management Direction - The Department will continue to advocate spatial or temporal separation between bighorn sheep and domestic sheep and goats, concurrent with established Commission policy and WAFWA guidelines.

**Strategy: The Department will actively work with individual livestock permittees to develop and implement “Best Management Policies” to assist in ensuring physical separation of these species, consistent with Idaho Code.**

**Strategy: The Department will collaborate with ISDA and the Idaho Woolgrowers to develop an education and outreach effort to inform owners of farm flocks (domestic sheep and goats) of the risks associated with comingling and recommendations to avoid contact.**

**Strategy: The Department will work with land management agencies to identify appropriate alternative management options.**

**Strategy: The Department will work with appropriate stakeholders to ensure adequate monitoring occurs for maintaining separation.**

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# PREDATION

## Predators and Bighorn Sheep

Like all prey species, bighorn sheep coevolved with predators. Numerous predators prey on bighorn sheep, including gray wolves (*Canis lupus*), coyotes (*C. latrans*), mountain lions (*Puma concolor*), bobcats (*Lynx rufus*), lynx (*L. lynx*), black bears (*Ursus americanus*), grizzly bears (*U. arctos horribilis*), wolverines (*Gulo gulo*), and golden eagles (*Aquila chrysaetos*). In response, bighorn sheep have developed efficient anti-predator strategies, including gregarious behavior and use of rugged escape terrain, that reduce their vulnerability to predation (Geist 1971, Jorgenson et al. 1997, Wishart 2000). These behaviors appear to be particularly effective at reducing predation by coursing predators such as coyotes and wolves (Sawyer and Lindzey 2002). However, under some circumstances, predators may limit bighorn sheep populations. Specifically, mountain lions have been documented to cause population-level impacts in bighorn sheep that occupy suitable habitats (Ross et al. 1997, Sawyer and Lindzey 2002).

Mountain lion predation is believed to most often be a proximate cause to other factors that ultimately lead to low bighorn sheep densities and population declines (Anderson 2008), including prolonged drought (Logan and Sweanor 2001, Bender and Weisenberger 2005), changes in habitat (Holl et al. 2004), disease (Logan and Sweanor 2001), and changes in primary prey species abundance (Schaefer et al. 2000, Logan and Sweanor 2001, Kamler et al. 2002, Holl et al. 2004, Rominger et al. 2004, Festa-Bianchet 2006). Essentially, when bighorn sheep are already struggling with factors such as disease, inadequate habitat, or changes in availability of other prey species, mountain lion predation may have an undue impact on populations.

Wolf predation has not been documented to cause population-level impacts on bighorn sheep. In Yellowstone National Park wolves did not prevent the bighorn sheep population from increasing (7% annual increase from 1998-2005) during the decade after wolf reintroduction when wolf numbers increased from 21 to a maximum of 106 (White et al. 2008). In the Salmon River Mountains of central Idaho, Husseman et al. (2003) documented 120 wolf and 98 mountain lion-killed ungulates. Of these documented kills, bighorn sheep comprised 1% of

mountain lion-killed ungulates and 0% of wolf-killed ungulates.

Beginning in March 2002, a graduate student (Berkley 2005) conducted a bighorn sheep mortality study in the Big Jacks, Little Jacks, and Shoofly Creek drainages in Owyhee County, Idaho. The Department continued monitoring radiocollared bighorn sheep after the conclusion of graduate student field work. A total of 52 radiocollars were deployed on adult bighorn sheep. Thirty radiocollared sheep died between March 2002 and February 2007. Bighorn sheep carcasses were accessed as soon as possible to determine cause of death. Of the 30 confirmed mortalities, 7 (28%) were attributable to cougar predation. An additional 4 (17%) were considered possibly attributable to cougar predation. Two (9%) were attributed to capture related mortality, 1 (3%) succumbed to sinusitis, and 3 (10%) died from falls. The remaining 12 (40%) were due to unknown causes. Annual survival rates for ewes varied from 77% (Mar 2003 - Mar 2004) to 87% (Mar 2004 - Mar 2005), and were generally stable at 85-87% during the last 3 years of monitoring (Mar 2004 - Feb 2007).

Cassirer and Sinclair (2007) discussed mortality factors for bighorn sheep in Hells Canyon during 1997-2003. Pneumonia was the most common cause of adult mortality (43%) and the primary factor limiting population growth. Mountain lion predation was the second most frequent source of adult mortality (27%) but did not significantly reduce the rate of population growth. There has not been any documented wolf-caused mortality of bighorn sheep in Hells Canyon.

## Predation Management

Management of predators to increase bighorn sheep populations is a contentious issue, in part because different segments of society value predators differently, and because previous research on the effects of predation on prey populations is ambiguous, as is research into the effects of predator management. Nonetheless, predator management is desired by many sportsmen and is an important tool for IDFG to have available when appropriate to aid in management of prey populations. The Idaho Fish and Game Commission approved the Policy for Avian and Mammalian Predation Management

to guide IDFG's implementation of predator management activities ([http://fishandgame.idaho.gov/cms/wildlife/plans/mam\\_predation.cfm](http://fishandgame.idaho.gov/cms/wildlife/plans/mam_predation.cfm)).

The Policy for Avian and Mammalian Predation Management directs managers to "recognize the role of predators in an ecological and conservation context. Impacts of the removal of individual predators on the structure of the predator population, as well as the prey population, will be considered. The actions by the Department must be based on the best available scientific information, and will be evaluated in terms of risk management to all affected wildlife species and habitats."

Within this context, it is important to consider research that gives insights into:

- What habitat, prey, or predator population characteristics indicate that predator control may effectively improve bighorn sheep population demographics;
- Whether such control efforts are the most efficient use of resources, given the benefit that may be derived from them;
- What are the most effective means of controlling predators to reduce the impacts of predation on bighorn sheep; and
- What secondary effects might be expected to result from predator control efforts.

Because mountain lions are the predator species most likely to cause population-level impacts on bighorn sheep, most research that addresses the issues above has focused on the effects of mountain lion control.

Research indicates that predator control is most effective at improving bighorn sheep population performance only under very specific conditions. For small (<125), isolated populations, short-term predator management may be appropriate if mountain lion predation becomes common (Anderson 2008). Small, isolated, and recently translocated populations of bighorn sheep are most vulnerable to declines caused by mountain lion predation (Wehausen 1996, Hayes et al. 2000, Logan and Sweanor 2001, Kamler et al. 2002, Real and Festa-Bianchet 2003, Rominger et al. 2004, Festa-Bianchet et al. 2006). In areas where mountain lion predation may impact translocation success, researchers have recommended careful evaluation of translocation sites (Bender et al. 2005), release of larger number of bighorns to increase group size

and increase vigilance for predators (Mooring et al. 2004), and short-term mountain lion control prior to release of bighorns into new habitat (Rominger et al. 2004, McKinney et al. 2006).

Although the abundance of predators is commonly thought by the public to be the primary factor affecting predation rates or limiting growth of bighorn sheep populations, researchers have determined that predation on bighorn sheep is largely a function of the behavior of individual mountain lions rather than the total number of mountain lions (Ross et al. 1997, Logan and Sweanor 2001). Because of this density independent relationship, indiscriminate removal of mountain lions or overall reduction in mountain lion numbers may not reduce the number of mountain lion-related bighorn sheep mortalities (Ernest et al. 2002, Cougar Management Guidelines Working Group 2005). Indiscriminate removal of mountain lions may create territorial vacancies that will likely be filled by dispersing juveniles, and mountain lions that did not prey on bighorn sheep may be replaced by mountain lions that will prey on bighorn sheep (Cougar Management Guidelines Working Group 2005).

In some instances, predation by relatively few individual mountain lions may be responsible or contributing to bighorn sheep population declines or possibly extinction in small isolated populations (Festa-Bianchet et al. 2006, Logan and Sweanor 2001). Ross et al. (1997) and Mooring et al. (2004) suggested targeting specific mountain lions to address predation problems on bighorns. If predator removals can be focused on specific mountain lions that are preying on bighorn sheep, the management effort would be more likely to have the desired effect. To be effective, selective mountain lion removal requires that wildlife managers are able to identify and remove specific individuals responsible for preying primarily on bighorn sheep (Anderson 2008).

Mountain lion removal does not appear to be an effective management strategy for sustaining bighorn populations comprised of >125 animals (Anderson 2008). Rather, short-term management actions focusing on specific individual mountain lions that overlap bighorn sheep habitat will likely be most efficient (Anderson 2008). However, habitat enhancement projects that improve forage quality and quantity and that reduce mountain lion stalking cover will likely provide the best long-term benefit (Anderson 2008).

Predator control is often expensive, time consuming, and controversial. Therefore, it is essential that managers consider whether the investment inherent in predator control is warranted by the anticipated benefits realized by prey populations. Bowyer et al. (2005) developed a model to aid in determining when predation might have a large impact on prey population size, and thus where the prey population would respond to predator removal. Essentially, ungulate populations that are likely to experience additive mortality as a result of predation exhibit certain demographic cues. For example, if a population of ungulates is comprised of animals in good physical condition which generally exhibit relatively high pregnancy rates, larger average litter sizes, and heavier birth weights, then predation mortality is likely to be additive. Conversely, ungulate populations comprised of animals that are in poorer physical condition and exhibit lower pregnancy rates, smaller average litter size, and lower birth weights are more likely to be mainly food limited. Predation mortality in these populations is more likely to be compensatory (Bowyer et al. 2005).

Many of these population parameters are difficult to assess, and more often than not, managers will only have insights into a few of them for a given population. Interpretation of population characteristics may be further confounded in populations impacted by disease (e.g., bighorn sheep herds suffering from periodic pneumonia-related die-offs). Low-density population characteristics will be present in any population far below carrying capacity, even if there is no predation. Therefore, even when the ungulate population is well below carrying capacity, a decision to reduce mountain lion numbers is only appropriate when data indicate mountain lion predation is the strongest limiting factor operating on the ungulate population (Cougar Management Guidelines Working Group 2005). Furthermore, if there is no alternative prey species and mountain lions are preying exclusively on the ungulate species of concern, mountain lion numbers will decline (after a time lag) even without increased harvest (Cougar Management Guidelines Working Group 2005).

## Predator Management Direction

Management Direction - The Department will implement the Predator Management Policy when evidence indicates that mountain lions (or other predators) are a major cause for bighorn sheep herds not meeting state management objectives.

**Strategy: The Department will focus any predator reduction programs in specific areas for targeted time periods to ensure the long-term survival of bighorn sheep herds.**

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# TRANSLOCATION

Most areas in Idaho that do not have bighorn sheep are either not suitable habitat or disease or another risk factor precludes reestablishment of the species. Consequently, most translocations are currently conducted to augment existing populations in order to increase numbers and speed population growth, or to encourage range expansion. However, translocations into unoccupied habitat may still occur in response to changing habitat conditions or extirpation of existing populations.

## Guidelines

A successful translocation leads to the establishment of self-sustaining populations, or to increasing the size, growth rate, genetic diversity, or occupied range of existing populations (Griffith et al. 1989, Roy et al. 1994). While translocations have been an important tool in restoring bighorn sheep and other wildlife populations, they are expensive, pose risks to animals and humans, and are sometimes failures. The following guidelines are intended to build upon knowledge gained through many decades of translocations to increase the chances of success of bighorn sheep translocations in Idaho. As new information becomes available it should be incorporated into these guidelines.

Factors that have been correlated with enhanced success of native wildlife translocations in general include: release of wild-caught rather than captive-reared animals; release of animals out of an increasing source population; good or excellent habitat at release site, which is often associated with release into core rather than peripheral historic range; and removal of the factor that caused the original decline (Griffith et al. 1989, Wolf et al. 1996, Fischer and Lindenmayer 2000). Success of bighorn sheep translocations (Roy and Irby 1994, Singer et al. 2000, Enk et al. 2001, McKinney et al. 2006) has been generally correlated to:

1. Habitat suitability at the release site (including factors associated with disease and predation risks).
2. Health and ecological characteristics of the source and destination (if augmentation) populations.

In addition to these factors, capture technique (Roy and Irby 1994) and number of animals released

(Komers and Curman 2000) have been suggested as possible factors affecting translocation success.

## Habitat Characteristics

The quality and quantity of suitable habitat is one of the single most important factors affecting the success of wildlife translocations. Habitat (Armstrong and Seddon 2008) includes not only vegetative and physical characteristics but also factors that are especially important to the success of bighorn sheep translocations which include predation risk (Kamler et al. 2002, Rominger et al. 2004, McKinney et al. 2006) and risk of introduction of infectious disease (Zeigenfuss et al. 2000).

Prior to any translocation, a geographic information system (GIS)-based habitat evaluation should be conducted, followed by an on-site visit by a regional biologist, and several other department employees with bighorn sheep habitat expertise. Both extent and distribution of potential habitat, including distribution of seasonal habitats and migration corridors, should be evaluated. The GIS evaluation of the physical attributes in Table 3 should be completed with a layer including known distribution of domestic sheep and goat grazing. Layers available for GIS evaluation may not include all domestic sheep and goats, especially those on private lands, so a regional biologist should map any additional locations. No bighorn sheep should be released in areas where they may contact domestic sheep and goats or other bighorn sheep populations that are known to have acute or chronic problems with pneumonia-caused mortality. Distances to domestic sheep and goats associated with successful translocations and population restoration have been identified as 16-20 km (Singer et al. 2000*a, b*), 23 km (Zeigenfuss et al. 2000), and 40 km (Monello et al. 2001). Factors such as habitat continuity and barriers to movement should be taken into account in a site-specific analysis.

If water is a limiting factor (habitat >3.2 km from perennial water sources) based on the GIS evaluation, a regional biologist may be able to provide additional information on water availability not captured by the GIS. To minimize predation effects on newly translocated animals, releases should not occur on deer or elk winter ranges, or in areas of known high rates of mountain lion predation on livestock.

Based on GIS and field assessments, a regional biologist in conjunction with several other biologists with habitat expertise should develop an estimate of the population size the habitat could support.

**Table 3.** Physical attributes and minimum area requirements for GIS habitat evaluation of proposed bighorn sheep translocation sites.

Habitat Attribute	Minimum Area Requirement
Suitable habitat	85 km <sup>2</sup>
Winter range	20 km <sup>2</sup>
Lambing habitat	>4% of suitable habitat
Summer range	51 km <sup>2</sup>
Escape terrain	15 km <sup>2</sup>
Property ownership	>75% of all habitat types should be on public lands

## Population Characteristics

### Native Populations

The Salmon River drainage in central Idaho contains native (never extirpated) populations comprising the largest numbers of bighorn sheep in the state. These animals represent an irreplaceable genetic and ecological resource unique to Idaho. Native bighorn sheep populations in general have greater genetic variability than reintroduced populations (Luikart and Allendorf 1996, Fitzsimmons et al. 1997) and may be more valuable as source populations for reintroductions (Singer et al. 2000). Thus, to protect this genetic and ecological resource, no bighorn sheep from outside populations will be translocated into or adjacent to native populations.

### Health

Mixing populations of wildlife through translocations involves an inherent risk of inadvertently spreading diseases that can have either short- or long-term consequences. Parasites such as scabies mites (*Psoroptes ovis*) or diseases such as contagious ecthyma (orf) can be relatively benign in bighorn sheep populations that have developed immunity to them, but may cause, at a minimum, short-term impacts if introduced into naïve populations. Exposure to respiratory or other serious disease agents can have long-term, serious consequences and any disease introduction can set back rather than further population restoration. While some diseases may be visually apparent, others may be transmitted through asymptomatic

carriers. Treatments are currently unavailable to effectively prevent or mitigate disease agents in free-ranging bighorn sheep.

Assessment of the health histories of both source and any resident populations that translocated sheep might come into contact with will be conducted prior to making decisions about translocation. If these data are not available, the translocation should not be conducted. Translocations for the purpose of range extension of an existing population may be an exception if they are unlikely to contact any other populations due to distance or likely barriers to movement. Mixing source populations is not recommended due to increased risk of disease exposure.

Supplementing bighorn sheep populations that are performing poorly because of pneumonia-caused mortality has not been shown to be successful. In these situations, translocated sheep are more likely to die from disease than resident sheep and lamb recruitment does not differ among resident and translocated animals (Enk et al. 2001, Cassirer and Sinclair 2007), thus no population growth occurs. This is likely due to immunologically naïve translocated animals being exposed to endemic pathogenic organisms in the resident population (Cunningham 1996). Likewise, if mountain lion predation is limiting a population, adding more sheep will likely not be beneficial.

Data on population dynamics and causes of mortality in a stagnant or declining recipient population are needed prior to consideration of supplementation. Similar information is needed for the source population. Populations with a recent (within 10 years) history of respiratory disease or fall ratios of <25 lambs:100 ewes should not be considered as source or recipient populations. If these data are not available, then no translocations should be considered. If an initial supplement is unsuccessful, no further supplements will be undertaken until the problem is identified and remedied.

### Numbers and Source Populations

Several studies have suggested that a minimum number of animals increases the likelihood of translocation success (Griffith et al. 1989, Wolf et al. 1996, Kormers and Curman 2000). This relationship is generally asymptotic depending on the species: increasing the number only enhances success up to a certain point. Kormers and Curman (2000) suggested a minimum release size of 20 ungulates and a sex ratio of 1:1, however many states typically include



only 0.25-0.33:1 males to females in bighorn sheep translocations. It is generally accepted that younger males are preferred for translocations due to logistics of transporting larger rams (George et al. 2008).

Finally, in general, animals do best when they are physiologically and genetically adapted to their environment.

A minimum of 20 animals should be translocated to a new site, although fewer can be used for augmentation or range extensions. Habitat at source and release sites should be similar and as close as possible geographically.

## Monitoring

All translocated animals should be marked with a tag in  $\geq 1$  ear. At least 50%, and preferably all, animals moved should also be radiomarked. If possible, collars should be individually identifiable with vinyl or plastic colored alphanumeric markers. If available, GPS collars could be used to gather additional data from translocated animals.

Where possible, animals should be monitored  $\geq 1$ /week for the first month post-release,  $\geq 1$ /month for the first year, and  $\geq 2$ /year for the life of the animals or the radiocollars. A population monitoring program should also be implemented to assess whether goals of the translocation were achieved; a progress report should be submitted within 3 years post-release to help improve and adapt the translocation program. These expenses should be included in the cost of the translocation project.

## Prioritization

Translocations shall be prioritized collaboratively by regions and the wildlife bureau based on proposals containing a justification for the translocation, expected outcome, and an evaluation of all the above factors.

## Public Information

All bighorn sheep translocations will be conducted in accordance with existing legislation and policy. Idaho Code 36-106 requires notification of county commissioners, federal and state land grazing permittees, and private owners or leaseholders of land in or contiguous to the proposed release site prior to a translocation. The president pro tempore of the Senate and the speaker of the House of Representatives shall also receive a translocation plan from the director of IDFG. Any affected individual or entity can request a hearing within 10

days of notification of the proposed translocation and a hearing shall be scheduled within 30 days of the request. The department will develop an agreement with other cooperating agencies and private entities to protect existing sheep or livestock operations if there are any federal or state lands grazing permittees or owners or leaseholders of private lands that may be affected by a translocation. Title 36-408 states that no auction tag funding may be used for translocations south of the Snake River and west of U.S. 93. A press release will be issued prior to any wildlife capture or translocation.

## Bighorn Sheep Translocation Management Direction

Management Direction – The Department will maximize the likelihood of translocation success at establishing or augmenting bighorn sheep populations

**Strategy:** The Department will use the guidelines established in this plan to evaluate potential translocations.

**Strategy:** The Department will use source stock from within Idaho that is adapted to Idaho climatic conditions whenever possible.

**Strategy:** The Department will match source and destination habitat and elevation type.

**Strategy:** The Department will use native genetic stock (with regard to Rocky Mountain bighorn sheep in particular) for future translocations to maintain, in so far as possible, the unique genetic identity of Idaho's native Rocky Mountain bighorn sheep.

**Strategy:** The Department will evaluate individual population health histories of both source and destination (if any) population to reduce or eliminate potential transfer of pathogens from one location to another.

**Strategy:** The Department will comply with all population health guidelines established for movement of domestic livestock.

**Strategy:** The Department will develop and implement a post-release monitoring protocol to determine the success of the translocation operation.

**Strategy:** The Department will not translocate bighorn sheep into areas where they are likely to contact domestic sheep or goats.

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# HARVEST MANAGEMENT AND HUNTING

Bighorn sheep are one of the most sought after game species in North America, as evidenced by extremely high demand for limited hunting opportunities. Across the western U.S., >90 hunters apply for each available bighorn tag. Bighorn sheep hunting offers a unique experience, generally requiring significant effort in rugged, remote country. Because of the unique, often once-in-a-lifetime, opportunity, harvest is usually managed under a conservative framework to provide a high-quality experience. In the fall of 2008, IDFG conducted a survey to capture hunters' opinions toward bighorn sheep harvest management issues (Appendix F).

## Harvest Management

Over the last 75 years, ram tags and harvest have varied considerably with changes in populations (Fig. 10). Disease-related die-offs that have impacted large portions of Idaho's sheep population typically resulted in large reductions in tag levels, followed by slow increases in tags as herds have recovered.

Under the most recent bighorn sheep plan (1991-95), hunting was not recommended unless a population was estimated at >100 animals. This criterion

is likely appropriate for most healthy bighorn populations because most populations in Idaho function as components of larger metapopulations. However, a 100-animal minimum may preclude legitimate ram-only harvest opportunities in some smaller populations where habitat carrying capacity prevents achieving minimum population size or risk of catastrophic, all-age die-off is high.

In Idaho, harvest has been restricted to  $\frac{3}{4}$ -curl or larger rams (1970-83) and  $\frac{3}{4}$ -curl or larger rams or rams >4 years old ( $\geq 3$  annual growth rings on horns, 1984-2006). The addition of the annual growth ring criterion was designed to allow harvest of older rams with broomed horns and California bighorn rams with widely flared horns or older rams that did not attain  $\frac{3}{4}$ -curl horn length. In 2007, regulations were changed to allow harvest of any ram. This change simplified regulations, allowed hunters to define their own hunting experience, and reduced enforcement problems. Based on information from states where a similar change occurred, average age of harvested rams increased under any-ram regulations, while hunter success rates tended to remain stable.

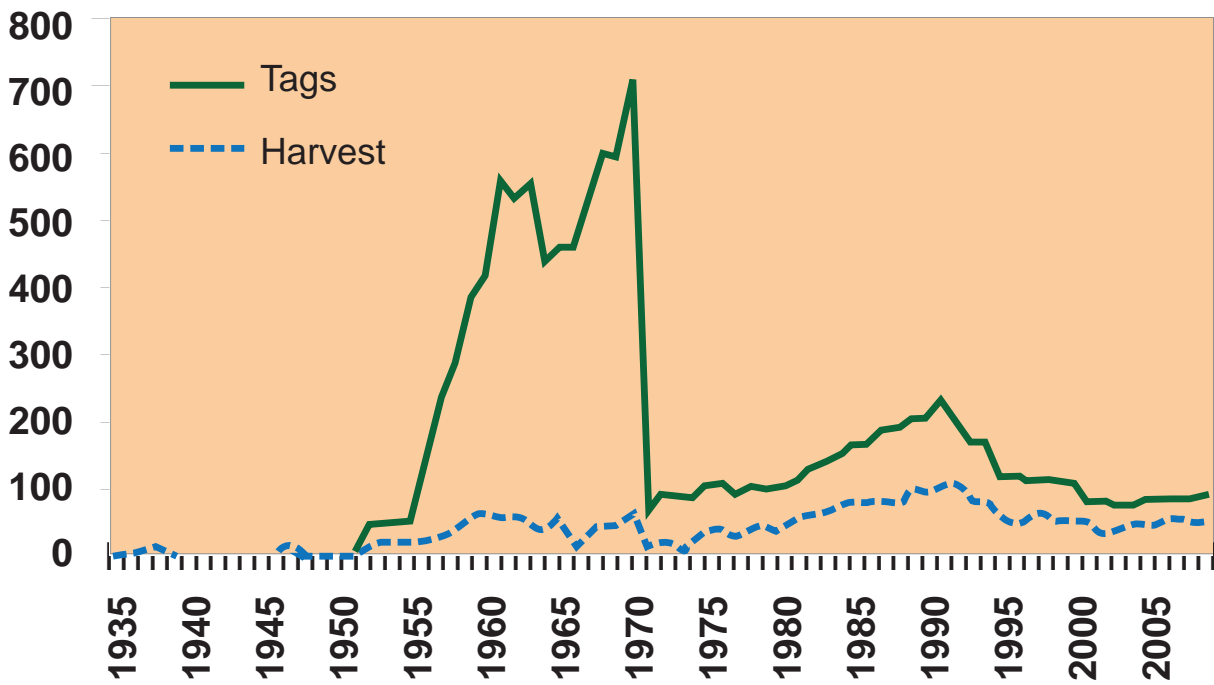


Figure 10. Bighorn sheep tags (actually issued) and harvest, Idaho, 1935 to present.

Direction from the 1991-95 bighorn sheep plan is to set tag levels so that harvest is  $\leq 20\%$  of class III and IV rams ( $\frac{3}{4}$ -curl or larger) observed in the most recent survey in each hunt unit. This conservative harvest strategy ensures adequate mature rams for harvest and biological-behavioral requirements (social dominance hierarchy, genetics, mature male:female ratios, etc.). Average hunter success rates are typically incorporated in determination of appropriate tag levels. For example, given comparable numbers of harvestable rams, tag levels for hunts in which long-term success rates average 33% can be 3 times greater than for hunts where hunter success approaches 100%.

Current timing of bighorn sheep seasons avoids hunting during the breeding season. California bighorn sheep seasons end by 8 October and Rocky Mountain bighorn sheep seasons end by 31 October. Most bighorn sheep seasons start 30 August and continue until 14 September or 8 October for California bighorns and until 13 October for Rocky Mountain bighorns. Some late-season hunts exist: 6 of 7 California bighorn hunts are open through 8 October; and 3 hunts for Rocky Mountain bighorns run 13-31 October. Depending on the hunt area, a split- or late-season structure is employed to provide a high-quality hunting experience (few hunters, greater opportunity for mature rams), address hunter density issues, or offer hunting opportunity for bighorns migrating into Idaho. Hunters generally favor (61%) current season timing and opportunity levels over allowing fewer tags during later seasons with higher success rates. Only 22% of survey respondents favored hunting during the rut if tag levels would have to be reduced.

Survey respondents supported accommodating hunters who are impacted by fire-related access closures by allowing deferral of hunting to the following year (67% support), but not by extending seasons into late October (only 35% support). Overall, those responding to the survey supported (53%) a later season opening date of 15 September to avoid most fire-related access closures. However, approval by Idaho residents for such a change was lower (45-49%), and the loss of 2 weeks of hunting opportunity would probably create a negative impact on some hunters and outfitters. Further, fire-related closures are temporally and spatially sporadic, generally affecting relatively few hunts in some years.

Reduction of ewe numbers may be necessary (although unlikely in foreseeable future) when sheep numbers have increased above population

objectives, or when habitat degradation is possible due to overpopulation. Removal of ewes can be accomplished through capture and translocation (in-state or to other jurisdictions) or regulated harvest. Ewe removal is generally not recommended when populations are below habitat carrying capacity, newly reintroduced, or suppressed by a mortality factor (e.g., disease). In populations with a history of pneumonia, ewe removal is usually restricted because population growth following a die-off is often slow and density independent, and ewe removal would likely be additive to other mortality. Survey respondents displayed moderate support (49% vs. 36% opposed) for ewe harvest over out-of-state translocation if population reduction is necessary.

Under Idaho Code 36-408, 2 special bighorn sheep tags are set aside each year; 1 each to be auctioned and raffled by a qualified conservation organization via a bid system. Winners are able to hunt in any open bighorn sheep hunt in the state, with the exception of GMU 11 (Hells Canyon), which alternates between auction (odd years) and raffle (even years) tag holders. Net proceeds generated from the tag auction are dedicated to “bighorn sheep research and management purposes” (except translocation of sheep in southwest Idaho), whereas raffle tag net proceeds must be used for “solving problems between bighorn sheep and domestic sheep, solving problems between wildlife and domestic animals, or improving relationships between sportsmen and private landowners by being utilized in the veterinarian program.”

Idaho has a state policy of maintaining separation between wild and domestic sheep to prevent interaction between the species. At times, individual or small groups of bighorns may leave established ranges and wander through atypical habitat or areas occupied by domestic sheep. Because of concerns regarding intermingling (see bighorn health section), attempts are usually made to remove these wandering bighorns from the wild to prevent their return to established populations. Because timing and logistics are critical to these removal projects, IDFG personnel or designated agents conduct removals.

In addition to state-permitted hunting, native Americans harvest bighorns under provisions of various treaties. Tribal hunting regulations and harvest levels are generally not available to IDFG.

## Hunting

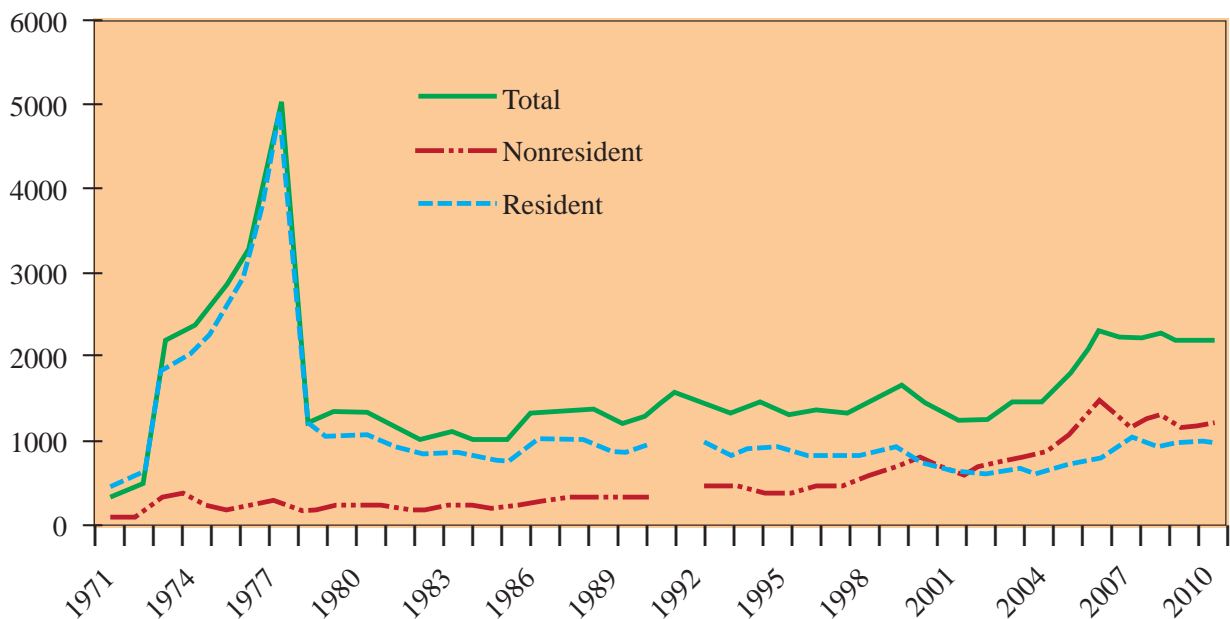
All bighorn hunting in Idaho is allocated via a controlled hunt (random drawing) system. Prior to 1971, bighorn sheep were hunted and managed under a combination of controlled hunts and a general season framework. Currently, nonresidents are limited to  $\leq 10\%$  of all bighorn sheep tags and not more than 1 nonresident tag can be issued for controlled hunts with  $\leq 10$  tags ( $\leq 10\%$  to nonresidents in hunts with  $> 10$  tags). Chances of obtaining a bighorn tag have generally declined over time as interest and demand have increased, particularly for nonresidents (Fig. 11). Notwithstanding, overall controlled hunt draw success in Idaho is the highest among western states (3.9% in 2009). Further, because nonresident applicants outnumber residents and nonresidents can only obtain 10% of tags, resident draw rates average approximately 2.2 times greater than the overall draw rate (approx. 7.2% in 2009, <http://fishandgame.idaho.gov/apps/ch/odds.cfm>).

From 1975 to 1985 hunters were allowed to harvest only 1 bighorn sheep in their life (excluding sheep harvested before 1974). Beginning in 1986 the lifetime bag limit was expanded to allow harvest of 1 California bighorn and 1 Rocky Mountain bighorn. Ewes were excluded from lifetime limit restrictions beginning in 1991. Unsuccessful hunters may apply for another tag after a 2-year waiting period.

Although recent genetic research suggests California bighorn sheep and Rocky Mountain bighorn sheep are a single, genetically indistinguishable subspecies, phenotypic differences are apparent. Further, each type of bighorn provides a unique hunting opportunity in distinctive habitat.

The ability of some hunters to apply for additional tags reduces overall chances of drawing a tag by a small amount. A review of recent application and harvest history indicated that approximately 6% of tags were issued as second or subsequent tags for individual hunters. However, eliminating application eligibility for all previous tag holders (the most restrictive scenario) would have increased the overall drawing rate by only 0.2 percentage points in 2008 (3.8% vs. 3.6%). Based on public input, 62% of respondents favored retaining the current system of allowing hunters to harvest 2 rams in their lifetime (1 California and 1 Rocky Mountain). Further, 48% opposed limiting harvest to 1 ram/lifetime, and 59% opposed limiting a person to 1 tag/lifetime.

Traditionally, hunters have been free to use any lawful weapon during controlled bighorn sheep hunts. The vast majority of sheep have been harvested with centerfire rifles and overall hunter success rates typically average 50-65%. However, success rates vary widely across hunt areas (20-100%) and type of sheep (Rocky Mountain avg.  $\approx 55\%$ , California avg.  $\approx 70\%$ ). Interest in special



**Figure 11.** Applicants for controlled bighorn sheep hunts, Idaho, 1971 to present.

weapon hunting for many species has been increasing through time as hunters seek out greater challenges and alternate hunting experiences. If success rates were lower with less efficient weapons (archery or muzzleloader), more tags could probably be allocated in some hunt areas than under any-weapon regulations. Hunter opinion about special-weapon hunting opportunity was somewhat mixed; approximately 38% favored special-weapon opportunities, whereas 46% opposed such hunts.

Because Idaho is a large state with very diverse and contrasting habitats, a wide array of hunting opportunities exist for prospective bighorn sheep hunters. Many hunts have contrasting hunting and harvest expectations and provide distinct and often dissimilar sheep hunting opportunities. The Department will continue to provide a diversity of hunting experiences in the state to meet the demands of hunters.

## Harvest Monitoring

Unsuccessful hunters are required to return unused tags to IDFG within 10 days of the close of their season. Successful hunters are required to present the horns of harvested rams at an IDFG regional office within 10 days of harvest. Information about the hunter (name, address, licensing), hunt (date, location, weapon, effort), and harvested animal (horn annuli and size) are recorded on a Big Game Mortality Report (BGMR). A uniquely numbered aluminum pin is placed in a hole drilled in a horn sheath and a sample of horn shavings resulting from the drilled hole are retained for DNA extraction. All information collected on BGMRs is entered in a statewide database. (The same information and sample are collected from bighorn sheep found dead from other causes, except horns from ewes and small rams, and old, deteriorated horns are not pinned). Hunters who fail to turn in unused tags or check in harvested rams are contacted to ascertain results of their hunt.

## Bighorn Sheep Harvest Management Direction

Management Direction - The Department will continue to recognize Rocky Mountain and California bighorn sheep as unique “trophy types;” with Rocky Mountain bighorn sheep north of I-84 and California bighorn sheep south of I-84.

Management Direction - The Department will optimize hunting opportunity, hunter flexibility, and regulation simplicity.

**Strategy:** Continue to allow Idaho hunters the opportunity to harvest 1 Rocky Mountain and 1 California bighorn sheep if successful in obtaining the appropriate tags.

**Strategy:** Maximize harvest opportunity for rams in herds at high risk of all-age die-offs or in limited habitat. Consider allowing ram harvest in herds of <100 total sheep when:

1. Range overlap with domestic sheep and goats has occurred regularly or is very likely to occur, or
2. Analysis of habitat conditions and population performance indicate a population is unlikely to reach 100 individuals.

**Strategy:** Maintain existing any-ram regulation.

**Strategy:** Maintain current hunting season structure. Continue to offer early and late-season hunts, allowing applicants for tags to choose hunt periods from late summer until the period immediately preceding, but not including, the “rut” or breeding season.

**Strategy:** The Department will maintain the availability of mature rams by restricting harvest to no more than approximately 20% of the Class III and IV rams observed during the most recent survey or believed present based on the best judgment of the individual Regional Wildlife Manager (as some surveys may not be completed due to weather or other external influences).

**Strategy:** Provide hunters who are unable to participate in their planned hunt because of fire-related access closures with the opportunity to defer their hunt to the following year.

**Strategy:** Maintain current any-weapon regulation which allows hunters to choose the type of weapon they wish to use.

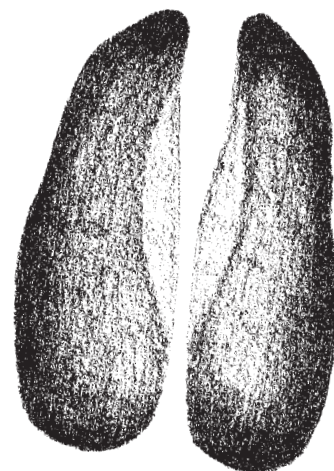
Management Direction - The Department will offer 1 Special bighorn sheep tag to be sold at auction annually and 1 Special bighorn sheep tag to be offered by special drawing annually, to raise funds to administer the bighorn sheep research, management, and health-monitoring programs.

Management Direction – The Department will evaluate and consider using additional hunter harvested samples to monitor health status. Encourage staff to collect alternate tissue samples (e.g., muscle, integument) in addition to horn shavings to increase success of DNA extraction.

Management Direction - The Department will monitor trend in average age at harvest and horn measurements to capture any indication of decline in age or size of animals harvested.

Management Direction - The Department will monitor annual hunter harvest success rate and average number of days for a successful hunter to locate and harvest a bighorn as a potential indicator of population decline.

Management Direction - The Department will use in-state translocation to manage ewe reduction when efficacious and translocation criteria are satisfied. Otherwise, establish ewe harvest seasons unless inter-jurisdictional obligations or need for out-of-state translocation are considered necessary for overall bighorn sheep conservation.



# ENFORCEMENT OF BIGHORN SHEEP REGULATIONS

Illegal harvest or poaching of bighorn sheep can have a significant impact on population goals, recovery efforts, and loss of opportunities for hunters and nonconsumptive wildlife users. Individual poaching cases may pose a greater threat to bighorn sheep populations because of the high value of mature bighorn sheep ram horns and their relatively small populations in comparison to deer or elk. Preventative measures, focused law enforcement, and reduced commercial opportunities will help bighorn recovery efforts, increase legally harvestable animals, improve drawing odds, and increase watchable wildlife opportunities.

The very high interest in bighorn sheep hunting creates more demand for bighorn sheep rams than any other big game animal hunted in Idaho, with the possible exception of mature mule deer bucks. The difficulty in drawing a “once-in-a-lifetime tag” and the illegal market value of ram horns provide motives for would-be poachers to find creative ways to kill a bighorn ram. Historically, enforcement cases have involved taking sheep during closed season, transferring tags to people that were not successful in the draw, tribal members with treaty rights claiming non-tribal harvested animals, claiming illegally killed ram heads as “picked-up heads” found dead, and hiring of unlicensed outfitters. Enforcement of bighorn sheep harvest regulations requires a significant amount of time, personnel, and equipment resources in order to be effective at apprehending violators.

Examples of illegal activity involving bighorn sheep:

- In 2004, 3 Idaho men were caught unlawfully selling 9 bighorn sheep heads for \$6,000. Felony charges were later reduced to misdemeanors for a total of 37 charges. The suspects paid over \$6,000 in fines and restitution, and were sentenced with suspended jail time and probation. Investigators were unable to determine the origin of all 9 sheep heads, but several had altered pins, and it was not determined how each was killed.
- In 2008 an Idaho resident was charged with intentionally killing a bighorn ram in a hunt area outside that for which his tag was valid. The man admitted to applying for a different hunt area with easier drawing odds while intending to kill a mature ram in another area.
- In February 2010 a group of young individuals were shooting ground squirrels (*Spermophilus* spp.) in the Reynolds Creek area of Owyhee County when one of them intentionally shot and killed a bighorn ewe and left the animal on the hillside. An observant witness reported the incident and conservation officers were able to apprehend the group as they left the area.

Under current Idaho Code 36-1404, the “reimbursable damage” owed the state by a person found guilty of the unlawful killing, possession, or waste of a bighorn sheep is \$1,500. This makes the poaching of a bighorn sheep a felony under Idaho Code 36-1401(c)3; which defines felonies as the unlawful killing, possessing, or wasting of any combination of wildlife having a reimbursable damage more than \$1,000. Idaho Code 36-202(h)4 further defines a “trophy bighorn sheep” as any ram, and assigns a reimbursable damage of \$10,000 for an unlawfully killed or possessed bighorn ram. Any unlawful killing of a bighorn sheep is also classified as a flagrant violation under Idaho Code 36-1402(e). In addition to fines from \$500 to \$1,000 and jail time; the individual found guilty of poaching a bighorn sheep may have hunting, fishing, or trapping privileges revoked up to the lifetime of the individual.

The possession, sale, and transfer of bighorn sheep parts are governed under a combination of Idaho Code and Idaho Fish and Game Commission administrative rules. Idaho Code 36-1101(b) prohibits any person to take or possess any game animals, except as may be provided under Idaho Code or Idaho Fish and Game Commission rules. Idaho Code 36-501(b) legalizes the possession or sale of lawfully taken game animals including bighorn sheep. However, Idaho Code 36-501(b) specifically excludes the lawful possession or sale of bighorn sheep horns when it makes lawful the possession or sale of the antlers or horns of deer,



elk, moose, pronghorn, and mountain goat that were naturally shed or from animals which have died of natural causes. Idaho Administrative Code, IDAPA 13.01.10.302, set by the Idaho Fish and Game Commission further specifies that bighorn sheep horns of animals that have died of natural causes may be recovered and possessed but may not be sold, bartered, or purchased, and may not be transferred to another person without a permit issued by the Director of Fish and Game. All such horns must be presented to IDFG for placement of a metal pin in the horn within 30 days of recovery. The Department occasionally receives inquiries regarding the use of sheep horns in carvings, buckles, lamps, etc. If the sheep horn is from a hunter harvested sheep, the parts may be sold with a statement from the seller stating its origin. If, however, the sheep horn is from a sheep found dead, the horns or items made of horn parts may not be sold or transferred to another person.

In 2007 administrative rules changed to allow a hunter with a valid tag to harvest any ram instead of only rams with a  $\frac{3}{4}$  or greater curl, or  $\geq 3$  growth annuli. The any ram rule made it simpler for hunters to identify a legal sheep and eliminated the sometimes difficult law enforcement scenario where a hunter harvested a ram close to the  $\frac{3}{4}$ -curl requirement.

The mandatory check in of all harvested and found dead (picked up) sheep horns, and the prohibition of the sale or transfer to another person of picked up horns, are the most important enforcement tools specific to bighorn sheep protection. Upon check in, a uniquely numbered silver aluminum pin is permanently inserted into the horn of a hunter harvested bighorn. Picked-up horns of bighorn sheep found dead from natural causes are permanently marked with uniquely numbered gold aluminum pin.

Unsuccessful bighorn sheep, mountain goat, and moose hunters must present or mail their unused tags to IDFG within 10 days of the close of their hunting season. This information is important for determining accurate success rates and documenting unsuccessful hunters' eligibility for drawing future tags. In recent years reporting compliance has decreased. Failure to report results renders hunters ineligible to apply for future controlled hunts. Continued education and adding the mandatory report requirement to administrative rules may be necessary to increase reporting compliance with tag holders.

Law enforcement efforts and preventive measures are needed to sustain and conserve Idaho's wildlife

populations for future generations. The IDFG enforcement and wildlife programs have identified areas where enhanced protection is required for bighorn sheep.

The following improvements can be made with the mandatory check in process:

- Revise and increase training of IDFG staff performing mandatory check-in.
- Work with prosecutors to revise the Big Game Mandatory Harvest Report to assist prosecution of individuals who falsify the BGMR.
- Collect DNA horn shavings and, if available, other DNA from all sheep horns and retain in a searchable database.
- Require persons checking in picked-up bighorn sheep horns to specify the exact location the head was found or return to the pick-up site upon request of a conservation officer in order to verify that the sheep died of natural causes in Idaho before the person may retain possession of the sheep horns.

Commercial over-exploitation of wildlife can place populations and management goals in jeopardy and led to the extinction of some species that were once numerous in North America. As a result, in the early 1900s sportsmen sponsored the creation of our nation's first conservation laws. According to a veteran Idaho conservation officer who has investigated multiple sheep cases, the illegal commercial market of bighorn sheep horns is "alive and well." Estimated value of a picked-up sheep head ranges from \$300 to \$700, but large-sized rams skulls can be sold for thousands of dollars. Furthermore, each state and province has different rules regarding possession, sale, and transfer of sheep skulls and other wildlife parts; adding to the difficulty in detection and prosecution. All states currently require pinning of hunter-harvested sheep horns, but regulations governing horn pick-up and transfer are inconsistent among states. Some picked-up sheep horns, claimed to have been found in Idaho, are suspected of originating in other states. There is a great need to coordinate between different jurisdictions and to be knowledgeable of other states rules.

Advances in technology and breeding of domestic and game-farmed species could create unique threats and challenges to Idaho's wild sheep populations. The potential for individuals to kill large wild sheep

for their genetic or breeding use in private game farms or high-fenced shooter operations exists today. The risk of genetic contamination of bighorn sheep herds creates the need for additional enforcement measures. The Department should coordinate with the Idaho Department of Agriculture to define wildlife similarly and regulate the possession of body parts and reproductive tissues to ensure that wild bighorn sheep populations are protected for the future.

Sheep are hunted in remote areas where proper meat care is difficult. Illegal wasteful destruction of game meat is too frequently an issue. Increased education of sheep hunters is needed. The IDFG brochure “Backcountry Game Meat Care Guide” should be distributed to sheep tag holders and outfitters and guides each year in order to educate people regarding the proper care of harvested bighorn sheep.

The overall economic value of bighorn sheep to Idaho should be studied and appropriate funding should be secured for their conservation, restoration, management, and regulatory enforcement. In addition to being one of the most valuable big game species in Idaho, bighorn sheep have tremendous watchable wildlife potential that could increase for nonconsumptive users. The enforcement program must have a significant amount of personnel and equipment resources dedicated to bighorn sheep protection to effectively support wildlife management goals. Education and enforcement of codes and regulations will continue to play an important role in the future of bighorn sheep conservation and management.

Management Direction - The Department will implement regulations to ensure that illegal harvest is minimized and potential harvest by regulated hunting is maintained.

**Strategy: Department law enforcement investigations will prioritize trophy species including bighorn sheep, and will strive to minimize potential abuse of the bighorn sheep resource.**

Management Direction - The Department will advocate changes to Idaho Code or Administrative Rule to improve BGMR law enforcement use. This would help minimize the potential for illegal harvest of bighorns outside of legally established seasons and procedures.

**Strategy: The Department will seek legislation or rule to require persons checking in picked-up bighorn sheep horns to specify the exact location the head was found or return to the pickup site upon request of a conservation officer in order to verify that the sheep died of natural causes in Idaho before the person may retain possession of the sheep horns.**

Management Direction - The Department will develop a summary of rules from different jurisdictions pertaining to possession, sale, transfer, and pickup of sheep horns, or parts.

**Strategy: The Department will coordinate with the Wild Sheep Foundation and the Northern Wild Sheep and Goat Council to develop a summary of each jurisdictions’ rules pertaining to possession, sale, transfer, and pick up of sheep horns or parts.**

Management Direction - The Department will address the issue of commercial exploitation of bighorn sheep via the sale and transfer of bighorn sheep horns, parts, and viable genetic material by enforcing existing laws and working to create new laws.

**Strategy: The Department will maintain the prohibition of the sale and transfer of picked-up sheep horns.**

**Strategy: The Department will seek legislation or rule to prevent unregulated harvest or possession of viable genetic material from wildlife.**

# PUBLIC AWARENESS AND EDUCATION

Bighorn sheep are among Idaho's most treasured wildlife species and widespread fascination with this majestic animal can provide a means of educating the public about wildlife and wildlife management in general. A critical component of bighorn sheep management is ensuring that all stakeholders are provided information, and that the information is readily available through traditional and innovative communication methods. The Department uses newsletters, public meetings, workshops, media outlets, internet, and other communication tools to share information with stakeholders. However, the way society receives information is ever changing and will continue to evolve. It is critical that IDFG keep current with evolving media formats and communication methods.

## Bighorn Sheep Viewing

While bighorn sheep are one of Idaho's most highly desired trophy species, great demand also exists for information and viewing opportunities. Many Idaho river rafting and jet boat touring companies use bighorn sheep viewing to promote their trips. Many people who have no interest in hunting bighorn sheep are very interested in learning more about them and observing bighorn sheep in the wild.

To raise the social awareness and to help diminish unwanted mortality of bighorn sheep, IDFG has already partnered with private donors, agencies, and an assortment of outdoor-oriented groups to develop bighorn sheep viewing-interpretive sites near the towns of Salmon and Challis, Idaho. Interpretive signs highlight the species and visitors can use built-in spotting scopes to scan the nearby hillsides for bighorn sheep.

While viewing opportunities are encouraged, special emphasis must be given to avoid potential negative impacts of human activity on sheep (winter range, lambing areas, road mortality, etc.).

Management Direction - The Department will pursue a wide range of channels to educate the public about the value of Idaho's native wildlife resources, including bighorn sheep.

**Strategy:** The Department will expand the use of the department's website, media releases, and electronic mailings to better inform the public of bighorn sheep ecology, management, research, policy, direction, and the rationale behind decisions related to management.

**Strategy:** The Department will provide educational information including pamphlets, brochures, signs, and management summaries to all interested parties.

**Strategy:** The Department will develop educational programs for presentation to schools, educators, groups, and interested individuals; investigate the use of trained volunteer facilitators where appropriate.

**Strategy:** The Department will develop and provide resources to hunters on care and handling of their meat, horns, and skin.

**Strategy:** The Department will develop and provide educational information regarding use of pack goats in bighorn sheep habitat.

**Strategy:** The Department will support educational events that inform Idahoans and others about Idaho bighorn sheep and other wildlife resources.

**Strategy:** The Department will emphasize professional management and scientific background information regarding bighorn sheep.

**Strategy:** The Department will develop an emergency protocol for any observation of interactions between wild sheep and domestic sheep or goats where the public can contact authorities through a variety of means.



Management Direction – The Department will develop informational products for prospective hunters that describe the diversity of bighorn hunting experiences available in different hunt areas, including information regarding access and topography, success rates and hunter effort, typical age and horn size of harvested rams, unique hunt area attributes, etc. to assist in matching hunter expectations with the appropriate hunting experience.

**Strategy:** The Department will develop these informational products and provide access to them on the IDFG website.

Management Direction –The Department will collaborate with ISDA and the Idaho Woolgrower’s Association to develop an education-outreach effort to inform owners of domestic sheep and goats of the risks associated with comingling and recommendations to avoid contact.

**Strategy:** The Department will develop information that can be provided to domestic sheep and goat owners and the general public to help prevent contact between bighorn sheep and domestic sheep or goats.

**Strategy:** Where necessary, provide photo identification cards and other information to producers in multiple languages.

Management Direction - The Department will continue to expand collaborative partnerships with other state agencies, federal agencies, conservation organizations, and private landowners to achieve mutual goals for bighorn sheep.

Management Direction - The Department will continue to provide opportunities for bighorn sheep wildlife viewing statewide.

**Strategy:** The Department will develop viewing opportunities, including roadside viewing kiosks, to increase public awareness of bighorn sheep and encourage understanding of and support for bighorn sheep management. The Department will continue to identify additional potential viewing and interpretive sites and work with partners to improve the sites in areas which will not adversely impact bighorn sheep.

**Strategy:** The Department will advertise bighorn sheep viewing opportunities in the Idaho Wildlife Viewing Guide.



# STATEWIDE MANAGEMENT DIRECTION

**Table 4.** Department strategic plan objectives and corresponding bighorn sheep management direction.

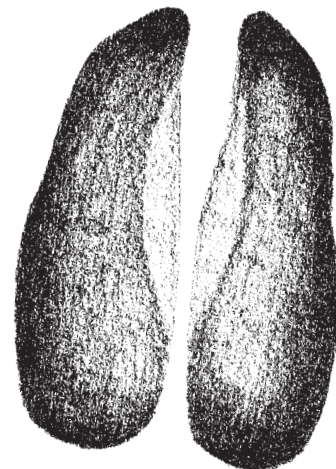
Compass Objective	Bighorn Sheep Management Direction
<p><b>Maintain or improve game populations to meet the demand for hunting, fishing, and trapping.</b></p>	<p>The Department will use historic documented population levels or densities consistent with suitable range availability to establish a baseline for management objectives. The Department will strive to allow populations to grow to ecologically sustainable densities as determined by habitat and range conditions unless conflicts with other uses of the habitat have been documented that would require management intervention to maintain bighorn herds at some lower population level.</p>
	<p>The Department will seek to improve understanding of metapopulation structure and interaction.</p>
	<p>The Department will manage native Rocky Mountain sheep populations as a unique and irreplaceable resource.</p>
	<p>In areas where elk are suspected to compete with bighorn sheep for limited resources, IDFG will closely monitor both elk and bighorn sheep numbers and will adapt management practices to move numbers of both species towards IDFG population objectives.</p>
	<p>The Department will implement the Predator Management Policy when evidence indicates that mountain lions (or other predators) are a major cause for bighorn sheep herds not meeting state management objectives.</p>
	<p>The Department will maximize the likelihood of translocation success at establishing or augmenting bighorn sheep populations</p>
	<p>The Department will improve the quality of bighorn sheep population data to better evaluate population trend and viability.</p>
	<p>The Department will implement regulations to ensure that illegal harvest is minimized and potential harvest by regulated hunting is maintained.</p>
	<p>The Department will advocate changes to Idaho Code or Administrative Rule to improve BGMR law enforcement use. This would help minimize the potential for illegal harvest of bighorns outside of legally established seasons and procedures.</p>
	<p>The Department will develop a summary of rules from different jurisdictions pertaining to possession, sale, transfer, and pickup of sheep horns, or parts.</p>
	<p>The Department will use in-state translocation to manage ewe reduction when efficacious and translocation criteria are satisfied. Otherwise, establish ewe harvest seasons unless inter-jurisdictional obligations or need for out-of-state translocation are considered necessary for overall bighorn sheep conservation.</p>
	<p>The Department will address the issue of commercial exploitation of bighorn sheep via the sale and transfer of bighorn sheep horns, parts, and viable genetic material by enforcing existing laws and working to create new laws.</p>



Compass Objective	Bighorn Sheep Management Direction
<p><b>Increase the capacity of habitat to support fish and wildlife.</b></p>	<p>The Department will engage with land management agencies and other land users and groups to improve the quality and quantity of bighorn sheep habitat throughout Idaho.</p>
	<p>The Department will work with other land and resource management agencies to ensure that critical areas of habitat are protected from inadvertent disturbance associated with recreational activities such as hiking, off-road vehicle use, low-altitude aerial activity, rock climbing, or trail riding.</p>
	<p>The Department will continually refine efforts at mapping occupied, unoccupied, potential, and suitable bighorn sheep habitat statewide.</p>
<p><b>Eliminate the impacts of fish and wildlife diseases on fish and wildlife populations, livestock, and humans.</b></p>	<p>The Department will continue to emphasize studies pertinent to resolving bighorn sheep disease issues.</p>
	<p>The Department will use standard procedures to safely capture and handle bighorn sheep.</p>
	<p>The Department will continue to advocate spatial or temporal separation between bighorn sheep and domestic sheep and goats, concurrent with established Commission policy and WAFWA guidelines.</p>
<p><b>Maintain a diversity of fishing, hunting, and trapping opportunities.</b></p>	<p>The Department will continue to recognize Rocky Mountain and California bighorn sheep as unique “trophy types,” with Rocky Mountain bighorn sheep north of Interstate 84 and California bighorn sheep south of Interstate 84.</p>
	<p>The Department will optimize hunting opportunity, hunter flexibility, and regulation simplicity.</p>
	<p>The Department will offer no more than 1 Special bighorn sheep tag to be sold at auction annually and 1 Special bighorn sheep tag to be offered by special drawing annually, to raise funds to administer the bighorn sheep research, management, and health-monitoring programs.</p>
	<p>The Department will evaluate and consider using additional hunter harvested samples to monitor health status. Encourage staff to collect alternate tissue samples (e.g., muscle, integument) in addition to horn shavings to increase success of DNA extraction.</p>
	<p>The Department will monitor trend in average age at harvest and horn measurements to capture any indication of decline in age or size of animals harvested.</p>
	<p>The Department will monitor annual hunter harvest success rate and average number of days for a successful hunter to locate and harvest a bighorn as a potential indicator of population decline.</p>
<p><b>Increase opportunities for wildlife viewing and appreciation.</b></p>	<p>The Department will continue to provide opportunities for bighorn sheep wildlife viewing statewide.</p>



Compass Objective	Bighorn Sheep Management Direction
<p><b>Maintain broad public support for fish and wildlife recreation and management.</b></p>	<p>The Department will pursue a wide range of channels to educate the public about the value of Idaho's native wildlife resources, including bighorn sheep.</p>
	<p>The Department will develop informational products for prospective hunters that describe the diversity of bighorn hunting experiences available in different hunt areas, including information regarding access and topography, success rates and hunter effort, typical age and horn size of harvested rams, unique hunt area attributes, etc. to assist in matching hunter expectations with the appropriate hunting experience.</p>
	<p>The Department will collaborate with ISDA and the Idaho Woolgrower's Association to develop an education-outreach effort to inform owners of domestic sheep and goats of the risks associated with comingling and recommendations to avoid contact.</p>
	<p>The Department will continue to expand collaborative partnerships with other state agencies, federal agencies, conservation organizations, and private landowners to achieve mutual goals for bighorn sheep.</p>



# FINANCIAL PLAN

## Introduction

Bighorn sheep management is a substantial portion of the statewide trophy species management program which is funded through license dollars leveraged with Federal Assistance funds, grants, and other monies.

Income from the sale of all bighorn sheep harvest tags offered to hunters through the normal drawing process totals about \$30,000 annually, which is deposited into the IDFG general account. Sale of 1 auction tag annually has averaged \$82,450 over the last 10 years, which has historically has been directed to bighorn sheep research and restoration in Hells Canyon. In addition, annual sale of 1 tag by lottery has yielded an average of \$62,031 per year over the last 10 years, with those funds dedicated to operation of the Department's Wildlife Health Laboratory.

Grants totaling approximately \$300,000 have been received from the Wild Sheep Foundation to aid in bighorn sheep research, land acquisition, and translocation projects since the last statewide Bighorn Sheep Plan was completed in 1990.

## Operations

Data collection for management (primarily bighorn sheep survey and inventory) is funded in large part by an annual Federal Aid in Wildlife Restoration grant, matched on a 1:3 basis by state license and tag sale funds. At present, \$115,000 is available for distribution across the entire state, and this amount must cover all surveys for not only bighorn sheep, but mountain goats and moose as well. Because bighorn sheep surveys are conducted primarily by helicopter at a cost of approximately \$1,000/hour of flight time, it quickly becomes evident that funding is insufficient to survey all bighorn sheep populations annually. Instead, funding is allocated so that some populations are surveyed once every 5 years on average. In order to minimize costs, bighorn sheep surveys are often flown as "add-ons" to other programs, such as deer and elk surveys. While this can potentially save money, results for bighorn sheep may be compromised when flown with other species.

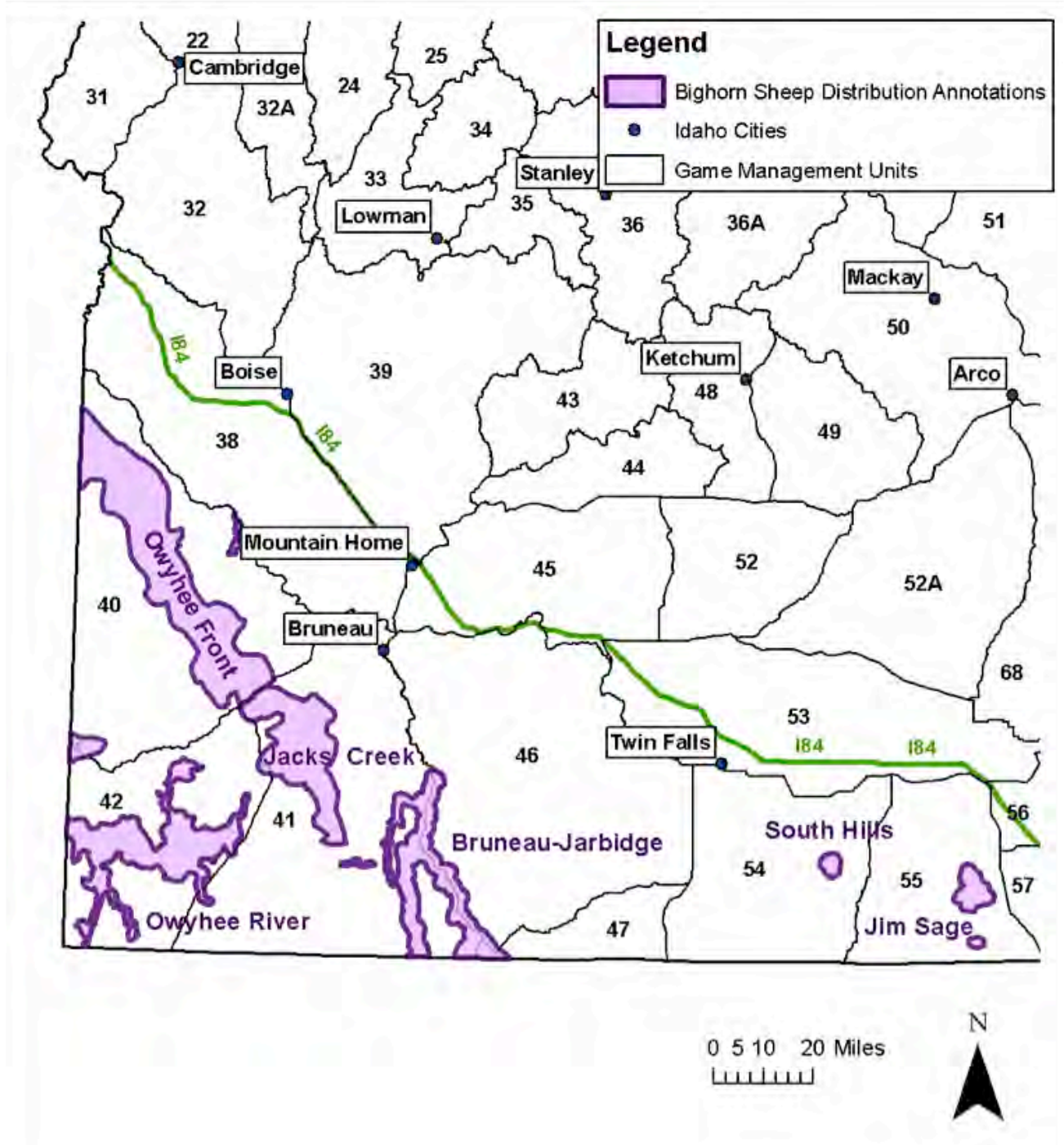
## Summary

Income derived from the sale of bighorn sheep tags is insufficient to fund statewide management, even with the addition of matching federal funds. Legislative approval of 2 special tags, sold annually via auction and lottery, has done much to make bighorn sheep research and management programs viable. Grants from sportsmen have also played a key role. However, the most significant factor has been the development of many strong and effective collaborative partnerships involving state and federal agencies and private organizations interested in bighorn sheep. By sharing their respective personnel and funding, many projects have been completed to the benefit of bighorn sheep and Idaho citizens that might otherwise never have been started.



# POPULATION MANAGEMENT UNITS

## CALIFORNIA BIGHORN SHEEP



**F**rom historical records, bighorn sheep ranged widely in Idaho in the early 1800s and are believed to have been one of the most abundant game animals in the state prior to the mid-1800s. Beginning in the 1870s, Idaho's bighorn sheep populations declined drastically. Idaho estimated 1,000 bighorns in the state in the early 1920s, mostly in the Salmon River drainage. By 1940 bighorn sheep were extirpated from the Owyhee River area. The 3 primary factors believed responsible for the large decline of bighorn sheep in Idaho were unregulated hunting, competition with domestic livestock for forage, and disease.

Idaho began efforts to reestablish bighorn sheep populations in the 1960s. Bighorn sheep from British Columbia were translocated to the East Fork Owyhee River drainage in 1963. Numerous bighorn sheep have been moved into and out of Idaho since then. In 1992, IDFG estimated there were >1,200 California bighorn sheep in the state. From 1980 to 2003, Idaho's California bighorn sheep populations provided a source for numerous reintroduction projects and nearly 400 bighorn sheep were captured and moved to other locations in Idaho, Nevada, Oregon, and North Dakota.

Bighorn sheep distribution for this plan is defined as the geographic range regularly or periodically occupied by bighorn sheep. Not all areas within this range have sufficient suitable habitat to support persistent populations and bighorn sheep can and do occasionally move outside this area. Distribution can change through time as a consequence of changes in population density, habitat, or other factors. We divided the California bighorn sheep distribution into 6 PMUs. Bighorn sheep populations were separated into PMUs based on current knowledge of distribution and connectivity between subpopulations and populations. Data is lacking for some of Idaho's California bighorn sheep populations, additional information from radio telemetry, aerial surveys, ground surveys, etc. would be beneficial for population management.

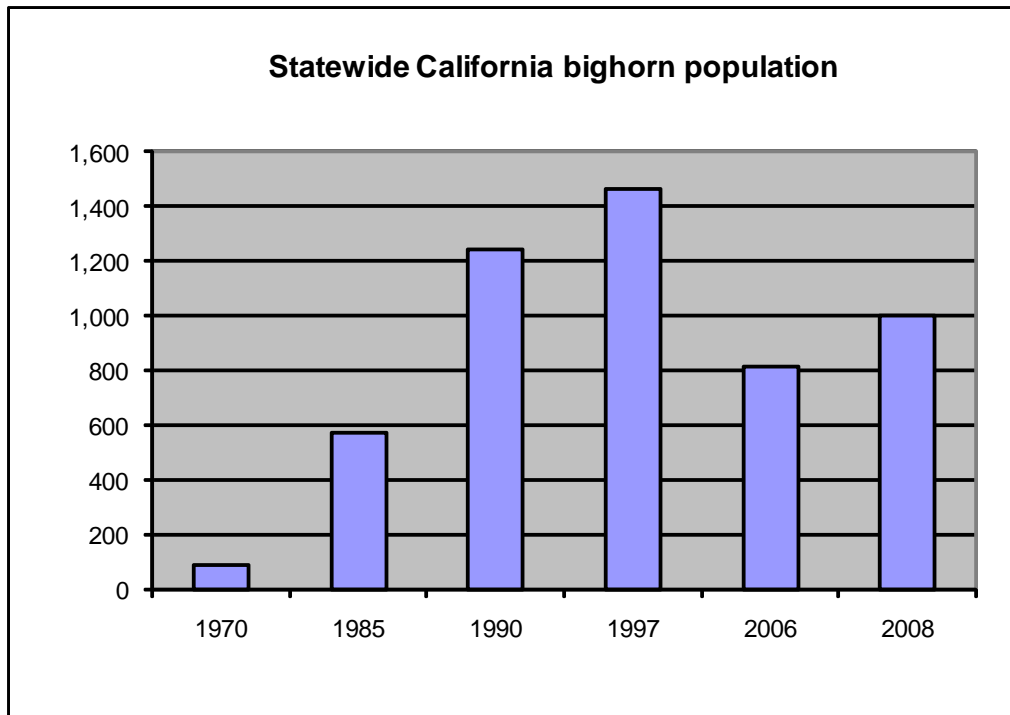
Idaho plans to continue to manage bighorn sheep north and south of Interstate 84 separately and will continue to refer to them as California and Rocky Mountain bighorn sheep "trophy types." The California and Rocky Mountain bighorn sheep display differences in physical appearance and occupy different habitats. California bighorn sheep generally occupy canyon and desert habitat while the Rocky Mountain bighorn sheep occupy rugged mountainous terrain. Currently, there are approximately 1,000 California bighorn sheep in Idaho.



# California Bighorn Sheep

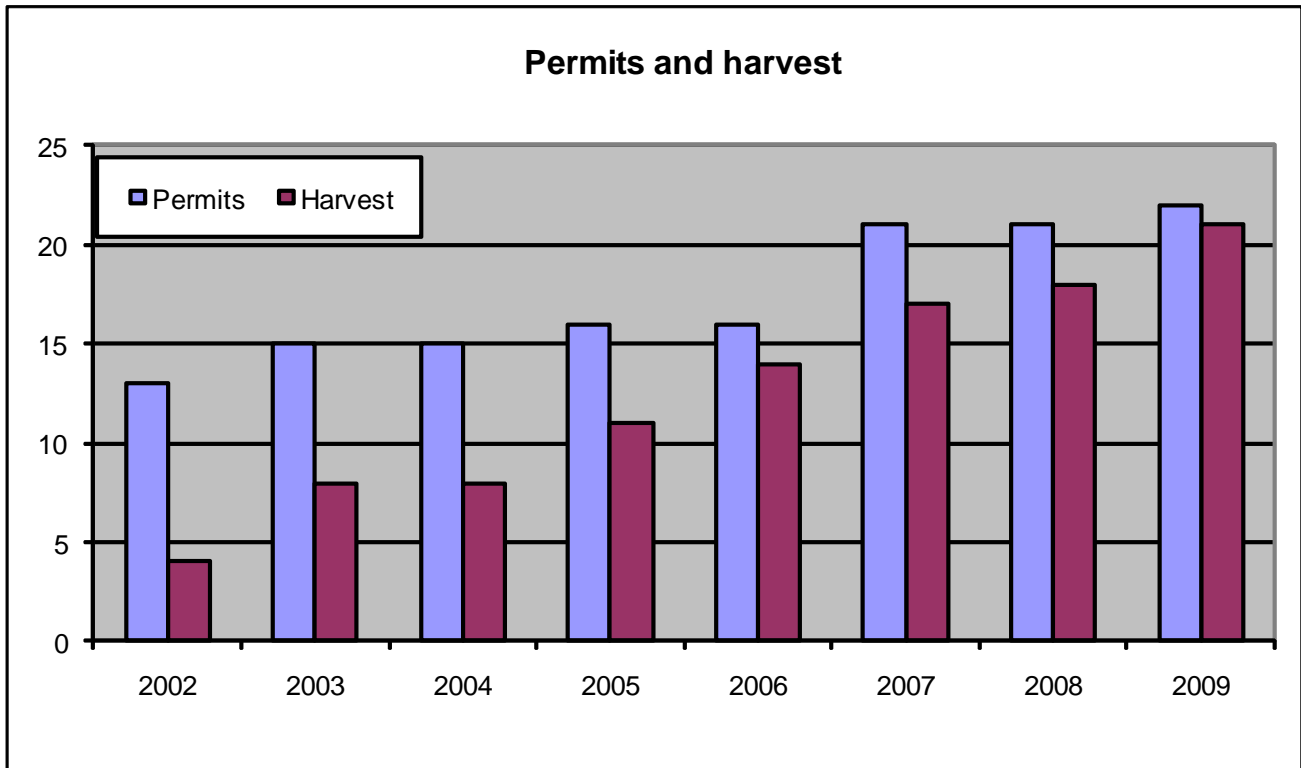
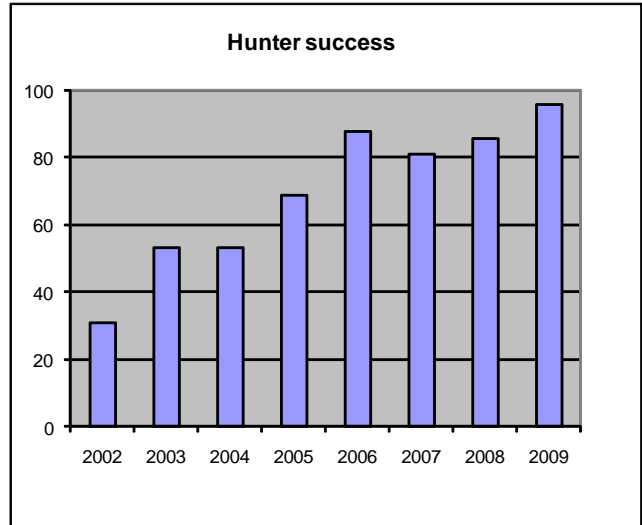
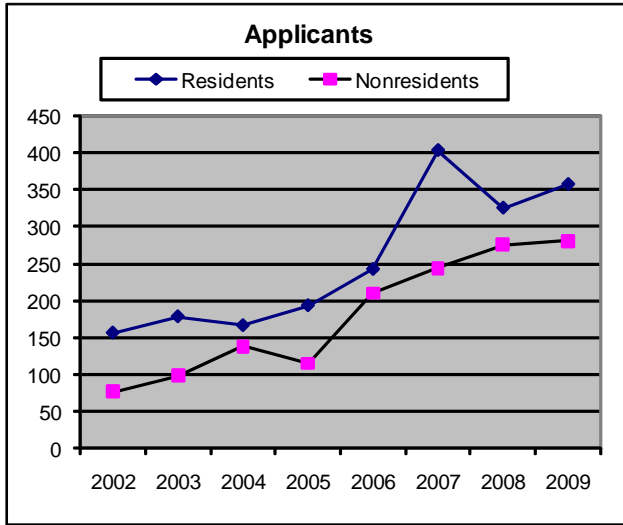
Population Status												
PMU	Observed						Modeled					Most Recent Survey
	Ewes	Lambs	Rams		Unclass	Total	Ewes	Lambs	Rams		Total	
			I, II	III, IV					I, II	III, IV		
Owyhee Front	0	0	7	17	0	24						2008
Owyhee River	149	62	37	56	0	304	197	82	47	70	396	2008
Jacks Creek	110	44	33	18	0	205	161	64	44	23	292	2008
Bruneau-Jarbidge	59	36	26	19	0	140	92	55	40	25	212	2008
South Hills	4	1	4	3	0	12						2008
Jim Sage	29	7	13	3	0	52	34	6	13	11	64	2009
<b>Total</b>	<b>351</b>	<b>150</b>	<b>120</b>	<b>116</b>	<b>0</b>	<b>737</b>	<b>484</b>	<b>207</b>	<b>144</b>	<b>129</b>	<b>964</b>	

Estimates of Statewide Population						
1970	1985	1990	1997	2006	2008	
90	570	1,240	1,460	810	1,000	

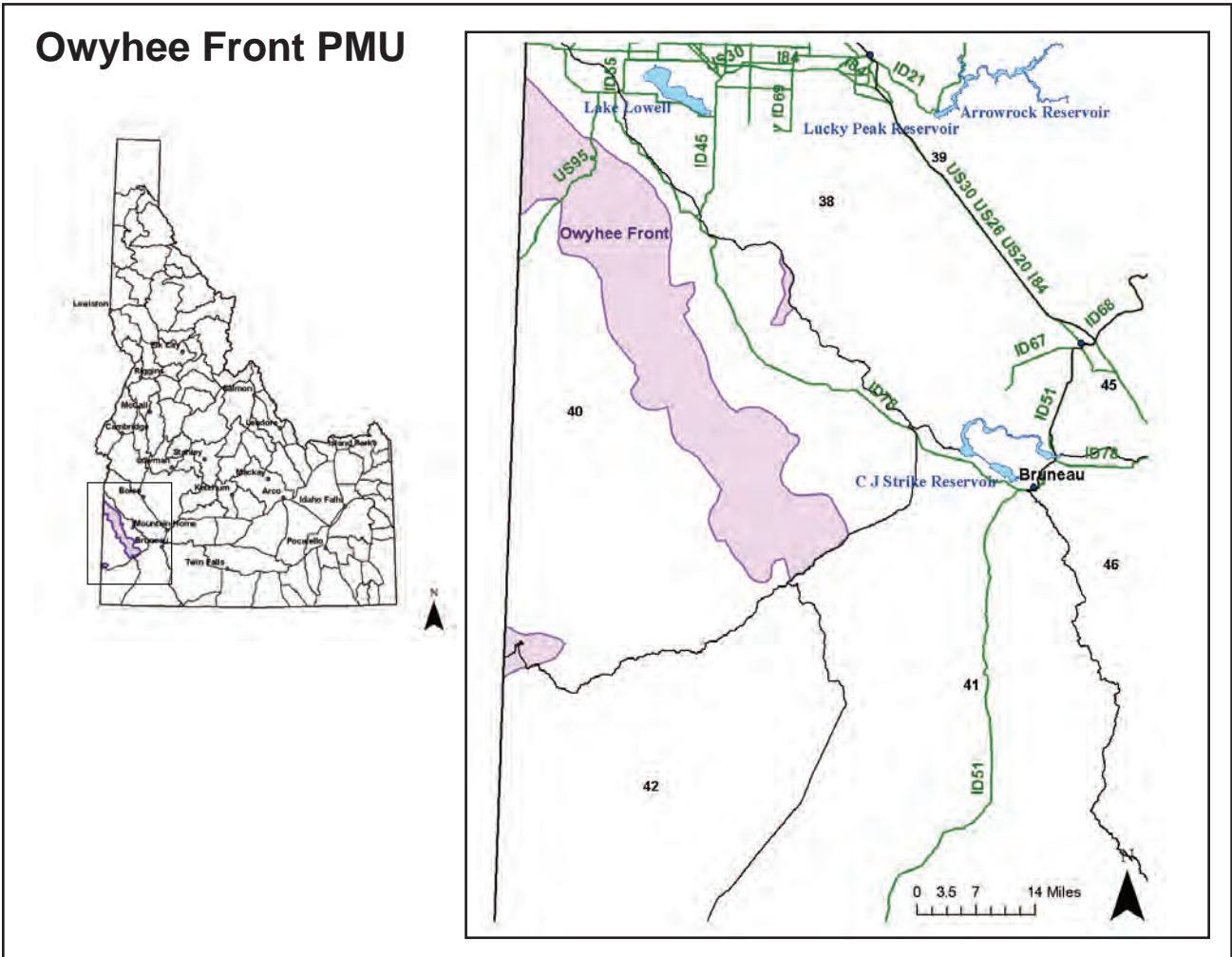


# California Bighorn Sheep

Hunting Permits, Applications, and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	13	15	15	16	16	21	21	22
Resident applicants	156	178	166	193	242	403	325	357
Nonresident applicants	77	99	138	115	210	244	276	281
Harvest	4	8	8	11	14	17	18	21
Hunter success (%)	31	53	53	69	88	81	86	95
Average ram age (yrs)	6.3	6.1	5.9	6.3	7.9	7.1	6.9	6.6



# Owyhee Front PMU



## Description

The Owyhee Front in GMU 40 is characterized by sagebrush (*Artemisia* spp.)-steppe dominated foothills above the Snake River plain with scattered pockets of suitable escape terrain in which bighorns persist. The main drainages sheep occupy are Reynolds Creek and Castle Creek. Ewes and lambs occupy the most rugged and broken country, whereas rams seek out areas that provide abundant forage and isolation from human disturbance, often using low rock outcroppings or steep slopes in the absence of “typical” escape terrain. This PMU differs from other California bighorn sheep habitat in Idaho in that it lacks the deep canyon topography which typifies much of the bighorn habitat in Owyhee County. While much of the Owyhee Front is managed by the Bureau of Land Management, approximately 1/3 is privately owned rangeland. In 2009, approximately 75 sheep occupied the Owyhee Front.

## Historical Perspective

The first bighorn sheep to colonize the Owyhee Front after extirpation in the early 1900s are thought to have immigrated from Oregon’s Leslie Gulch following a wildfire in the 1980s. The sheep occupying the Castle Creek drainage likely colonized from Shoofly Creek in GMU 41. Unit 40 was included in the Little Jacks hunt area, but only 1 ram had ever been taken in GMU 40. To better distribute hunting pressure, a hunt in this GMU alone was created in 2009.

## Issues

The Owyhee Front is close to the largest human population center in Idaho and the area is frequently used for recreation in the form of off-road vehicle use, hiking, hunting, trapping, horseback riding, wildlife viewing, sightseeing, and recreational shooting year round.

Habitat degradation, due largely to increased and unregulated off-road motorized vehicle use, and risk of disease threaten this bighorn sheep population. Energy development in the form of wind power,

transmission lines, and geothermal development are currently being considered on the Owyhee Front and may threaten bighorn sheep and habitat. Livestock grazing is also prevalent, both on private and public lands, and a large herd of feral horses occupy habitat near suitable bighorn sheep habitat. Competition with domestic livestock and feral horses is a concern, particularly due to the limited nature of bighorn sheep habitat.

Bighorn sheep, especially rams, are known to make long distance movements between the areas of suitable habitat. Generally, the bands of rams move 5-10 miles away from summer pastures to reach the ewe groups during the rut. Bighorn sheep have been documented crossing GMU boundaries and the Oregon state line. These movements increase risk of contact with domestic sheep, risk of poaching, and likely risk of predation. A domestic sheep trailing route crosses a portion of this PMU, and efforts have been made to reduce contact between bighorns and domestic sheep. Additionally, due to the prevalence of roads, trails, and off-road vehicle use in the area, sheep migration corridors are threatened by human recreation and the ability of sheep to move undisturbed between patches of habitat is reduced.

## Management Direction

This sheep population will continue to be managed conservatively, offering hunters a reasonable chance to harvest a mature ram.

Little population data is available for the sheep occupying the Owyhee Front in GMU 40. Within current distribution, modeled habitat comprises 464 km<sup>2</sup>, which could support approximately 880 animals (assuming all habitat is suitable year-round and relatively high densities of 1.9 sheep/km<sup>2</sup>). It is likely that the lack of lambing habitat and escape terrain would limit this bighorn sheep population and bighorn sheep numbers would remain lower than the currently predicted population estimate. Additionally, much of the area within bighorn sheep distribution in this PMU is used primarily for travel corridors between isolated patches of critical habitat. Further refinement of habitat models is necessary to better estimate potential population size, and will likely lead to an estimate <880 bighorn sheep. The management objective is to maintain or increase this bighorn sheep population, provided the increase occurs in portions of the PMU where separation from domestic sheep can be maintained.

Plans are currently being developed to capture and radiocollar bighorn sheep within the Owyhee Front PMU. Because these sheep are making long distance movements between available habitats, deploying radiocollars will allow us to track movement patterns and travel corridors, identify critical habitats, document population size and status, locate additional bighorn sheep herds, and determine cause-specific mortality. This effort is necessary to manage and protect this bighorn sheep population.

## Management Actions

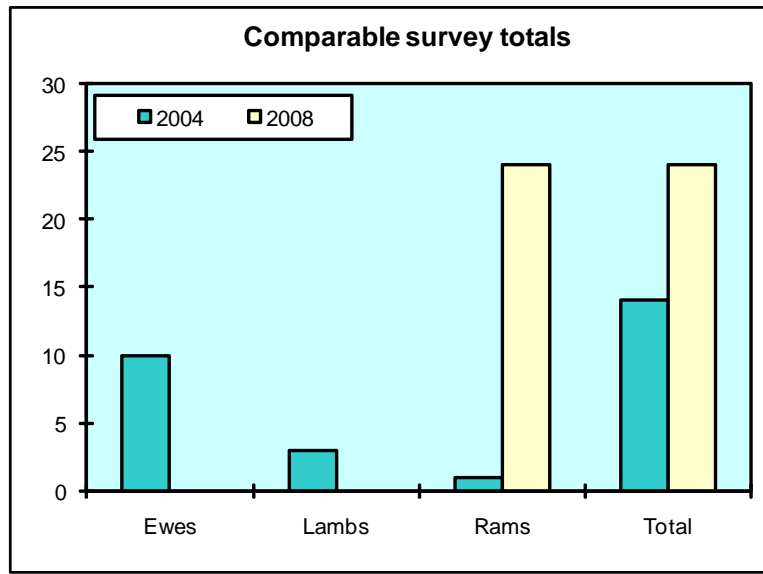
1. **Work with willing domestic sheep permittees, USFS, and BLM to use BMPs to maintain separation between bighorn sheep and domestic sheep and goats.**
2. **Increase knowledge of movement patterns, habitat use, survival, etc. using radiomarked bighorn sheep.**
3. **Refine habitat modeling to more accurately characterize sustainable population levels.**

# California Bighorn Sheep

## Owyhee Front

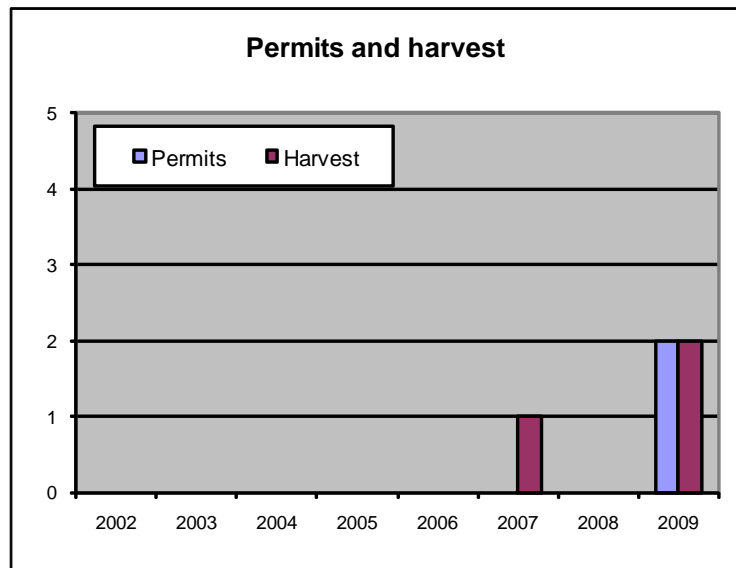
GMU 10; Hunt Area 10

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
40	2004	10	3	1	0	1	0	14
	2008	0	0	7	17	24	0	24
Modeled estimate								
Per 100 ewes observed								

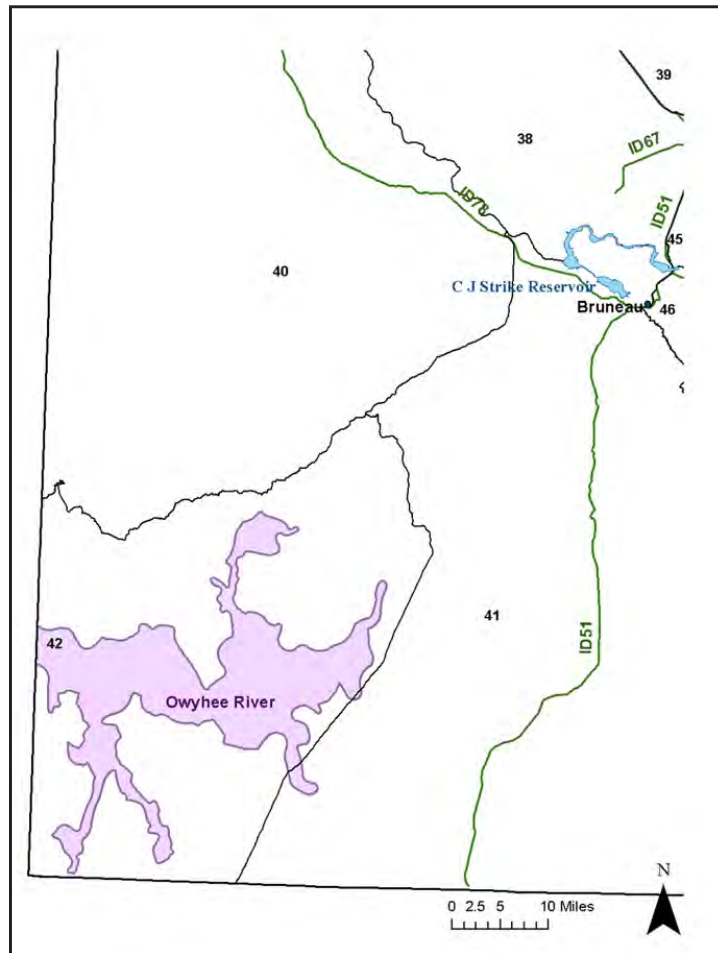


Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	0	0	0	0	0	0	0	2
Harvest	0	0	0	0	0	1	0	2
Hunter success								100
Ave ram age						6.5		5.0

Note: Hunt Area 40 was included in Hunt Area 41 through 2006 and 41-1 in 2007-08.



# Owyhee River PMU



## Description

This PMU encompasses GMU 42 in southwestern Idaho. Most of the habitats suitable for bighorn sheep are managed by the BLM, although a few private- and state-owned parcels exist in the area. The majority of currently occupied sheep habitat occurs within the Owyhee Canyonlands Wilderness, which was designated in May 2008 as part of the Owyhee Initiative. This unit is characterized by large expanses of sagebrush-steppe habitat intersected by steep drainages that are 300-400 m deep. Grass-covered benches and terraces within these rugged canyons provide foraging areas preferred by California bighorn sheep, although it is common to see sheep foraging up to 1 mile away from canyon rims. Sheep are found within the East Fork Owyhee River and its major tributaries (Deep Creek, Battle Creek, and others), and within the South Fork Owyhee River and the Little Owyhee River. This sheep herd is non-migratory.

## Historical Perspective

Bighorn sheep were extirpated from this area by 1940. Subsistence hunting by mining camps, heavy grazing by domestic livestock, and diseases introduced by domestic livestock led to the demise of this native sheep population. Three releases of bighorn sheep in the 1960s, translocated from British Columbia, provided the nucleus for this reintroduced herd (Appendix B). By 1982, this sheep population was established well enough to be used as a source population for translocations to other parts of Idaho, in addition to 3 other states. Translocations from the PMU continued through 2003. This sheep population increased to a high of near 750 animals (observed) in 1992, but declined after the severe winter of 1992-93 (>200 sheep were also translocated from this area in 1990-93) and has remained relatively stable at approximately 250-350 animals (observed) since 2006 (Fig. 12).



The steep and rugged canyon terrain and isolation of some forage areas by rimrock reduces competition between bighorn sheep and domestic livestock. However, the potential for conflict may exist adjacent to the canyons and in portions of canyons accessible to cattle. Competition for forage may increase as bighorn or cattle numbers increase, or as forage availability decreases due to drought, grazing pressure, wildfire, or invasion of unpalatable exotic weeds or grasses. Anecdotal observations of elk wintering along the East Fork Owyhee River (300-500 animals) appear to be increasing, and elk may be competing with bighorn sheep for forage in winter as well.

While this bighorn sheep population has largely been unaffected by disease, the potential exists due to the proximity of private inholdings in or adjacent to bighorn sheep habitat. However, as long as domestic sheep and bighorn sheep remain separated, potential for disease transmission is low. The nearest domestic sheep grazing allotment is 25 miles away, but there is no way to regulate or monitor small farm flocks on private land.

Predation by mountain lions is a concern for many bighorn sheep enthusiasts, but the impact of predation on this population is largely unknown. Evidence of illegal off-road vehicle use in bighorn sheep habitat and along canyon rims has increased over the last 10-15 years. Enforcement is challenging due to the remoteness of the area, but the new wilderness designation will likely help assuage some of the illegal use by off-road vehicles.

The new wilderness designation eliminated >30 miles of roads within the entire Owyhee Initiative area. However, 17 miles of these closed roads occurred in the Dickshooter Ridge area, within the Owyhee River PMU. Hunter congestion at the remaining access points may need to be addressed in the future if contention arises.

This area is used by the Air Force for training missions. Impacts of military overflights to bighorn sheep are not fully understood. Agreements have been made to mitigate the potential impacts to bighorn sheep (e.g., flights will take place perpendicular to the canyons and not parallel to them), but monitoring and compliance is unknown. Expanded use of the area for military training could have negative impacts to bighorn sheep, especially during critical times of year (e.g., lambing, winter, etc.).

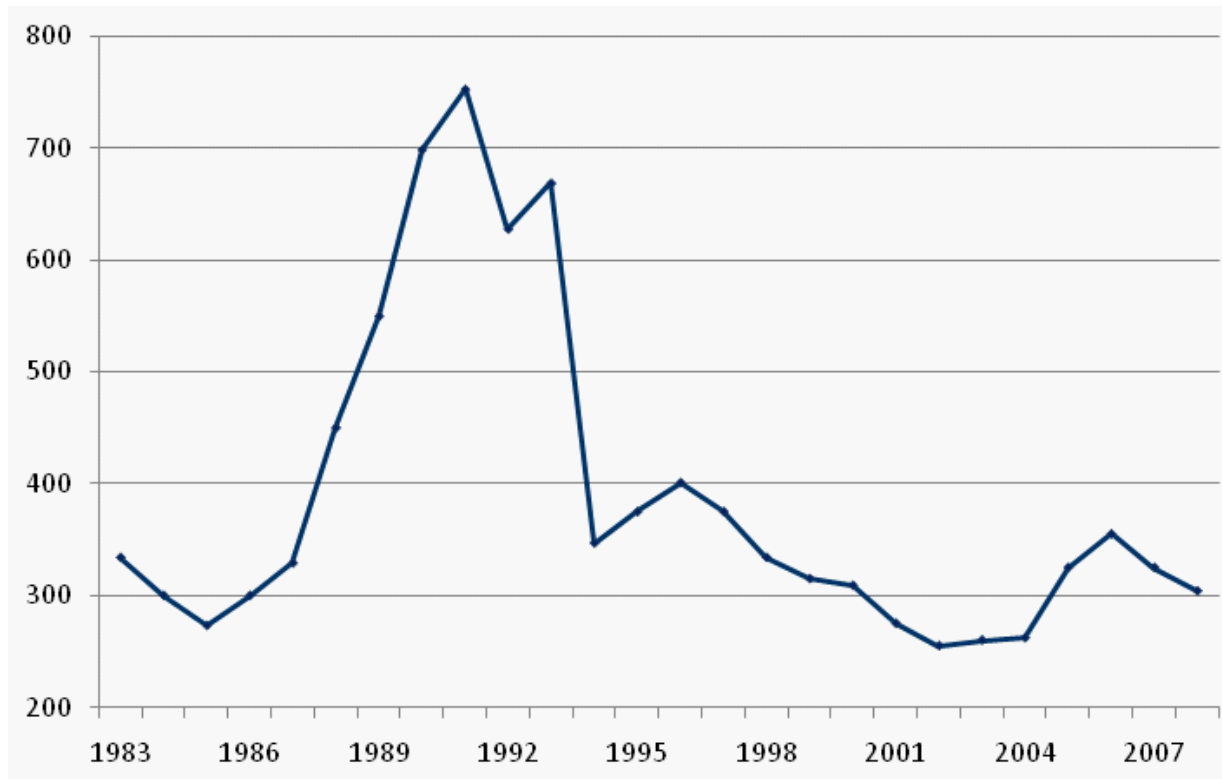
This sheep herd will continue to be managed conservatively, offering a hunter with a reasonable chance at harvesting a mature ram. Recent hunter success rates have been 70-90%.

The predicted bighorn population of 731 sheep that is supportable by habitat within current distribution (Table 2) is similar to the population high observed in early 1990s. However, seasonal habitats (winter range) and specific habitat needs (lambing areas) are not accounted for in the habitat model. Further refinement of the habitat model will likely result in a lower estimate of potential population size. Available information suggests the Owyhee River PMU is capable of supporting >400 bighorn sheep and the overall management goal is to maintain or increase the current population.

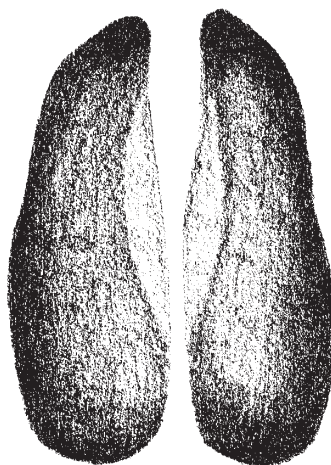
### Management Actions

1. **Work with BLM to enforce motorized travel restrictions in the Owyhee Initiative area.**
2. **Refine habitat modeling to more accurately characterize sustainable population levels.**





**Figure 12.** Total bighorn sheep observed (or estimated in years without surveys) during aerial surveys, GMU 42, Owyhee River PMU, 1983-present. These numbers represent actual counts and are considered minimum population estimates.

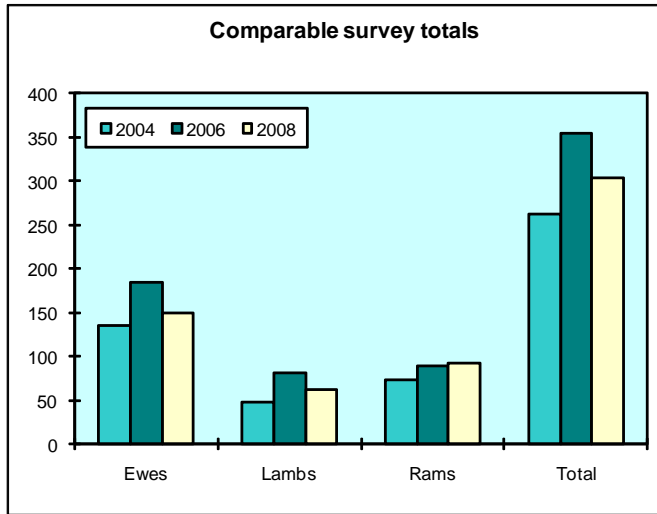


# California Bighorn Sheep

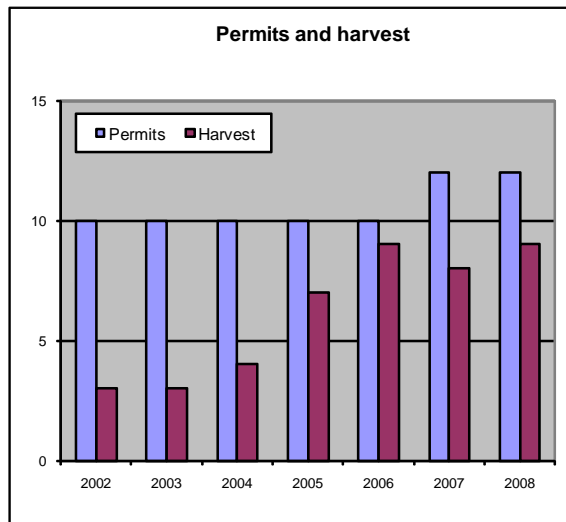
## Owyhee River

GMU 42; Hunt Areas 42-1, 42-2

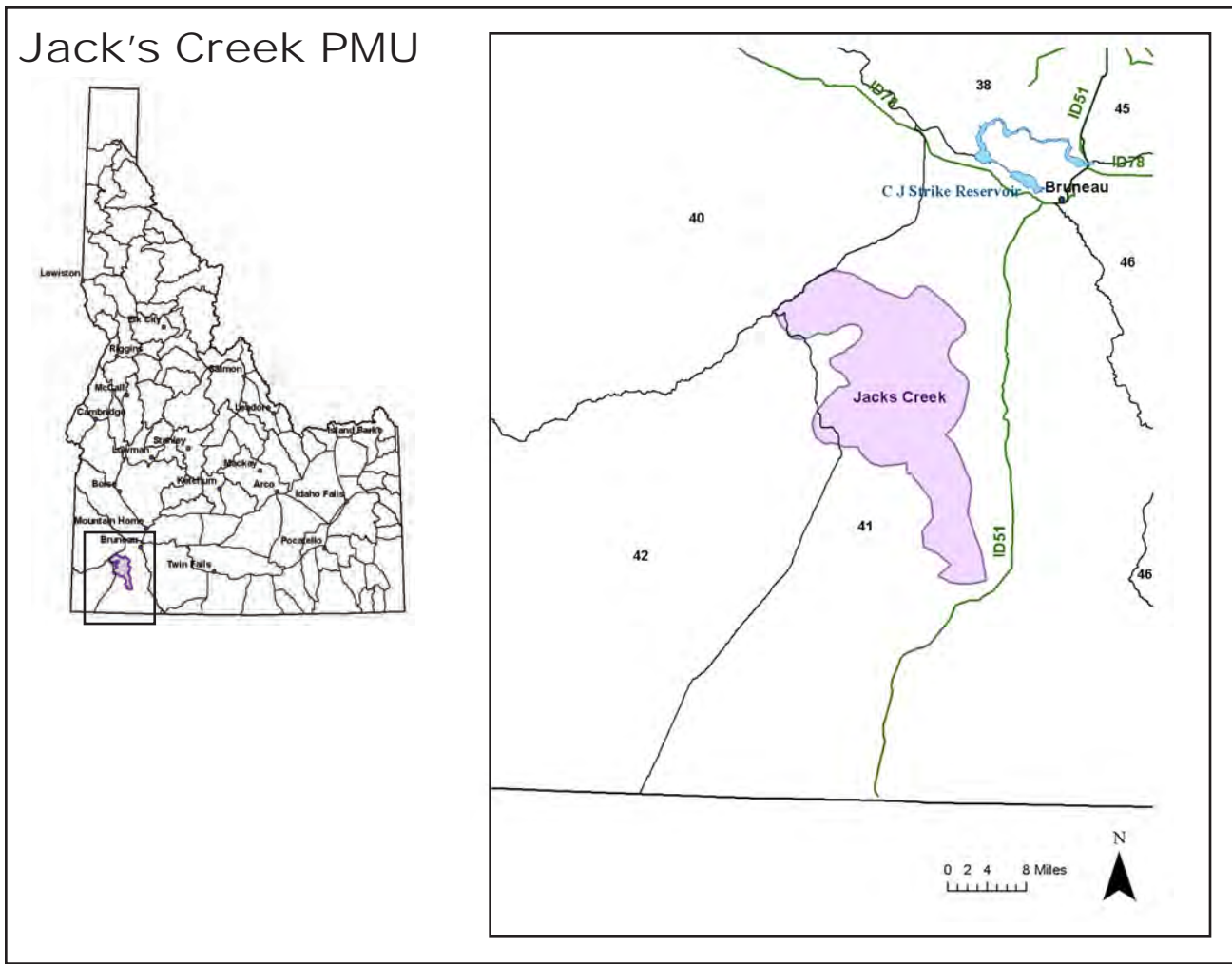
Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
Total	2004	135	48	46	28	74	5	262
	2006	184	81	53	37	90	0	355
	2008	149	62	37	56	93	0	304
Modeled estimate		197	82	47	70	117	0	396
Per 100 ewes observed			42	25	38	62		



Hunting Permits and Harvest Information									
		2002	2003	2004	2005	2006	2007	2008	2009
Permits	42-1	5	5	5	5	5	6	6	6
	42-2	5	5	5	5	5	6	6	6
	Total	10	10	10	10	10	12	12	12
Harvest	42-1	3	1	1	3	4	5	4	6
	42-2	0	2	3	4	5	3	5	5
	Total	3	3	4	7	9	8	9	11
Hunter success		30	30	40	70	90	67	75	92
Ave ram age		5.5	5.0	5.2	6.6	7.7	6.4	6.3	6.9



## Jack's Creek PMU



### Description

This area averages 1,100-1,900 m in elevation, and surrounds Big Jacks, Little Jacks, and Shoofly creeks. These perennial streams cut through terraced canyons that average 300 m deep and are generally characterized by cliff bands interspersed with vegetated benches. The vegetative community is dominated by sagebrush, rabbitbrush (*Chrysothamnus* spp.), cheatgrass (*Bromus tectorum*), and bluebunch wheatgrass (*Pseudoroegneria spicata*).

### Historical Perspective

Bighorn sheep were abundant in southwestern Idaho prior to European settlement, but numbers began to decline following the mining boom of the late 1800s. Several causes have been implicated in this decline, including competition from cattle, disease introduced by domestic sheep, and indiscriminate hunting to provide meat for mining camps. The last reported sighting of a native bighorn sheep in Owyhee County occurred in 1927.

The first release of California bighorns into Jacks Creek occurred in 1967, when 12 sheep from British Columbia were released into Rattlesnake Creek, a tributary of Little Jacks Creek. Sheep were reintroduced into Big Jacks Creek in 1988. The Jacks Creek population of California bighorn sheep grew from those 12 animals to 392 animals observed on a 1999 helicopter survey. Following 1999, however, the number began to decline; only 134 individuals were observed in 2002. In 2008, 222 sheep were observed during aerial counts.

### Issues

The steep and rugged canyon terrain and isolation of some forage areas by rimrock reduces competition between bighorn sheep and domestic livestock. However, the potential for conflict may exist adjacent to the canyons and in portions of the canyons accessible by cattle. Competition for forage may increase as bighorn or cattle numbers increase, or as forage availability decreases due to drought, grazing pressure, wildfire, or invasion of unpalatable exotic weeds or grasses.

While this sheep population has largely been unaffected by disease and die-offs experienced in other parts of the state and country, the potential exists due to the proximity of private inholdings in or adjacent to bighorn sheep habitat. However, as long as domestic sheep and bighorn sheep remain separated, potential for disease transmission is low. The nearest domestic sheep grazing allotment is 25 miles away; however, there is no way to regulate or monitor small farm flocks on private land.

Predation by mountain lions is a concern by many sheep enthusiasts, but the impact of predation on this population is largely unknown.

Evidence of illegal off-road vehicle use in sheep habitat and along the canyon rims has increased during the last 10-15 years. Enforcement is challenging due to the remoteness of the area, but the new wilderness designation will likely help assuage some of the illegal use by off-road vehicles.

The new wilderness designation eliminated >30 miles of roads within the entire Owyhee Initiative Area, and several key access roads were closed within the Jacks Creek PMU. Hunter congestion at the remaining access points may need to be addressed in the future if contention arises.

This area is used by the Air Force for training. Impacts to bighorn sheep are not fully understood. Agreements have been made to mitigate the potential impacts to bighorn sheep (e.g., flights will take place perpendicular to the canyons and not parallel to them). Expanded use of the area for military training could have negative impacts to bighorn sheep, especially during critical times of the year (e.g., lambing, winter, etc.). Compliance with overflight agreements are unknown and difficult to enforce.

## Management Direction

This sheep herd will continue to be managed conservatively, offering hunters a reasonable chance at harvesting a mature ram. Hunter success rates since 2005 have been 100%.

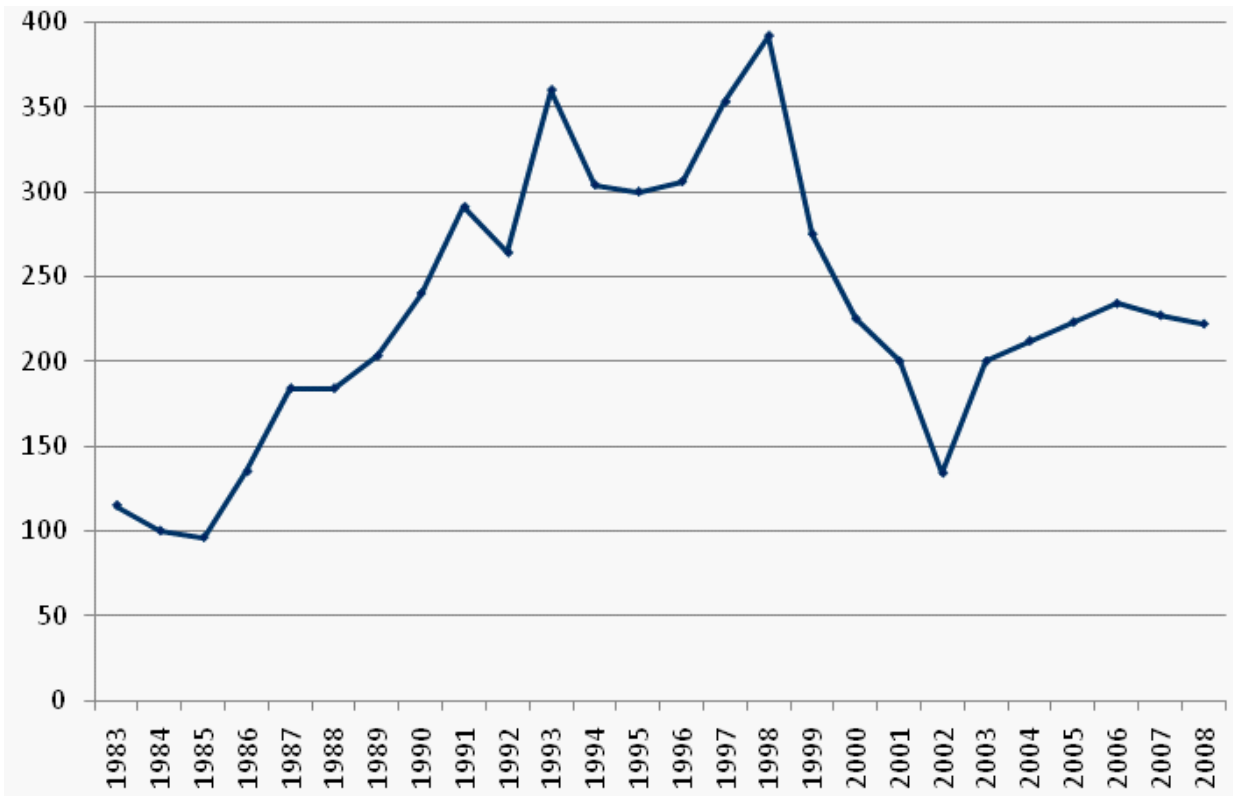
These herds have been stable since 2003 at approximately 200-250 sheep (Fig. 13). The Little Jacks herd experienced a population decline following the severe winter of 1992-93 after peaking in the early 1990s. Big Jacks herd has increased since introduced in 1988, and has been relatively stable since 1998. It is estimated approximately 475 sheep could occupy the Jacks Creek PMU based on suitable habitat within current sheep distribution (Table 2). This estimate is similar to the population

high observed in early 1990s. However, seasonal habitats (winter range) and specific habitat needs (lambing areas), are not accounted for in the habitat model. Further refinement of the habitat model will likely decrease the estimated potential population size. Current available information indicates the Jacks Creek PMU is capable of supporting >300 sheep and the overall management goal is to maintain or increase the current population.

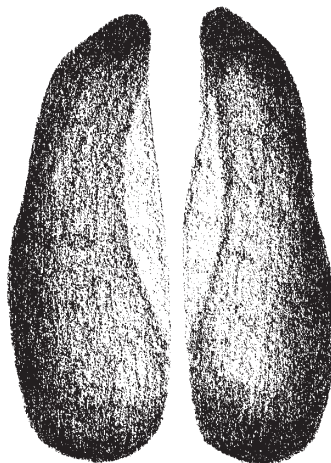
Plans are currently being developed to capture and radiocollar bighorn sheep within the Jacks Creek PMU. This effort will increase the ability of managers to estimate populations during aerial surveys. Additionally, lamb survival and recruitment, sheep movements, and cause-specific mortality will be documented to assist in the management of these bighorn sheep.

## Management Actions

- 1. Work with BLM to enforce motorized travel restrictions in the Owyhee Initiative area.**
- 2. Increase knowledge of habitat use, lamb survival, etc. using radiomarked bighorn sheep.**
- 3. Refine habitat modeling to more accurately characterize sustainable population levels.**



**Figure 13.** Total bighorn sheep observed (or estimated in years without surveys) during aerial surveys, GMU 41, Jacks Creek PMU, 1983-present. These numbers represent actual counts and are considered minimum population estimates.



# California Bighorn Sheep

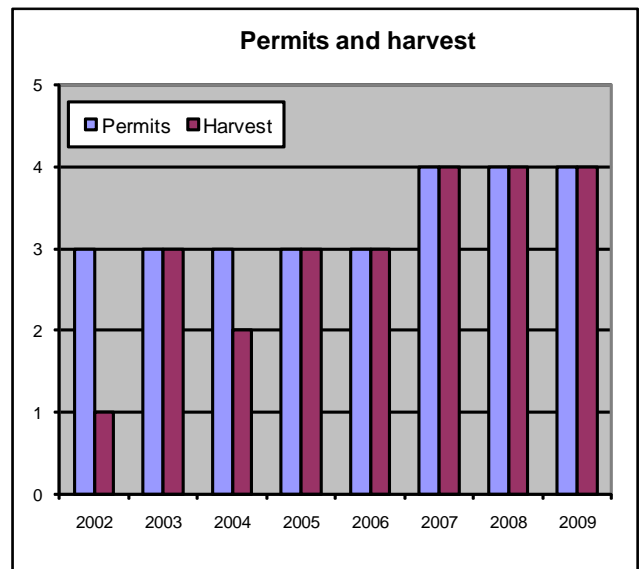
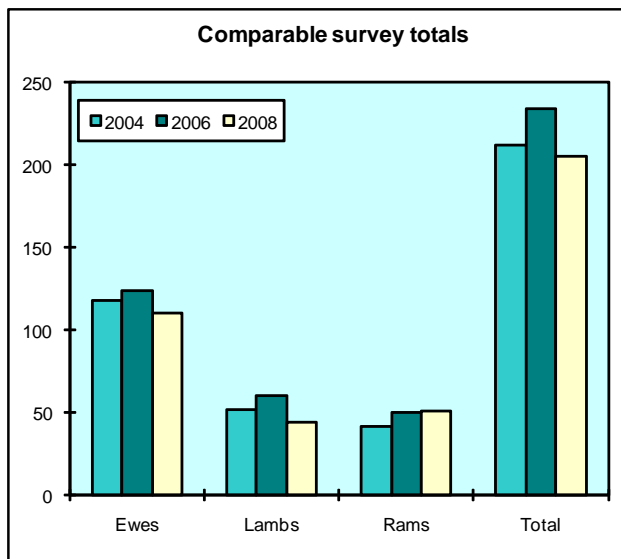
## Jacks Creek

GMU 41; Hunt Areas 41-1, 41-2

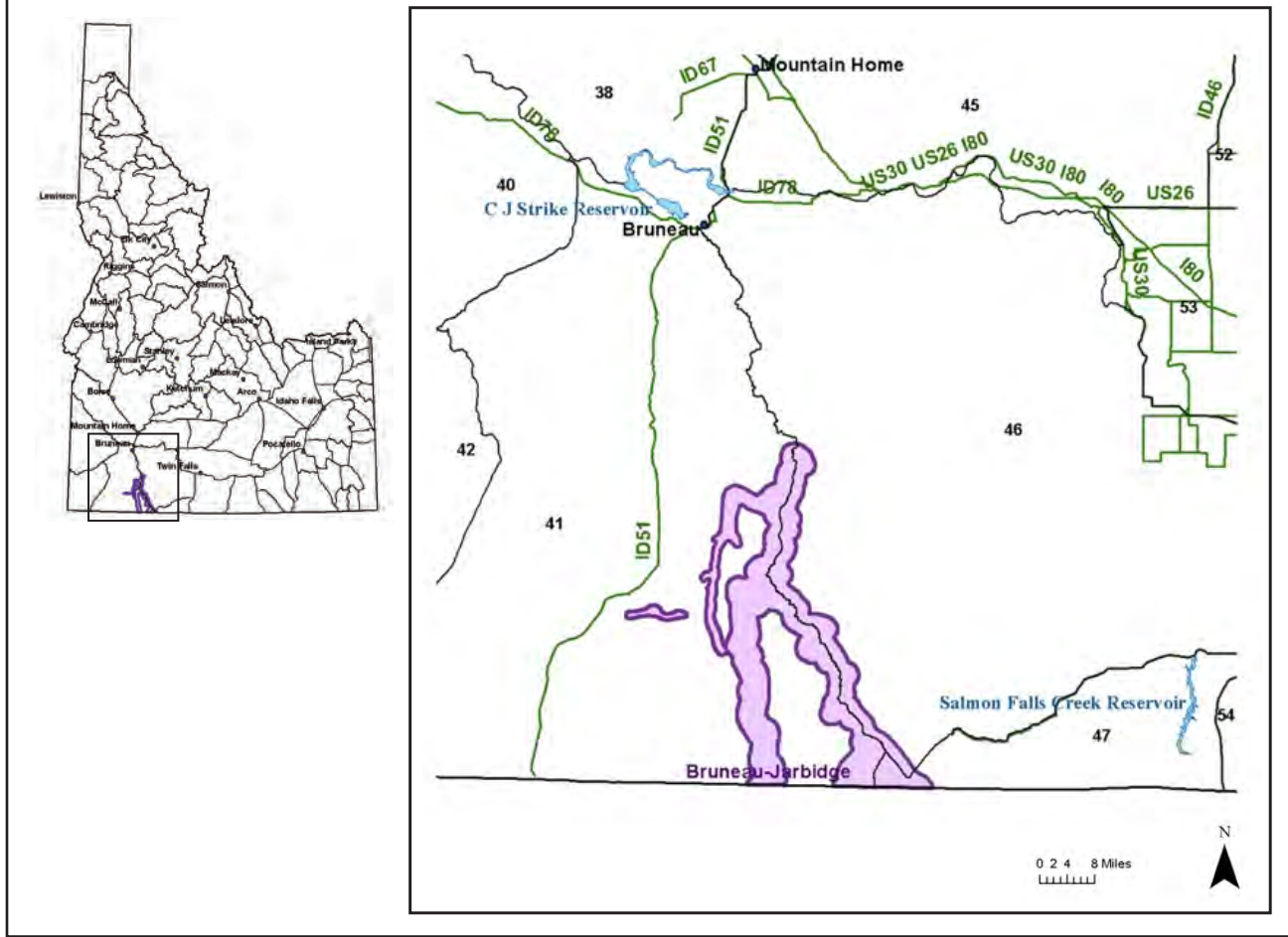
Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
41	2004	118	52	28	14	42	0	212
	2006	124	60	36	14	50	0	234
	2008	110	44	33	18	51	0	205
Total	2004	118	52	28	14	42	0	212
	2006	124	60	36	14	50	0	234
	2008	110	44	33	18	51	0	205
Modeled estimate		161	64	44	23	67	0	292
Per 100 ewes observed			40	30	16	46		

Hunting Permits and Harvest Information									
		2002	2003	2004	2005	2006	2007	2008	2009
Permits	41	3	3	3	3	3			
	41-1						2	2	2
	41-2						2	2	2
	Total	3	3	3	3	3	4	4	4
Harvest	41	1	3	2	3	3			
	41-1						2	2	2
	41-2						2	2	2
	Total	1	3	2	3	3	4	4	4
Hunter success		33	100	67	100	100	100	100	100
Ave ram age		7.5	7.5	5.5	7.8	7.5	8.2	8.2	6.0

Note: Hunt Area 40 was included in Hunt Area 41 through 2006 and 41-1 2007-08.



# Bruneau-Jarbidge PMU



## Description

This population includes bighorn sheep in GMUs 46, 47, and that portion of 41 east of Highway 51. Bighorn sheep in this area primarily use lands managed by the U.S. Bureau of Land Management, but occasionally use private lands. Elevations in the area used by bighorn sheep range from 1,100 m in canyon bottoms to approximately 1,500 m on desert plateaus. The landscape is characterized by steep, rugged canyons that are 300-400 m deep. Vegetation is almost exclusively shrub-steppe, with some riparian shrub communities along river corridors. Road densities in the area are relatively low, and the distance and difficulty of travel serve as natural limitations on human use of the area. Bighorn sheep in this area do not exhibit seasonal migratory movements.

## Historical Perspective

Bighorn sheep were extirpated from southern Idaho in the early 1900s. In the 1960s, IDFG initiated a program to reestablish California bighorn sheep populations in the Owyhee River and Little Jacks Creek drainages in Owyhee County. These early releases were successful and bighorn sheep populations increased and expanded their range in southwest Idaho.

From 1982-1993, IDFG and Nevada Department of Wildlife (NDOW) released nearly 100 California bighorn sheep into portions of the Jarbidge and Bruneau drainages (Appendix B, Table 1). The bighorn sheep released by NDOW in 1982 and 1984 moved north into the Jarbidge River Canyon in Idaho. Bighorn sheep have also been released by IDFG near the confluence of the Jarbidge and West Fork Bruneau Rivers, at Dorsey Creek, and near Black Rock Pocket on the West Fork Bruneau Canyon. Currently, bighorn sheep are distributed throughout the Jarbidge and West Fork Bruneau



canyons upstream from their confluence. Bighorns have been observed as far north in the Bruneau Canyon at Cave Draw and are occasionally observed in the Sheep Creek and Marys Creek drainages.

## Issues

Population surveys in 1998 and 2000 indicated poor recruitment and a downturn in the Bruneau-Jarbidge bighorn population. The substantial and rapid decline of this sheep population suggested a disease die-off, although no conclusive evidence was available. Possible sources of disease for the Bruneau-Jarbidge herd were identified in the Marys Creek and Contact, Nevada, areas. The decline in bighorn sheep numbers prompted the closure of the hunting season in 2001 and 2002.

Results from aerial surveys in 2006 and 2008 indicated that the population was increasing (Fig. 14). From 2005 to 2010 3 tags were offered annually in Hunt Area 46.

Because of suspected previous disease issues, continued monitoring of population trends and productivity are warranted.

## Management Direction

Within current distribution, modeled habitat comprises 400 km<sup>2</sup>, which could support approximately 759 animals (assuming all habitat is suitable year-round and relatively high densities of 1.9 sheep/km<sup>2</sup>). However, these models were not developed for desert-dwelling bighorn sheep,

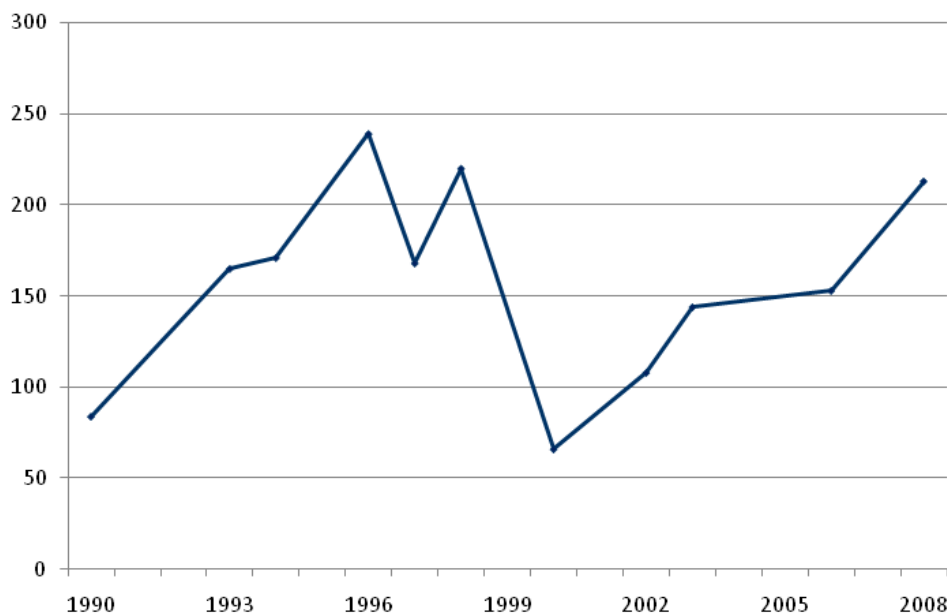
and do not account for small-scale variation in habitat quality or for specific habitat needs such as lambing and winter habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size.

Given previous survey data, the Bruneau-Jarbidge area seems capable of supporting  $\geq 200$  bighorn sheep. The overall management goal will be to maintain or increase the current population. No portion of the Bruneau-Jarbidge PMU overlaps any domestic sheep or goat grazing or trailing allotments. However, in those portions of bighorn sheep distribution that overlap private lands, management will focus on minimizing potential contact between bighorn sheep and domestic sheep and goats. Management will also focus on providing hunters the opportunity to take 5-6 year-old rams with an annual hunter success  $>50\%$ .

## Management Actions

1. **Work with private land owners to minimize potential contact between bighorn sheep and domestic sheep and goats.**
2. **Refine habitat modeling to more accurately characterize sustainable population levels.**

**Figure 14.** Total bighorn sheep estimated (modeled) during aerial surveys, Bruneau-Jarbidge PMU, 1990-present.

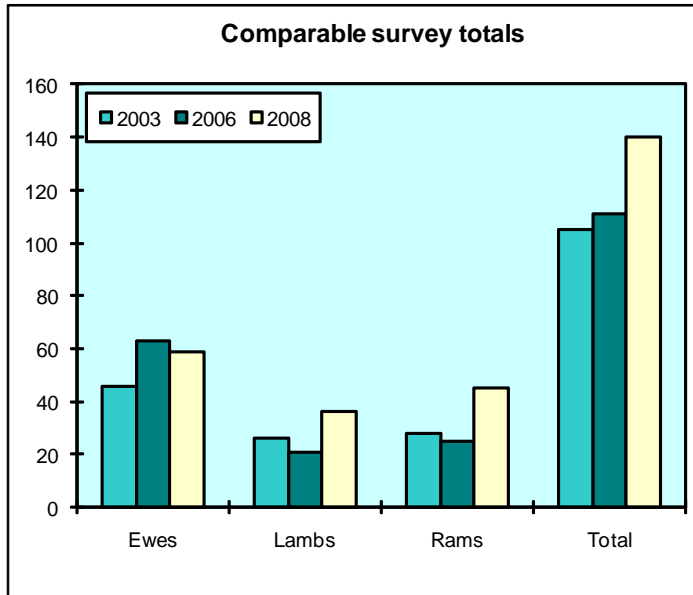


# California Bighorn Sheep

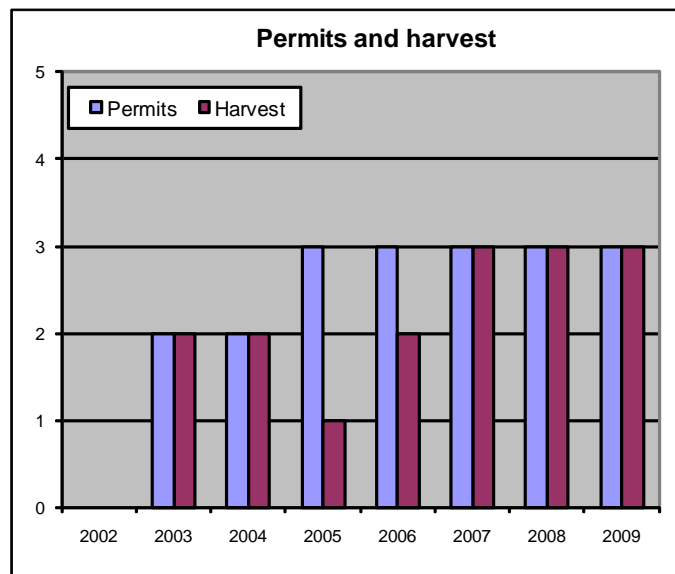
## Bruneau-Jarbidge

GMUs 41 (east), 46, 47; Hunt Areas 46-1, 46-2

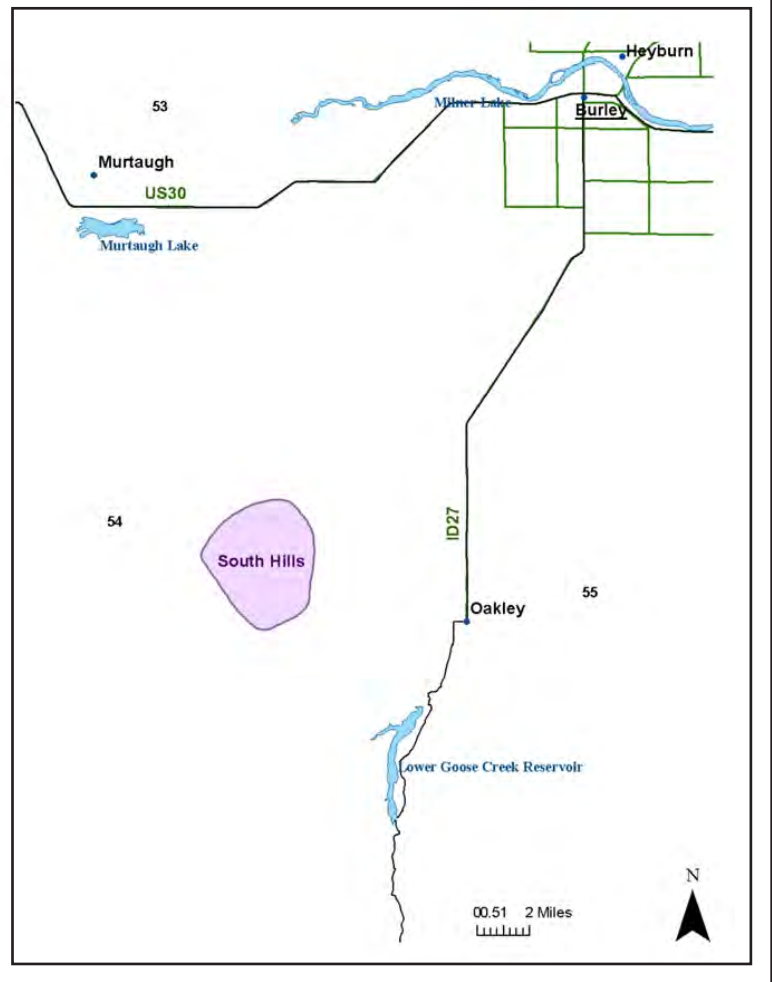
Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
Total	2003	46	26	18	10	28	5	105
	2006	63	21	15	10	25	2	111
	2008	59	36	26	19	45	0	140
Modeled estimate		92	55	40	25	65	0	212
Per 100 ewes observed			61	44	32	76		



Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	0	2	2	3	3	3	3	3
Harvest		2	2	1	2	3	3	3
Hunter success		100	100	33	67	100	100	100
Ave ram age		7.0	8.0	4.5	9.5	7.0	7.5	7.8



## South Hills PMU



### Description

The South Hills PMU (GMU 54) is an isolated mountain range of approximately 1,600 km<sup>2</sup>. The landscape is characterized by low mountains bisected by moderately rugged canyons. Lower elevations and south and west facing slopes feature predominately shrub-steppe vegetation and juniper (*Juniperus* spp.) woodlands. Lodgepole pine (*Pinus contorta*) and quaking aspen (*Populus tremuloides*) communities occur at higher elevations.

Suitable habitat for bighorn sheep occurs in the Rock Creek, Dry Creek, and Big Cottonwood Creek drainages. In recent years most bighorn sheep use has been confined to a relatively small area in the lower portions of Big Cottonwood and Big Cedar canyons. While most bighorn sheep use is on the Sawtooth National Forest, bighorns also use lands managed by the BLM, IDL, and IDFG. Elevations in the area used by bighorn sheep range from 1,400 m to 2,100 m. Motorized road and trail densities in bighorn sheep habitat are moderate to high. Bighorn sheep in this area do not exhibit seasonal migratory movements.

### Historical Perspective

Bighorn sheep were extirpated from southern Idaho, including the South Hills, in the early 1900s. In 1963, the Department initiated a successful program to reestablish California bighorn sheep populations in Owyhee County. By the mid 1980s, the healthy bighorn populations in Owyhee County provided a source for many translocations, including efforts to reestablish bighorns in the South Hills.

From 1986-1993, 50 California bighorn sheep were released into the Big Cottonwood drainage and 24 bighorns were released into the East Fork of Dry Creek (Appendix B). In 1989, the bighorns in Big Cottonwood experienced a dieoff and despite additional releases numbers continued to decline. Currently, <15 bighorn sheep persist in GMU 54 and reintroduction efforts are considered impractical due to several issues, including the proximity of domestic sheep and goats, motorized recreation, and habitat issues such as juniper encroachment.

There is no legal harvest of bighorn sheep in GMU 54.

## Issues

The future of the bighorn sheep population in GMU 54 is uncertain. Bighorn sheep have persisted in the Big Cottonwood area without additional releases since 1988, however, it is believed <15 sheep remain. Wild bighorns were reported to have contacted domestic sheep on 2 occasions: once near Big Cottonwood Canyon, and once near Dry Creek. Characteristics of the subsequent population declines in both areas suggest that disease may have played a role. However, in March 1991 5 bighorn sheep were captured and tested for disease; all results were negative. Several other issues affecting the suitability of the South Hills for bighorn sheep include 1) increasing human recreational activities in sheep habitat and 2) the expansion of juniper in the lower reaches of the canyons. Further efforts to establish a viable wild sheep population in GMU 54 will only be pursued if potential conflicts with all these issues can be resolved.

During spring 2008, Department staff worked with representatives of the USFS, BLM, ISDA, and 2 domestic sheep permittees to craft the Strategy for managing separation between bighorn sheep and domestic sheep and goats in the South Hills (Strategy). The Strategy is designed to improve monitoring of and decrease likelihood of contact between bighorn and domestic sheep in GMU 54. All of the above parties endorsed the final plan, and aspects of the plan have been incorporated into the permittees' annual operating instructions.

## Management Direction

Overall management in this area is intended to maintain the existing population of bighorn sheep within the core area described in the Strategy. In those portions of bighorn sheep distribution that overlap or abut domestic sheep and goat grazing or trailing allotments, and within those portions that overlap private lands, management will focus on minimizing potential contact between bighorn sheep and domestic sheep and goats. As prescribed in the Strategy, management in this area will include an annual meeting to review the Strategy with all involved parties.

Within current distribution, modeled habitat comprises 30 km<sup>2</sup>, which could support approximately 56 animals (assuming all habitat is suitable year-round and relatively high densities of 1.9 sheep/km<sup>2</sup>). However, specific habitat needs such as lambing and seasonal habitats are not accounted for in these figures. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size.

### Management Actions

- 1. Meet annually with representatives from Noh and Pickett Livestock Companies, Sawtooth National Forest, Burley BLM, and Idaho Department of Lands to discuss items described in the South Hills Sheep Strategy.**
- 2. Improve quality and quantity of data on abundance, distribution, and movements of bighorn sheep in Unit 54.**



# California Bighorn Sheep

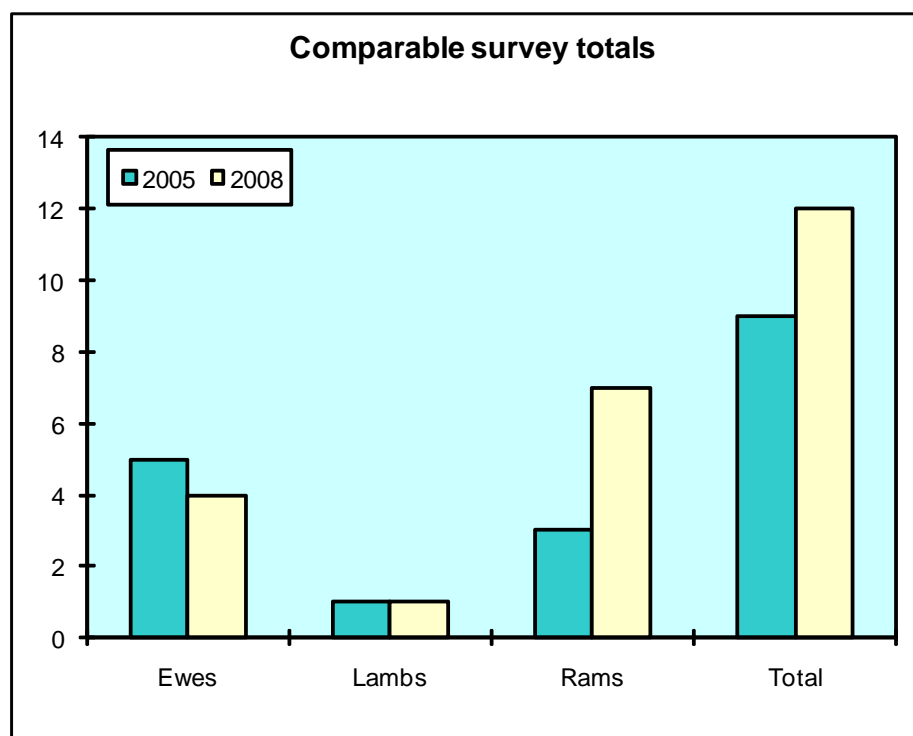
## South Hills

GMU 54

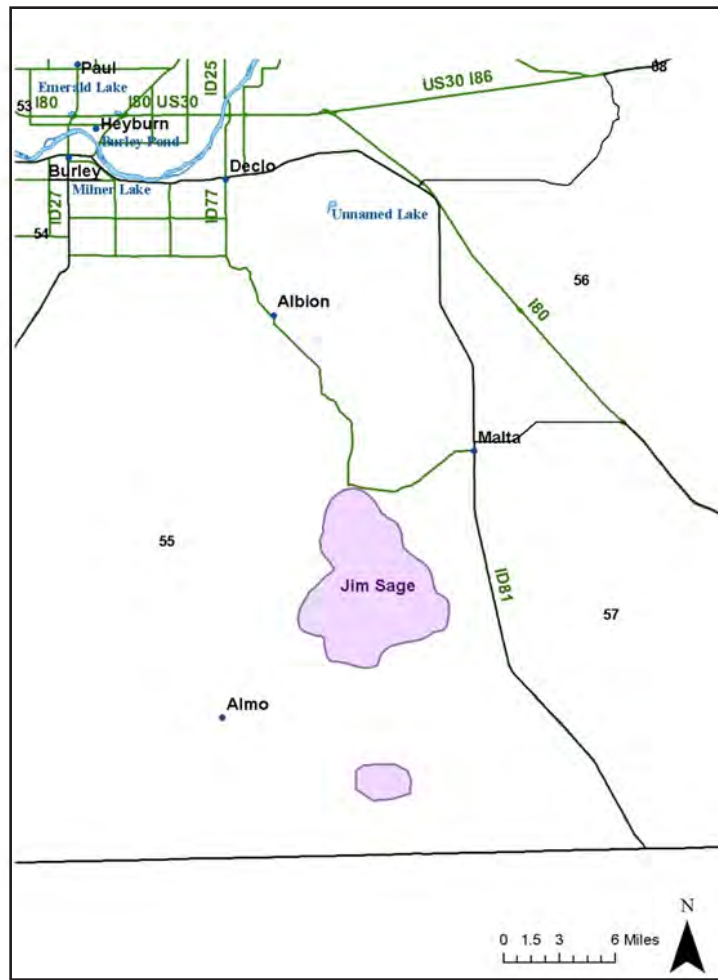
### Hunting permits and harvest information

**No hunting season in this area**

Population surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
54	2005	5	1	2	1	3	0	9
	2008	4	1	4	3	7	0	12
Modeled estimate								<15
Per 100 ewes observed			25	100	75	175		



# Jim Sage PMU



## Description

This population includes bighorn sheep in GMU 55. Jim Sage Mountain is one of many small, isolated mountain ranges that occur throughout southern Idaho. Bighorn sheep primarily use lands managed by the BLM, but also occasionally use private land. Elevations in the area used by bighorn sheep range from 1,500 to 2,400 m. The landscape is characterized by moderately rugged canyons and low mountains. Lower elevations and south slopes feature predominately shrub-steppe vegetation. Many slopes on the southern and western portions of Jim Sage Mountain exhibit thick juniper cover. Road densities in the area used by bighorn sheep are moderate. Bighorn sheep in this area do not exhibit seasonal migratory movements.

## Historical Perspective

Bighorn sheep were extirpated from southern Idaho in the early 1900s. In the 1960s, IDFG initiated a program to reestablish California bighorn sheep populations in the Owyhee River and Little Jacks Creek drainages in Owyhee County.

By the 1980s the healthy bighorn sheep population in Owyhee County was providing sheep for translocation programs in several western states including Idaho. From 1988 through 2004, the Department embarked on a program to reestablish California bighorns into historic range in several locations in Cassia County including the Jim Sage and Albion mountains.

During 1999, domestic sheep grazing on federal grazing allotments in GMU 55 was eliminated, clearing the way for bighorn sheep releases. From 2000 to 2004, 93 bighorns were released into historic habitat on the Jim Sage and Albion mountains (Appendix B). The Jim Sage population has increased steadily to an estimated 80-100 bighorns. The Albion Mountain releases were unsuccessful. Released sheep began dispersing immediately from the habitat selected for them and no sheep are known to currently exist in the area.

The 2006 helicopter survey suggested that the population may be stabilizing at 80-100 individuals (Fig. 15); probably near the carrying capacity of the existing habitat. Until approximately 2007, a small farm flock of domestic sheep occurred near the south end of Jim Sage Mountain. A few of the bighorn sheep from Jim Sage had migrated to this area, and still spend much of their time on 2 low hills just south of the Narrows Road. Although no contact between domestic and bighorn sheep was confirmed, there is a chance contact may have occurred. Currently, the landowner no longer has domestic sheep on his private land; however, the close proximity of private land and the potential of previous contact warrant some monitoring.

Key to maintaining a wild sheep population on Jim Sage Mountain will be minimizing the potential adverse effects of an increasing human population in the surrounding mountain valleys. Increasing human activities on and surrounding the mountain would be expected to lessen the suitability of existing habitat and could jeopardize the long-term viability of the herd.

Thick juniper cover occurs on portions of Jim Sage Mountain, reducing the amount of available suitable habitat. While bighorn sheep on Jim Sage Mountain tend to avoid thick juniper habitats, the junipers likely serve as a buffer to discourage bighorn movements to areas with increased human activities. A long-term juniper management program designed to improve bighorn sheep habitat, while considering the needs of mule deer and other wildlife, should be considered.

The 2003 and 2004 releases of bighorn sheep on the Albion Mountains appear unsuccessful in establishing a new wild sheep population. Presently there are no known wild sheep remaining in the release area.

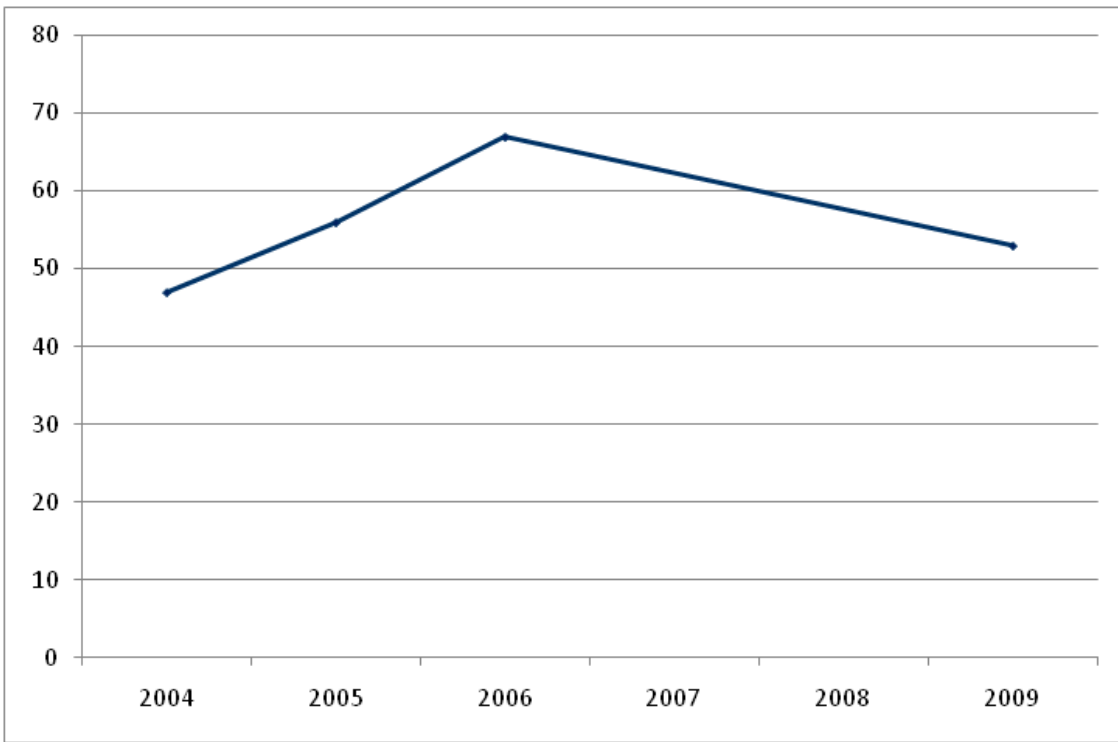
In light of the high rate of dispersal away from the Albion Mountains release sites, it is apparent that the bighorn sheep habitat model developed in the Jim Sage Mountains failed to accurately predict bighorn habitat in the Albion area. In addition, habitat differences between source locations and release locations may have exacerbated the disorientation experienced by sheep in the new terrain. Specifically, the release site exhibited taller, shrubby vegetation than the source sites; this difference may have contributed to the rejection of the area by the translocated sheep.

Within current distribution, modeled habitat comprises 53 km<sup>2</sup>, which could support approximately 102 animals (assuming all habitat is suitable year-round and relatively high densities of 1.9 sheep/km<sup>2</sup>). However, specific habitat needs such as lambing and seasonal habitats are not accounted for in these figures. Thus, further refinement of habitat models and available habitat could reduce the estimate of potential population size.

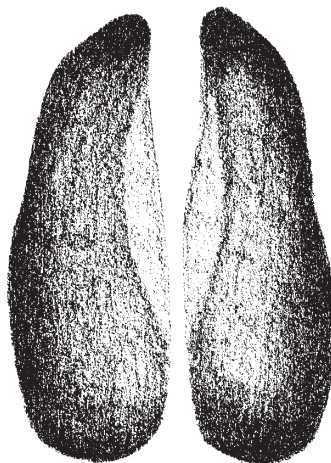
Given the isolated nature and limited amount of suitable habitat on Jim Sage Mountain, it is likely that this herd is approaching carrying capacity. The habitat-based population modeling approach detailed in the habitat section of this plan supports this theory as it yields a population goal of 102 bighorn sheep. Furthermore, because releases in the Albion Mountains have proven unsuccessful, future releases are not currently under consideration, unless future habitat modeling can better identify potential source herds with more similar source habitats. Because of these factors, management will likely focus on maintaining, or slightly increasing, the bighorn sheep population on Jim Sage Mountain. In those portions of bighorn sheep distribution that overlap or abut domestic sheep and goat grazing or trailing allotments, and within those portions that overlap private lands, management will focus on minimizing potential contact between bighorn sheep and domestic sheep and goats. Harvest on Jim Sage Mountain will likely be limited for the immediate future, as this small herd has few mature rams and therefore cannot sustain high harvest rates.

#### Management Actions

1. **Work with domestic sheep and goat owners to minimize potential contact with bighorn sheep.**
2. **Work with BLM staff to discuss bighorn sheep habitat on Jim Sage Mountain, with particular emphasis on juniper density within bighorn sheep habitat.**
3. **Refine habitat modeling to more accurately characterize sustainable population levels.**



**Figure 15.** Total bighorn sheep estimated during aerial surveys, Jim Sage PMU, 2004-present.



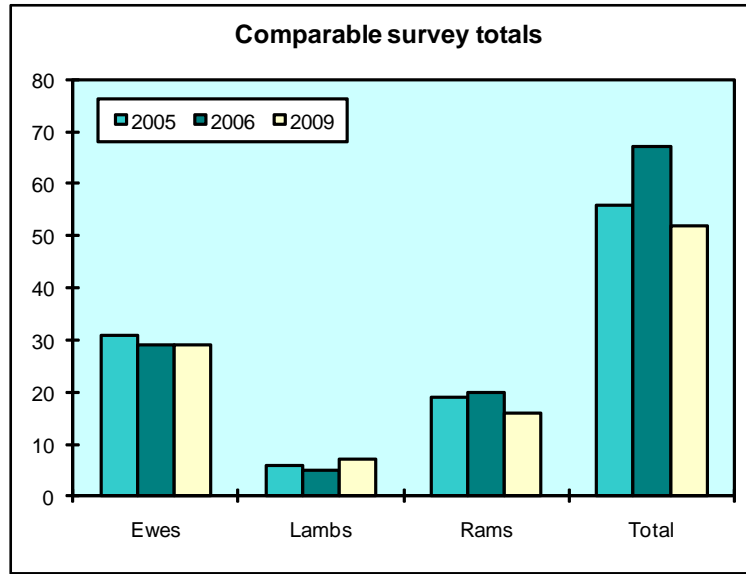


# California Bighorn Sheep

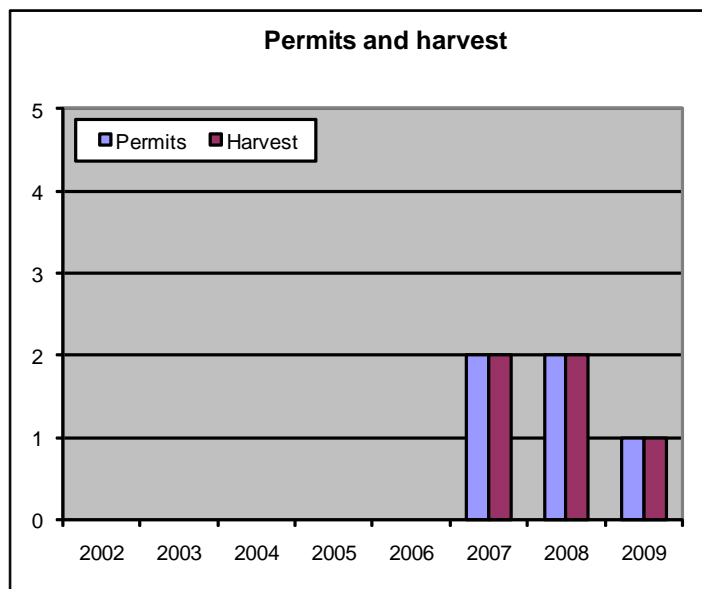
Jim Sage

GMU 55; Hunt Area 55

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
55	2005	31	6	16	3	19	0	56
	2006	29	5	11	9	20	13	67
	2009	29	7	13	3	16	0	52
Modeled estimate		34	6	13	11	24	15	79
Per 100 ewes observed			24	45	10	55		

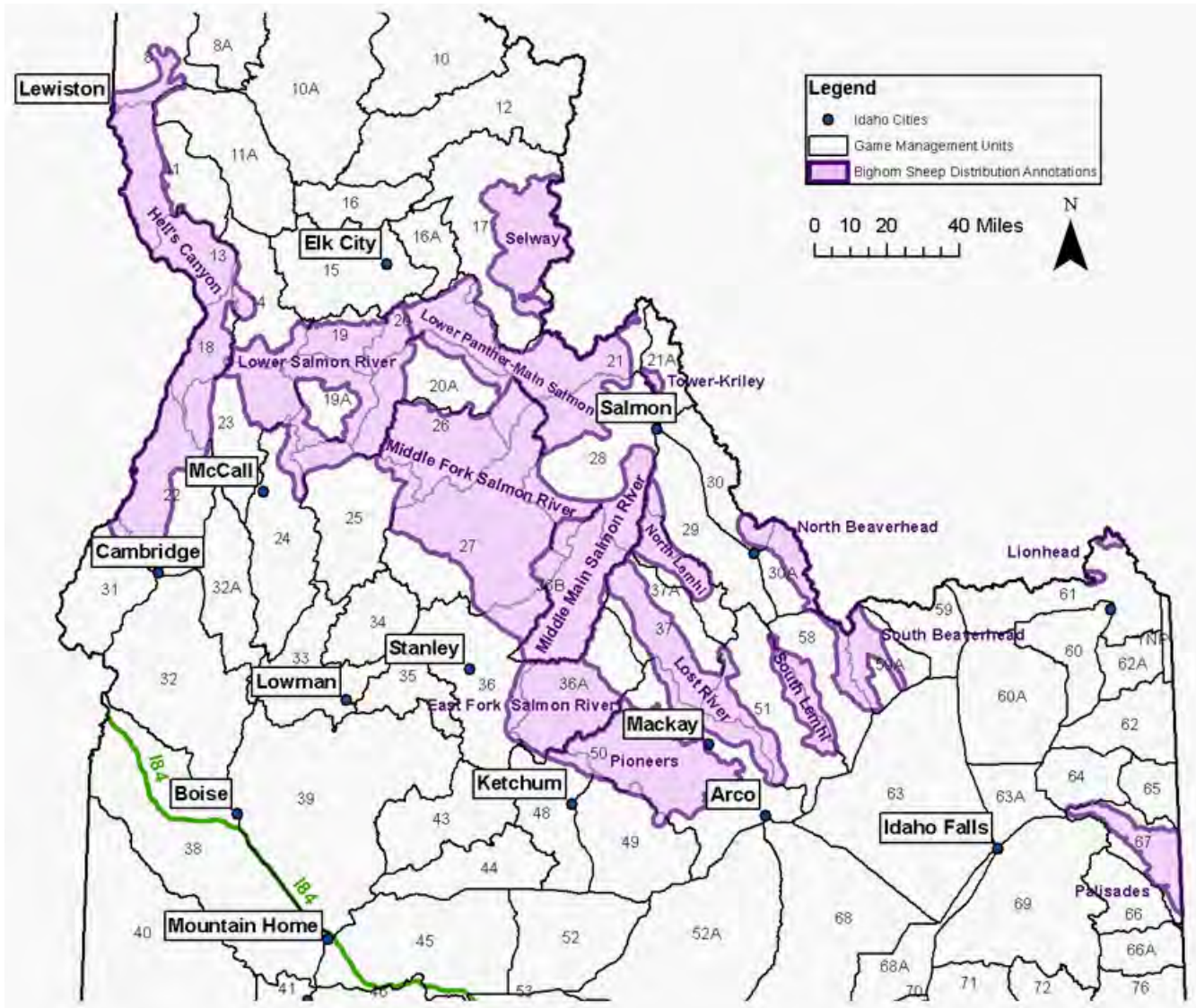


Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	0	0	0	0	0	2	2	1
Harvest	0	0	0	0	0	2	2	1
Hunter success						100	100	100
Ave ram age						7.0	6.0	4.5



# POPULATION MANAGEMENT UNITS

## ROCKY MOUNTAIN BIGHORN SHEEP



**F**rom historical records, bighorn sheep ranged widely in Idaho in the early 1800s and are believed to have been one of the most abundant game animals in the state prior to the mid-1800s. Beginning in the 1870s, Idaho's bighorn sheep populations declined drastically. Idaho estimated 1,000 bighorns in the state in the early 1920s, mostly in the Salmon River drainage. In 1925 the last bighorn sheep was reported killed in Hells Canyon. The 3 primary factors believed responsible for the large decline of bighorn sheep in Idaho were unregulated hunting, competition with domestic livestock for forage, and disease.

Idaho began efforts to reestablish Rocky Mountain bighorn sheep populations in the late 1960s when animals from central Idaho were translocated near Mt. Borah (1969). Numerous bighorn sheep have been moved into, within, and out of Idaho since then. The most recent translocation was 62 bighorn sheep from Montana released in 2 different locations in the Lost River Range in 2005.

Bighorn sheep distribution for this plan is defined as the geographic range regularly or periodically occupied by bighorn sheep. Not all areas within this range have sufficient suitable habitat to support persistent populations and bighorn sheep can and do occasionally move outside this area. Distribution can change through time as a consequence of changes in population density, habitat, or other factors. We divided the Rocky Mountain bighorn sheep distribution into 16 PMUs. Bighorn sheep populations were separated into PMUs based on current knowledge of distribution and connectivity between subpopulations and populations. Data is lacking for several of Idaho's Rocky Mountain bighorn sheep populations. Additional information from radiotelemetry, aerial surveys, ground surveys, etc. would be beneficial for population management.

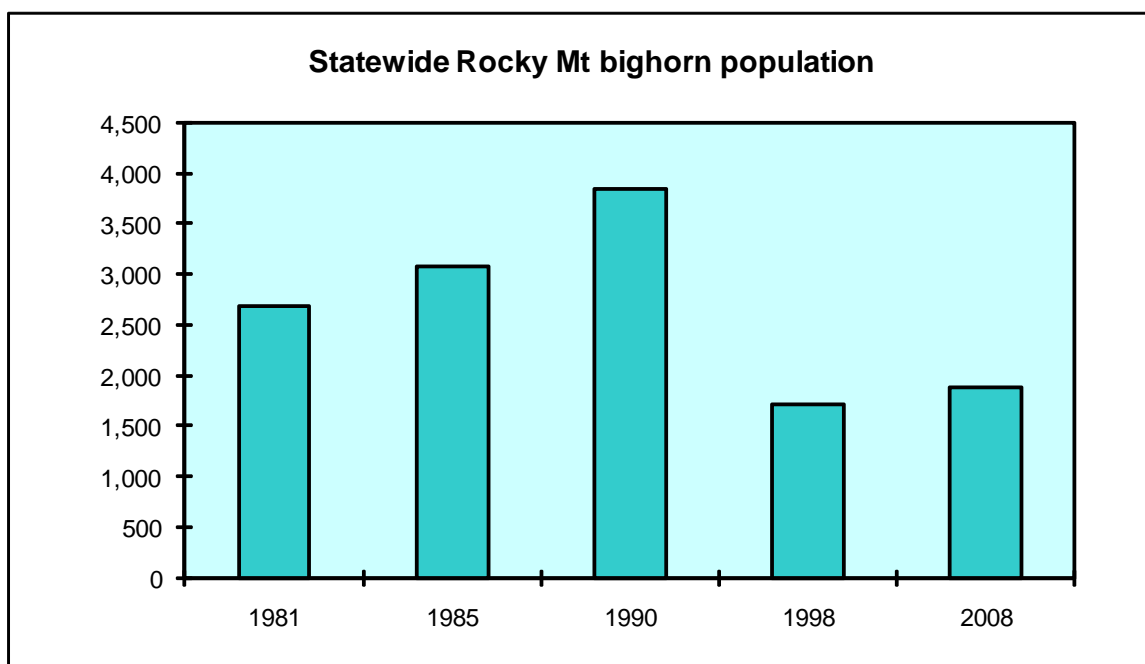
Idaho plans to continue to manage bighorn sheep north and south of Interstate 84 separately and will continue to refer to them as California and Rocky Mountain bighorn sheep "trophy types." The 2 types display differences in physical appearance and occupy different habitats. California bighorn sheep generally occupy canyon and desert habitat, whereas the Rocky Mountain bighorn sheep occupy rugged mountainous terrain. Currently, there are approximately 1,800 Rocky Mountain bighorn sheep in Idaho.



# Rocky Mountain Bighorn Sheep

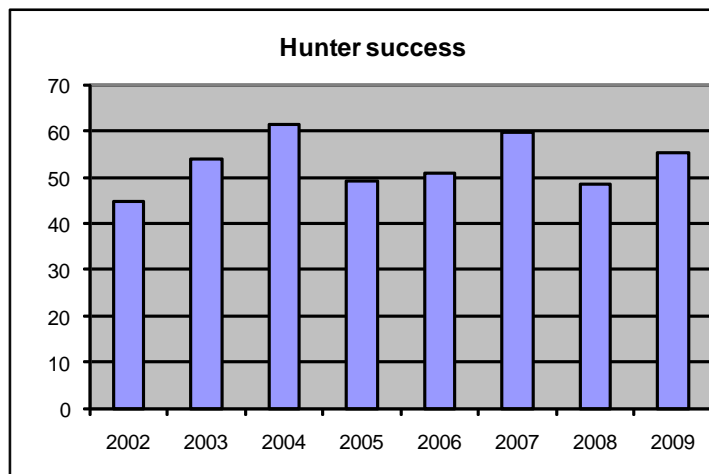
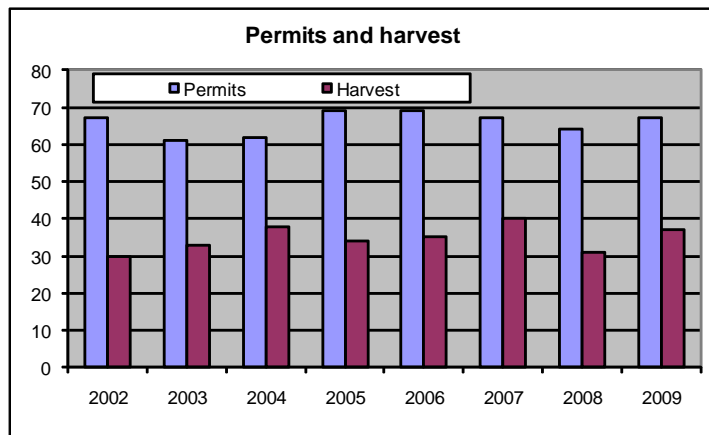
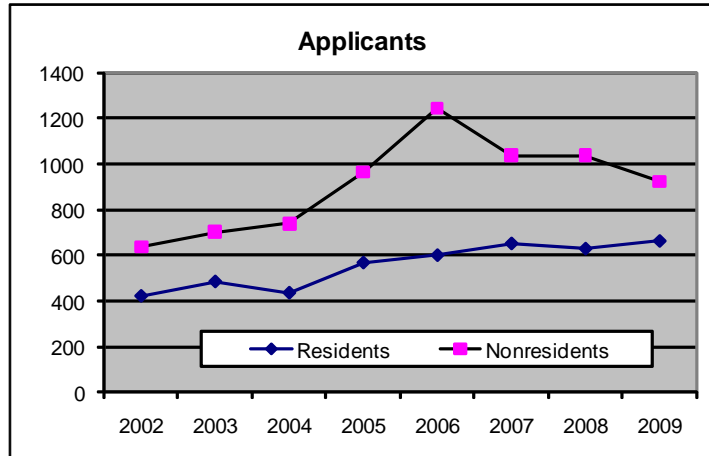
Population Status										
PMU	Observed				Modeled				Most recent survey	
	Ewes	Lambs	Rams		Total	Ewes	Lambs	Rams		
			I, II	III, IV				I, II		III, IV
Hells Canyon	79	20	25	26	150					2009
Lower Salmon	159	29	23	32	243					2007
Selway	21	1	3	1	26					2007
Middle Fork Salmon	347	75	81	64	567					2009
Panther-Main Salmon	112	31	24	21	188					2008
Tower-Kriley	6	3	6	0	15					2010
North Beaverhead	26	0	7	1	34					2008
South Beaverhead	2	5	1	5	13					2007
North Lemhi	68	19	11	14	112					2007
South Lemhi	1	1	0	0	2					2007
Lost River	117	47	38	38	240					2010
East Fork Salmon	33	5	16	14	68					2008
Middle Main Salmon	129	36	29	21	215					2010
Pioneers										
Palisades										
Lionhead										
<b>Total</b>	<b>1,100</b>	<b>272</b>	<b>264</b>	<b>237</b>	<b>1,873</b>					

Estimates of Statewide Population				
1981	1985	1990	1998	2008
2,690	3,080	3,850	1,710	1,873

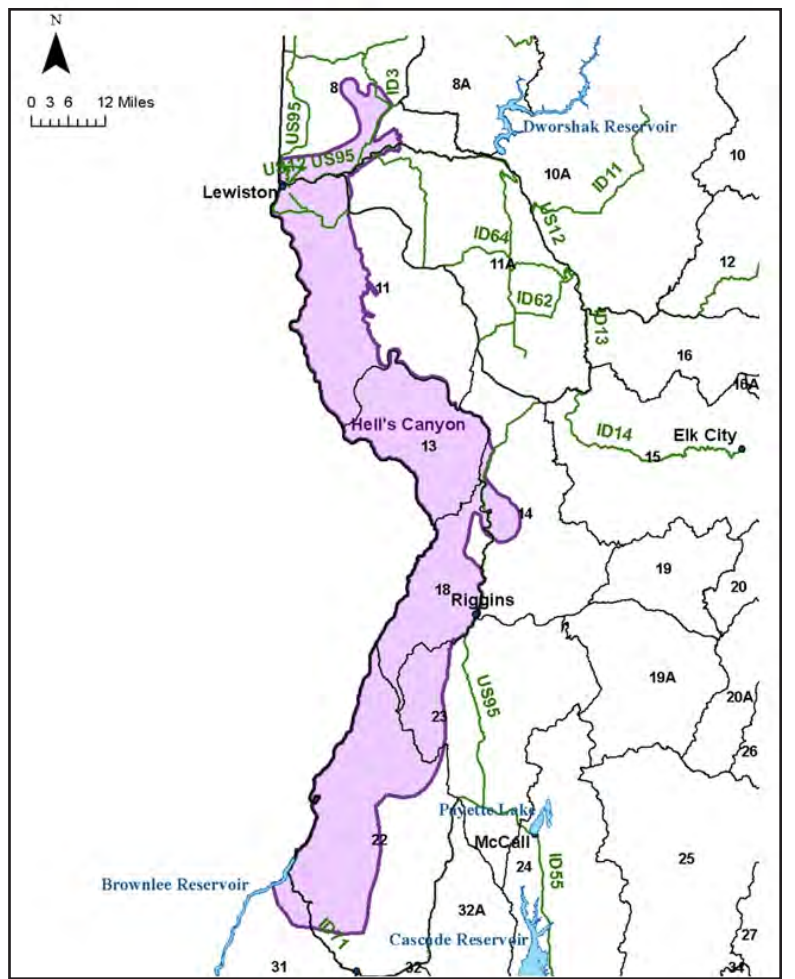


# Rocky Mountain Bighorn Sheep

Hunting Permits, Applications, and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	67	61	62	69	69	67	64	67
Resident applicants	421	485	435	569	602	654	631	665
Nonresident applicants	636	703	739	964	1,245	1,037	1,037	923
Harvest	30	33	38	34	35	40	31	37
Hunter success (%)	45	54	61	49	51	60	48	55
Average ram age (yrs)	6.3	7.1	7.2	5.9	7.3	7.5	6.8	7.4



# Hells Canyon PMU



## Description

The Hells Canyon PMU includes sheep in at least 4 populations in GMUs 11, 13, 18, and 22. Extensive bighorn sheep habitat in these units consists of dry, bunchgrass vegetation and rocky cliffs along the Snake and Salmon River breaks and their tributaries. Land ownership in GMU 11 is primarily public along the Snake River and includes IDFG's Craig Mountain Wildlife Management Area (CMWMA). There are also several significant blocks of private land, including one of the primary lambing areas for the population. The Salmon River breaks in GMU 11 and both the Snake and Salmon River breaks in GMU 13 are predominantly in private ownership, although the BLM manages much of the river corridor along the Salmon River and most of the Snake River corridor is protected by conservation easements with the USFS. The USFS is the major land manager in the Snake River corridor portion of GMUs 18 and 22 which includes portions of the Hells Canyon National Recreation Area and wilderness. Idaho Power manages the reservoirs and adjacent access sites in

Unit 22 above Hells Canyon Dam. Road access into occupied sheep habitat is extremely limited in all 4 units. Bighorn sheep provide a valuable viewing resource for river recreationists in the Hells Canyon area.

## Historical Perspective

Bighorn sheep were native to Hells Canyon, but were extirpated in the early part of the 20th century. The last-known native bighorn sheep in this PMU was observed in GMU 18 in 1932. Speculation at that time attributed the loss of bighorn sheep to over-hunting by miners for subsistence and disease outbreaks associated with domestic sheep contact.

Bighorn sheep were reintroduced into Hells Canyon beginning with a translocation of bighorn sheep from the upper Salmon River into GMU 18 in 1975 followed by releases into GMUs 11, 13, and 18 through 2002 (Appendix B, Table 2). Since reintroduction, populations in GMU's 13 and 18 and 22 have experienced significant mortality from all-age disease outbreaks. All populations have experienced intermittent adult mortality and

poor lamb recruitment due to pneumonia-caused mortalities.

In 1984, 17 sheep from Wyoming were released on the Craig Mountain Wildlife Management area in GMU 11. There were no surveys until 1992 when 57 animals were observed. The herd remained stable until the late 1990s when the population started increasing and reached 148 total sheep in 2002 (Fig. 16). Intermittent poor lamb survival from 1998 through 2008 and low adult survival in 2006 resulted in a decline to 109 bighorn sheep counted in 2010. The primary cause of mortality in recovered dead lambs and in adults that died in 2006 was pneumonia.

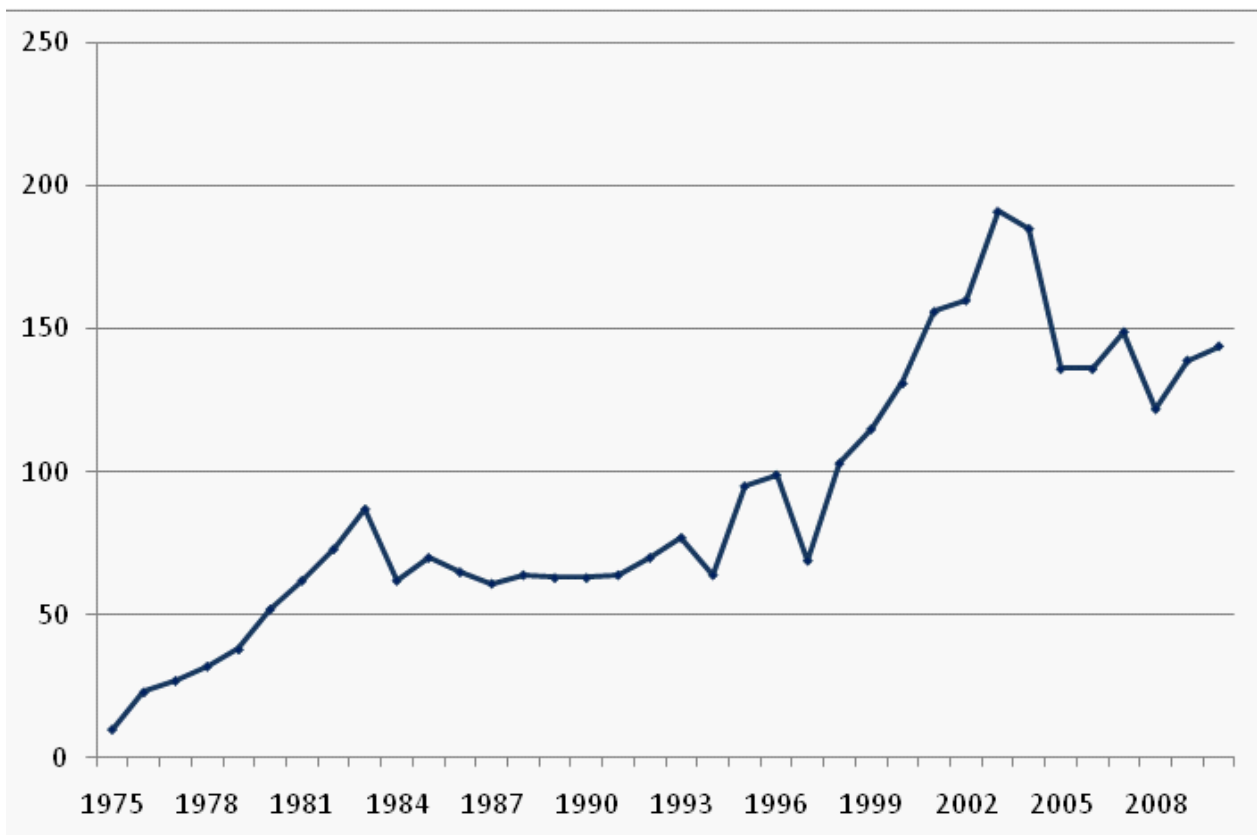
After translocations in 1997 and 1999, the GMU 13 population was estimated at a high of 45 sheep in summer 2000. Disease outbreaks in adults between 2000 and 2003 due to scabies infection (2000) and pneumonia (2000 – 2003), and low recruitment of lambs 2000 – 2008 have resulted in a decline in this population. In 2009, 16 sheep were observed in GMU 13.

Five translocations occurred in GMUs 18 and 22 1975 – 2002. Access is difficult and survey data are limited, however a high count of 87 sheep was

tallied in 1982. Disease outbreaks were observed in 1983 and 1991. Since 1992, about 20 – 35 sheep are usually observed in GMU 18. During the most recent survey (2010), 21 bighorn sheep were observed in GMU 18 and GMU 22 below Hells Canyon Dam.

Bighorn sheep translocated by the Oregon Department of Fish and Wildlife to the west side of the Snake River below Brownlee Reservoir 1990 - 1995, and above and below Hells Canyon Dam 1971 - 1999 periodically cross the river into GMU 22. The sheep released across from the extreme southern end of the unit in 1990 and 1995 spend a significant portion of time in Dukes Creek. This population peaked at 76 sheep in 1998. In 1999, an all-age disease outbreak occurred and the population has not recovered due to lack of lamb recruitment and sporadic chronic pneumonia mortality in adults. Eight sheep were counted in 2010.

Hunting was initiated in GMU 11 in 1993. A controlled hunt with 2 tags was offered in 1993 and 1994. The likelihood of participation by the state auction or lottery tag holder in the GMU 11 hunt, as occurred from 1993-1996, led to a reduction in the number of tags offered in the hunt from 2 to 1 in 1995. Beginning in the late 1990s, the GMU 11 hunt has consistently produced some of the largest rams



**Figure 16.** Total bighorn sheep observed or estimated between surveys, Hells Canyon PMU, 1975-present.

taken statewide. The Idaho state record bighorn ram was picked up in 1997 after probably having died in 1996. Many record book rams have been harvested in this hunt, including the largest ever taken in Idaho. Consequently, tags are highly sought after. Drawing odds reached an all-time high of 1 in 345 in 2006, with many out-of-state applicants.

No bighorn sheep hunts have been offered in GMU 13 or 22.

Hunts were offered in GMU 18 beginning in 1984. Tag levels were reduced in subsequent years concurrent with the population decline. The hunt was closed in 1993.

## Issues

Disease is the largest issue facing bighorn sheep in the Hells Canyon PMU. The very low or absence of recruitment because of sporadic lamb die offs and pneumonia in adults is the reason populations in this PMU have not grown. Currently, all populations in this PMU are disease limited. Increases in elk herds in this PMU could theoretically cause increased competition but currently little spatial overlap is observed. High rates of reproduction and large body and horn size in bighorn sheep suggest forage is not limiting.

## Management Direction

GMU 11 is the only unit in the Hells Canyon PMU that currently has a sheep population large enough to support a hunt. The hunt in GMU 11 is the most sought-after sheep hunt in the state. The recipient of the auction and raffle tag (alternate years) have consistently hunted in GMU 11 and drawing odds are the most difficult in Idaho (less than 3% in 2006-2010). Hunter success is usually 100%.

Hunting opportunity in GMU 11 will be managed to provide the opportunity to harvest large mature rams. Poor lamb recruitment due to disease issues represents the largest threat to continued bighorn sheep hunting opportunity in this unit. As a result, tag levels will remain conservative as a response to limited ram availability. Access for hunting bighorn sheep in GMU 11 is considered fair to moderately difficult. Units 13, 18, and 22 will be managed solely for population growth until such a time when hunting can be offered.

Within current distribution, modeled habitat comprises approximately 817 km<sup>2</sup>, which could support approximately 1,550 bighorn sheep

(assuming that all habitat is suitable year-round at bighorn sheep densities of 1.9/km<sup>2</sup>). There is extensive lambing and year round habitat in this PMU but further refinement of habitat models could reduce or increase estimates of available habitat and potential population size.

Noxious weeds, especially yellow starthistle, have become established in a significant portion of this PMU. Currently IDFG is working with cooperative weed management groups and aggressively spraying weeds and using biological controls on department managed ground to improve wildlife habitat.

Cooperation with wildlife agencies in Oregon and Washington, public land management agencies including USFS and BLM, and private individuals is necessary to manage habitat and bighorn sheep in the Hells Canyon PMU.

The current objective in this PMU is to maintain or increase bighorn sheep populations.

## Management Actions

- 1. Continue work with the Hells Canyon Initiative research.**
- 2. Implement management actions as possible to reduce impacts of disease.**
- 3. Improve bighorn sheep habitat by working to reduce noxious weeds.**
- 4. Refine habitat modeling to more accurately characterize sustainable population levels.**
- 5. Use radiomarked sheep to provide data points for sightability modeling.**

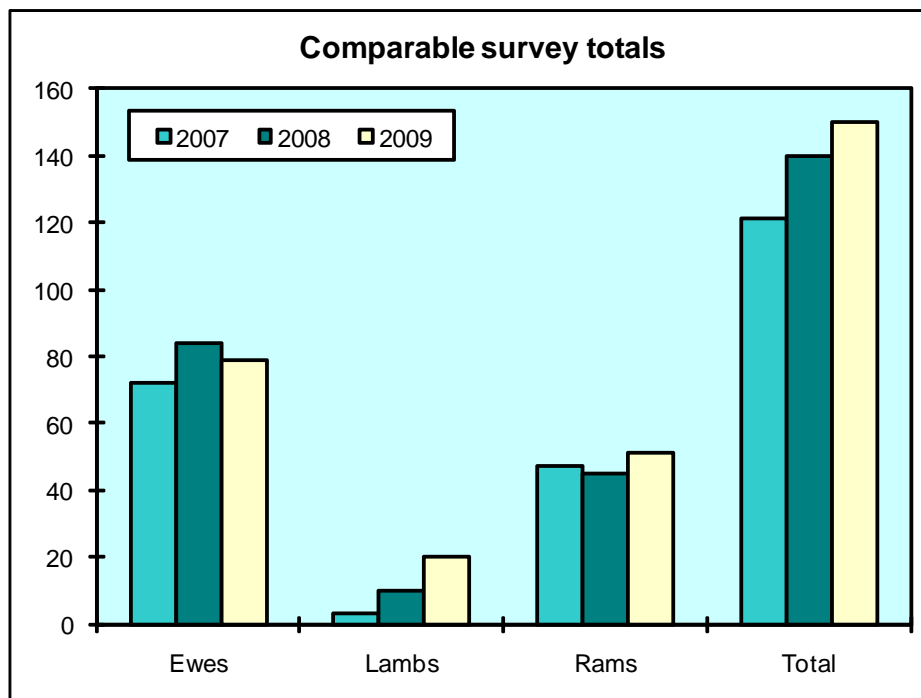


# Rocky Mountain Bighorn Sheep

## Hells Canyon

GMUs 11,13,18, 22; Hunt Area 11

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
11	2007	57	1	11	23	34	0	92
	2008	67	9	5	30	35	0	111
	2009	59	17	21	18	39	0	115
13	2007	9	0	3	5	8	0	17
	2008	9	1	3	3	6	0	16
	2009	12	3	1	6	7	0	22
18	2007	6	2	3	2	5	0	13
	2008	8	0	2	2	4	0	12
	2009	8	0	3	2	5	0	13
22								
Total	2007	72	3	17	30	47	0	121
	2008	84	10	10	35	45	0	140
	2009	79	20	25	26	51	0	150
Modeled estimate								
Per 100 ewes observed			25	32	33	65		



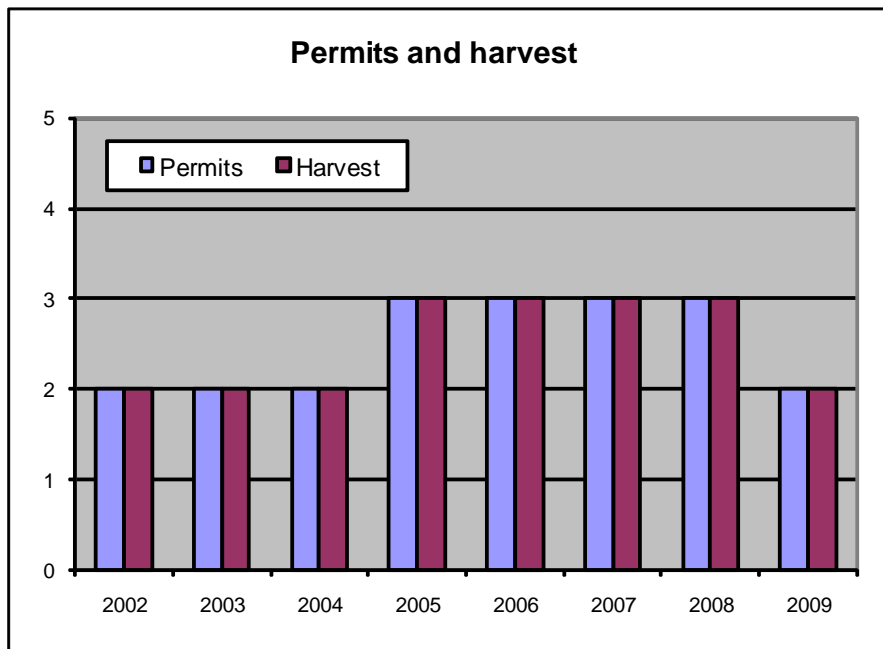
# Rocky Mountain Bighorn Sheep

## Hells Canyon

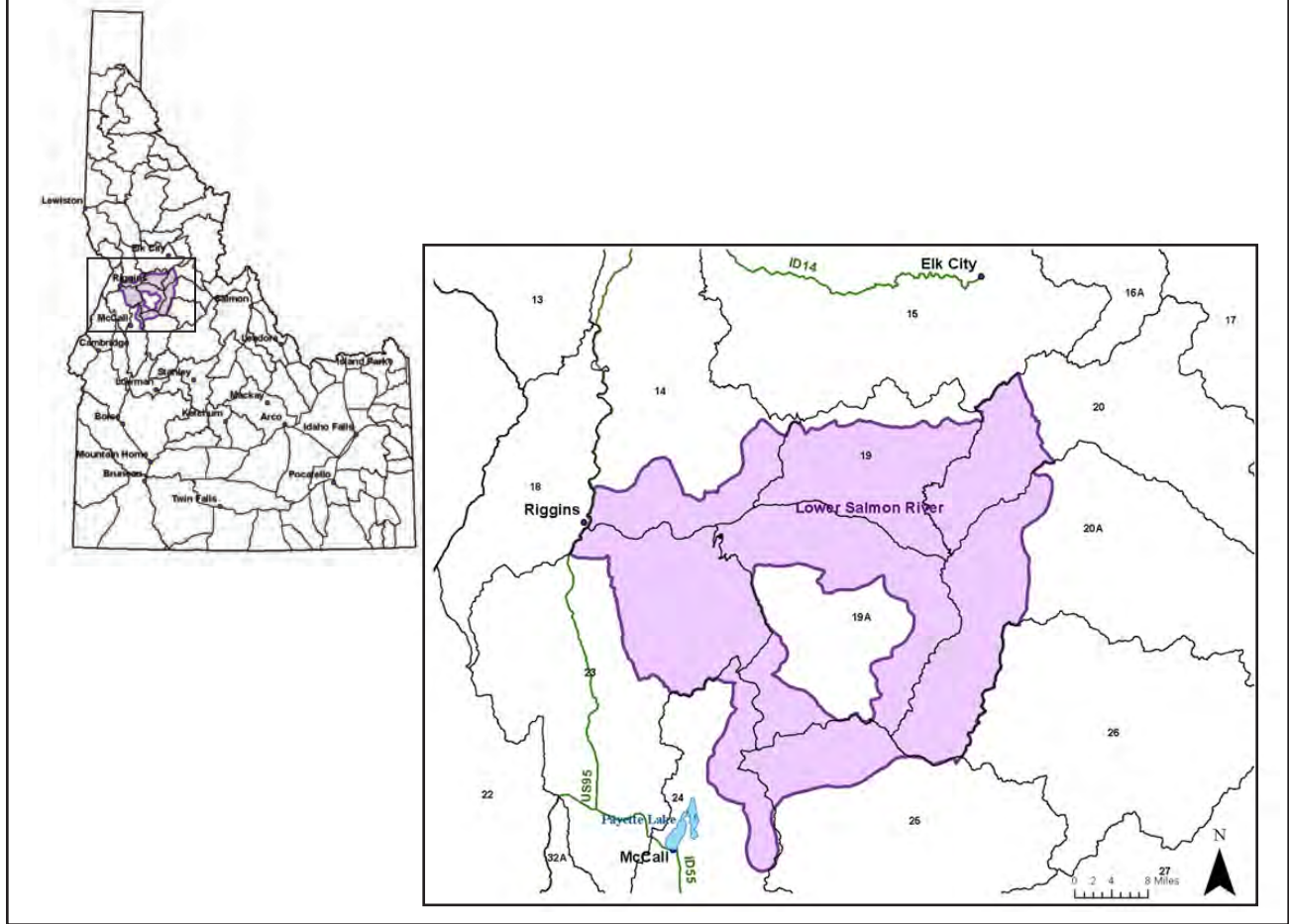
GMUs 11,13,18, 22; Hunt Area 11

Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits*	2	2	2	3	3	3	3	2
Harvest*	2	2	2	3	3	3	3	2
Hunter success	100	100	100	100	100	100	100	100
Ave ram age	9.5	8.0	6.0	9.8	9.8	8.8	9.3	9.5

\*Includes auction or raffle permits.



# Lower Salmon River PMU



## Description

The Salmon River PMU includes GMUs 14, 19, 19A, 20 (western portion), 20A (western portion), 23, 24, and 25. Bighorn sheep habitat in these units consists of dry, bunchgrass habitat types along the Salmon River breaks and some high elevation, alpine summer habitat. Habitat along this river corridor is primarily under USFS ownership with the eastern portions of this PMU occurring within the Gospel Hump and Frank Church River of No Return wilderness areas. Habitat also occurs on some BLM land and small in-holdings of private land. Road access is extremely limited with the exception of the Salmon River Road downstream of Vinegar Creek (primarily in GMU 14).

## Historical Perspective

Bighorn sheep are native to these units and were not extirpated in the early 1900s. No reintroductions or augmentations have occurred in the PMU.

Beginning in 1952 and lasting until 1970, bighorn sheep hunting in the Lower Main Salmon PMU

was offered on a general hunt basis. From 1971 to present, all sheep hunting in these units has been by controlled hunts. Season structure and tag levels were modified starting in 1993 to reflect the decline in total numbers of sheep and lamb recruitment. Currently, there is only 1 hunt offered in this area. Hunt Area 19 consists of portions of GMUs 14, 19 and 20 and has 4 tags.

## Issues

Bighorn sheep have usually been surveyed by helicopter coincidentally with elk sightability surveys. Total numbers of bighorn sheep observed during surveys have declined in GMUs 19 and 20 since the early to mid 1980s. These surveys have yielded very conservative bighorn sheep population estimates for this PMU. The Department is developing a sightability model for bighorn sheep surveys in this area to increase precision of population estimates.

In GMU 19, between 122 and 136 bighorn sheep were observed during 1983 and 1984 surveys.

However, only 40-60 were observed in 1992, 1993, 1996, 2001 and 2007. The most recent survey conducted in March 2010 was flown strictly as a bighorn sheep survey and 115 animals were observed. This estimate reflects an attempt to collect more precise data rather than an actual change in the population. Similar trends have been noted for GMUs 19A and 20A (Fig. 17).

Low recruitment rates and overall declines in sheep numbers over the years in these units may have been caused by disease and habitat conditions. Population numbers have dwindled in the western portion of this PMU (GMU 14) that is closest to active domestic sheep allotments. Disease has resulted in low lamb survival in adjacent herds along the Salmon River. Respiratory disease is the most significant disease, resulting in negative effects on population dynamics through increased adult and lamb mortality.

### Management Direction

Sheep in the Lower Salmon River PMU are hunted in 1 hunt area within only a portion of the total PMU area. Hunt Area 19 consists of portions of GMUs 14, 19, and 20. This hunt will continue to be managed primarily to maximize bighorn sheep hunting opportunity. Hunter success typically averages 56% in Hunt Area 19 despite difficult access. The potential for that portion of the PMU in the lower South Fork Salmon River drainage to be opened to hunting will be assessed. Bighorn sheep in this

PMU will continue to be monitored for impacts from disease and conflicts with domestic sheep operations.

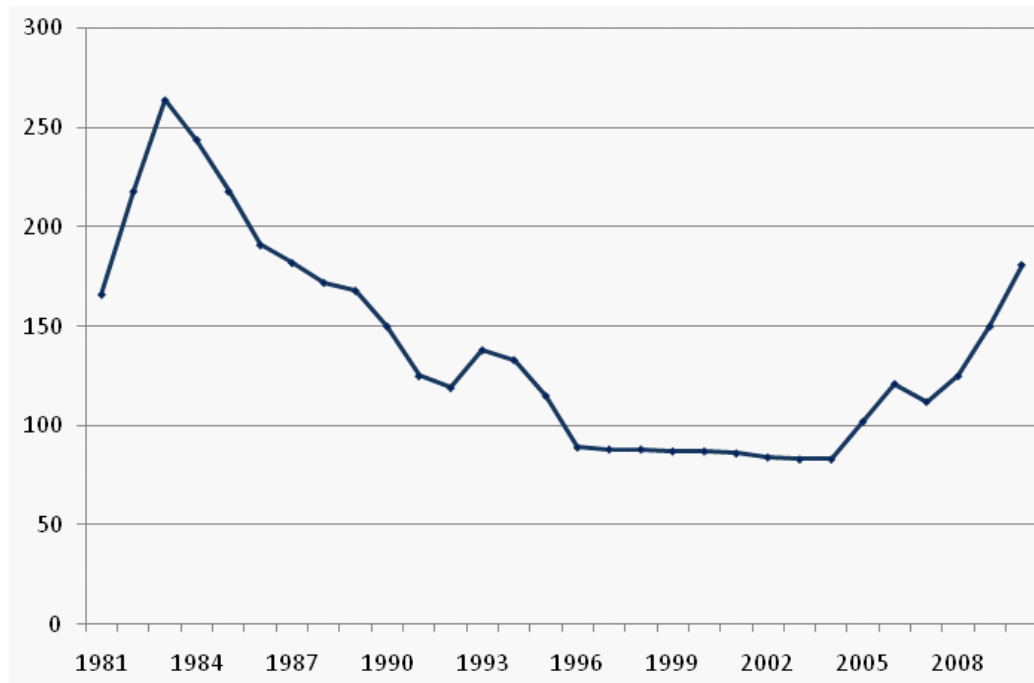
In this PMU the current management strategy for bighorn sheep is to manage for separation from domestic sheep and goats using BMPs as outlined in the health section of this document. The BMP agreements will be evaluated annually and adjusted as necessary to try to achieve this goal.

Within current distribution, modeled habitat comprises approximately 496 km<sup>2</sup>, which could support approximately 950 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. The current objective in this PMU is to maintain or increase bighorn sheep populations.

### Management Actions

1. **Work with willing domestic sheep permittees, USFS, and BLM to use BMPs to maintain separation between bighorn sheep and domestic sheep and goats.**
2. **Increase knowledge of movement patterns, habitat use, survival, etc. using radiomarked bighorn sheep.**
3. **Refine habitat modeling to more accurately characterize sustainable population levels.**
4. **Use radiomarked sheep to provide data points for sightability modeling.**

**Figure 17.** Approximate total bighorn sheep observed or estimated, Lower Salmon River PMU (GMUs 19, 19A, and 20A west), 1981-present.



# Rocky Mountain Bighorn Sheep

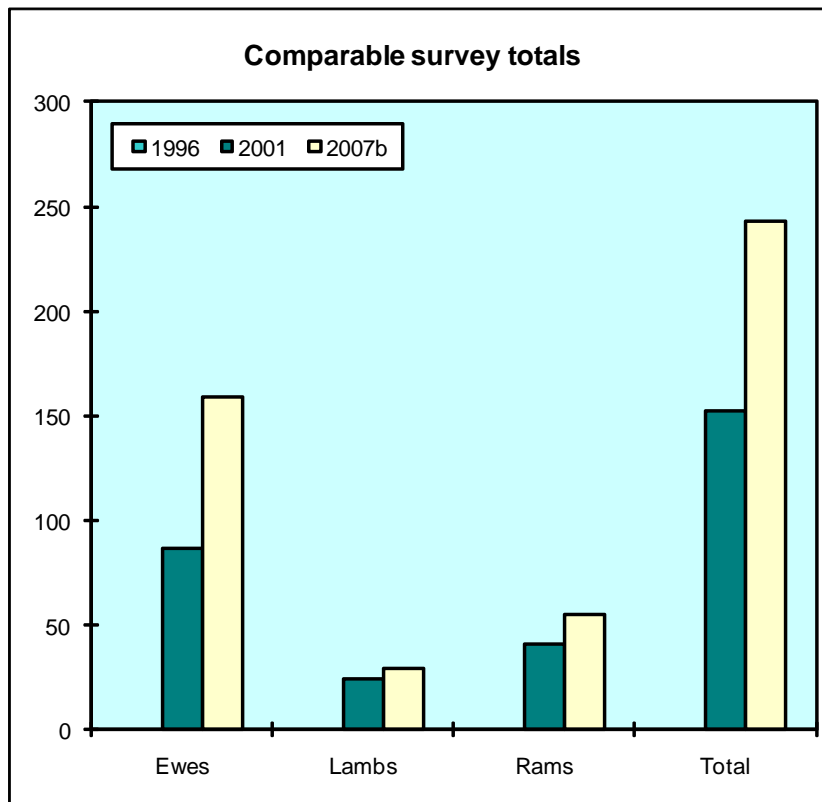
## Lower Salmon River

GMUs 14, 19, 19A, 20 (west), 20A (west); Hunt Area 19

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
14	2007 <sup>a,b</sup>	5	1	3	3	6	0	12
	2009	10	1	5	7	12	0	23
	2010	20	2	2	8	10	0	32
19	2007 <sup>b</sup>	31	5	2	0	2	0	38
	2009 <sup>a</sup>	55	17	6	0	6	0	78
	2010	81	6	15	12	27	0	114
19A	1996	31	5	2	0	2	0	38
						0	0	0
	2006	13	7	1	0	1	0	21
20	1996	51	7	9	10	19	1	78
	2001	22	6	10	13	23	0	51
	2007 <sup>b</sup>	11	1	1	6	7	0	19
20A	1996	17	2	0	1	1	0	20
						0		0
	2006	34	13	4	6	10	0	57
Total	1996	135	20	16	14	30	1	186
	2001	87	24	21	20	41	0	152
	2007 <sup>b</sup>	159	29	23	32	55	0	243
Modeled estimate								
Per 100 ewes observed			18	14	20	35		

<sup>a</sup> Incomplete count

<sup>b</sup> Incidental to elk survey

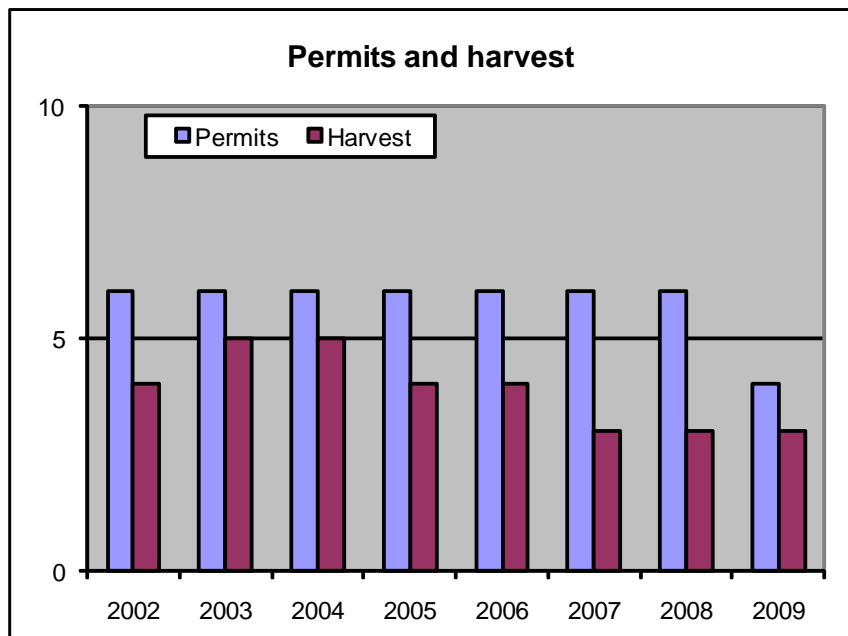


# Rocky Mountain Bighorn Sheep

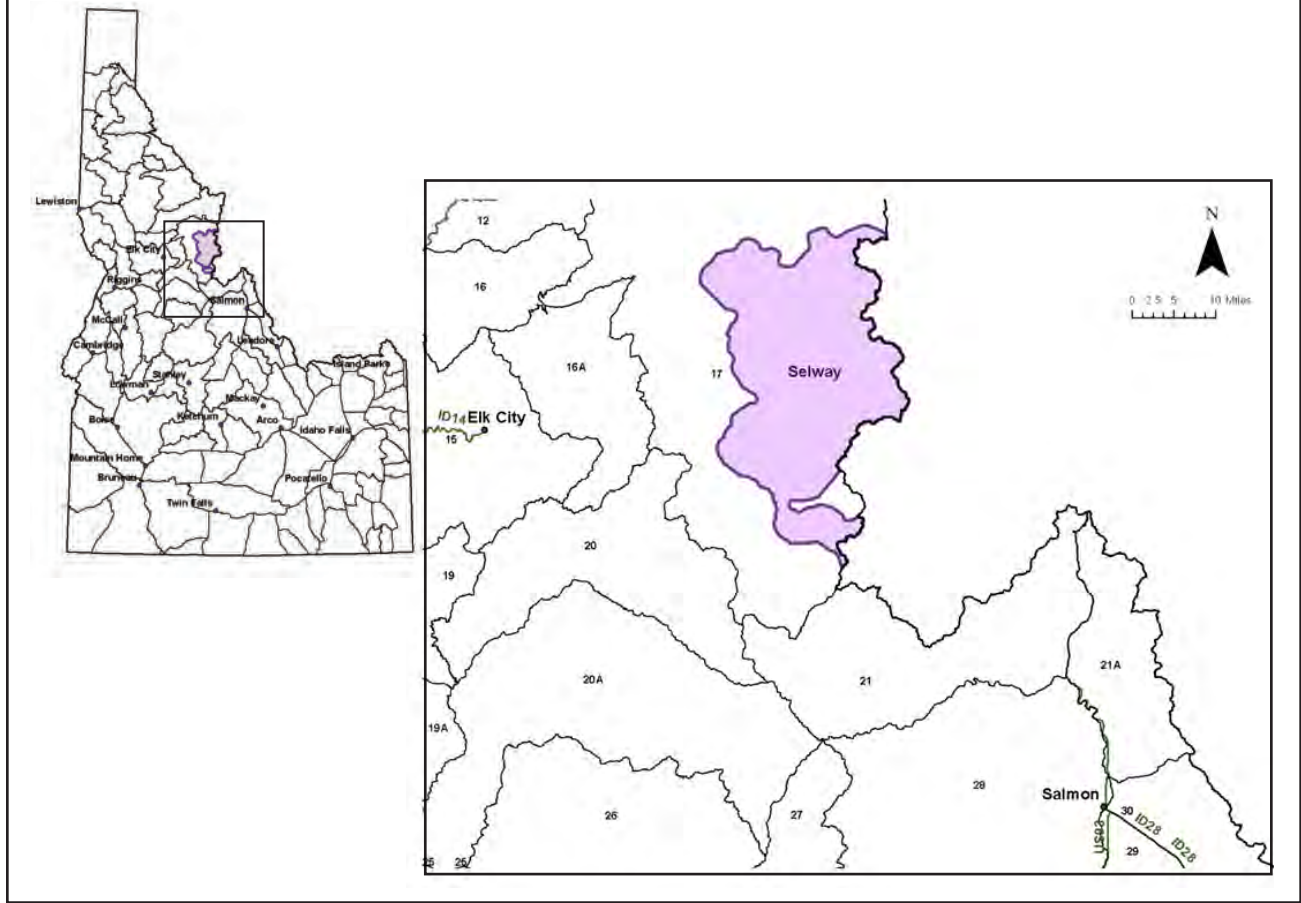
## Lower Salmon River

GMUs 14, 19, 19A, 20 (west), 20A (west); Hunt Area 19

Hunting permits and harvest information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	6	6	6	6	6	6	6	4
Harvest	4	5	5	4	4	3	3	3
Hunter success	67	83	83	67	67	50	50	75
Ave ram age	6.5	5.3	7.3	7.0	6.0	6.5	3.8	6.5



# Selway PMU



## Description

The Selway PMU includes the upper portion of the Selway River drainage in GMU 17. Bighorn sheep occurred naturally in this area. Sheep in GMU 17 move between Idaho and Montana. Summer range lies along the border of the 2 states, with most animals moving down into Idaho to winter (between Indian Creek and White Cap Creek and on the east side of the Selway River). In some years, some of these sheep may winter in Montana. Sheep marked by Klaver (1978) were observed in both states over several years.

Sheep habitat in GMU 17 consists of dry, bunchgrass habitat types. Land ownership is almost entirely USFS, with just a few small in-holdings of private land. The area is encompassed by the Selway-Bitterroot and Frank Church River of No Return wilderness areas. The only road access in this area is provided by USFS roads 468 and 6223 which runs from Nez Perce Pass on the Idaho-Montana border, down Deep Creek to the Selway River, and downstream along the Selway to White Cap Creek.

## Historical Perspective

In February 1989, a total of 29 bighorns from Morgan Creek in GMU 36B were translocated into 2 sites along the Selway River in GMU 17 (Appendix B). Both of these releases were made outside of currently occupied bighorn range within the unit. Recent surveys and observations have suggested that neither translocation was successful.

Most bighorn sheep surveys have been conducted by helicopter coincidental to elk sightability surveys in January or February. Bighorns have been counted in GMU 17 since 1981 (Fig. 18). The highest counts were obtained in 1982, 1983 and 1984, and were 121, 99 and 109 total sheep, respectively. Since that time, counts have ranged between 26 and 52 total sheep. During the most recent survey, conducted in 2007, 26 sheep were observed. There is concern that the currently employed survey methodology may not accurately reflect current population status.

Bighorn sheep were hunted under a general season framework in the Clearwater Region between 1952 and 1970. This season framework allowed more

accessible populations to be overexploited. The general season bighorn sheep hunt was discontinued in this PMU in 1971, and no hunting occurred in the Selway PMU until 2007 when a new hunt with 1 tag was initiated as Hunt Area 17L. The late timeframe of this hunt (14-31 October) was established to ensure enough time for bighorns to move from their summer range on the Idaho-Montana border back into Idaho where they would be available to Idaho hunters.

## Issues

Low lamb survival and recruitment rates have been an issue in some years since the early 1980s. The timing and causes of this low survival are poorly understood.

Currently the largest issue effecting management of sheep in this PMU is the lack of information. Little is known about the current disease status in the Selway. Ground counts conducted in the last 5 years would indicate that lambs are surviving and this population should be growing.

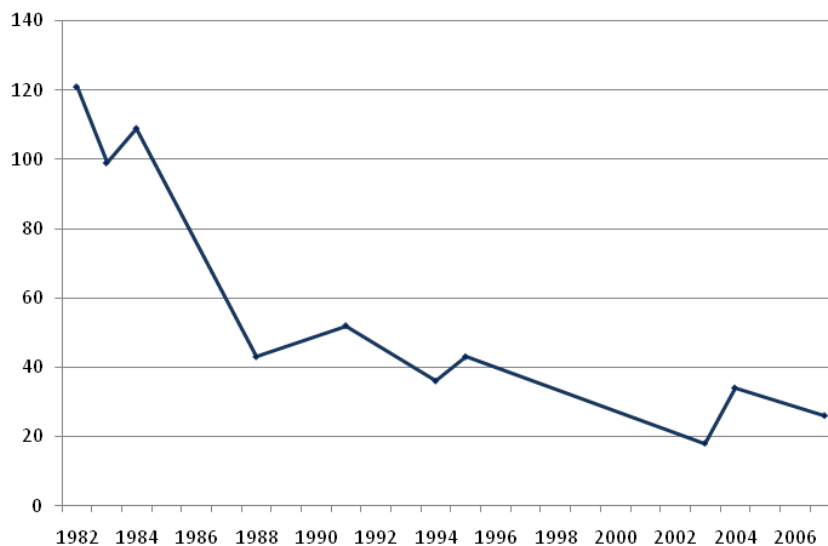
## Management Direction

Bighorn sheep have been hunted in a portion of GMU 17 (Hunt Area 17L) since 2007. Hunt Area 17L will be managed primarily to provide limited bighorn sheep hunting opportunity.

Given the short duration of this relatively new hunt and a general lack of reliable population data, future emphasis will be placed on improving knowledge of population status.

The Department has in the past and will continue in the future work with and encourage the USFS to improve bighorn sheep habitat in this PMU

**Figure 18.** Approximate total bighorn sheep observed, Selway PMU, 1982-present.



through prescribed burning, let burn policies, and management of weeds.

Within current distribution, modeled habitat occupies approximately 290 km<sup>2</sup>, which could support approximately 550 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. The current objective in this PMU is to increase bighorn sheep populations.

## Management Actions

1. **Conduct an aerial survey specifically for bighorn sheep.**
2. **Improve bighorn sheep habitat by working to reduce noxious weeds.**
3. **Improve bighorn sheep habitat by working to limit timber encroachment.**
4. **Increase knowledge of movement patterns, habitat use, survival, etc. using radiomarked bighorn sheep.**
5. **Refine habitat modeling to more accurately characterize sustainable population levels.**
6. **Use radiomarked sheep to provide data points for sightability modeling.**

## Literature Cited

Klaver, R. W. 1978. A management-oriented study of the ecology of bighorn sheep in the Bitterroot Mountains, Montana and Idaho. Thesis, University of Montana, Missoula, USA.

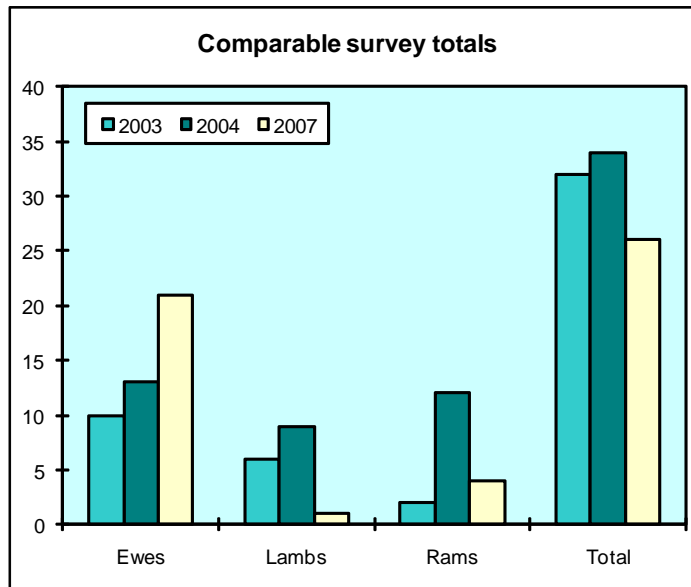


# Rocky Mountain Bighorn Sheep

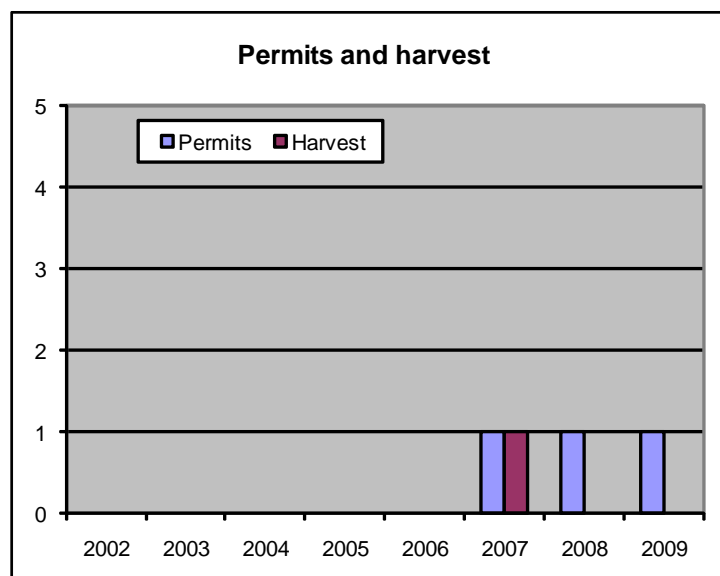
## Selway

GMU 17; Hunt Area 17L

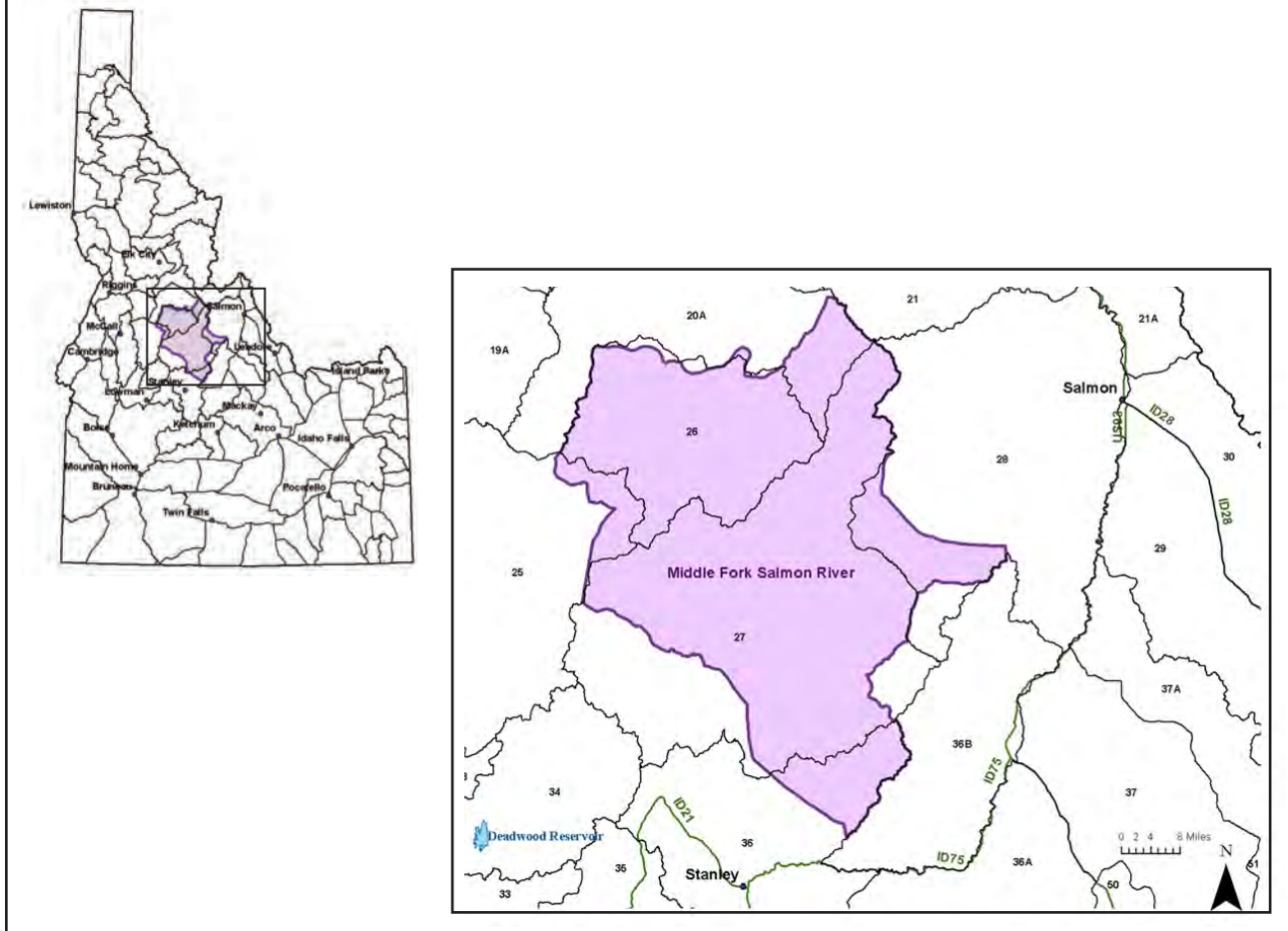
Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
17	2003	10	6	2	0	2	14	32
	2004	13	9	4	8	12	0	34
	2007	21	1	3	1	4	0	26
Modeled estimate								
Per 100 ewes observed			5	14	5	19		



Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	0	0	0	0	0	1	1	1
Harvest						1	0	0
Hunter success						100	0	0
Ave ram age						4.5		



# Middle Fork Salmon River PMU



## Description

This population includes sheep in GMUs 20A (east), 26, and 27, as well as smaller portions of northeast 25, southwest 28, and northeast 36. The majority of the area is managed by the U.S. Forest Service and falls within the Frank Church River-of-No-Return Wilderness. The area is typified by rugged canyons and dry, coniferous forest-grassland habitats with very low road densities. Access into most occupied bighorn sheep habitats is limited. Most bighorn sheep in the area winter along the river breaks corridor and migrate to sub-alpine habitats during summer. However, some bighorn sheep remain along the Middle Fork Salmon River during summer, where they provide a valuable viewing resource for river float recreationists.

## Historical Perspective

Bighorn sheep populations in this area were somewhat protected from pressures of early settlement by the remote nature of the area and thus were better able to maintain viable population levels when most front-country populations were

extirpated. However, subsistence hunting for mining camps and intensive livestock grazing in the late 1800s produced some negative impacts. Grass ranges important to bighorn sheep were converted to shrub habitats in the early part of the 20th century and bighorn populations declined to a low of perhaps 200-500 animals in the late 1920s (Smith 1954).

No translocations have taken place in the Middle Fork PMU and most consider the area one of the few native bighorn sheep populations in North America that was not extirpated. Hunting occurred under various combinations of controlled and general season frameworks from the early 1950s through 1970 and under a controlled hunt system since 1971.

Land and resource use changed after the mining boom; subsistence hunting and livestock use decreased and many shrub-dominated ranges began reverting to grasslands. The bighorn sheep population increased to approximately 1,000 animals by 1990, but declined by roughly 50% after a disease-driven, all-age die-off in the early 1990s and remains between 500-600 bighorn sheep (Fig. 19).

## Issues

Although modern land management activities in the wilderness are minimal, the landscape and productivity of habitats are continually changing. Wildfire has been prevalent during the last decade. Nearly 800,000 acres within the area have burned since 2000. In some cases, fires have likely benefited wild sheep by reducing conifer encroachment and promoting grass and forb production. However, because of the semi-arid nature of parts of the landscape, habitat response to fire may be slow or negative, particularly on winter ranges where noxious weeds such as knapweed, rush skeletonweed, and leafy spurge could ultimately have significant impacts on winter range productivity. Elk populations have declined somewhat since peaks during the late 1990s, but competition with a large elk herd may impact habitat capacity for bighorns.

Currently, the Middle Fork population appears to still be disease-limited, as evidenced by chronically low lamb:ewe ratios since the die-off in the early 1990s (Fig. 20). Ratios declined from an average of almost 37:100 (range 11-74) between 1973 and 1989 to 20:100 (range 5-38) since 1990.

## Management Direction

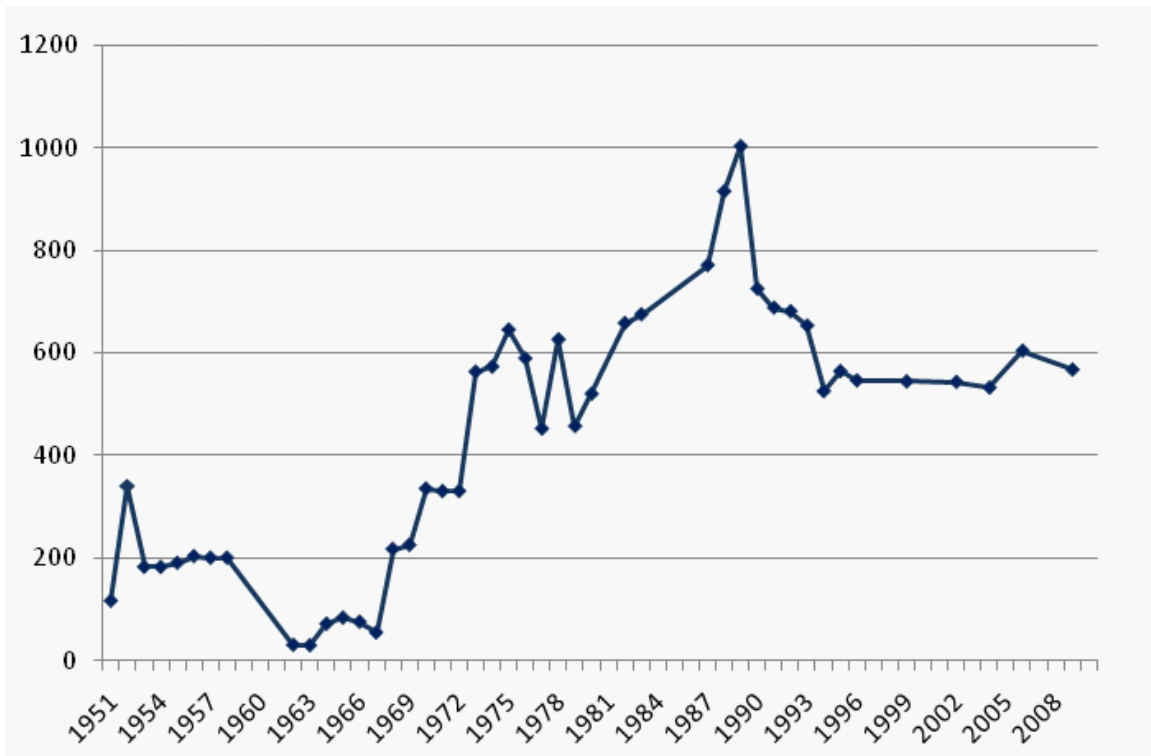
Because of the size of the area and population and access limitations, a variety of hunting experiences are available. During the standard season framework, hunter success is typically lower than in more accessible areas. Recent average hunter success ranged from 13% to 75% depending on area and year.

Because hunter success tends to be quite low and access is difficult, Hunt Area 27-1 will be managed primarily to maximize bighorn sheep hunting opportunity. Remaining hunt areas will be managed to maintain moderate success rates in a remote, wilderness setting.

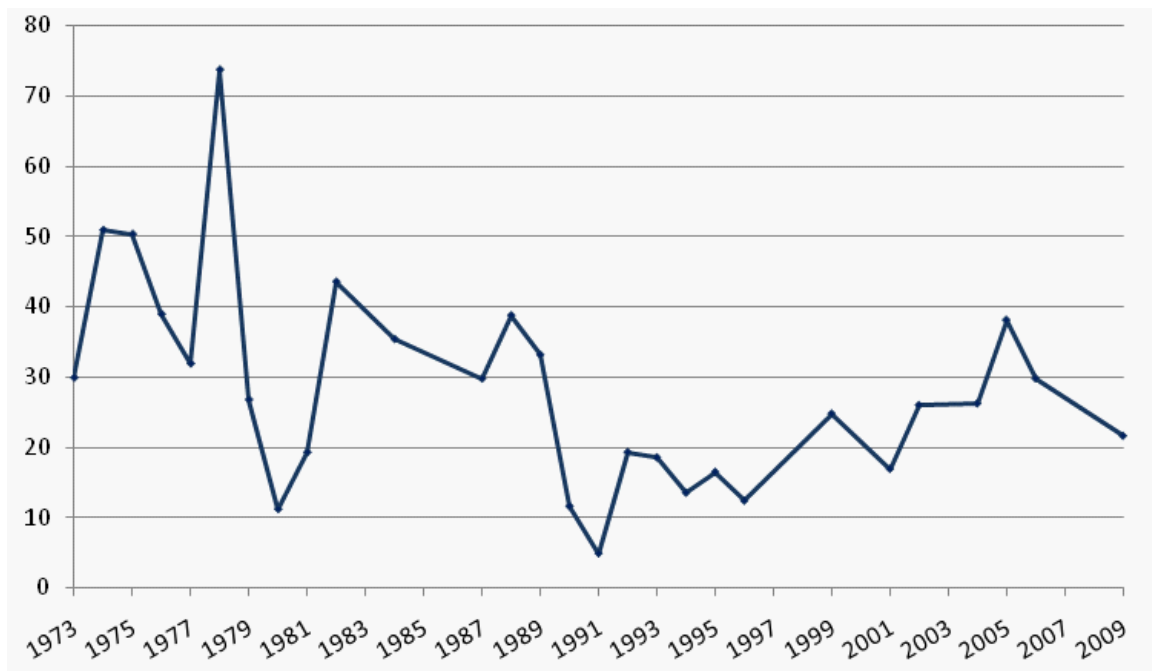
Within current distribution, modeled habitat occupies approximately 1,856 km<sup>2</sup>, which could support approximately 3,525 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. Regardless, historic and recent data indicates the PMU can sustain significantly more bighorn sheep and management direction will be to increase population levels.

## Management Actions

- 1. Work with USFS to maintain or improve habitat for bighorn sheep.**
- 2. Work with USFS and other partners to control or reduce noxious weed occurrence.**
- 3. Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
- 4. Refine habitat modeling to more accurately characterize sustainable population levels.**



**Figure 19.** Approximate total bighorn sheep observed or estimated, Middle Fork Salmon River PMU (1951-72 includes only GMU 27 estimates), 1951-present. Some early estimates were derived from historical observations by USFS and IDFG personnel. More recent values are primarily observed numbers from IDFG aerial surveys.



**Figure 20.** Observed bighorn sheep lamb:100 ewe ratios, Middle Fork Salmon River PMU, 1973-present.

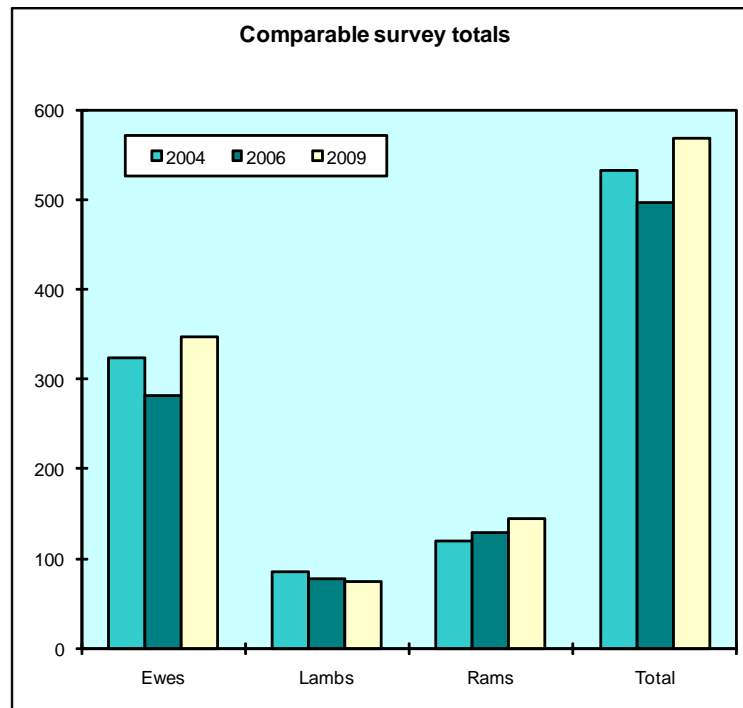


# Rocky Mountain Bighorn Sheep

## Middle Fork Salmon River

GMUs 20A (east), 26, 27, 36 (northeast); Hunt Areas 20A, 26, 26L, 27-1, 27-2, 27-3, 27-4, 27L

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
20A	2004	21	8	5	2	7	0	36
	2006	48	9	6	5	11	0	68
	2009	47	15	8	7	15	0	77
26	2004	90	23	19	12	31	0	144
	2006	120	23	10	33	43	0	186
	2009	63	4	5	14	19	0	86
27-1	2004	100	24	15	24	39	0	163
	2006	50	16	16	18	34	0	100
	2009	102	21	35	14	49	0	172
27-2	2004	44	9	5	9	14	0	67
	2006	23	14	6	5	11	0	48
	2009	61	20	10	7	17	1	99
27-3	2004	57	13	10	14	24	4	98
	2006	31	11	10	9	19	7	68
	2009	41	5	12	11	23	0	69
27-4	2004	12	8	2	2	4	0	24
	2006	10	5	2	9	11	0	26
	2009	33	10	11	11	22	0	65
Total	2004	324	85	56	63	119	4	532
	2006	282	78	50	79	129	7	496
	2009	347	75	81	64	145	1	568
Modeled estimate Per 100 ewes observed								
			22	23	18	42		



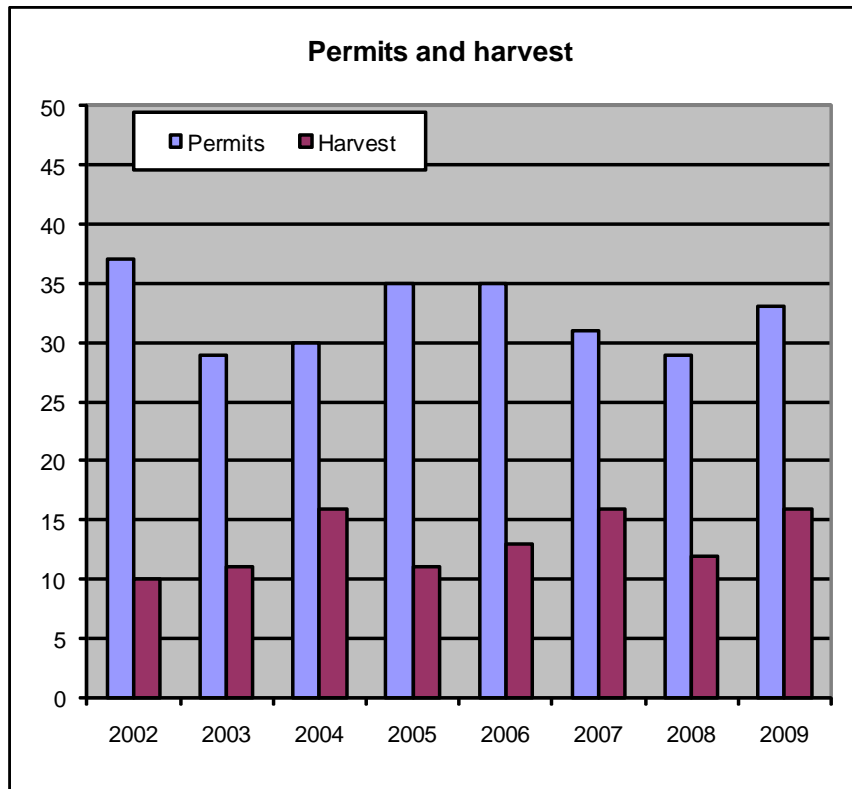
# Rocky Mountain Bighorn Sheep

## Middle Fork Salmon River

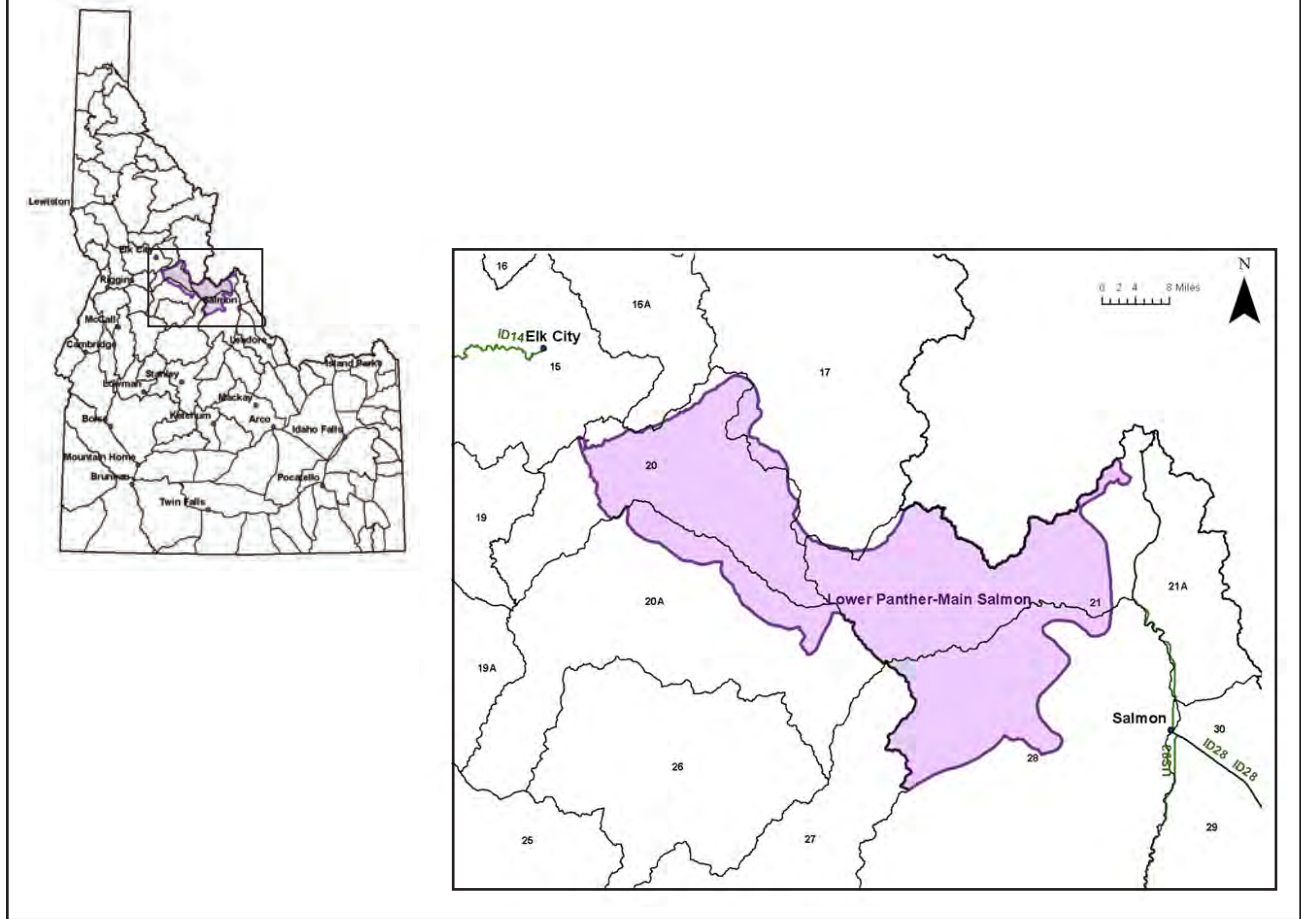
GMUs 20A (east), 26, 27, 36 (northeast); Hunt Areas 20A, 26, 26L, 27-1, 27-2, 27-3, 27-4, 27L

Hunting Permits and Harvest Information									
		2002	2003	2004	2005	2006	2007	2008	2009
Permits*	20A	6	2	2	2	2	2	2	2
	26	6	2	2	2	2	4	4	4
	26L	2	2	2	2	2	2	2	2
	27-1	12	12	12	15	15	9	8	12
	27-2	6	6	7	6	7	6	6	6
	27-3	2	2	2	5	4	4	4	4
	27-4	3	3	3	3	3	4	3	3
	27L	2	2	2	2	2	2	2	2
	Total	37	29	30	35	35	31	29	33
	Harvest*	20A	1	1	0	0	0	2	0
26		2	0	2	0	2	2	1	2
26L		1	1	2	1	2	2	2	1
27-1		2	2	3	5	2	2	0	4
27-2		0	2	4	0	2	4	4	1
27-3		2	1	2	3	3	1	1	3
27-4		2	3	2	1	1	2	2	2
27L		0	1	1	1	1	1	2	2
Total		10	11	16	11	13	16	12	16
Hunter success			27	38	53	31	37	52	41
Ave ram age		7.1	8.0	6.9	6.0	7.3	7.7	6.7	7.6

\*Includes auction or raffle permits.



# Lower Panther - Main Salmon River PMU



## Description

This population includes sheep in GMUs 20 (east), 20A (north-central), 21, and 28 (northwest). The majority of the area is managed by the U.S. Forest Service and a significant portion falls within the Frank Church River-of-No-Return Wilderness. The area is typified by rugged canyons and dry, coniferous forest-grassland habitats with very low to moderate road densities. Access into occupied bighorn sheep habitat within wilderness is limited, whereas sheep can be observed along roads in some portions of the PMU. Most bighorn sheep in the area winter along the river breaks corridor. Some animals migrate to sub-alpine habitats during summer, but many remain along the main Salmon River during summer, where they provide a valuable viewing resource for both river float parties and others traveling along Forest Road 030 (“River Road”) downstream from North Fork.

## Historical Perspective

Bighorn sheep populations in this area were somewhat protected from pressures of early settlement by the remote nature of the area and, thus, were better able to maintain viable population levels when most front-country populations were extirpated. However, subsistence hunting for mining camps and intensive livestock grazing in the late 1800s produced some negative impacts. Grass ranges important to bighorn sheep were converted to shrub habitats in the early part of the 20th century. Land and resource use changed after the mining boom: subsistence hunting and livestock use decreased and many shrub-dominated ranges began reverting to grasslands. Smith (1954) estimated approximately 290 animals occupied the area in the early 1950s.

Bighorn sheep populations in GMUs 21 and 28 were considered high-quality herds, exhibiting high lamb production and herd growth through the 1970s. However, populations along Panther Creek experienced a decline in the early 1980s, probably

due to weather-related mortality. The same herd suffered a major population decline (approximately 50%) during 1989-1990, likely caused by pneumonia (Fig. 21). Low lamb recruitment followed the decline and persisted for several years. The population has displayed a gradual, long-term decline; <150 sheep were observed during the last complete survey in 2008.

The Panther Creek bighorn sheep population was the primary source of Rocky Mountain bighorn sheep for translocation to other sites; nearly 125 were captured and moved between 1975 and 1985 (Appendix B, Table 2). However, capture and translocation have been curtailed since populations and productivity declined. Only 1 translocation into the PMU has occurred (16 sheep from northeast Oregon were released near Shoup in 1984). Hunting occurred under various combinations of controlled and general season frameworks from the early 1950s through 1970 and under a controlled hunt system since 1971.

## Issues

Human access to some portions of bighorn sheep ranges and ongoing or planned development projects dictate special management considerations in this area. Units 21 and 28 have high road densities, with potential for copper and cobalt mining, geothermal development, and timber harvest, which could lead to even more development and roads. Increased road densities can lead to high levels of unregulated harvest. However, viewing and photographing bighorn sheep along Salmon River and Panther Creek are popular recreational pastimes. We expect this type of nonconsumptive use to increase in importance. Native American harvest occurs in portions of the PMU, but harvest levels are essentially unknown.

Wildfire has been prevalent during the last decade. Tens of thousands acres within the area have burned since 2000. In some cases, fires have likely benefited wild sheep by reducing conifer encroachment and promoting grass and forb production. However, because of the semi-arid nature of parts of the landscape, habitat response to fire may be slow or negative, particularly on winter ranges where noxious weeds such as knapweed, rush skeletonweed, and leafy spurge could ultimately have significant impacts on winter range productivity. Elk populations have declined somewhat since peaks during the mid 2000s, but competition with a large elk herd may impact habitat capacity for bighorns.

Currently, the population appears to still be disease-limited, as evidenced by generally low lamb:ewe ratios since the die-off in the early 1990s (Fig. 22). Ratios declined from an average of 46:100 (range 22-76) between 1974 and 1989 to 23:100 (range 11-33) since 1990 (for years in which >50 sheep were classified). The population appears to be at a recent low and has demonstrated a downward trend for the last 15-20 years.

## Management Direction

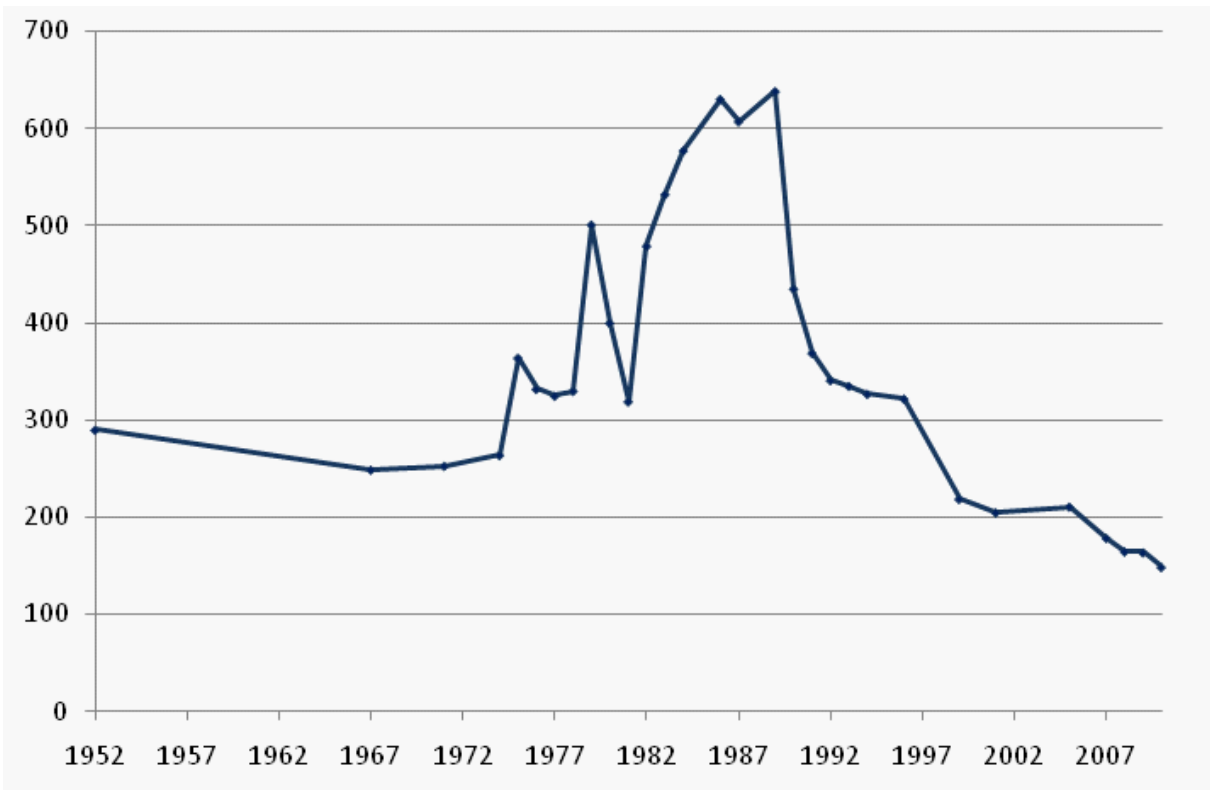
Because the PMU encompasses diverse access and land management objectives, hunting opportunity and experiences vary considerably. Hunter success rates can be quite low in predominantly wilderness hunt areas and range near 100% in areas with road access. Hunt area boundaries have been adjusted several times to better match sub-population groupings and access, as well as improve hunter and harvest distribution.

Within current distribution, modeled habitat occupies approximately 570 km<sup>2</sup>, which could support approximately 1,075 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. Regardless, historic and recent data indicates the PMU can sustain significantly more bighorn sheep and management direction will be to increase population levels.

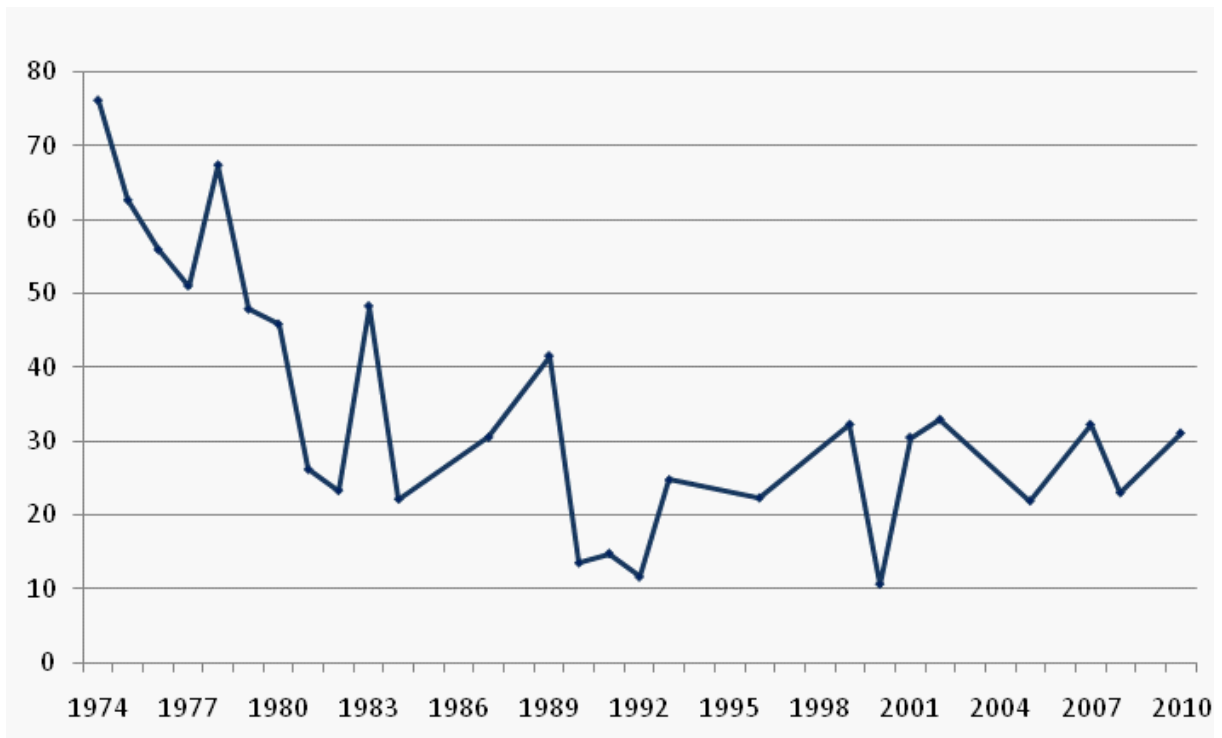
## Management Actions

- 1. Work with USFS to maintain or improve habitat for bighorn sheep.**
- 2. Work with USFS and other partners to control or reduce noxious weed occurrence.**
- 3. Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
- 4. Refine habitat modeling to more accurately characterize sustainable population levels.**
- 5. Use radiomarked sheep to provide data points for sightability modeling.**





**Figure 21.** Approximate total bighorn sheep observed or estimated, Lower Panther-Main Salmon River PMU (GMU 20 included only from 1982 forward), 1952-present. Some early estimates were derived from historical observations by USFS and IDFG personnel. More recent values are primarily observed numbers from IDFG aerial surveys.



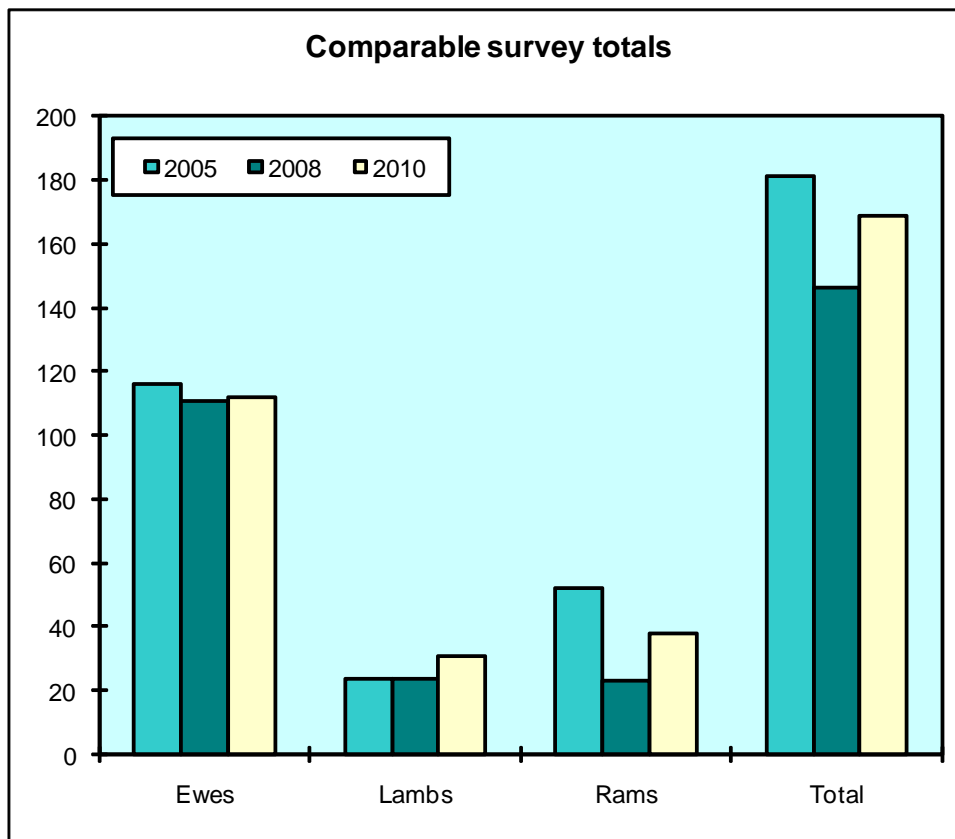
**Figure 22.** Observed bighorn sheep lamb:100 ewe ratios, GMUs 21 and 28, Lower Panther-Main Salmon River PMU, 1974-present.

# Rocky Mountain Bighorn Sheep

## Lower Panther-Main Salmon River

GMUs 20 (east), 21, 28 (north); Hunt Areas 20, 21, 28-1, 28-3

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
20	1996	51	7	9	10	19	1	78
	2001	22	6	10	13	23	0	51
	2007 <sup>b</sup>	11	1	1	6	7	0	19
21	2005	48	9	16	11	27	0	84
	2008	78	19	13	4	17	0	114
	2010	75	24	11	13	24	0	123
E Panther	2005	47	11	15	1	16	1	75
	2008	14	1	3	1	4	0	19
	2010	15	2	8	2	10	0	27
W Panther	2005	10	3	7	2	9	0	22
	2008	8	3	2	0	2	0	13
	2010	11	4	4	0	4	0	19
Total	2005	116	24	39	20	52	1	181
	2008	111	24	19	11	23	0	146
	2010	112	31	24	21	38	0	169
Modeled estimate								
Per 100 ewes observed			28	21	19	34		

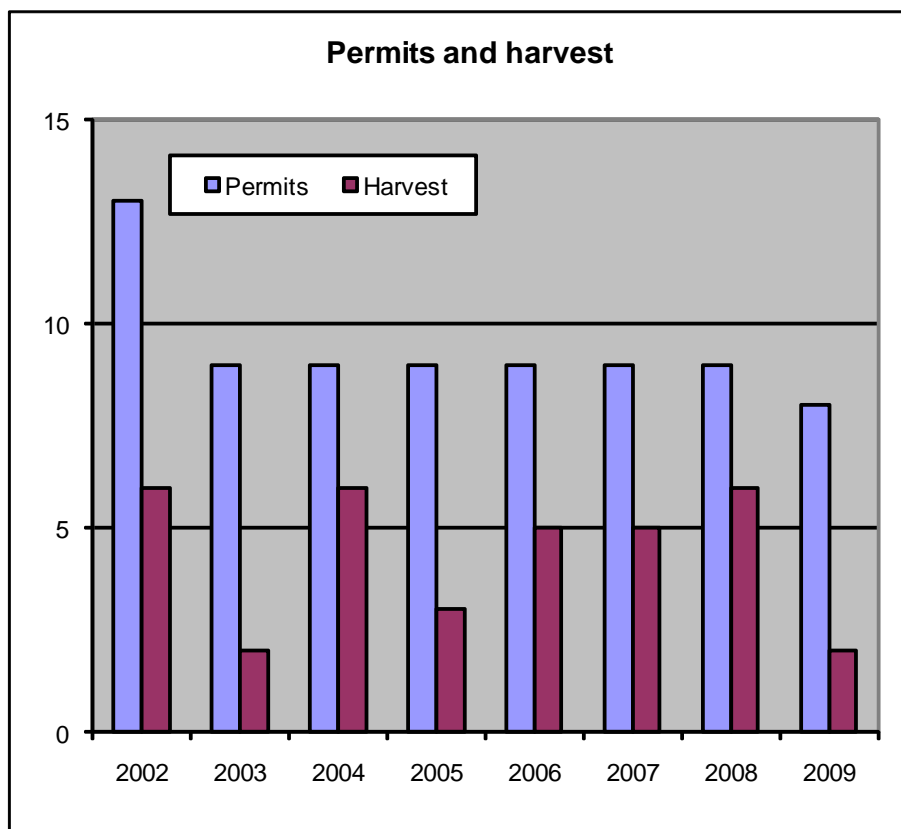


# Rocky Mountain Bighorn Sheep

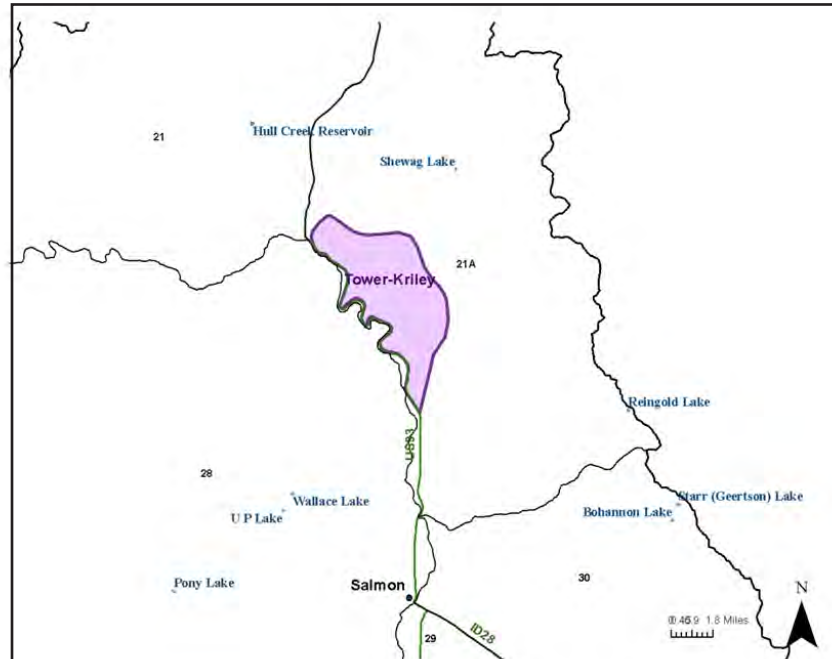
## Lower Panther-Main Salmon River

GMUs 20 (east), 21, 28 (north); Hunt Areas 20, 21, 28-1, 28-3

Hunting Permits and Harvest Information									
		2002	2003	2004	2005	2006	2007	2008	2009
Permits	20								2
	20-1	2	2	2	2	2	2	2	
	20-2	2	2	2	2	2	2	2	
	21	3	3	3	3	3	3	3	3
	28	3							
	28-1	3	2	2	2	2	2	2	2
	28-3								1
	Total	13	9	9	9	9	9	9	8
Harvest	20								0
	20-1	1	0	2	1	1	2	1	
	20-2	1	1	1	0	1	1	2	
	21	2	0	3	2	2	2	2	2
	28	2							
	28-1	(1)	1	0	0	1	0	0	0
	28-3	(1)						1	0
	Total	6	2	6	3	5	5	6	2
Hunter success		46	22	67	33	56	56	67	25
Ave ram age		6.5	8.5	6.5	4.5	7.1	6.9	6.3	7.0



# Tower-Kriley PMU



## Description

This small, relatively isolated population occupies a small portion of GMU 21A, primarily along the east side of the Salmon River between Tower Creek and Fourth of July Creek. The majority of the area is managed by the BLM, with some interspersed private land. The area is typified by sagebrush hills and cliffs; U.S. Highway 93 parallels the river. Because of their habit of using sites immediately adjacent to the highway, these sheep provide some viewing opportunity, but are subject to vehicle collisions.

Because of sporadic bouts of vehicle collisions, managers made 1 unsuccessful attempt to capture and move this small herd. Motorist warning signs were deployed (twice), but were quickly stolen. A collaborative effort among Idaho Outfitters and Guides Association, Idaho Chapter Wild Sheep Foundation, IDFG, and several other entities resulted in development of a bighorn sheep viewing station at Red Rock Access Site in 2009. Unfortunately, a change in land ownership and land use practices on adjacent property appears to have deterred wild sheep use of the viewing area.

## Historical Perspective

This general area along the Salmon River was occupied bighorn sheep range through approximately the 1930s (Smith 1954). Bighorns re-colonized the area in the 1990s; the source is unknown, but was most likely the Lower Panther-Main Salmon population. No translocations have taken place in the Tower-Kriley PMU and the number of bighorns in the area has varied between 10 and 20 (Fig. 23).

## Issues

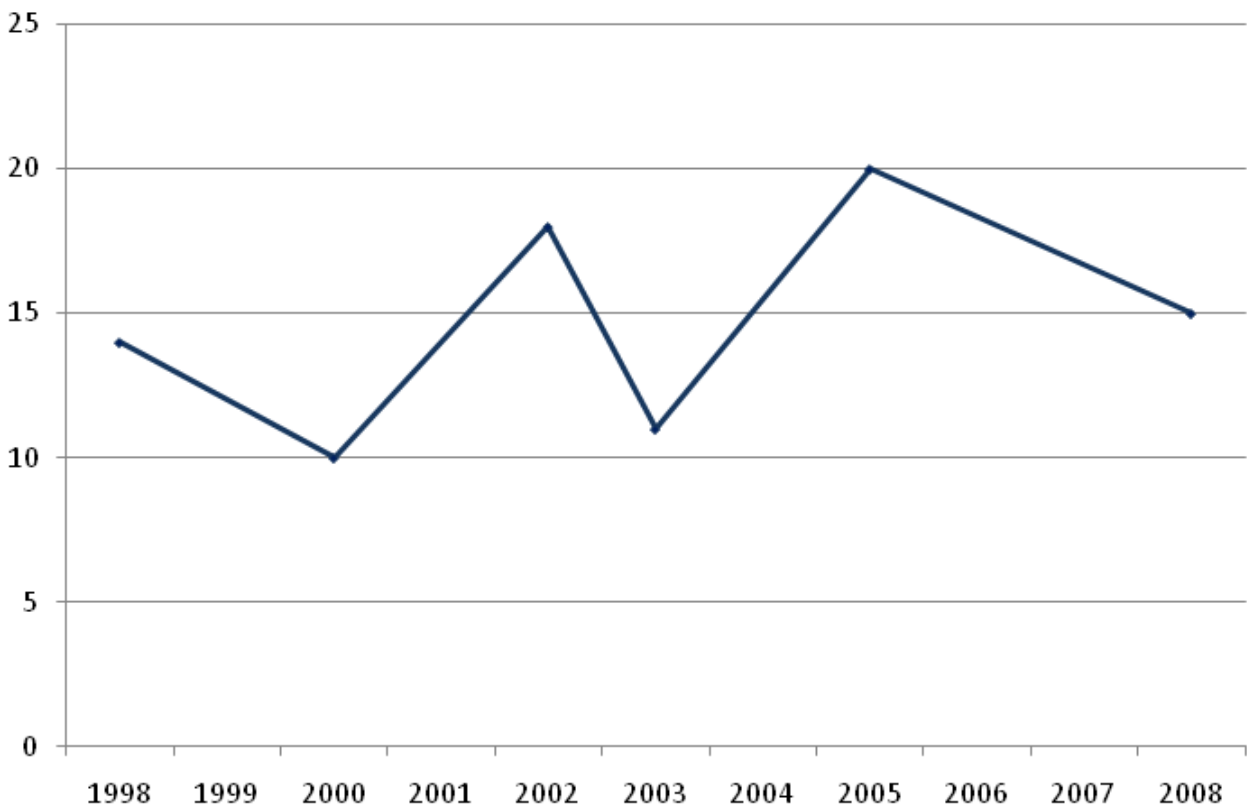
The greatest threat to persistence is likely the small population size which makes it unstable in the face of random environmental impacts. Vehicle collisions contribute to mortality and may prevent further population increases. Continued development and encroachment on areas used by these sheep also contribute to reduced likelihood of long-term persistence. Lastly, potential for exposure to domestic sheep or goats in local farm flocks is high.

## Management Direction

Because of the small size of the area and population, few management options exist. Within current distribution, modeled habitat comprises approximately 18 km<sup>2</sup>, which could support approximately 35 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). At this time, the greatest value of this population is to enhance public knowledge and appreciation of bighorn sheep and their habitat through active information and education projects. Therefore, management direction will be to maintain or increase population levels.

## Management Actions

1. **Continue to promote viewing and educational opportunities associated with this small, but visible, population.**
2. **Work with BLM to maintain or improve habitat for bighorn sheep.**
3. **Work with BLM and other partners to control or reduce noxious weed occurrence.**
4. **Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**



**Figure 23.** Bighorn sheep observed during IDFG aerial surveys, Tower-Kriley PMU, 1998-present.

# Rocky Mountain Bighorn Sheep

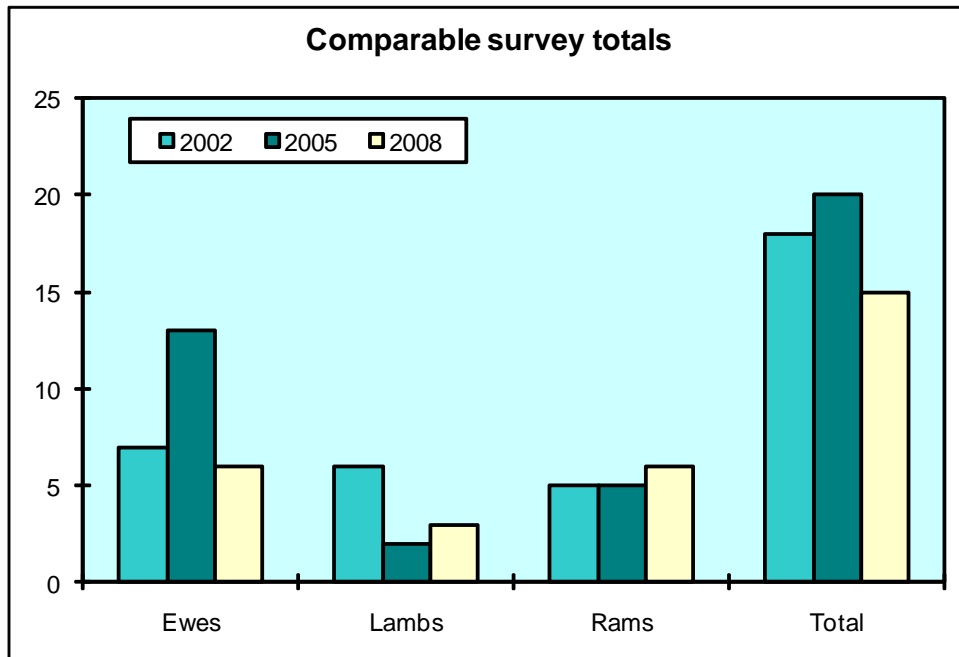
Tower-Kriley

GMU 21A

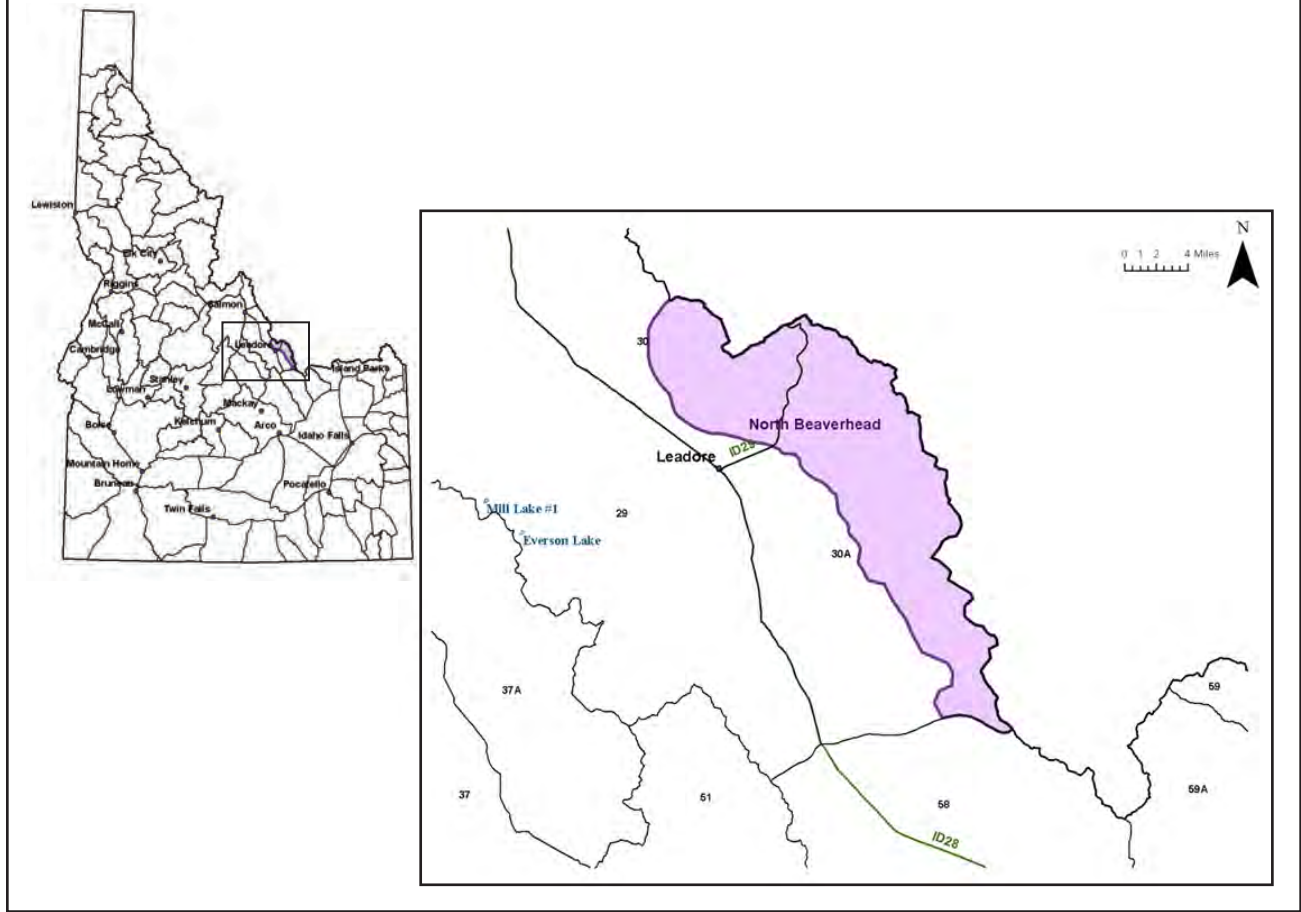
## Hunting permits and harvest information

**No hunting season in this area**

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
21A	2002	7	6	3	2	5	0	18
	2005	13	2	4	1	5	0	20
	2008	6	3	6	0	6	0	15
Modeled estimate								
Per 100 ewes observed			50	100	0	100		



# North Beaverhead PMU



## Description

This population includes sheep in GMUs 30 and 30A. The majority of the area is managed by the USFS with some bighorn sheep range on BLM lands. The area is typified by rugged canyons and dry, coniferous forest-grassland habitats with moderate road densities. There is generally motorized access to or near much of the occupied bighorn sheep habitat. Bighorn sheep in the area winter in and around the mouths of small canyons between Stroud Gulch and Hawley Creek. The animals migrate to sub-alpine and alpine habitats to the south and east during summer, moving as far south as upper Eighteen-mile Creek. Some sheep cross into Montana during summer and autumn.

## Historical Perspective

As with most front-country populations, bighorn sheep in this area were extirpated in the late 1800s to early 1900s (Smith 1954). Restoration began with 2 translocation events in the mid-1980s (Appendix B, Table 2). Little population growth occurred after the translocations. Staff observed a high of 61 bighorns

incidental to an elk survey in 2004. Fewer sheep were observed in recent years, but the population appears to have stabilized between 40 and 50 sheep (Fig. 24).

## Issues

Currently, the area occupied by the North Beaverhead population can likely support more bighorn sheep. However, the existence of a domestic sheep allotment in Montana adjacent to or overlapping summer range is a risk factor. For a number of wildlife species, including bighorn sheep, the Beaverhead Range forms a potential travel corridor between the Yellowstone ecosystem and ecosystems farther north and west. If populations increase, bighorns may move along the length of the Beaverheads and form a more stable metapopulation. Conversely, the movement corridor could also provide an avenue for spread of diseases or parasites among sub-populations.

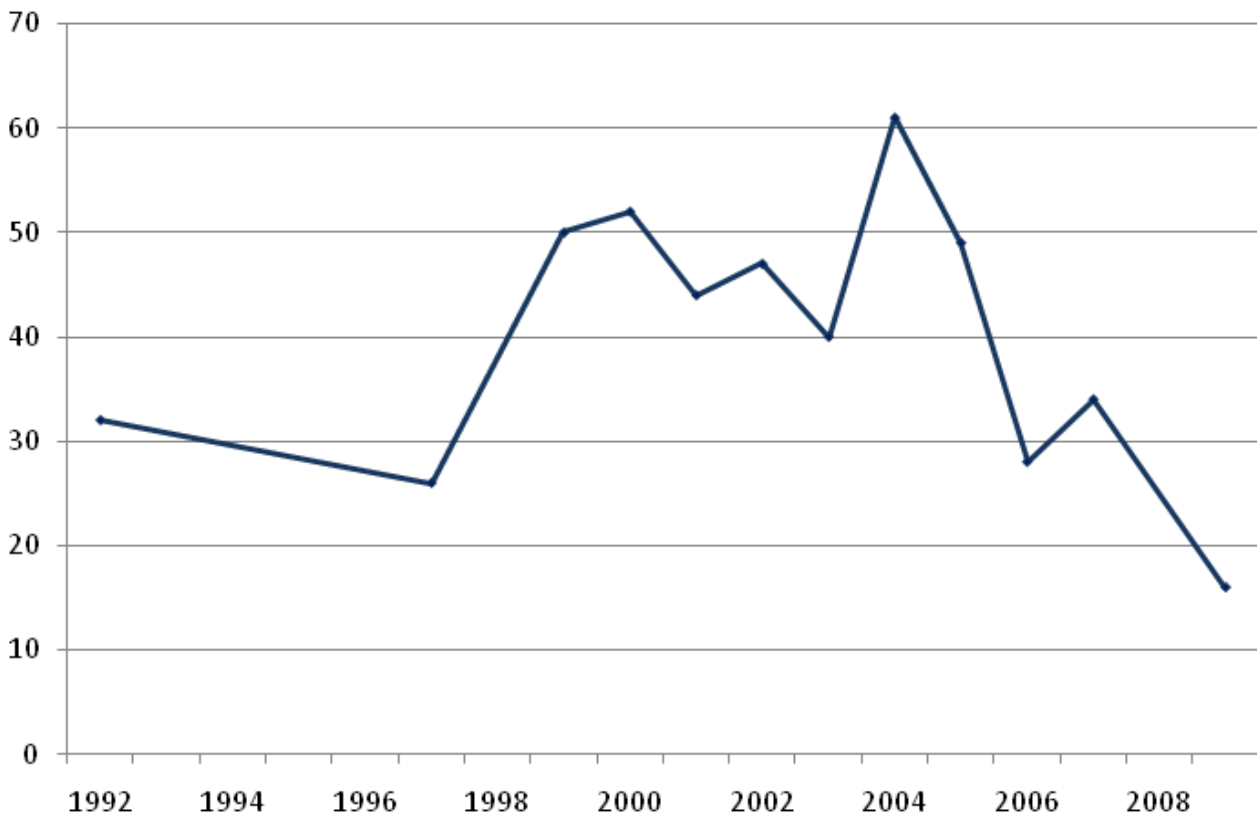
## Management Direction

Modern hunting seasons were established in 2001. Because the risk of an all-age die-off is relatively high, IDFG will continue to offer ram harvest even though the population does not exceed 100 individuals. Hunter success has been 100% in most years since the Hunt Area was opened.

The relatively small amount of occupied habitat and number of sheep somewhat limit management options. Within current distribution, modeled habitat occupies approximately 137 km<sup>2</sup>, which could support approximately 250 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. Regardless, recent data indicate the PMU can sustain more bighorn sheep and management direction will be to increase population levels.

## Management Actions

1. **Work with USFS to maintain or improve habitat for bighorn sheep.**
2. **Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
3. **Refine habitat modeling to more accurately characterize sustainable population levels.**
4. **Use radiomarked sheep to provide data points for sightability modeling.**



**Figure 24.** Total bighorn sheep observed during IDFG aerial surveys, North Beaverhead PMU, 1992-present.

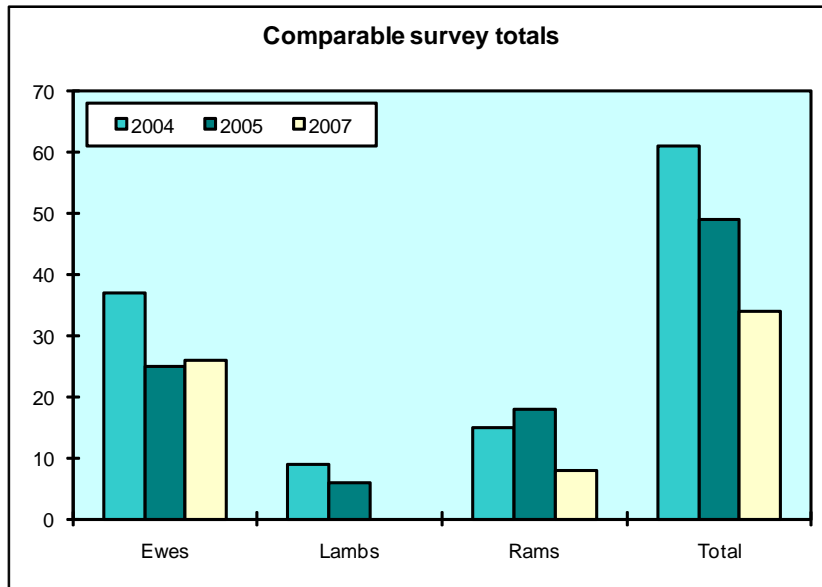


# Rocky Mountain Bighorn Sheep

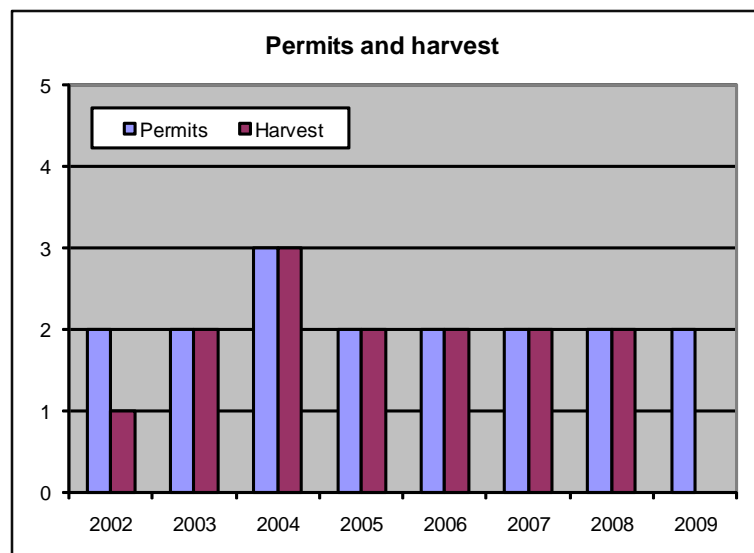
## North Beaverhead

GMUs 30, 30A; Hunt Area 30

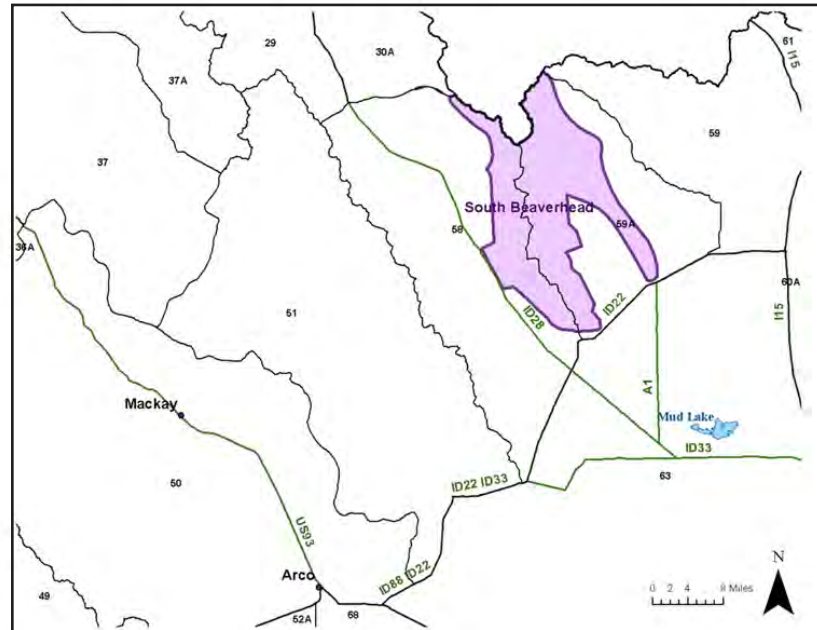
Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
30, 30A	2004	37	9	4	11	15	0	61
	2005	25	6	5	13	18	0	49
	2007	26	0	7	1	8	0	34
Modeled estimate								
Per 100 ewes observed			0	27	4	31		



Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	2	2	3	2	2	2	2	2
Harvest	1	2	3	2	2	2	2	0
Hunter success	50	100	100	100	100	100	100	0
Ave ram age	6.5	7.0	8.2	6.5	7.0	7.0	7.5	



# South Beaverhead PMU



## Description

Bighorn sheep in the South Beaverhead PMU primarily occur in GMUs 58 (east), 59A, and 59. Habitats in the South Beaverhead PMU are diverse, generally mountainous types with bighorn sheep summering mostly at higher elevations on alpine and sub-alpine ranges. The winter ranges are mostly sagebrush-grass or curl-leaf mountain mahogany (*Cercocarpus ledifolius*) types where snow depth is low. The USFS generally administers summer ranges, whereas both USFS and BLM manage winter ranges. Bighorn sheep are observed consistently in the southern Beaverhead Range.

The bighorn sheep population in the south Beaverhead Range commonly uses private land on the Waggoner, Simmons, and Taylor ranches from Goddard canyon north to Bruce canyon during the rut and early winter. These ranches no longer have domestic sheep operations, but the bighorns still come to the area and often feed with corralled cattle. Some of the bighorns often move south into

Bloom, Deadman, and Peterson canyons as winter progresses, but the majority seem to stay on the slopes from Goddard canyon north to Bruce canyon (near the Simmons Ranch).

## Historical Perspective

There is little historic data available for Rocky Mountain bighorn sheep in the South Beaverhead PMU. The journals of early trappers, settlers, miners, and other sources indicate that sheep were more plentiful and widely distributed than what is currently observed (Seton 1929, Smith 1954, Russell 1955). By the early 1900s, bighorn sheep were eliminated from most of the area and severely reduced in the remaining habitats. Vegetative changes due to livestock use on winter ranges, loss to disease, and indiscriminate harvest by settlers and miners probably were the main causes of bighorn sheep declines.

Subsistence and indiscriminate harvest of bighorn sheep by early settlers and pioneering travelers was greatly reduced after establishment of IDFG

in 1937. Changes in federally controlled domestic sheep grazing allotments, habitat improvement projects, and bighorn sheep translocations have all been implemented in hopes of increasing wild sheep populations in the southern Beaverhead Range.

Forty-one bighorn sheep from GMU 28 were released into Long, Skull, and Bloom canyons of GMU 58 in 4 translocations between 1976 and 1982 (Appendix B, Table 2).

Counts in this PMU have generally been made incidental to aerial surveys for other big game species and, therefore, do not represent thorough population surveys or composition trends (Fig. 25). Bighorns have been observed across the southern Beaverheads. The largest concentration of observations are centered around the Skull canyon area, but there are observations from Crooked Creek, Horsethief Ridge, Snakey Canyon, the TNC ranch, Sullivan Ridge, Irving Creek, and numerous other locations throughout the area.

## Issues

Risk of contact with domestic sheep exists near allotments on USFS and BLM lands in GMUs 58 and 59A (Mahogany Butte, Nicholia/Chandler, Snakey, Kelly, and Crooked Creek). Domestic sheep on private land near bighorn sheep habitat within the PMU are also a potential source of contact.

## Management Direction

The Department is working with federal agencies and willing domestic sheep producers in the South Beaverhead PMU to reduce risk of contact (using BMPs outlined in this plan) between domestic and bighorn sheep, particularly for active domestic sheep allotments that overlap bighorn sheep distribution in this area. Management priority in this PMU is to maintain separation between bighorn sheep and domestic sheep and goats.

Within current distribution, modeled habitat is limited to approximately 151 km<sup>2</sup>, which could support approximately 275 bighorn sheep (assuming all habitat is suitable and relatively high densities of 1.9/km<sup>2</sup>). There is no current population estimate for this PMU, but incidental observations appear to show a decline in bighorn sheep numbers since the mid 1990s. Management direction is to maintain populations and increase them in areas of the PMU where separation can be maintained.

There have been no bighorn hunts in the South Beaverhead PMU and none are planned until the population increases enough to allow hunting.

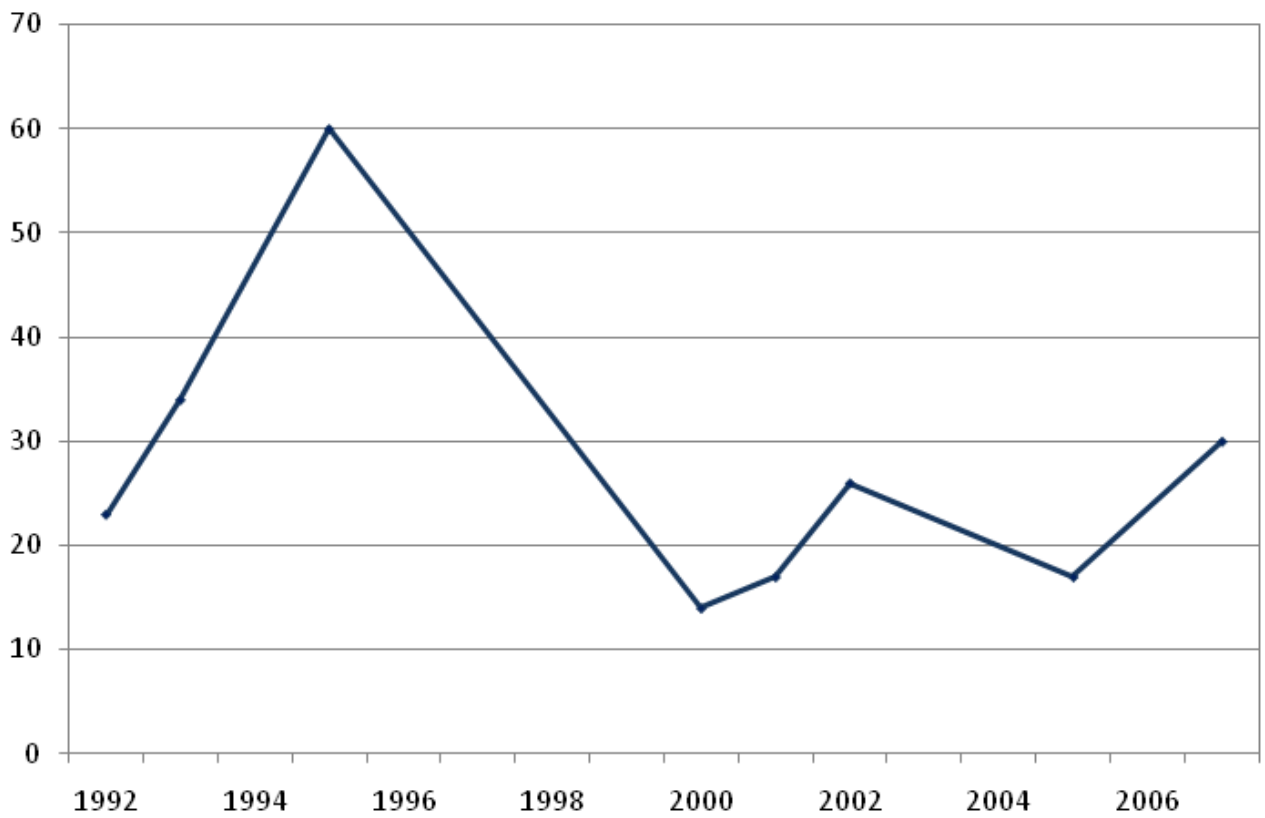
More information is needed to manage this population; including use areas, seasonal movements, a population estimate, survival rates, and production. The Department is actively pursuing funding to initiate a study to gather this type of data in the South Beaverhead PMU.

## Management Actions

1. **Work with willing domestic sheep permittees, USFS, and BLM to use BMPs to maintain separation between bighorn sheep and domestic sheep and goats.**
2. **Increase knowledge of movement patterns, habitat use, survival, etc. using radiomarked bighorn sheep.**
3. **Conduct an aerial survey specifically for bighorn sheep.**
4. **Refine habitat modeling to more accurately characterize sustainable population levels.**
5. **Use radiomarked sheep to provide data points for sightability and habitat modeling.**

## Literature Cited

- Russell, O. 1955. *Journal of a trapper*. University of Nebraska Press, Lincoln, USA.
- Seton, E. T. 1929. *Lives of game animals*, volume 3. Doubleday, Doran, Garden City, New York, USA.
- Smith, D. R. 1954. *The bighorn sheep in Idaho: its status, life history, and management*. Idaho Department of Fish and Game, Boise, USA.



**Figure 25.** Total bighorn sheep observed (primarily during mule deer and elk surveys), South Beaverhead PMU, 1992-present.



# Rocky Mountain Bighorn Sheep

South Beaverhead

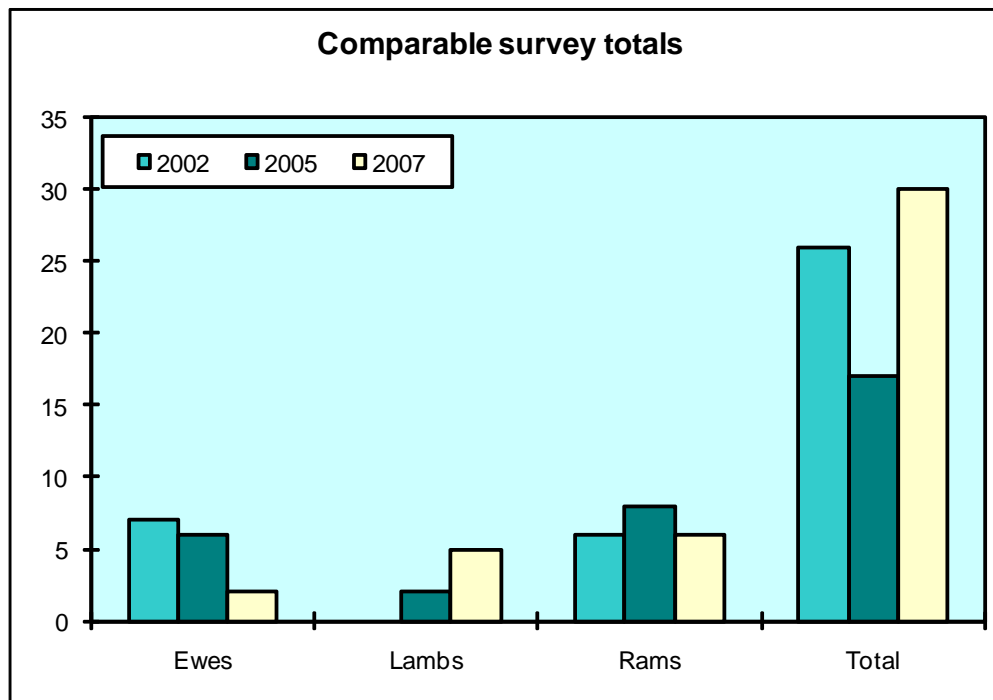
GMUs 58 (east), 59, 59A

## Hunting permits and harvest information

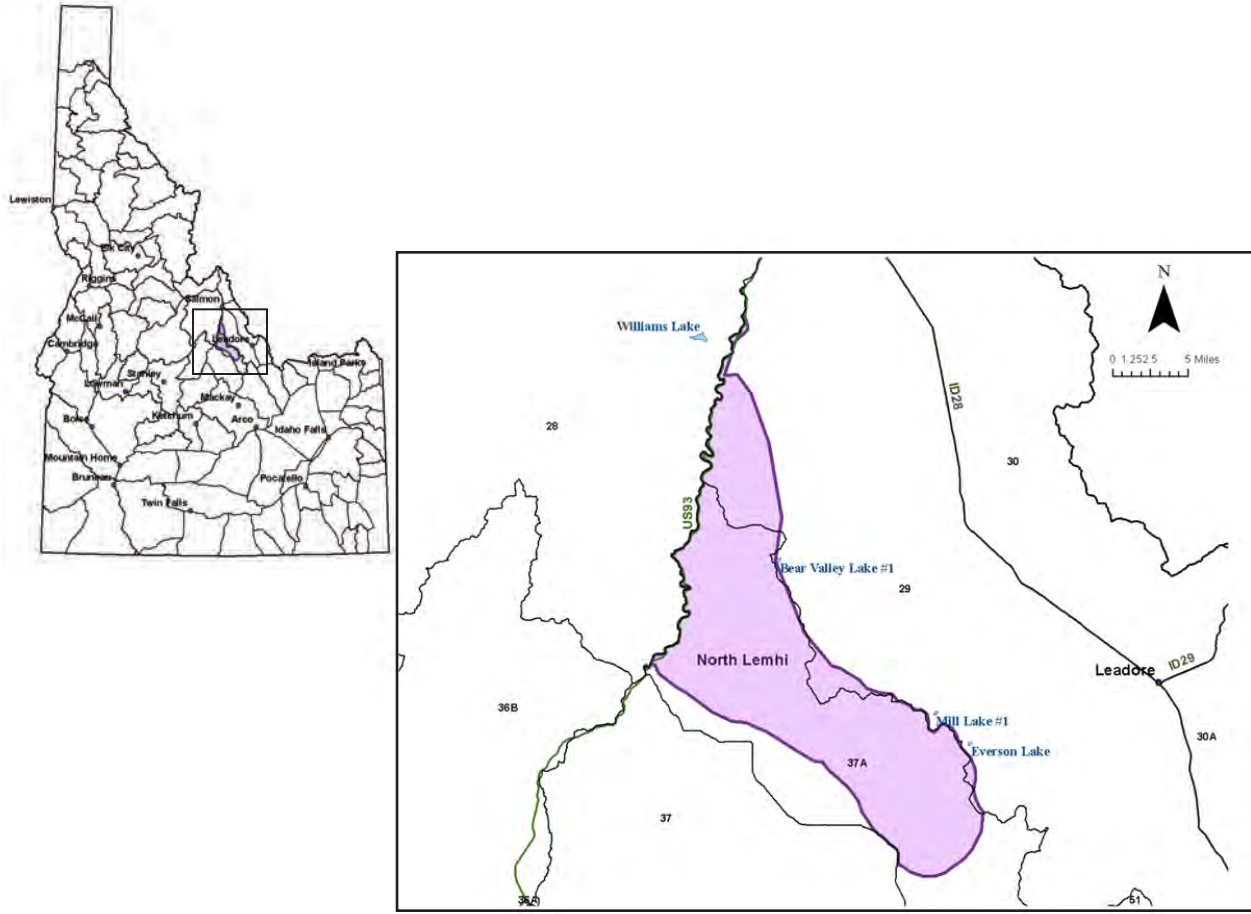
**No hunting season in this area**

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
58/59A	2002	7	0	5	1	6	13	26
	2005	6	2	4	4	8	1	17
	2007	2	5	1	5	6	17	30
Modeled estimate								
Per 100 ewes observed			250	50	250	300		

NOTE: All aerial counts are incidental to other surveys (not representative of populations).



# North Lemhi PMU



## Description

Habitat used by this population occurs primarily in GMU 37A, but includes some areas in GMU 29. Although the USFS manages most of the bighorn range, important portions of the winter and year-round range occur on BLM-managed lands. The area is a combination of the rugged Salmon River canyon to the west and the equally rugged southwest flank of the Lemhi Range to the east. Habitat varies from sagebrush-steppe at lower elevations though dry coniferous forest-grassland to alpine at the highest elevations. U.S. Highway 93 parallels the Salmon River along the western edge of the PMU, but few other roads provide access to occupied bighorn sheep range. Bighorn sheep in the area winter along the river breaks corridor and lower elevation south-southwest facing slopes in the Pahsimeroi Valley. Some bighorns remain in these areas during summer, whereas others apparently migrate to higher elevation sub-alpine and alpine habitats.

## Historical Perspective

Bighorn sheep populations in this area were essentially extirpated during the early 20th century. Occasional sightings of small numbers of sheep in the 1960s-early 1980s likely resulted from temporary movements of animals from the adjacent Middle Main Salmon River or Lost River Range PMUs. The current population resulted from 3 translocation events between 1986 and 1989 (Appendix B, Table 2). Sheep numbers appeared rather stagnant for 10-15 years following translocation, but increased to  $\geq 112$  animals in 2007 (Fig. 26). A hunting season was established in 2005.

## Issues

Elk populations in this area expanded rapidly in the 1970s-80s and remain at relatively high numbers. Competition with this large elk herd may impact habitat capacity for bighorns. Risk of contact with domestic sheep or goats is relatively high in this PMU, primarily related to “farm flocks” on adjacent private land. One domestic sheep allotment occurs near potential bighorn habitat; however risk of

contact on the allotment is relatively low due to season of use and location relative to currently occupied bighorn range.

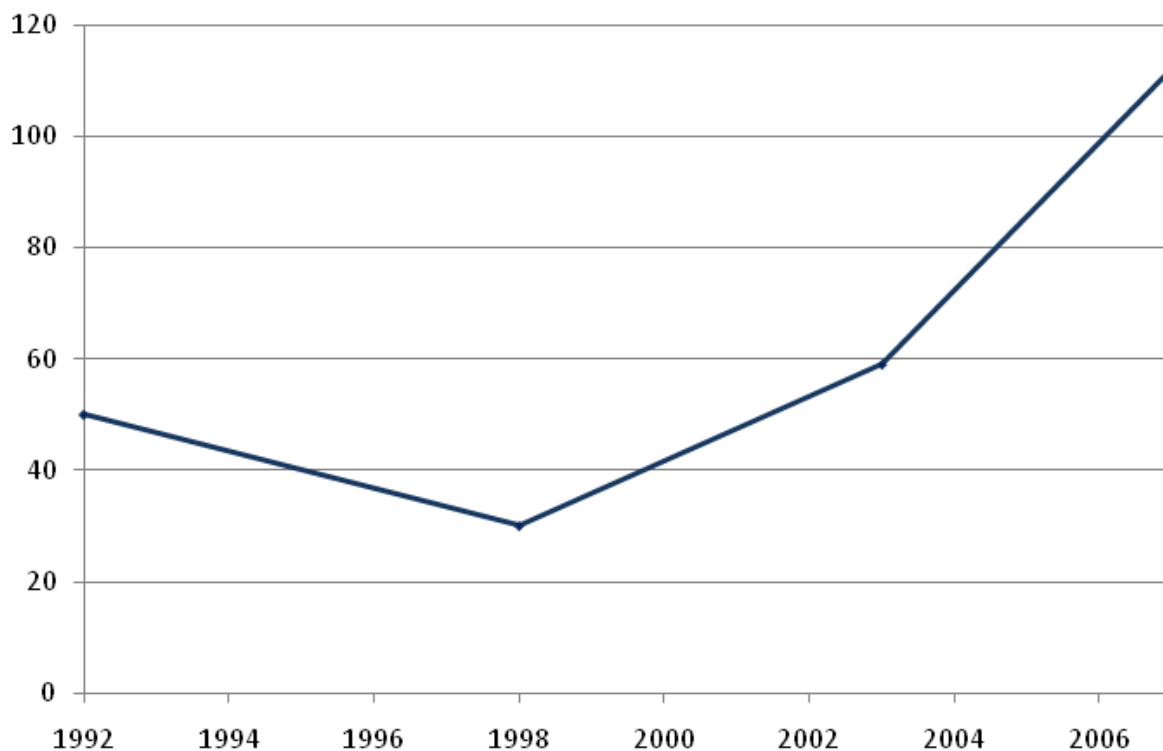
### Management Direction

Because of the relatively high risk of contact with domestic sheep and goats, a hunting season was established before the total population reached 100 individuals. Limited access and rugged terrain provide opportunity for semi-wilderness hunting experience. Since the area was opened for hunting, 5 of 6 hunters have been successful.

Within current distribution, modeled habitat occupies approximately 312 km<sup>2</sup>, which could support approximately 600 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. Given recent growth rates, the population is expected to continue growing in the near future and management direction will be to increase population levels.

### Management Actions

1. **Work with USFS to maintain or improve habitat for bighorn sheep.**
2. **Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence.**
3. **Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
4. **Refine habitat modeling to more accurately characterize sustainable population levels.**
5. **Use radiomarked sheep to provide data points for sightability modeling.**
6. **Work with domestic sheep owners/permittees to employ BMPs designed to maintain separation of wild and domestic sheep.**



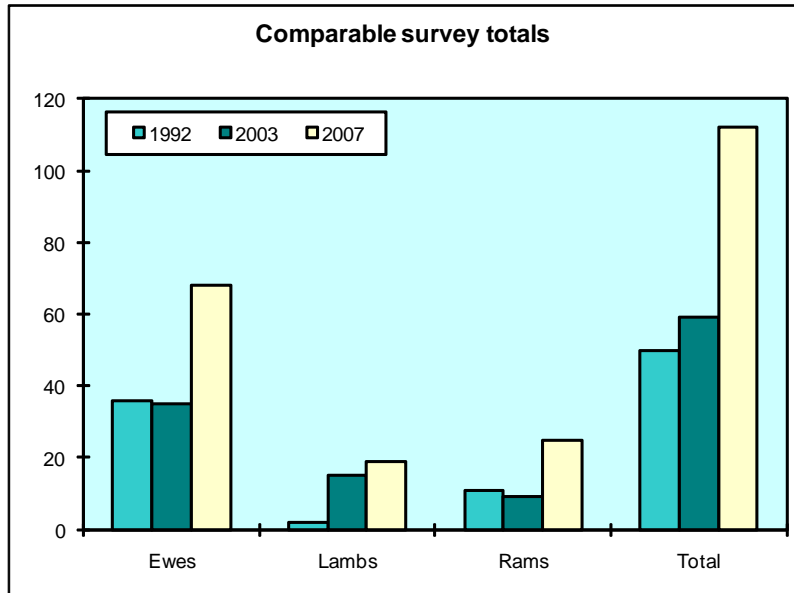
**Figure 26.** Total bighorn sheep observed during IDFG aerial surveys, North Lemhi PMU, 1992-present.

# Rocky Mountain Bighorn Sheep

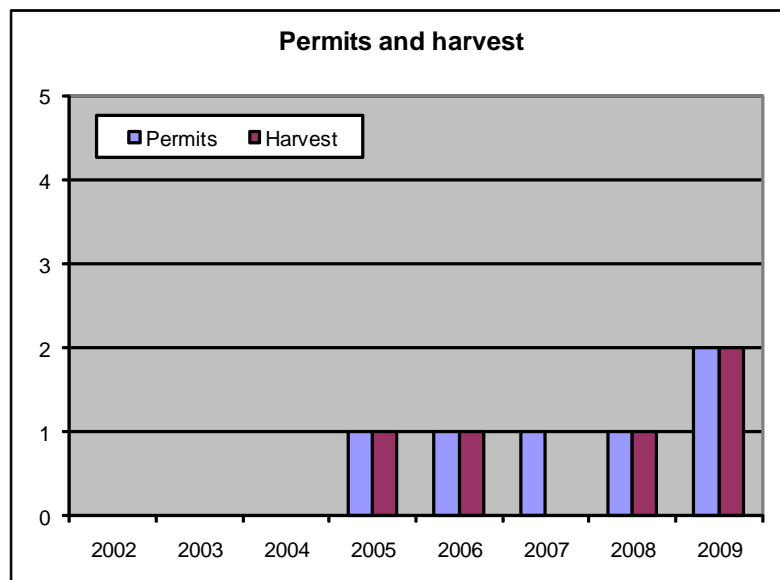
## North Lemhi

GMUs 29, 37A; Hunt Area 37A

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
Total	1992	36	2	3	8	11	1	50
	2003	35	15	6	3	9	0	59
	2007	68	19	11	14	25	0	112
Modeled estimate								
Per 100 ewes observed			28	16	21	37		

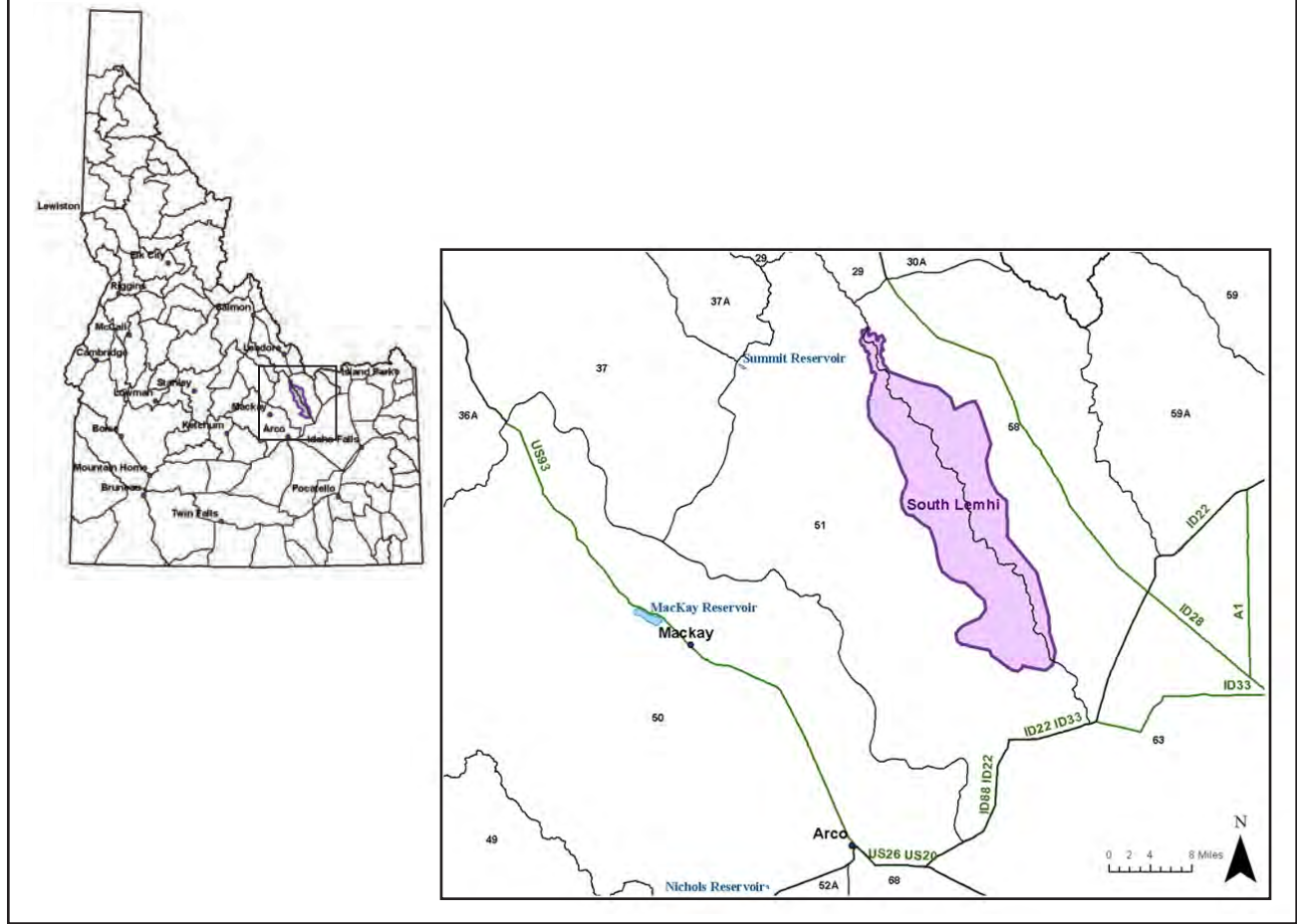


Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	0	0	0	1	1	1	1	2
Harvest	0	0	0	1	1	0	1	2
Hunter success				100	100	0	100	100
Ave ram age				6.5	6.5		6.5	8.0





# South Lemhi PMU



## Description

Bighorn sheep in the South Lemhi PMU primarily occur in GMUs 51 (east) and 58 (west). Habitats are diverse, generally mountainous types with bighorn sheep summering mostly at higher elevations on alpine and sub-alpine ranges. Winter ranges are mostly sagebrush-grass or curl-leaf mountain mahogany types where snow accumulation is light. The USFS generally administers summer ranges, whereas both USFS and BLM manage winter ranges. Bighorn sheep have been observed throughout the southern Lemhi Range.

## Historical Perspective

Similar to some other areas in central Idaho, historic data for Rocky Mountain bighorn sheep in the southern Lemhi Range is lacking. The journals of early trappers, settlers, miners, and other sources indicate that sheep were more plentiful and widely spread than what is currently observed (Seton 1929, Smith 1954, Russell 1955). By the early 1900s, bighorn sheep were eliminated from most of the area and severely reduced in the remaining habitats.

Vegetative changes due to livestock use on winter ranges, loss to disease, and indiscriminate harvest by settlers and miners probably were the main causes of bighorn sheep declines.

Subsistence and indiscriminate harvest of bighorn sheep by early settlers and pioneering travelers was greatly reduced after establishment of IDFG in 1937. Changes in federally controlled domestic sheep grazing allotments, habitat improvement projects, and wild bighorn translocations have all been implemented in hopes of increasing wild sheep populations in the Lemhi Range.

There have been 2 bighorn sheep translocations in the South Lemhi PMU (Appendix B, Table 2). All of the sheep (41 total) were captured from the Whiskey Basin population in Wyoming and were released in Badger Creek and Uncle Ike Creek on the west side of the Lemhi range in 1983 and 1984. Counts of these sheep have generally been made incidental to aerial surveys for other big game species and, therefore, do not represent complete population surveys or composition trends.

## Issues

There is risk of contact between domestic and wild sheep in parts of the Lemhi Range. There are both “farm flocks” on private land and active domestic sheep allotments (Mahogany Butte and Eightmile) that overlap bighorn sheep distribution in this area. In addition, the Bernice allotment (operated by a Memorandum of Understanding between the BLM and the USFS Experimental Sheep Station) overlaps bighorn sheep distribution. One known farm flock of approximately 100 domestic sheep is located in the Deep Creek area. Domestic sheep allotments that occur on Idaho National Laboratory land may also be a source of potential contact.

Although information about the number of bighorn sheep is poor, the small numbers observed in recent years is a concern.

## Management Direction

The Department will continue to work with federal agencies and willing domestic sheep producers in the South Lemhi PMU to reduce risk of contact between domestic and bighorn sheep, particularly for active domestic sheep allotments that overlap or abut bighorn sheep distribution in this area. Management direction will focus efforts on maintaining separation between bighorn sheep and domestic sheep and goats.

Within current distribution, modeled habitat occupies approximately 297 km<sup>2</sup>, which could support approximately 550 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce

the estimate of potential population size. There is no current population estimate for this PMU, but incidental observations appear to show a decline since 1992. Management direction is to maintain populations and increase them in areas of the PMU where separation can be maintained.

There have been no bighorn hunts in the South Lemhi PMU and none are planned until the population increases enough to allow hunting.

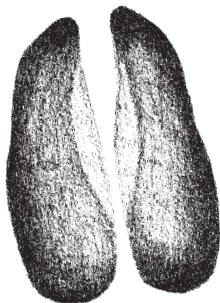
More information is needed to manage this population; including use areas, seasonal movements, a population estimate, survival rates, and production. The Department will pursue funding to initiate a study to gather this type of data in the South Lemhi PMU.

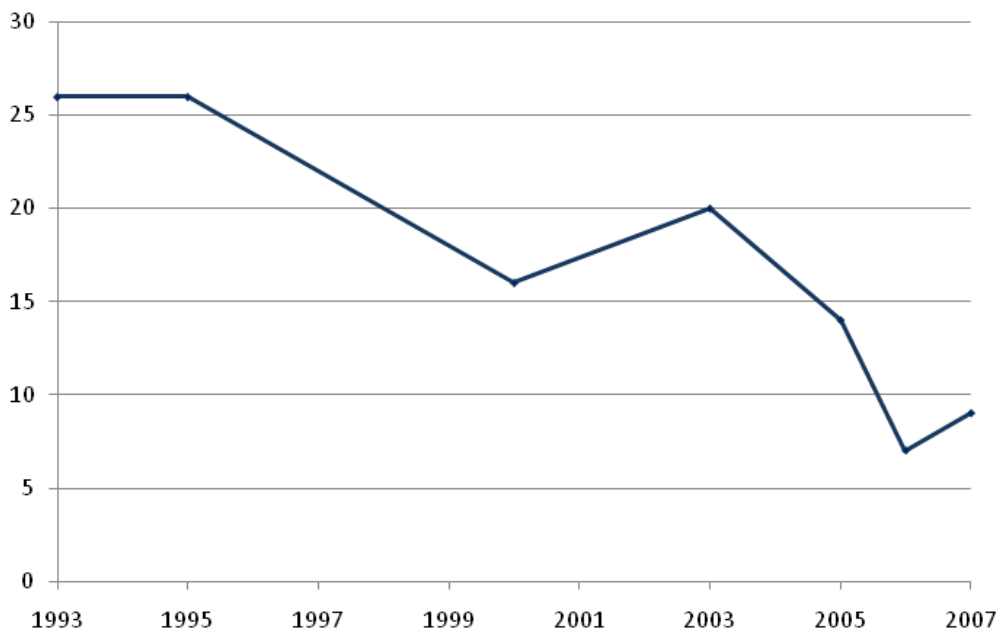
## Management Actions

1. **Work with willing domestic sheep permittees, USFS, and BLM to use BMPs to maintain separation between bighorn sheep and domestic sheep and goats.**
2. **Increase knowledge of movement patterns, habitat use, survival, etc. using radiomarked bighorn sheep.**
3. **Conduct an aerial survey specifically for bighorn sheep.**
4. **Refine habitat modeling to more accurately characterize sustainable population levels.**
5. **Use radiomarked sheep to provide data points for sightability modeling.**

## Literature Cited

- Russell, O. 1955. *Journal of a trapper*. University of Nebraska Press, Lincoln, USA.
- Seton, E. T. 1929. *Lives of game animals*, volume 3. Doubleday, Doran, Garden City, New York.
- Smith, D. R. 1954. *The bighorn sheep in Idaho: its status, life history, and management*. Idaho Department of Fish and Game, Boise, USA.





**Figure 27.** Total bighorn sheep observed, South Lemhi PMU, 1993-present.

## Rocky Mountain Bighorn Sheep

### South Lemhi

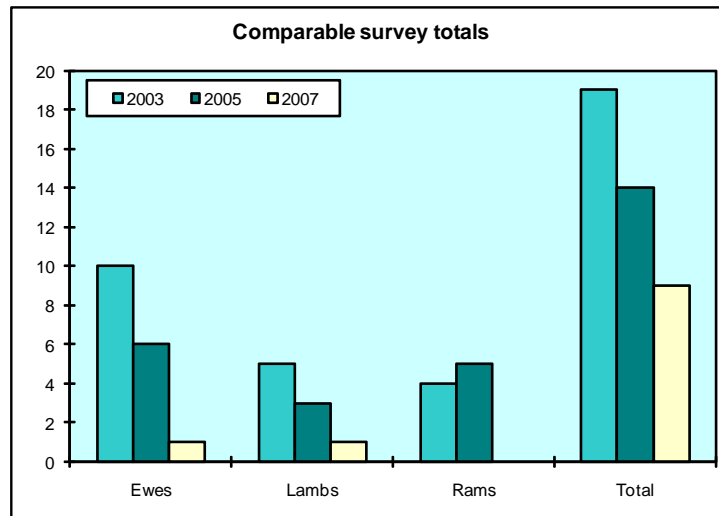
GMUs 51 (east), 58 (west)

### Hunting permits and harvest information

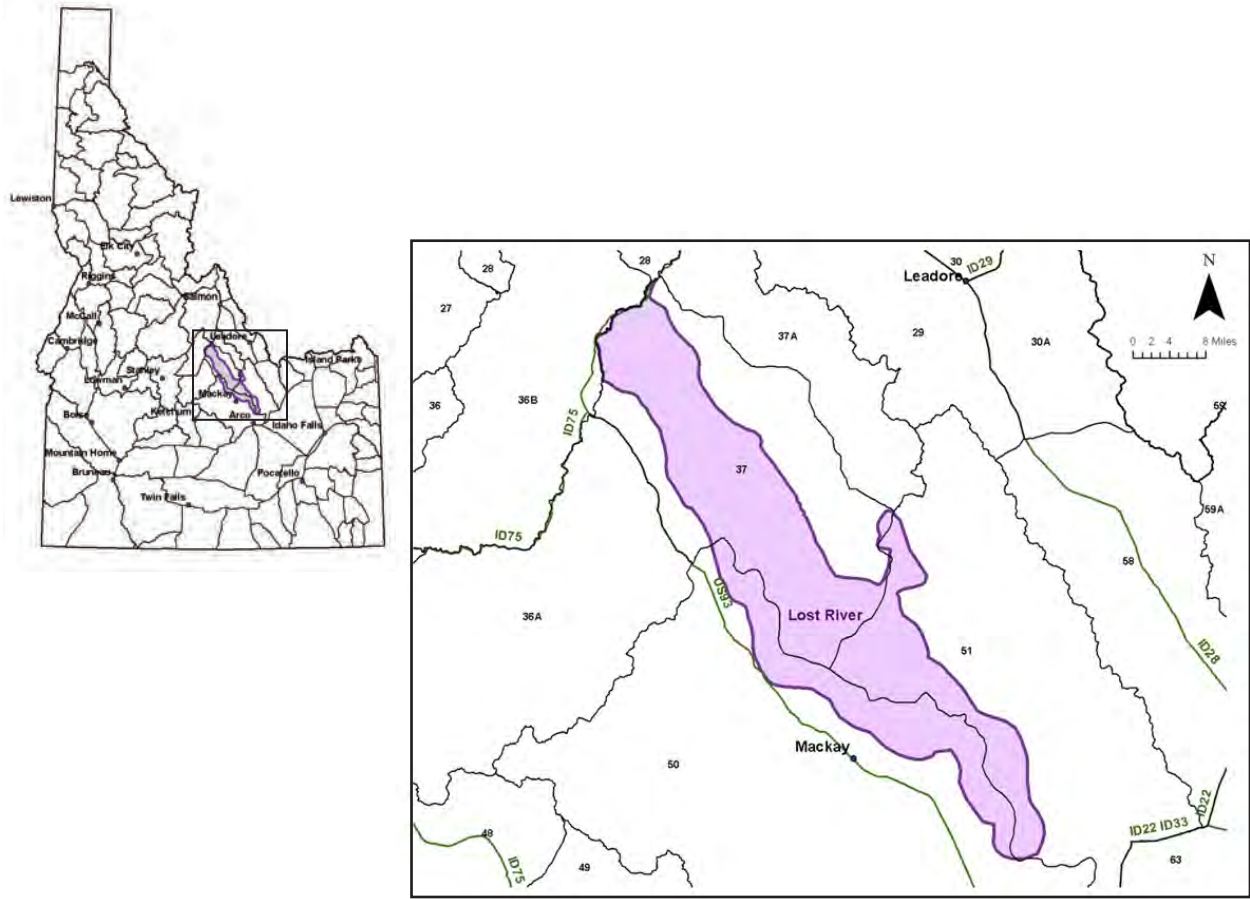
**No hunting season in this area**

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
51	2003	10	5	3	1	4	0	19
	2005	6	3	2	3	5	0	14
	2007	1	1	0	0	0	7	9
Modeled estimate								
Per 100 ewes observed			100	0	0	0		

**NOTE:** All aerial counts are incidental to other surveys (not representative of populations).



# Lost River PMU



## Description

This population occurs on the Lost River Range in GMUs 37, 50, and 51. Although USFS manages most of the bighorn range, there is some use of BLM-managed lands. The area is typified by dry coniferous forest-grassland and alpine habitats with low motorized road or trail densities. Access into most occupied bighorn sheep habitats is limited. Bighorn sheep primarily summer at higher elevations in alpine ranges. Winter ranges extend from the lower elevation foothills to mountain ridges >11,000 feet and include multiple habitat types. Bighorn sheep are observed consistently throughout this PMU.

## Historical Perspective

There are no quantitative historical data for the number of bighorn that occurred on the Lost River Range. However, by the 1950s bighorn throughout the central Idaho area had declined substantially. In the Lost River area where Seton (1929) reported thousands of bighorn sheep in the late 1800s, Smith

(1954) reported there were only a few dozen bighorn left.

Initial releases of Rocky Mountain bighorn sheep into the Lost River Range began in 1969 and continued through 1980; a large augmentation occurred in 2005 (Appendix B, Table 2). All releases were considered successful. Prior to the 2005 augmentation, IDFG entered into a Memorandum of Understanding (MOU) with the BLM and USFS to foster enhanced management of bighorn sheep in the Lost River Range. The MOU was spurred by removal of domestic sheep from grazing allotments within and adjacent to occupied bighorn sheep range.

Bighorn numbers on the Lost River Range appear to increase steadily until the early 1980s, reaching a high of 182 observed during a 1980 survey. The population remained near that level through the late 1980s. However, by 1992 the population appeared to have suffered the same decline and persistent low recruitment as other bighorn sheep populations in the region (Fig. 28). Recovery from a period of

low recruitment and augmentation with 62 wild sheep from Montana apparently spurred significant population growth; a record high 240 (since reintroduction) bighorn sheep were observed during the most recent survey in 2010.

## Issues

Although reduced by several changes in land management practices in recent years, risk of contact with domestic sheep remains an issue. At the time of the augmentation release, IDFG and USFS staff developed a response plan to address and reduce wild sheep-domestic contact in the event bighorns left the defined project area.

The Lost River Range is relatively dry and availability of surface water is sporadic. The USFS has developed some water sources (guzzlers) to address potentially limited natural water distribution. With current available information and considering the potential of increased disease risk, IDFG currently discourages the development of water sources (see habitat section).

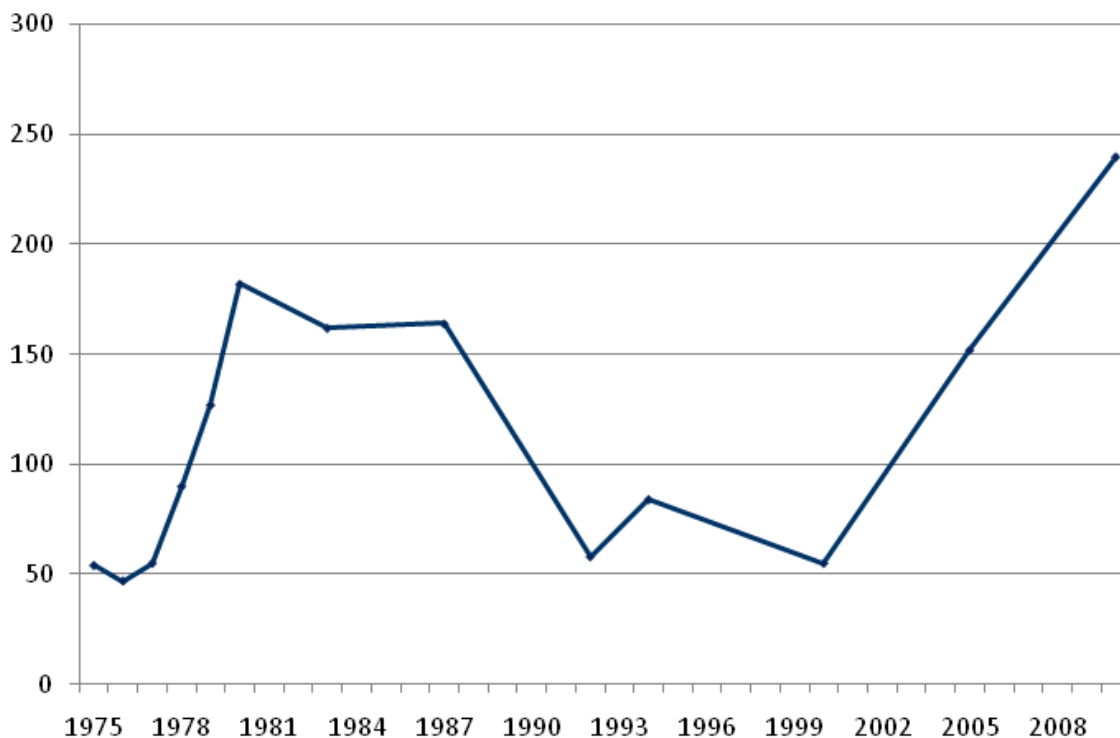
## Management Direction

Within current distribution, modeled habitat occupies approximately 678 km<sup>2</sup>, which could support approximately 1,290 bighorn sheep (assuming all habitat is suitable year-round and relatively high

densities of 1.9/km<sup>2</sup>). Point agreement with the habitat model is low (~60%), indicating sheep have spent significant time outside of predicted habitat areas. Conversely, there could be greater limitation based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. Regardless, the PMU can sustain more bighorn sheep and IDFG will continue to manage for an increase in population in the PMU.

## Management Actions

1. **Work with USFS to maintain or improve habitat for bighorn sheep.**
2. **Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence.**
3. **Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
4. **Refine habitat modeling to more accurately characterize sustainable population levels.**
5. **Work with domestic sheep owners or permittees to employ BMPs designed to maintain separation of wild and domestic sheep.**



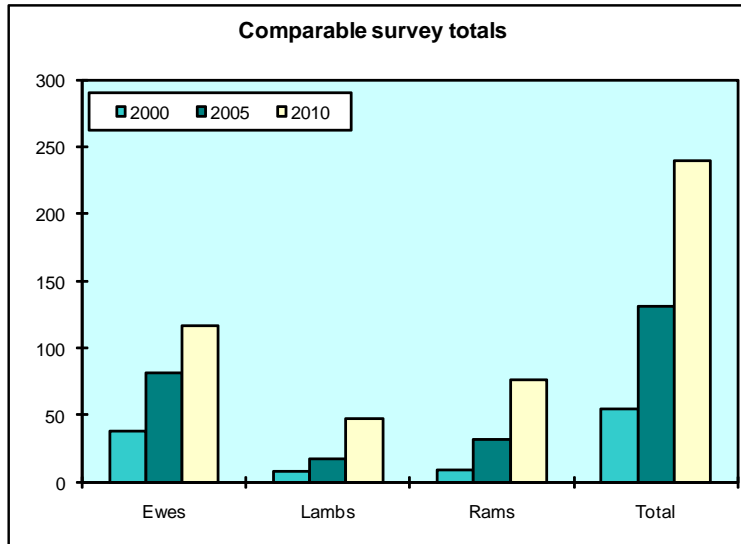
**Figure 28.** Total bighorn sheep observed during IDFG aerial surveys, Lost River Range PMU, 1975-present.

# Rocky Mountain Bighorn Sheep

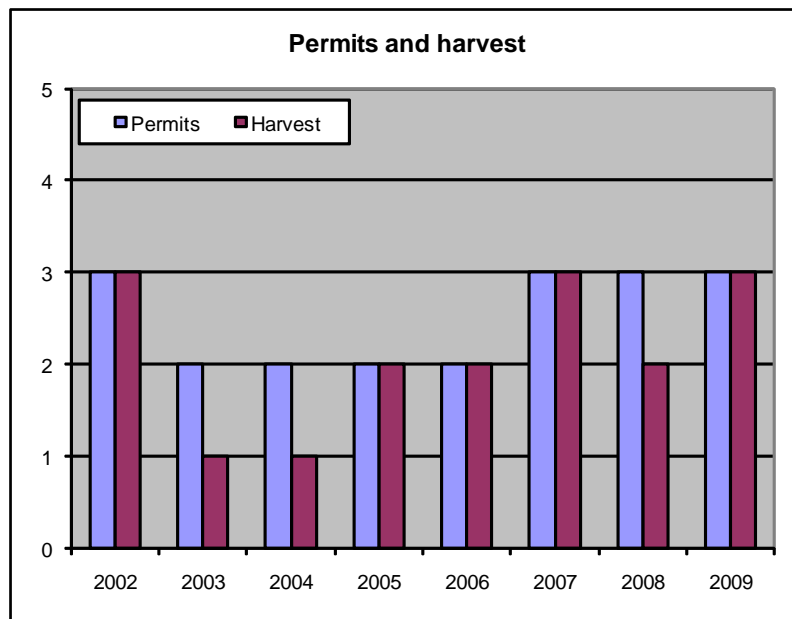
## Lost River Range

GMUs 37, 50 (east), 51 (west); Hunt Area 37

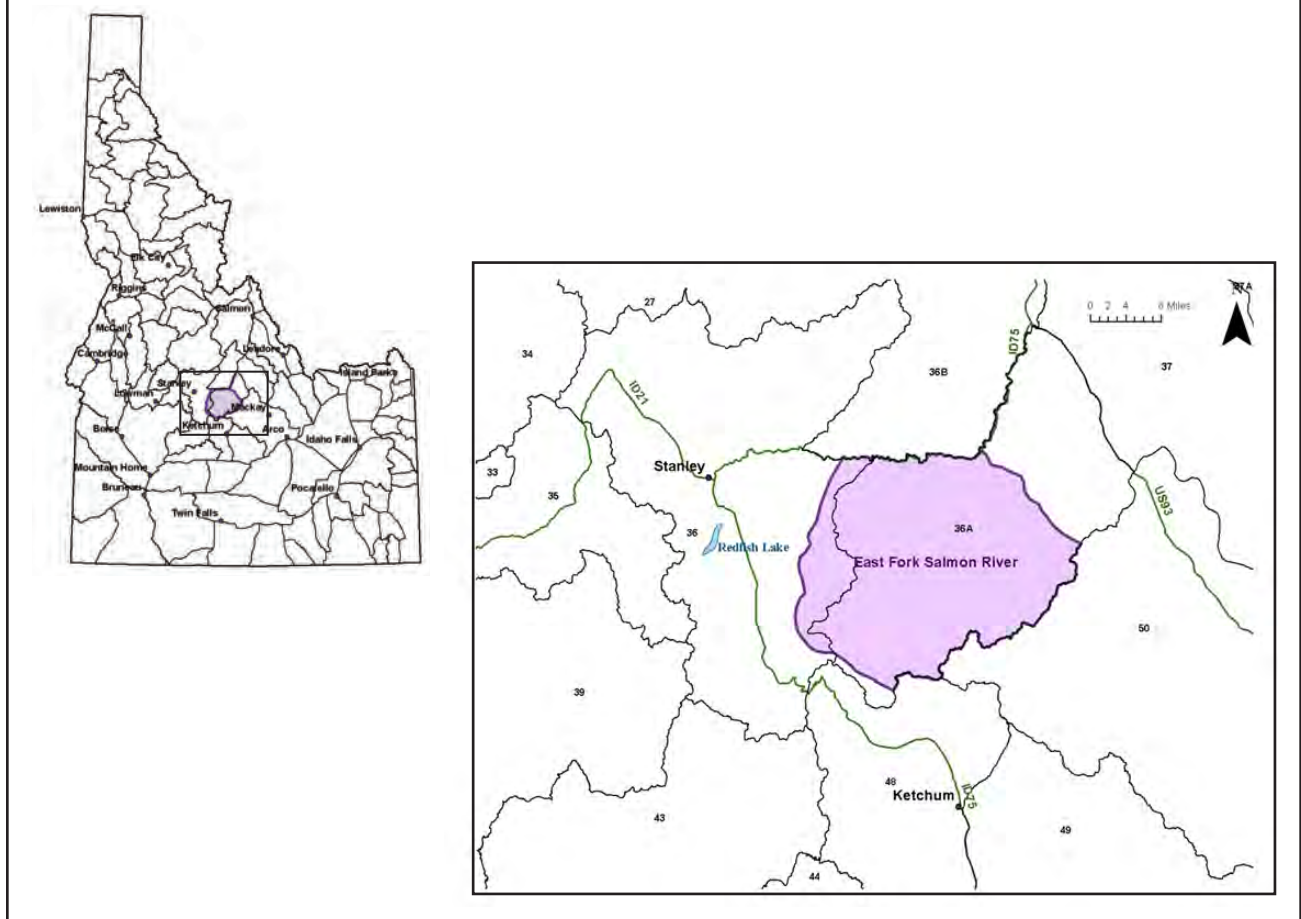
Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
37, 50, 51	2000	38	8	5	4	9	0	55
	2005	82	17	19	13	32	0	131
	2010	117	47	38	38	76	0	240
Modeled estimate								
Per 100 ewes observed			40	32	32	65		



Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits	3	2	2	2	2	3	3	3
Harvest	3	1	1	2	2	3	2	3
Hunter success	100	50	50	100	100	100	67	100
Ave ram age	6.8	6.5	8.5	6.5	8.5	9.2	8.0	6.2



# East Fork Salmon River PMU



## Description

This population includes sheep in GMUs 36A and 36 (southeastern portion). Ownership of bighorn range is split between USFS (summer range) and BLM (winter range). The area is typified by dry, coniferous forest-grassland habitats with low motorized road-trail densities. Access into most occupied bighorn sheep habitats is limited. Bighorn sheep in the area winter in a relatively small area of shrub-steppe habitat west of the East Fork Salmon River between Joe Jump Basin and Big Boulder Creek. Sheep migrate west into the White Cloud Mountains to summer in sub-alpine to alpine habitats.

## Historical Perspective

Bighorn sheep populations in this area persisted despite pressures of early settlement. However, subsistence hunting for mining camps and intensive livestock grazing in the late 1800s reduced numbers to low levels. Estimated sheep numbers from various sources in the early 20th century ranged from 50 to 150. Sheep in this PMU became the subject of

much social and political interest in the 1960s and 1970s, resulting in several research and habitat enhancement projects, as well as a cooperative management agreement between BLM and IDFG.

No animals have been translocated into this native population and only 1 translocation out of the PMU has occurred (Appendix B, Table 2). Population estimates for the PMU varied considerably over time (50-150 in the early-mid 20th century) depending on the source (USFS, private landowners, IDFG). Annual variations included some that do not appear biologically feasible. Regardless, the population apparently reached a modern peak in 1990 (191 observed), a level higher than estimates from earlier in the century (Fig. 29). The population suffered an all-age die-off along with surrounding PMUs and declined by 50% by 1993. Hunting was permitted through 1996, but closed until 2007 because of low sheep numbers.

## Issues

Quantity and quality of winter range may be important limiting factors for this PMU. Grazing management has changed over time and should have improved range for bighorns. However, the winter range is quite dry and vegetative production appears low. Elk numbers in the East Fork drainage increased dramatically beginning in the 1970s and competition with a large elk herd may impact habitat capacity for bighorns.

Contact with domestic sheep is a risk factor at the edges of occupied summer range near USFS allotments. Risk could increase in the event individuals of either species wander. Separation strategies have been developed to minimize risk of contact.

Lastly, the East Fork population appears to still be disease-limited, as evidenced by very low lamb:ewe ratios since the die-off in the early 1990s (Fig. 30). Ratios declined from an average of 57:100 (range 22-88) between 1977 and 1990 to <9:100 (range 3-15) since 1991 (for years in which >50 sheep were classified).

## Management Direction

Hunting seasons were closed for 10 years and reopened in 2007 because adequate numbers of rams were available to support limited harvest.

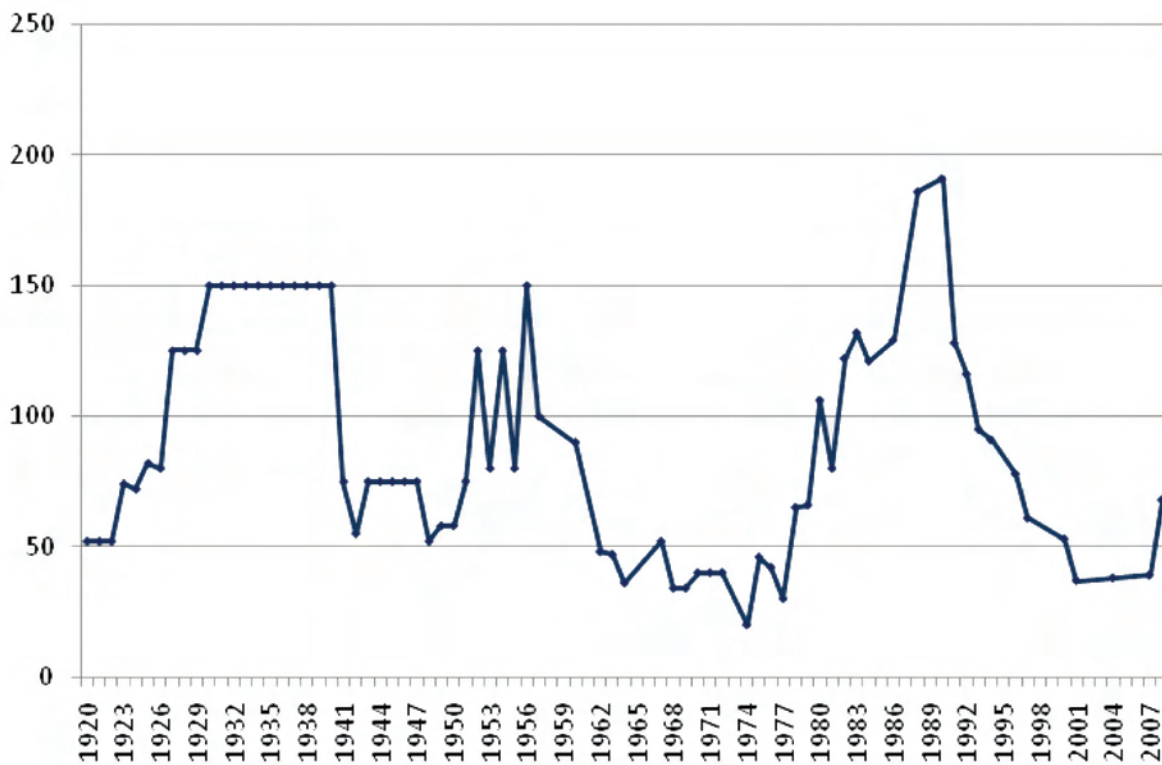
Within current distribution, modeled habitat occupies approximately 558 km<sup>2</sup>, which could support approximately 1,060 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, with the current restricted winter range, total sheep numbers that can be supported in this PMU are likely much lower. Regardless, historic and recent data indicates the PMU can sustain significantly more bighorn sheep and management direction will be to increase population levels.

### Management Actions

- 1. Work with USFS and BLM to maintain or improve habitat for bighorn sheep.**
- 2. Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence.**
- 3. Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
- 4. Refine habitat modeling to more accurately characterize sustainable population levels.**
- 5. Use radiomarked sheep to provide data points for sightability modeling.**
- 6. Work with domestic sheep owners or permittees to employ BMPs designed to maintain separation of wild and domestic sheep.**







**Figure 29.** Approximate total bighorn sheep estimated or observed, East Fork Salmon River PMU, 1920-present. Some early estimates were derived from historical observations by USFS and IDFG personnel. More recent values (1978 forward) are primarily observed numbers from IDFG aerial surveys.

### Lambs:100 ewes East Fork



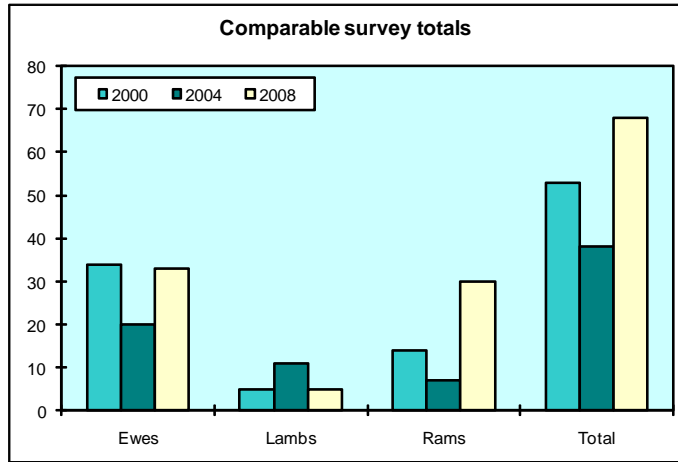
**Figure 30.** Observed bighorn sheep lamb:100 ewe ratios, East Fork Salmon River PMU, 1962-present.

# Rocky Mountain Bighorn Sheep

## East Fork Salmon River

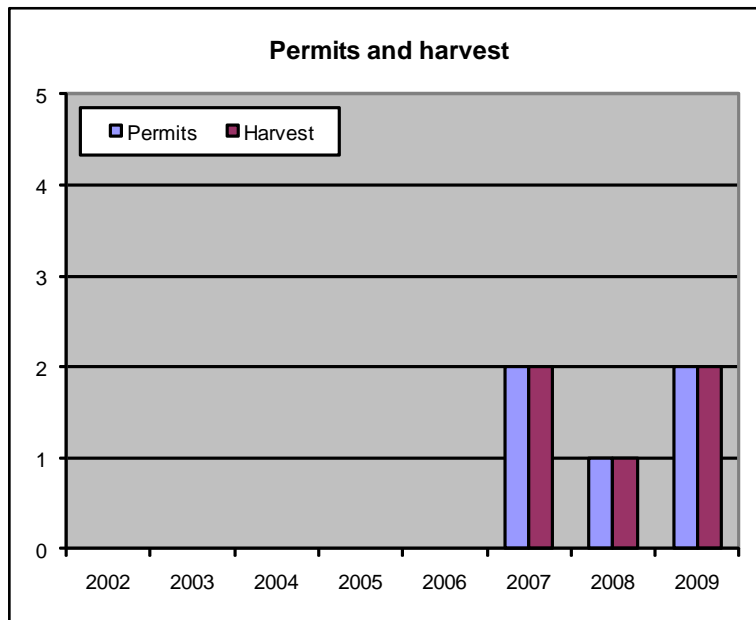
GMUs 36 (southeast), 36A; Hunt Area 36A

Population Surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
36A	2000	34	5	12	2	14	0	53
	2004	20	11	4	3	7	0	38
	2008	33	5	16	14	30	0	68
Modeled estimate								
Per 100 ewes observed			15	48	42	91		

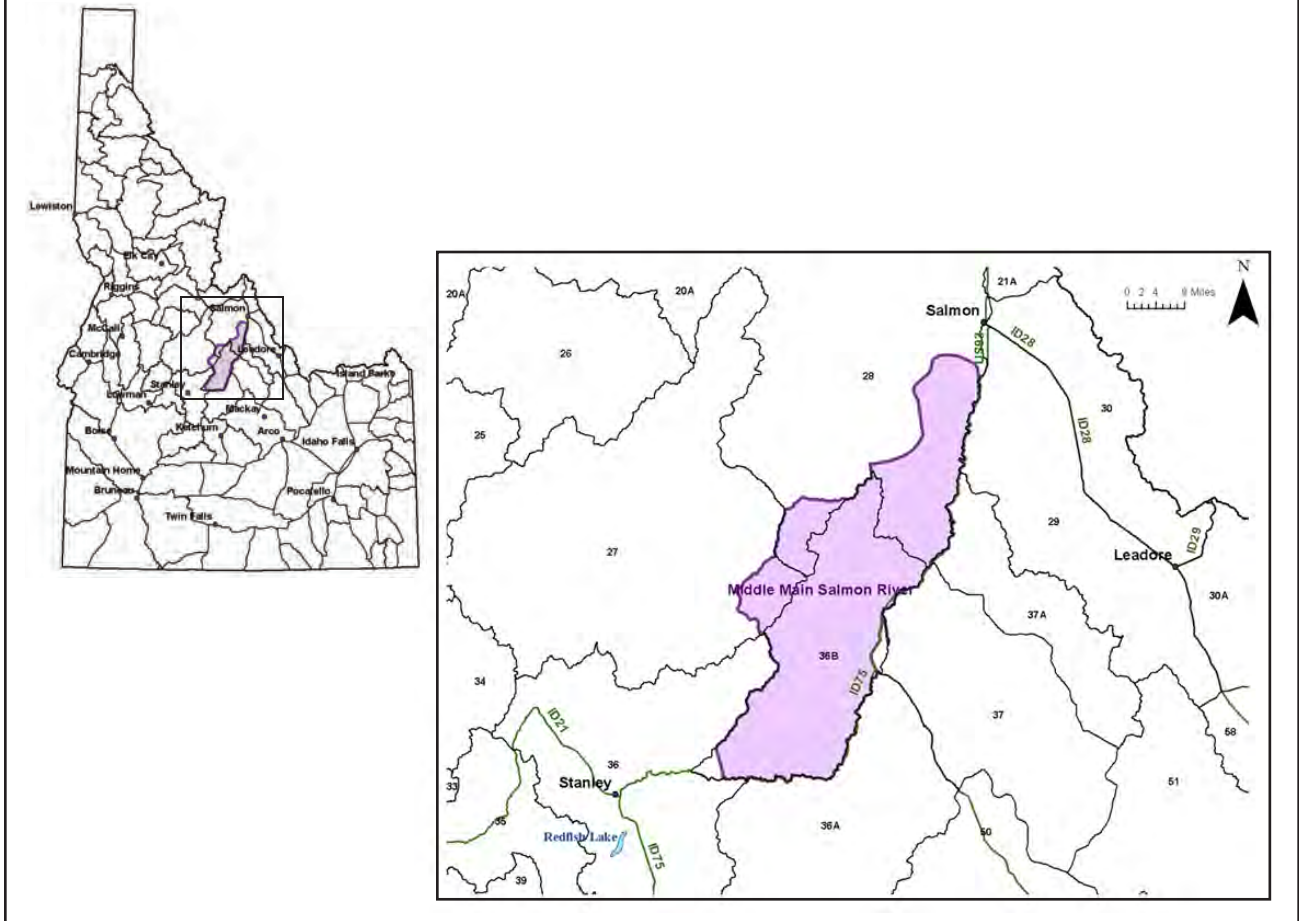


Hunting Permits and Harvest Information								
	2002	2003	2004	2005	2006	2007	2008	2009
Permits*	0	0	0	0	0	2	1	2
Harvest*						2	1	2
Hunter success						100	100	100
Ave ram age						9.0	8.5	8.5

\*Includes auction or raffle permits.



# Middle Main Salmon River PMU



## Description

The Middle Main population includes sheep in GMU 36B and small portions of GMUs 27 (upper Warm Springs and Camas creek drainages) and 28 (Hat Creek and upstream). Two subpopulations exist: the smaller Birch Creek subpopulation occupies the area from Challis upstream to approximately Sink Creek; and the Morgan Creek herd ranges downstream from Challis to approximately Hat Creek in GMU 28. Ownership is split between the BLM and USFS, including some area within the Frank Church River-of-No-Return Wilderness. Habitat grades from sagebrush-steppe at lower elevations though dry, coniferous forest-grassland to alpine at the highest elevations. This PMU contains some of the least rugged terrain occupied by bighorns in eastern Idaho. Highways 93 and 75 parallel the Salmon River along the eastern edge of the PMU; some gravel roads provide access to occupied bighorn sheep range. Bighorn sheep in the area winter along the main Salmon River corridor. Some bighorns remain in these areas during summer, whereas others migrate to higher elevation sub-alpine and alpine habitats.

## Historical Perspective

Even though they were near human population centers, bighorn sheep in this area persisted when most front-country populations were extirpated. Like most areas, subsistence hunting for mining camps and intensive livestock grazing in the late 1800s produced some negative impacts. Little information about historic population trends exists.

The native population of the Middle Main PMU provided a source of animals for translocation within and outside Idaho for >20 years (Appendix B, Table 2). A small number of sheep were moved from the adjacent Lower Panther-Main Salmon PMU to augment the Birch Creek sub-population.

Land and resource use changed after the mining boom: subsistence hunting and livestock use decreased and many shrub-dominated ranges began reverting to grasslands. The bighorn population increased to approximately 300 animals by 1988, but declined by roughly 50% after a disease-driven, all-age, die-off in the early 1990s and remains between 130-160 sheep (Fig. 31).

## Issues

Wildfire has impacted some portions of the PMU, particularly since 2007. In some cases, fires have likely benefited wild sheep by reducing conifer encroachment and promoting grass and forb production. However, because of the semi-arid nature of parts of the landscape, habitat response to fire may be slow or negative, particularly on winter ranges where noxious weeds such as knapweed, rush skeletonweed, and leafy spurge could ultimately have significant impacts on winter range productivity. Elk populations have declined somewhat since peaks during the mid 2000s, but competition with a large elk herd may impact habitat capacity for bighorns.

Because bighorns in this PMU occupy less rugged winter ranges than typical of wild sheep, predation risk from wolves may be somewhat higher than in other PMUs. Some farm flocks of domestic sheep occur in and near the PMU, creating a risk of contact. Several animals from the Birch Creek sub-population spend most of the year in close proximity to Highway 75 just south of Challis and are subject to mortality due to vehicle collisions. Past attempts to reduce vehicle collisions by drawing sheep farther west of the highway with habitat improvements have met with limited success, as have highway signage. In April 2010, a sheep viewing station was opened to enhance public knowledge and appreciation of bighorn sheep and their habitat (a collaborative effort among Idaho Outfitters and Guides Association, Idaho Chapter Wild Sheep Foundation, IDFG, and several other entities).

Unlike populations in most other PMUs affected by the early 1990s die-off, lamb production appeared to rebound relatively quickly and ratios have averaged near 30:100 in recent years.

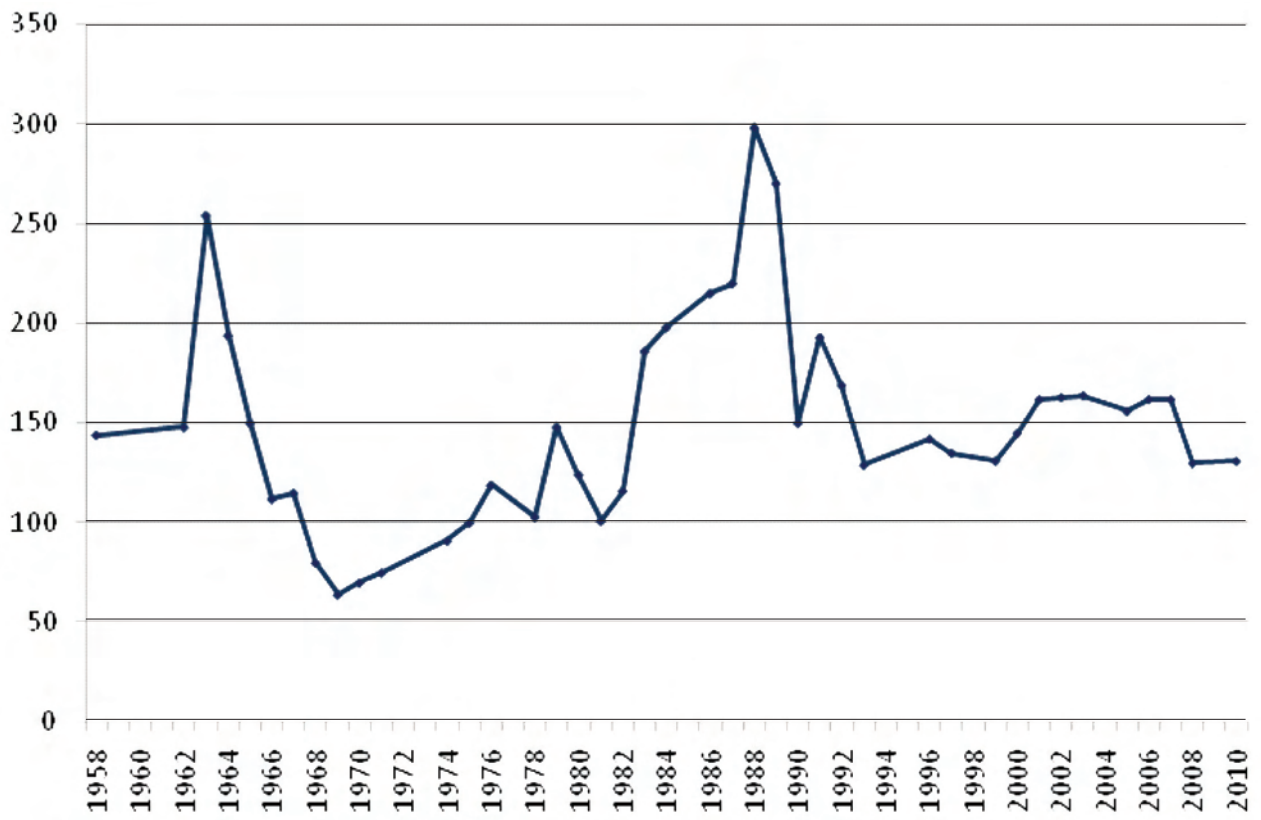
## Management Direction

Because of relatively easy access to much of the hunt area, hunter success tends to be high most years. Backcountry hunting experiences are available within wilderness portions of the hunt area.

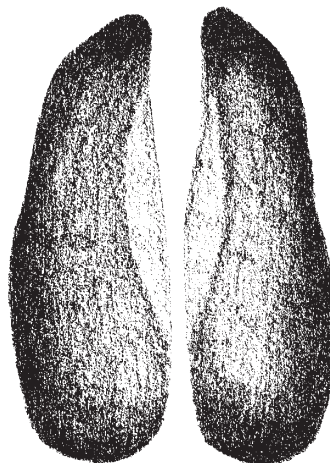
Within current distribution, modeled habitat occupies approximately 567 km<sup>2</sup>, which could support approximately 1,075 bighorn sheep (assuming all habitat is suitable year-round and relatively high densities of 1.9/km<sup>2</sup>). However, there are limitations based on specific habitat needs such as lambing and wintering habitat. Thus, further refinement of habitat models and available habitat will likely reduce the estimate of potential population size. Regardless, historic and recent data indicates the PMU can sustain significantly more bighorn sheep and management direction will be to increase population levels.

### Management Actions

1. **Work with USFS and BLM to maintain or improve habitat for bighorn sheep.**
2. **Work with USFS, BLM, and other partners to control or reduce noxious weed occurrence.**
3. **Increase knowledge of movement patterns among hunt areas and adjacent PMUs to better understand metapopulation characteristics (connectivity and genetic exchange).**
4. **Refine habitat modeling to more accurately characterize sustainable population levels.**
5. **Use radiomarked sheep to provide data points for sightability modeling.**
6. **Work with domestic sheep owners to employ BMPs designed to maintain separation of wild and domestic sheep.**



**Figure 31.** Approximate total bighorn sheep observed or estimated, Middle Main Salmon River PMU, 1958-present. Values are primarily observed numbers from IDFG aerial surveys.

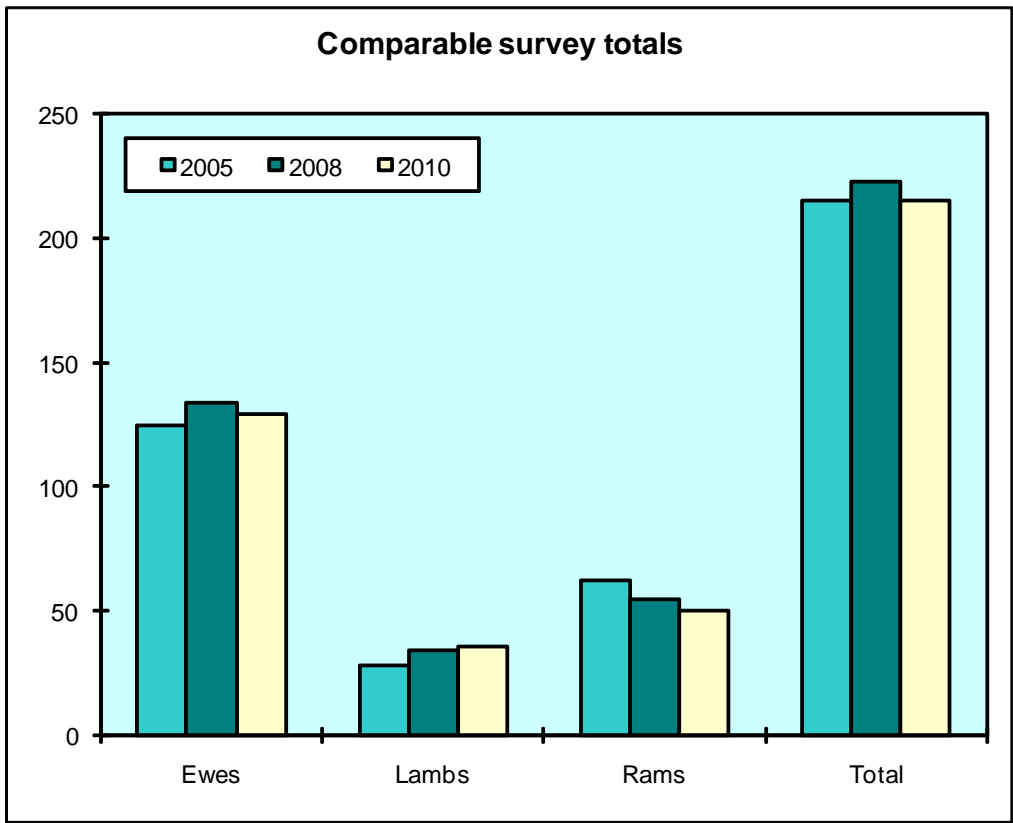


# Rocky Mountain Bighorn Sheep

## Middle Main Salmon River

GMUs 28 (southeast); 36B, 27 (southeast); Hunt Areas 28-2, 36B

Population surveys								
Area	Year	Ewes	Lambs	Rams			Unclass	Total
				I, II	III, IV	Total		
Morgan Cr.	2005	76	18	26	13	39	0	133
	2008	61	18	10	19	29	0	108
	2010	63	22	21	11	32	0	117
Birch Cr.	2005	21	2	5	4	9	0	32
	2008	22	6	2	4	6	0	34
	2010	6	2	4	2	6	0	14
SE 28	2005	28	8	9	5	14	0	50
	2008	51	10	10	10	20	0	81
	2010	60	12	4	8	12	0	84
Total	2005	125	28	40	22	62	0	215
	2008	134	34	22	33	55	0	223
	2010	129	36	29	21	50	0	215
Modeled estimate								
Per 100 ewes observed			28	22	16	39		

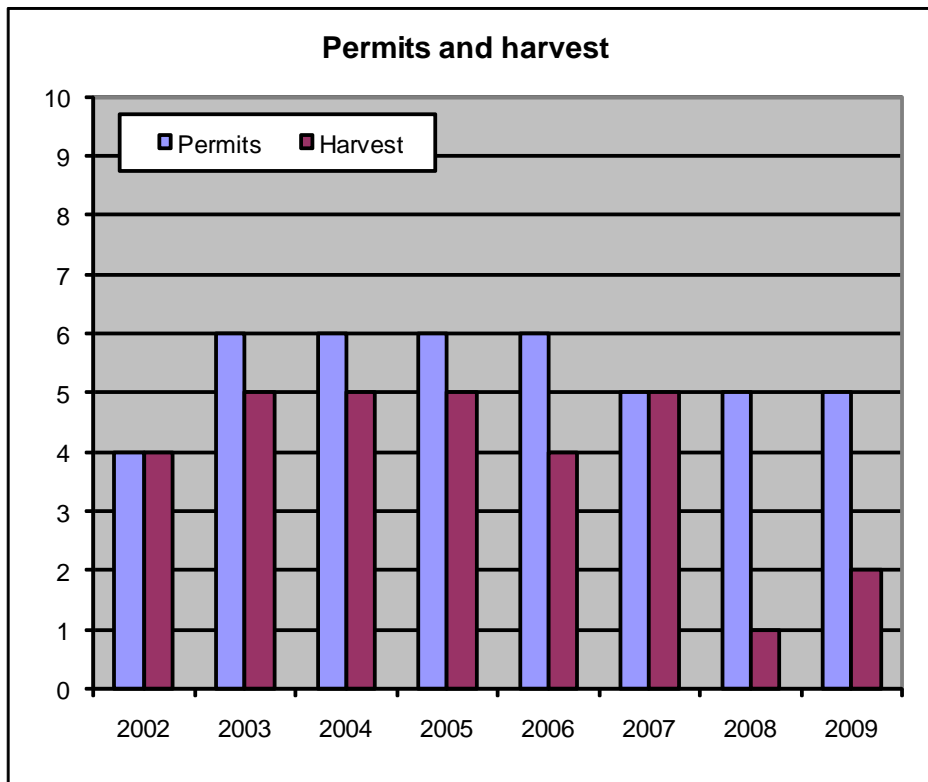


# Rocky Mountain Bighorn Sheep

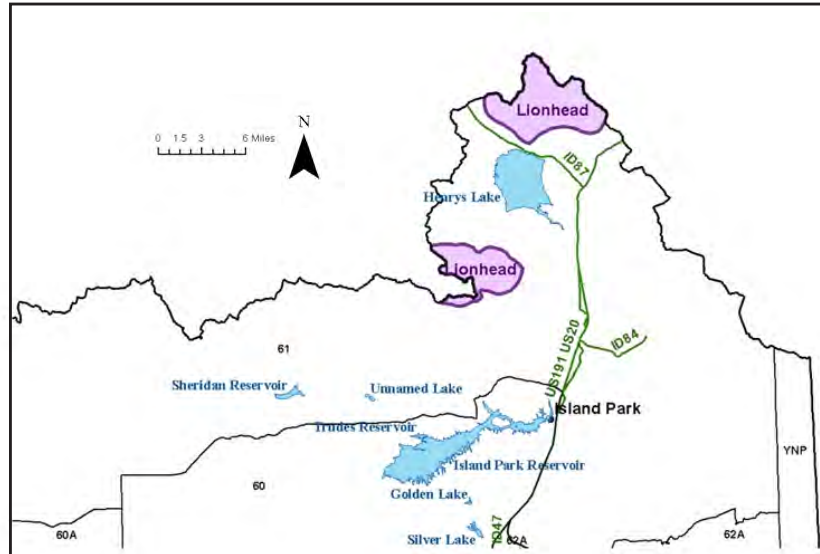
## Middle Main Salmon River

GMUs 28 (southeast), 36B, 27 (southeast); Hunt Areas 28-2, 36B

Hunting Permits and Harvest Information									
		2002	2003	2004	2005	2006	2007	2008	2009
Permits	28-2		2	2	2	2	1	1	1
	36B	4	4	4	4	4	4	4	4
	Total	4	6	6	6	6	5	5	5
Harvest	28-2		2	1	1	1	1	0	1
	36B	4	3	4	4	3	4	1	1
	Total	4	5	5	5	4	5	1	2
Hunter success		100	83	83	83	67	100	20	40
Ave ram age		6.5	8.3	7.5	5.5	6.5	6.3	10.5	6.0



# Lionhead PMU



## Description

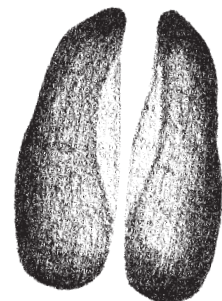
This area includes portions of GMU 61 near Henry’s Lake. There is a small population of bighorn sheep that occurs on the Idaho-Montana border. Montana’s state plan refers to this as the Hilgards population. These sheep spend varying amounts of time in Idaho. Montana has periodically issued hunting tags for this herd. Idaho authorized a 5-tag controlled hunt on this population in 1962, 1964, 1965, and 1966. Currently this population of bighorn sheep is not hunted in Idaho and has a high nonconsumptive value, particularly to those recreating in the Targhee Creek area.

## Management Action

1. **Document bighorn sheep locations to better understand their use of this area.**
2. **Provide information to those interested in bighorn sheep viewing opportunities.**

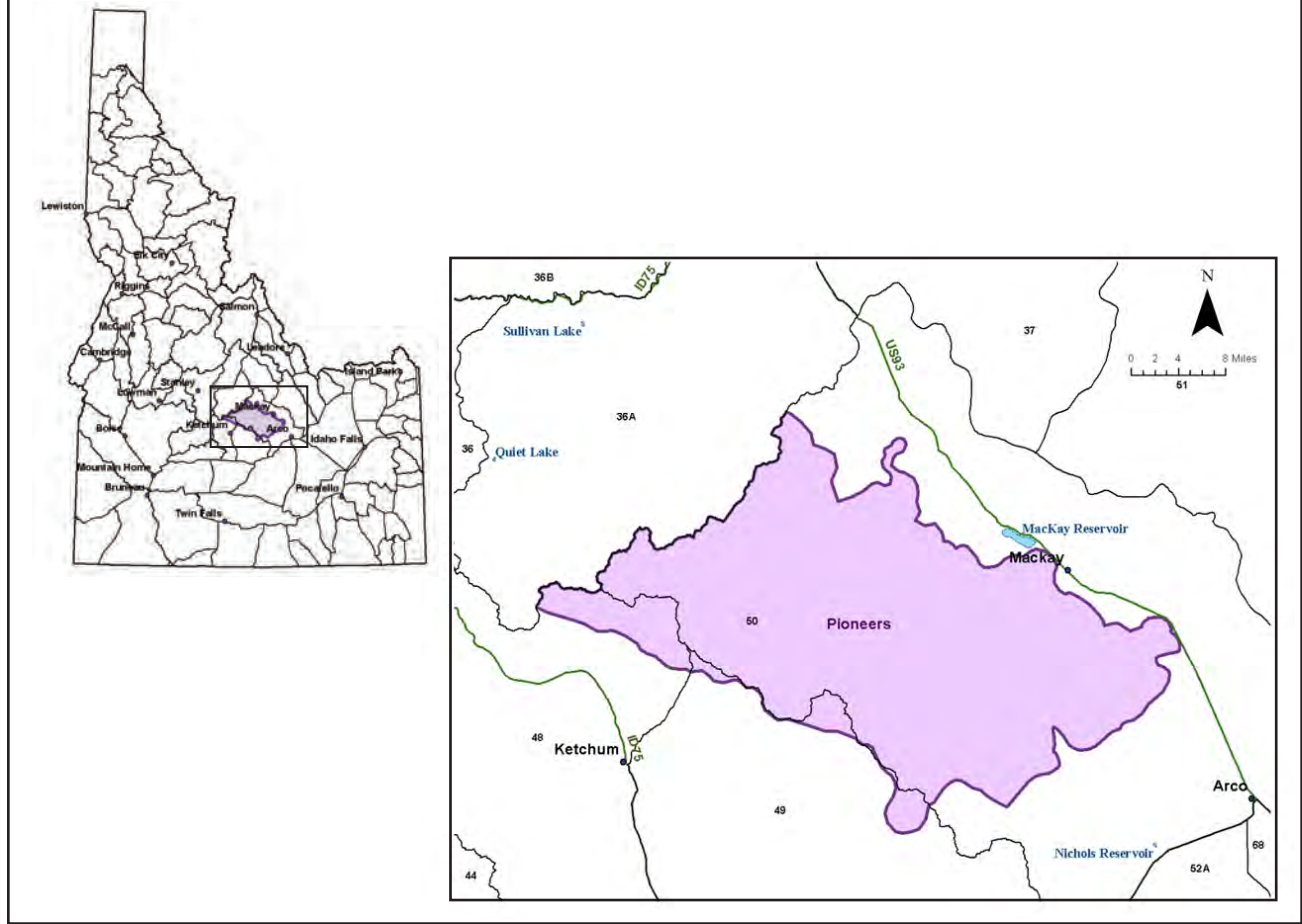
## Management Direction

Management direction is to document observations and provide for nonconsumptive use. The Department does not currently manage this sheep population for hunting, but there has been interest in the past to try to provide limited opportunity that is shared cooperatively between Montana and Idaho.





# Pioneers PMU



## Description

This area includes portions of GMUs 48, 49, and 50. On average, there are confirmed sightings of bighorn sheep in this area every 2-3 years. Often, these sheep are young rams which are observed once or a few times, but then apparently leave the area. We are uncertain of the source populations for these sheep; they may migrate from either the East Fork Salmon River population or the Lost River population. There does not appear to be a persistent bighorn sheep population in the Pioneers PMU.

## Management Direction

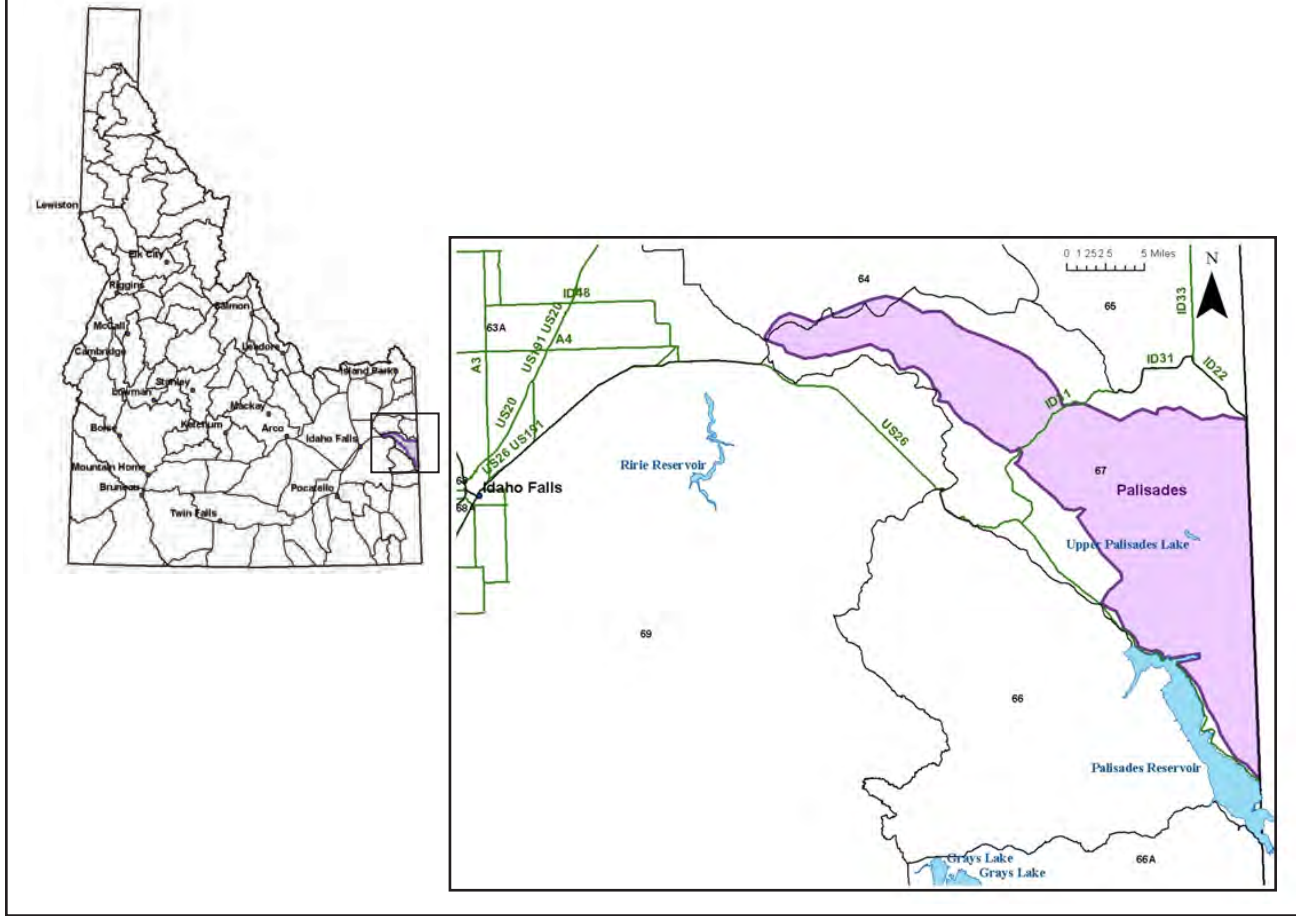
The Department does not manage to maintain a population of bighorn sheep in the Pioneers PMU. Management will focus on minimizing potential contact between bighorn sheep and domestic sheep and goats, and preventing bighorn sheep that contact domestic sheep in this area from returning to an established population of bighorn sheep. To this end, IDFG has agreed to BMPs with all of the known domestic sheep producers who operate within this PMU. These BMPs focus on prompt communication

of bighorn sightings and minimizing the likelihood of contact between domestic and bighorn sheep. Furthermore, the BMPs outline tools IDFG may use when a bighorn sheep is sighted. These tools include monitoring, deploying a radiocollar on, or euthanizing the bighorn sheep.

## Management Action

1. **Continue to collect observation data on bighorn sheep that move into the Pioneers PMU. If the opportunity arises, this may include deploying radiocollars on bighorn sheep to learn about movements, source herds, and other bighorn sheep that may use the Pioneers PMU.**

# Palisades PMU



## Description

This area includes portions of GMUs 67 and 64. Periodically bighorn sheep are observed in this area. There are reports of 4 different bighorn sheep that have been in the area for a short duration during the last 3 years. The individual sheep are usually seen a few times and then apparently leave the area. These sheep most likely come from Wyoming, but this has not been confirmed with telemetry data. There is not a persistent bighorn sheep population in the Palisades PMU.

## Management Direction

The Department does not manage to maintain a population of bighorn sheep in the Palisades PMU. Management will focus on minimizing potential contact between bighorn sheep and domestic sheep and goats, and preventing bighorn sheep that contact domestic sheep in this area from returning to an established population of bighorn sheep. If possible, the bighorn sheep that wander into this area will be captured, radiocollared, and monitored to learn more about their travel routes and source population(s).

Management may also include lethal removal of bighorn sheep that have contact with domestic sheep.

## Management Action

1. **The Department will work to establish direction for communication among the USFS, Wyoming Game and Fish, permittees, the public, and IDFG so that bighorn sheep sightings are reported promptly to appropriate personnel.**
2. **When possible, radiocollar bighorn sheep to learn more about their movements and source population(s).**
3. **Remove bighorn sheep that have contact with domestic sheep.**

# APPENDIX A

## Glossary of Terms

**Big Game Mortality Report (BGMR):** Department form that a hunter must complete at an IDFG office within 10 days of harvesting a bighorn sheep. A report is also mandatory (within 30 days) for any horns that are picked up from sheep that are found dead from natural causes.

**Bighorn sheep:** A member of the species *Ovis canadensis* (family *Bovidae*, tribe *Caprinae*) found in the mountains and canyons of western North America. Three subspecies are currently recognized: *O. c. canadensis*, *O. c. nelsoni*, and *O. c. sierrae*. Rocky Mountain and California bighorn sheep in Idaho are classified as *O. c. canadensis*.

**Bighorn sheep distribution:** Geographic range regularly or periodically occupied by bighorn sheep. Not all areas within this range have sufficient suitable habitat to support persistent populations and bighorn sheep can and do occasionally move outside this area. Distribution can change through time as a consequence of changes in population density, habitat, or other factors.

**Contact:** Direct contact or close proximity between body parts of 2 animals during which a disease might be transmitted from one to another. In this document, “contact” typically refers to nose-to-nose or face-to-face interaction that may lead to the transmission of respiratory disease via secretions or aerosols. Synonymous with “interaction.”

**Dispersal:** Movement of individuals away from their area of birth or from centers of population density.

**Escape terrain:** Topographic areas with slopes between 31° and 85°.

**Herd:** See population.

**Hunter survey:** A quantitative technique designed to collect information and opinions from a random or stratified random sample of hunters that can then be extrapolated to represent the hunting population or different segments of the population (e.g., resident and nonresident).

**Metapopulation:** A set of spatially distinct populations of the same species that are linked by movements and dispersal.

**Native:** A species or population that is present as a result of natural processes with no human intervention.

**Pathogen:** A biological agent that causes disease.

**Poll:** Responses of a self-selected (nonrandom) sample of the public to a questionnaire.

**Population:** A group of individuals of a single species in a defined area. Bighorn sheep populations are generally defined by core use areas of males and females. Also called herd in this document. In some cases it can be difficult to accurately identify distinct populations in continuous habitat (e.g., along the Salmon River). Therefore, we also use the term “population” relatively loosely to refer to management subgroups within population management units.

**Population Management Unit (PMU):** A population or groups of connected populations in similar habitats with similar management priorities.

**Reintroduced:** Population of a native species that has been reestablished (usually through translocations) to a part of its historical range from which it was extirpated.

**Risk/Risk Assessment/Risk Management:** In this context, evaluation of the probability that a wild sheep population could experience a disease event with subsequent demographic impacts. Identification of what factors might contribute to the probability of a disease event. Management actions taken to reduce the probability of exposure or infection among, or between, animals. Examples of risk management include separation of infected and non-infected animals, treatment of infected individuals, vaccination, manipulations of the host environment, or manipulations of the host population.

**Qualitative Risk Assessment:** Interpretation and analysis of factors that cannot necessarily be measured.

**Quantitative Risk Assessment:** Use of tangible data and measurements.

**Subpopulation:** Cohesive, distinct groups within a population that interact infrequently (e.g., ewe groups).

**Subspecies:** Taxonomic groups within species that exhibit significantly different morphological or genetic structure (greater differences between groups than within groups).

**Suitable bighorn sheep habitat:** Areas >1.6 ha that contain physical resources including steep, rugged, open, escape terrain, and proximity to water; characteristics that are selected by bighorn sheep. Not all suitable habitat is occupied by bighorn sheep or can support bighorn sheep populations. Changes in vegetation or other factors can alter the suitability of habitat for bighorn sheep.

**Translocation:** Moving animals from one area to another with the intention of establishing or augmenting populations.

**Trophy type:** A classification recognized by a big game scoring organization such as Boone and Crockett or Pope and Young. In Idaho, California bighorn sheep occur in the southwestern part of the state, south of Interstate 84. The rest of the state is designated as Rocky Mountain bighorn sheep range.

**Viability:** The probability of persistence of a population in a defined geographic area for a specified period of time.

**Viable population:** Numbers and distribution of reproductive animals that can be expected to persist through time.

# APPENDIX B

## Translocations

**Table 1.** California bighorn sheep translocations, 1963-present.

Date <sup>a</sup>	Capture site			Release site			Adults		Lambs		Total	Source
	PMU <sup>b</sup>	Unit/ state	Location	PMU	Unit/ state	Location	M	F	M	F		
31 Oct 1963		BC	Chilcotin R. (Junction)	OWY	42	E. Fork Owyhee R.	2	12	3	2	19	Hanna and Rath 1976, Hickey 1983a, Hatter and Blower 1996
18 Nov 1965		BC	Chilcotin R. (Junction)	OWY	42	E. Fork Owyhee R.	1	6	1	1	9	Hickey 1983a, Hatter and Blower 1996
2 Nov 1966		BC	Chilcotin R. (Junction)	OWY	42	E. Fork Owyhee R.	2	7	0	1	10	Hickey 1983a, Hatter and Blower 1996
27 Oct 1967		BC	Chilcotin R. (Junction)	JC	41	Little Jacks Cr.	3	7	1	1	12	IDFG 1968, Hickey 1983a, Hatter and Blower 1996
26-28 Mar 1980	JC	41	Little Jacks Cr.		NV	Washoe Co., S. Granite Range, Clear Cr.	1	3	0	0	4 <sup>c</sup>	Hickey 1980
26 Feb - 1 Mar 1981	JC	41	Little Jacks Cr.	B-J	NV	Elko Co., E. Fork Jarbidge R., Slide Cr.	1	8	2	1	12 <sup>d</sup>	IDFG 1981, IDFG 1990a, Cummings and Stevenson 1996
14-17 Dec 1982	OWY	42	E. Fork Owyhee R., Deep Cr.	B-J	41	W. Fork Bruneau R.	2	10	0	0	12 <sup>e</sup>	Hickey 1982a
21 Mar 1984		BC	Chilcotin R. (Junction)	B-J	NV/ 46	Elko Co., Jarbidge R. (Murphy Hot Springs)	2	8	1	1	12 <sup>f,g</sup>	Oldenburg and Nellis 1984, IDFG 1992
19-21 Dec 1984	OWY	42	E. Fork Owyhee R., Deep and Battle Crs.	B-J	41	Bruneau-Jarbidge confluence	1	8	1	1	11 <sup>g,h</sup>	IDFG 1984a
30 Jan 1985	JC	41	Little Jacks Cr.	OWY	42	S. Fork Owyhee R., Coyote Hole	1	7	1	0	9 <sup>i</sup>	IDFG 1985
30 Jan 1985	JC	41	Little Jacks Cr.	B-J	46	Bruneau-Jarbidge confluence	1	0	0	0	1	IDFG 1985
7 Dec 1985	OWY	42	E. Fork Owyhee R.		NV	Elko Co., S. Snowstorm Mts.	2	4	1	2	9 <sup>i</sup>	Scott 1985, Oldenburg and Nellis 1989, Cummings and Stevenson 1996
16-17 Dec 1986	OWY	42	E. Fork Owyhee R.		NV	Humboldt Co., N. Jackson Mts.	0	2	0	0	2	Parker 1987, Oldenburg and Nellis 1989
16-17 Dec 1986	OWY	42	E. Fork Owyhee R.		NV	Elko Co., S. Snowstorm Mts.	1	3	2	0	6	Parker 1987, Oldenburg and Nellis 1989, Cummings and Stevenson 1996
16-20 Dec 1986	OWY	42	E. Fork Owyhee R., Battle and Deep Crs.	SH	54	Big Cottonwood Cr.	1	9	1	2	14 <sup>g,l</sup>	Smith 1986, IDFG 1987, Parker 1987
15-17 Dec 1987	JC	41	Little Jacks Cr.	SH	54	Big Cottonwood Cr.	3	6	0	1	10 <sup>g,m</sup>	Smith 1987, IDFG 1992a

Date <sup>a</sup>	Capture site			Release site			Adults		Lambs		Total	Source
	PMU <sup>b</sup>	Unit/ state	Location	PMU	Unit/ state	Location	M	F	M	F		
3-5 Feb 1988		BC	Chilcotin R. (Junction), Deer Park Ranch	JC	41	Big Jacks Cr.	0	10	3	1	14	Smith and Parker 1988 <sup>a,b</sup>
4-5 Mar 1988	OWY	42	E. Fork Owyhee R., Battle and Yatahoney Crs.	JC	41	Big Jacks Cr.	2	0	0	0	2	Bodie 1988, Oldenburg and Nellis 1989
14-15 Nov 1988	JC	41	Shoofly Cr.-Poison Cr.	SH	54	Big Cottonwood Cr.	5	8	0	1	14 <sup>n</sup>	IDFG 1988 <sup>a</sup> , Oldenburg and Nellis 1989
15-16 Nov 1988	JC	41	Shoofly Cr.-Poison Cr.		NV	Elko Co., N. Snowstorm Mts., S. Fork Little Humboldt R.	2	7	0	3	12 <sup>g,o</sup>	IDFG 1988 <sup>b</sup> , Oldenburg and Nellis 1989
29 Nov 1988	OWY	42	E. Fork Owyhee R., Yatahoney and Battle Crs.	JC	41	Duncan Cr.	6	13	3	2	24	Johnson 1988
6-7 Dec 1989	JC	41	Little Jacks Cr.	B-J	41	W. Fork Bruneau R.	2	8	1	1	12	IDFG 1989 <sup>a</sup>
28-29 Nov 1990	OWY	42	E. Fork Owyhee R., Battle Cr.		ND	Killdeer Mts. WMA	5	16	1	1	23 <sup>g,p</sup>	IDFG 1990 <sup>b</sup> , NDGFD 1993, IDFG 1994, McKenzie 1996
29 Nov 1990	OWY	42	E. Fork Owyhee R.	B-J	41	W. Fork Bruneau R., Black Rock Crossing	1	9	4	2	16 <sup>g,q</sup>	Gebhards 1990, IDFG 1990 <sup>c</sup>
3-4 Dec 1991	OWY	42	E. Fork Owyhee R.		ND	Badlands	3	22	1	2	28 <sup>g</sup>	IDFG 1991 <sup>a</sup> , IDFG 1994
3-6 Dec 1991	OWY	42	E. Fork Owyhee R.		ND	Dutchman's Barn enclosure	2	6	1	1	10 <sup>g</sup>	IDFG 1991 <sup>a</sup> , McKenzie 1996
5-6 Dec 1991	OWY	42	E. Fork Owyhee R.	SH	54	E. Fork Dry Cr.	3	9	1	2	15 <sup>r</sup>	IDFG 1991 <sup>a</sup> , Smith et al. 1991
5-6 Dec 1991	OWY	42	E. Fork Owyhee R.		NV	Eureka Co., Sheep Cr. Range	3	16	2	0	21	IDFG 1991 <sup>a</sup>
6 Dec 1991	OWY	42	E. Fork Owyhee R.		NV	Washoe Co., Virginia Mts.	1	12	1	0	14 <sup>s,t</sup>	IDFG 1991 <sup>a,b</sup>
18-20 Dec 1993	OWY	42	E. Fork Owyhee R.		NV	Lander Co., Sheep Cr. Range, Battle Mt.	3	20	1	1	25	Johnson 1990(3), IDFG 1994, Cummings and Stevenson 1996
19 Dec 1993	OWY	42	E. Fork Owyhee R.	SH	54	Big Cottonwood Cr.	3	8	0	0	11 <sup>g,u</sup>	Johnson 1993 <sup>a</sup> ; IDFG 1993, 1994
19-21 Dec 1993	OWY	42	E. Fork Owyhee R.	SH	54	E. Fork Dry Cr.	1	7	1	1	10 <sup>g,v</sup>	Johnson 1993 <sup>a</sup> ; IDFG 1993, 1994
20-21 Dec 1993	OWY	42	E. Fork Owyhee R.		OR	Deschutes R.	6	25	2	2	35 <sup>g,w</sup>	Hunter 1993, ODFW 1993, IDFG 1994
21-22 Dec 1993	OWY	42	E. Fork Owyhee R.	B-J	41	Bruneau R., Black Rock Pocket	1	11	0	0	8 <sup>g,x</sup>	Johnson 1993 <sup>b</sup> ; IDFG 1993, 1994
21-22 Dec 1993	OWY	42	E. Fork Owyhee R.	B-J	41	Jarbidge R., Dorsey Cr.	2	7	0	0	9 <sup>g,x</sup>	Johnson 1993 <sup>b</sup> ; IDFG 1993, 1994

Date <sup>a</sup>	Capture site			Release site			Adults		Lambs		Total	Source
	PMU <sup>b</sup>	Unit/ state	Location	PMU	Unit/ state	Location	M	F	M	F		
5-8 Feb 2000		OR	Aldrich Mt.	JS	55	Jim Sage Mt., Parks Cr.	1	9	0	0	10	ODFW 2000a, IDFG 2004a
6-8 Feb 2000		OR	John Day R., Thirtymile Cr.	JS	55	Jim Sage Mt., Parks Cr.	7	6	1	6	20 <sup>y</sup>	ODFW 2000b, IDFG 2004a
30 Jan-1 Feb 2001		OR	Hart Mt. NWR	JS	55	Jim Sage Mt., Parks Cr.	0	14	0	1	15 <sup>z</sup>	ODFW 2001, IDFG 2004a
8-9 Mar 2003	OWY	42	E. Fork Owyhee R.	JS	55	Albion Mts., Thunder Mt., Grape Cr.	1	5	0	0	6	IDFG 2003a, IDFG 2004a
8-9 Mar 2003	B-J	41	Bruneau R.	JS	55	Albion Mts., Thunder Mt., Grape Cr.	1	5	0	1	7 <sup>aa</sup>	IDFG 2003b, 2004a
30 Nov-1 Dec 2004		OR	Diablo Mt.	JS	55	Albion Mts., Little Cove Ranch	2	8	0	1	11	ODFW 2004a
2-3 Dec 2004		OR	Deschutes R.	JS	55	Albion Mts., Little Cove Ranch	1	3	0	0	4 <sup>bb</sup>	ODFW 2004b
14-16 Dec 2004		NV	Calico Mt., Leadville Canyon	JS	55	Albion Mts., Little Cove Ranch	3	16	1	0	20	IDFG 2004b

<sup>a</sup> Single dates represent capture or release dates. A range of dates represents capture through release, including multiple captures and releases.

<sup>b</sup> OWY = Owyhee River, JC = Jacks Creek, B-J = Bruneau-Jarbidge, SH = South Hills, JS = Jim Sage

<sup>c</sup> Three additional sheep (2 Ad F, 1 Ad M) died during capture (helicopter darting) operation and 1 additional Ad F escaped from the transport vehicle at the capture site (Hickey 1983a).

<sup>d</sup> Three additional Ad F died during capture (helicopter darting) and transport operations (IDFG 1981).

<sup>e</sup> Three additional sheep (2 Ad F, 1 juv M) died during capture (helicopter darting) operation (Hickey 1982a).

<sup>f</sup> Nevada Department of Wildlife unable to reach intended release site further south in Jarbidge Mountains. Includes 1 Ad F, 1 Ad M that died shortly after release (Oldenburg and Nellis 1984).

<sup>g</sup> Discrepancies in sex-age composition or total numbers among sources, data shown represents best-supported values.

<sup>h</sup> One additional Ad F died during capture (helicopter darting) operation (IDFG 1984a).

<sup>i</sup> Five additional sheep (3 Ad M, 2 Ad F) died during capture (helicopter darting) operation (IDFG 1985).

<sup>j</sup> Two additional sheep (unknown sex or age) died during capture operation (Scott 1985).

<sup>k</sup> Six additional sheep (5 Ad F, 1 juv M) died and 1 Ad M escaped (possible mortality due to net entanglement) during capture (drive net and helicopter net-gun) operation 16-19 Dec 1986 (Parker 1987). Big Cottonwood release included 1 sheep of unknown sex or age (Smith 1986).

<sup>l</sup> Two additional sheep (1 Ad F, 1 juv F) died during capture and transport operation (Smith 1987).

<sup>m</sup> Two additional sheep (1 Ad M, 1 Ad F) died during capture (helicopter net-gun) operation (IDFG 1988a).

<sup>n</sup> One additional Ad F died during capture operation (IDFG 1988b), NDOW records indicate only 12 sheep released (Cummings and Stevenson 1996), (2 Ad M, 7 Ad F, 3 juv F according to Oldenburg and Nellis 1989).

<sup>o</sup> Three additional sheep (1 Ad M, 1 juv M, 1 unknown) died during capture (helicopter net-gun) operation (Gebhards 1990, IDFG 1990b).

<sup>p</sup> One additional Ad F died during capture (helicopter net-gun) operation; 1 juv M originally intended for North Dakota was included in this release (IDFG 1990c).

<sup>q</sup> One additional Ad F died during transport (Smith et al. 1991).

<sup>r</sup> Three additional Ad F died during transport (IDFG 1991b).

<sup>s</sup> Seven additional sheep (unknown sex or age) died during the overall Dec 1991 capture (helicopter net-gun) operation (IDFG 1991b).

<sup>t</sup> One additional Ad F died during capture (helicopter net-gun) operation (Johnson 1993a).

<sup>v</sup> One additional Ad F died during capture (helicopter net-gun) operation (Johnson 1993a).

<sup>w</sup> One additional Ad F intended for Oregon was not transported (Hunter 1993), disposition unknown.

<sup>x</sup> Four sheep (unknown sex or age) not accounted for and likely died during transport. Capture records (Johnson 1993b) show 21 total sheep (3 Ad M, 16 Ad F, 2 juv F) captured for Jarbidge and Bruneau release sites, but only 17 were released (IDFG 1993, 1994).

- <sup>y</sup> One additional Ad M died during capture (helicopter net-gun) operation. Unclear whether 1 of released M was age 0.5 or 1.5 (included as Ad) (ODFW 2000*b*).
- <sup>z</sup> One additional Ad F died during capture (helicopter net-gun) operation. Sex of 2 released Ad not recorded (included here as F) (ODFW 2001).
- <sup>aa</sup> One additional Ad F died during capture (helicopter net-gun) operation (IDFG 2003*b*).
- <sup>bb</sup> One additional juv M died during capture (helicopter net-gun) operation (ODFW 2004*b*).



**Table 2.** Rocky Mountain bighorn sheep translocations, 1969-present.

Date <sup>a</sup>	Capture site			Release site			Adults		Lambs		Total	Source
	PMU <sup>b</sup>	Unit/ state	Location	PMU	Unit/ state	Location	M	F	M	F		
27 Apr 1969	MMS	36B	Morgan Cr.	LR	37	Mahogany Cr.	2	4	0	1	7 <sup>c</sup>	Morgan 1970
26 Aug 1970		AB	Banff NP, Panther Cr. Station	LR	37	Mahogany Cr.	5	19	0	0	24	Hickey 1983a
30-31 Jan 1975	P-S	28	Burnt Gulch	HC	18	Little Granite Cr.	1	8	2	0	11 <sup>d</sup>	Bodie 1975, Bodie and Hickey 1975, Hanna 1975, Hickey 1975
15 Jan 1976	P-S	28	Bacon Ranch	SB	58	Beaverhead Range, Long Canyon	1	3	1	1	6	Bodie 1976a
21-23 Jan 1976	P-S	28	Pretty Gulch	HC	18	Little Granite Cr.	5	7	2	1	15 <sup>e</sup>	Bodie 1976b
18 Jan 1978	P-S	28	Burnt Gulch	SB	58	Beaverhead Range, Long Canyon	2	7	0	2	11 <sup>f</sup>	Hickey 1978a,b
26-27 Jan 1978		WY	Whiskey Basin	LR	50	Elbow Canyon	3	10	2	2	17 <sup>g</sup>	Hockley and Hickey 1978
3-4 Jan 1979	P-S	28	Burnt Gulch		OR	Imnaha R., Cow Cr.	5	9	1	0	15	Stein 1979, Hickey 1983a
11-12 Jan 1979	P-S	28	Burnt Gulch	HC	18	Bernard Cr.	0	7	0	0	7	Hickey 1979, Hickey 1983a
21-23 Jan 1980		WY	Whiskey Mt., BLM Ridge	LR	50	Jaggles Canyon	2	6	2	1	11	Hickey 1980, Hickey and Hockley 1980
29 Dec 1981	P-S	28	Burnt Gulch	SB	58	Beaverhead Range, Bloom Canyon	2	8	1	3	14 <sup>h</sup>	Hickey and Parker 1982a
11 Jan 1982	P-S	28	Clear Cr.	SB	58	Beaverhead Range, Goddard Canyon	1	3	2	0	6	Hickey and Parker 1982a
11 Jan 1982	P-S	28	Pretty Gulch	SB	58	Beaverhead Range, Goddard Canyon	0	3	0	0	3	Hickey and Parker 1982a
14 Jan 1982	P-S	28	Clear Cr.	MMS	36B	Birch Cr., below Wood Cr.	2	3	0	3	8	Hickey and Parker 1982b
4-6 Jan 1983		WY	Whiskey Basin, Torrey Rim	SL	51	Lemhi Range, Badger Cr.	3	11	1	4	19 <sup>h</sup>	Hickey 1983a
5-6 Jan 1984		WY	Whiskey Basin, Torrey Rim	SL	51	Lemhi Range, Uncle Ike Cr.	3	12	3	4	22	Hickey 1984, IDFG 1986
7 Jan 1984		WY	Whiskey Basin, Torrey Rim	HC	11	Captain John Cr.	8	7	1	1	17	Hickey 1984, IDFG 1984b, Oldenburg and Nellis 1989
24 Jan 1984		OR	Lostline R.	P-S	21	Shoup bridge	3	7	3	3	16	Oldenburg and Nellis 1984, IDFG 1994
4-5 Feb 1984	P-S	28	Pretty Gulch		OR	Imnaha R., Hass Ridge/ Horse Cr.	3	8	0	0	11	IDFG 1984b, Oldenburg and Nellis 1984, IDFG 1994, Coggins et al. 1996
11-13 Dec 1984	P-S	28	Burnt Gulch		OR	Grande Ronde R., Wenaha WMA	5	5	0	1	11 <sup>g,i</sup>	IDFG 1986, Oldenburg and Nellis 1989, IDFG 1994, Coggins et al. 1996
27 Dec 1984	P-S	21	Cove Cr.		OR	Grande Ronde R., Wenaha WMA	1	10	3	2	16	IDFG 1994, Coggins et al. 1996

Date <sup>a</sup>	Capture site			Release site			Adults		Lambs		Total	Source
	PMU <sup>b</sup>	Unit/ state	Location	PMU	Unit/ state	Location	M	F	M	F		
10-14 Jan 1985		OR	Lostine R.	NB	30A	Beaverhead Range, Rocky Canyon	3	14	3	2	22	Coggins and Van Dyke 1985, IDFG 1990 <sup>a</sup>
16-17 Dec 1985	P-S	21	Ebenezer Bar		OR	Minam R.	2	9	1	0	12	Oldenburg and Nellis 1989, IDFG 1994
5-7 Jan 1986	OR		Lostine R.	NL	37A	Lemhi Range, Falls Cr.	4	11	1	2	18	Coggins and Parker 1986, IDFG 1986
18 Feb 1988	EFS	36A	E. Fork Salmon R.	NL	37A	Lemhi Range, Morse Cr.	3	9	1	0	13 <sup>j</sup>	IDFG 1988 <sup>c</sup>
19 Feb 1988	MMS	36B	Morgan Cr.	NB	30A	Beaverhead Range, Cedar Gulch	4	11	2	0	17	IDFG 1988 <sup>d</sup>
19 Feb 1988	MMS	36B	Morgan Cr.	MMS	28	Williams Cr.	2	4	0	0	6	IDFG 1988 <sup>e</sup>
15-17 Feb 1989	MMS	36B	Morgan Cr.	SEL	17	Tango Bar	5	8	1	1	15	Power 1989
15-16 Feb 1989	MMS	36B	Morgan Cr.	SEL	17	Elevator Mt.	2	12	0	0	14 <sup>k</sup>	Power 1989
16-17 Feb 1989	MMS	36B	Morgan Cr.	NL	37A	Lemhi Range, Falls Cr.	2	18	2	1	23	IDFG 1989 <sup>b</sup>
3-4 Jan 1990		WY	Whiskey Basin, Torrey Rim	HC	18	Three Cr.	6	18	4	2	30 <sup>l</sup>	IDFG 1991 <sup>c</sup>
6-7 Feb 1992	MMS	36B	Morgan Cr.		WY	Bighorn Mts., Shell Canyon	2	16	2	2	22 <sup>m</sup>	IDFG 1992 <sup>a,b</sup>
11-13 Dec 1997		BC	Spences Bridge	HC	13	Big Canyon Cr.	3	12	1 <sup>n</sup>	0	16 <sup>g</sup>	IDFG 1997 <sup>a,b</sup> ; 1998
10-13 Feb 1999		AB	Hinton, Cadomin mine	HC	13	Big Canyon Cr.	3	3	0	0	6 <sup>g</sup>	IDFG 1999, 2000
12-13 Feb 2002		MT	Missouri R., Havre	HC	18	Myers Cr.	4	16	0	0	20	IDFG 2002, 2003 <sup>c</sup>
5-9 Jan 2005		MT	Sun R., Willow Cr.	LR	37	Rock Springs Cr.	3	27	0	4	34 <sup>g</sup>	IDFG 2005
7-9 Jan 2005		MT	Sun R., Willow Cr.	LR	50	Cedar Cr.	1	23	1	3	28 <sup>g</sup>	IDFG 2005

<sup>a</sup> Single dates represent capture or release dates. A range of dates represents capture through release, including multiple captures and releases.

<sup>b</sup> HC = Hells Canyon, SEL = Selway, P-S = Panther-Main Salmon., NB = North Beaverhead, SB = South Beaverhead, NL = North Lemhi, SL = South Lemhi, LR = Lost River, EFS = East Fork Salmon, MMS = Middle Main Salmon.

<sup>c</sup> Three additional bighorns died during capture (helicopter drive-net) operation (Morgan 1970).

<sup>d</sup> Two additional Ad F died during capture (corral trap) and release operation (Bodie 1975); and 2 of the 8 released Ad F apparently died shortly after release (Bodie 1975, Hickey 1977).

<sup>e</sup> Six additional sheep (3 Ad F, 2 juv M, 1 juv F) died during transport (Bodie 1976<sup>b</sup>).

<sup>f</sup> One additional Ad F died shortly after release (Hickey 1978<sup>b</sup>).

<sup>g</sup> Discrepancies in sex-age composition or total numbers among sources, data shown represents best-supported values.

<sup>h</sup> Two additional Ad F died during capture operation (Hickey 1983<sup>a,b</sup>).

<sup>i</sup> Twelve sheep captured, but only 11 moved to OR (Parker 1985).

<sup>j</sup> One additional Ad F died during capture (helicopter net-gun) operation and 1 additional Ad F was injured and taken to Boise Zoo (IDFG 1988<sup>c</sup>).

<sup>k</sup> One additional Ad M died at release site (Power 1989); 2 additional sheep (1 Ad F, 1 juv F) died during capture (helicopter net-gun) operation (Scott 1989).

<sup>l</sup> One additional Ad F died during capture operation (IDFG 1991<sup>c</sup>).

<sup>m</sup> One additional Ad F died during capture operation (IDFG 1992<sup>a</sup>).

<sup>n</sup> This juv M died shortly after release (IDFG 1998).

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# APPENDIX C

## Live Animal Sampling Protocol

Samples from wildlife, especially big game animals, handled by IDFG personnel, should be collected to allow for surveillance of disease agents and detection of new pathogens. This document outlines the recommended samples to collect from various species with some general recommendations on sample handling and storage prior to shipment to the Wildlife Health Laboratory (WHL) for processing. This protocol may change as technology evolves and sampling and testing protocols change.

If possible, contact the WHL prior to capture of animals to discuss samples to be collected, handling and storage, and to obtain the needed supplies. Appropriate training of individuals collecting samples is important prior to collection of specimens to ensure optimal sample quality.

### Sample Collection and Handling

Blood samples are one of the most valuable specimens that can be collected from live animals. Samples should be collected by a clean venipuncture from the jugular vein or a peripheral vein. Blood should be collected into sterile glass tubes of the appropriate type for the samples to be submitted. Red-top tubes have no anticoagulant and allow the blood to clot. After centrifugation, the serum is harvested and transferred to a second tube. Purple- and green-top tubes contain anticoagulants to keep blood from clotting. If needed, plasma can be harvested and transferred to a second tube after centrifugation. Serum and plasma can be frozen once removed from the original tube. Purple-, green-, and royal blue-top tubes must be kept from freezing! All blood samples must be treated gently to prevent excessive rocking and resulting hemolysis.

Serum is used for serology tests for detection of antibodies, serum biochemistry analysis, pregnancy testing, and serum banking. Plasma from royal blue-top tubes is used for trace mineral analysis. Whole blood from purple-top tubes is used for complete blood counts and selenium analysis. Green-top tubes are used for collection of genetic material.

Parasites are often observed on animals; both external and internal. External parasites such as ticks, fleas, and lice should be removed and placed in 70% ethanol. Feces should be collected into a clean plastic bag or latex glove. Feces should be

removed directly from the rectum, using a glove, and the samples chilled or refrigerated.

Samples for microbiology (bacteria, viruses, and fungi) must be collected cleanly with a minimal contamination from other organs or the gastrointestinal (GI) tract. Swabs from the oropharyngeal or nasal areas are most commonly collected for culture of *Pasteurella* spp. Samples should be kept cool, but not frozen.

### Samples to collect

- Blood
  - ◆ Red top or red and gray top (serum) 2 10-ml tubes
  - ◆ Purple top (blood) 1 5-ml tube and
  - ◆ Royal blue top (serum) 1 7-ml tube
- Oropharyngeal swab (*Pasteurella*) using an oral speculum, placed into Port-a-Cul media tube
- Nasal and oropharyngeal swabs (*Mycoplasma*) placed into a Port-a-Cul or Mycoplasma broth tube
- Ear swab placed in whirl-pak bag
- Feces placed in whirl-pak bag or glove

### Treatment Recommendations

- Ivermectin (1 mg/ml): 2 ml per 100 lb., subcutaneous (SQ)
- Long acting tetracycline (200 mg/ml): 5 ml per 100 lb., SQ or intramuscular (IM)
- Vitamin E (300 mg/ml): 5 ml per animal, SQ
- BO-SE (5 mg/ml): 5 ml per animal, IM
- Clostridium 7-way vaccine: 2-5 ml per animal, IM

Other samples may be requested by collaborators or for additional information about individual or herd health. This protocol may change as technology evolves and sampling and testing protocols change.

# APPENDIX D

## Necropsy Protocol

Understanding that not all carcasses are accessible, dead bighorn sheep or portions of the carcass should undergo complete diagnostic testing, pending condition of the carcass. Carcasses should be as fresh as possible, but it is recognized that field conditions may cause significant autolysis in very short time periods. If the carcass is in reasonable post-mortem condition, it is important to collect and preserve specimens as soon as possible. If it is possible to retrieve the carcass whole, it should be submitted to a veterinary diagnostic laboratory for complete necropsy. If not, a field necropsy can be conducted.

Necropsy equipment will depend on the size and number of animals. At a minimum, a sharp knife, a sharpening stone or steel, a forceps, and a scissors are needed to conduct a necropsy. Specimen collection containers including wide mouth jars with 10% buffered formalin, whirl-pak bags, culture swabs, needles and syringes, blood tubes, large plastic (garbage) bags, and sealable plastic bags are needed. Personal protection equipment should include latex gloves and old clothes. Rubber boots that can be cleaned and disinfected, shoulder length sleeves, coveralls, facemask, and eye protection may be needed. A pencil, pen, paper, and indelible markers are also needed. A cooler with ice or ice packs is needed to initially chill specimens and for transport.

### Necropsy Process

Examine the carcass from head to toe or tail for evidence of wounds, trauma, discharges, or other abnormalities. Observe the immediate area for signs of struggling or interactions with other animals or humans.

Open the carcass along the ventral midline from the thoracic inlet to the groin. Cut ribs and shoulders as needed to allow access to major organ systems. Observe all internal organs on initially opening the carcass for anatomical position, color, texture, and obvious abnormalities.

Examine all internal organs in a systematic manner from the oral cavity to the anus. If you do not look, you will not find many problems or lesions. Organs to target include the oral cavity, trachea, lungs, heart and major blood vessels, kidneys, liver, reproductive tract, spleen, pancreas, GI tract, and possibly the brain.

When the necropsy is finished, the carcass remains must be discarded in a manner that will not endanger other animals in the vicinity. All tools and equipment must be cleaned and disinfected.

### Specimen Collection

The fresher and more complete the specimen, the more useful it is for diagnostic purposes. Freshly dead, chilled, whole carcasses are the most useful. Where this is not possible, collect the entire heart, lungs, and lower portion of the trachea (the “pluck”) for diagnosis of respiratory disease at a diagnostic laboratory. The head including the upper trachea, sinuses, and middle ears can also provide important information and should be collected or sampled if possible. Frozen specimens, blood, and pieces of tissue in formalin are less desirable, but very useful and may be the best way to provide specimens from the field to the laboratory. Highly decomposed or skeletonized specimens are not suitable for diagnostic purposes.

Blood samples are one of the most valuable specimens that can be collected from dead or live animals. Samples should be collected cleanly by venipuncture in living animals, or by severing the jugular vein, decapitation, or directly from the heart in freshly killed animals. Blood should be collected into sterile glass tubes of 2 types. The red-top tube is used to allow the blood to clot and the serum is removed for further analysis. A purple-top tube is used to keep blood from clotting. Blood samples, other than serum, must be kept from freezing!

Feces should be collected into a clean plastic bag or latex glove. Feces should be removed directly from the rectum and the samples chilled or refrigerated until submitted to the laboratory.

Samples for microbiology (bacteria, viruses, and fungi) must be collected cleanly with a minimal contamination from other organs or the GI tract. Swabs from individual organs or lesions as well as large pieces (2 x 2 x 2 inches) of the affected organ should be collected. The organ and the animal should be identified on each specimen container. Samples should be kept cool, but not frozen, until submitted to the laboratory.

Samples for histology must be fixed in 10% buffered formalin to prevent decomposition. The ideal



specimen is a thin, flat specimen (1/4 x 1 inch). Tissues from all major organs (heart, lung, liver, spleen, kidney) should be collected. In addition, tympanic bullae, ileocecal lymph node (LN), mesenteric LN, bronchial LN, and thymus should be collected. The ratio of tissue to formalin should be 1:10 and tissues should be left in the formalin for  $\geq 48$  hours. Specimens in formalin must not be frozen and do not require refrigeration.

Parasites are often observed during necropsy. Most parasites can be preserved in small amounts of 70% ethanol.

Liver samples should be collected for trace mineral analyses. Liver samples should be placed into plastic bags and refrigerated or frozen.

As dictated by gross necropsy and details of the history of the animal(s), additional samples may need to be collected and submitted to an appropriate laboratory. If needed, specific tissue samples (stomach contents, liver, or kidney) may be collected for toxicology. Specimens for toxins are difficult to collect as individual tests and specific organs are needed to accurately identify the numerous toxin agents that could be present. Each toxin has a specific test for its identification. The more information that can be provided, the shorter the list of potential toxins and the lower the cost of toxicological analysis. The best specimens for

toxicology are frozen organs and GI tract contents. Blood, liver, kidney, brain, fat, and stomach-intestinal contents can also be useful. Specimens should be placed in clean glass container or wrapped in aluminum foil prior to being placed in plastic containers or bags.

All specimens must be labeled with the species, age, sex, date, collector, and identity of the specimen. Indelible markers should be used to permanently identify specimens

After necropsy, the long term storage of samples is critical to retrospective studies, especially as new diagnostic techniques and new pathogens are found. There are no known national repositories for paraffin blocks. Tissue samples, including duplicate upper respiratory swabs, tonsil, and lung, should be frozen at  $-70^{\circ}\text{C}$ .

Other samples may be requested by collaborators or for additional information about individual or herd health. This necropsy protocol may change as technology evolves and sampling and testing protocols change.

# APPENDIX E

## Bighorn Sheep Capture Guidelines

### Purpose

Increasing public and scientific scrutiny of wildlife management requires that these programs be based on reliable data. Generating such data often requires capturing individual animals for evaluation, sampling, measuring, marking, or fitting a transmitter. Animals may also need to be captured and relocated or euthanized if they are in an area that poses a risk to themselves or to people. For bighorn sheep this includes contact with domestic sheep or goats.

### Potential Impact on Animal Subjects

When performed correctly, the capture, processing, and release procedure has minimal ill effects on the animal. Serious injuries are rare. In the event that an animal is seriously injured, it will be evaluated on-site. If it is determined that the animal will likely survive in the wild, it will be treated and released. Animals will be euthanized if the injury is such that the animal is unlikely to survive in the wild. Animals will be euthanized via a gun shot in the head (preferable), sodium pentobarbital injection, or exsanguination under anesthesia. Euthanized animals will be retrieved and submitted for necropsy when feasible.

Based on similar captures over the last 10 years, we anticipate an injury rate  $\leq 3\%$  and a mortality rate  $\leq 2\%$  when using net-guns fired from helicopters and an injury rate of  $\leq 5\%$  and a mortality rate  $\leq 5\%$  when darting animals from the ground. If injury or mortality rates exceed these expected values the operation will be reassessed to identify and fix problems. If this is not possible, the capture may be stopped.

### Description

Helicopter net-gunning, drop nets, drive nets, corral traps, and chemical immobilization are the common methods for capturing bighorn sheep (Foster 2005).

#### Helicopter Net-gunning

Net-guns will generally be used to capture bighorn sheep on winter ranges (Dec-Mar). Animals will be located from a helicopter and patiently herded to an area with gentle topography, favorable habitats

(little or no obstructing vegetation), and no apparent hazards. An individual will be separated from the group, and the helicopter will give chase. Chase times will not exceed 2 minutes and individual animals will not be chased repeatedly. Chase times during warmer weather ( $>50^{\circ}$  F) will be  $\leq 1$  minute.

Net guns will be fired from a helicopter at a range of  $\leq 10$  m from the animal. The net will be fired such that it drapes over the animal's head and it becomes entangled. Biologists or qualified contractors will immediately exit the helicopter to remove the net and secure the animal with hobbles and a blindfold. The animal will be processed at the capture site or transported via helicopter to a central processing location. Transport should take  $< 5$  minutes and the animal should be transported sternum down.

Processing, which includes evaluation, taking biological measurements and samples, collecting blood, inserting ear tags, and fitting a radio collar, should take less than 15 minutes.

Biologists will monitor the animal's heart rate, respiration, body temperature, and capillary refill at least every 5 minutes. If the animal shows signs of distress, such as markedly reduced heart rate or respiration, or 3-4 degree increase in body temperature when compared to average values (IDFG Wildlife Restraint Manual, page 117), it will be cooled with water and banamine or ringer's solution will be administered to reduce the stress response. Animals should then be released as quickly as possible.

When processing is complete, the blindfold and hobbles will be removed and the animal will be released. Animals will be observed until they regain their feet and move off under their own power (usually  $< 1$  min). They will also be observed periodically over the next 24-48 hours as feasible.

#### Chemical Immobilization

Biologists using chemical immobilization will have completed First Aid-CPR training, IDFG's Animal Handling and Restraint Course or Advanced Drug Training Course. Where possible a veterinarian will also be on site. When animals are being chemically immobilized using narcotics, relevant information will be provided to local hospitals prior to the capture operation.

Chemical immobilization is the capture technique most likely to be used when individual bighorn sheep are at risk of or do come into contact with domestic sheep and goats. Chemical immobilization can be effective, however bighorn sheep can be difficult to dart safely in field conditions. Both darting from the ground and from a helicopter are possible, although net-gunning is the preferred technique for capturing bighorn sheep from a helicopter. Ground darting works well for animals that allow a close approach. Procedures for locating, herding, and chasing animals from a helicopter will be identical to those for net-gunning. The preferred protocol for immobilizing bighorn sheep is to deliver 0.037 mg/kg carfentanil citrate (3 mg/ml) and 0.6 mg/kg of xylazine (450 mg/ml) via projectile dart. In urban areas or other situations where human safety is a concern, non-narcotic agents such as a combination of Telazol (tiletamine) or ketamine with xylazine may be used.

The dart should be delivered from within 25 m to a large muscle mass, usually the rump or back. Animals are typically immobilized within 3-8 minutes. Small teams (2), can secure the animal with a blindfold and hobbles. A sterile ophthalmic ointment will be placed in the eyes before animals are blindfolded. The dart wound will be treated with a broad spectrum antibiotic and the dart will be placed in a “sharps” container. Processing is similar to animals captured with a net-gun, except that 1 of the ear tags will be a “drug tag” that advises hunters to call IDFG to be sure that enough time has passed (30 days) for the immobilizing drugs to cycle out of the animal’s system, making the meat safe for consumption.

When processing is complete, the carfentanil will be reversed with naltrexone (50 mg/ml) at 100x the carfentanil dose and the xylazine will be reversed with 4.1 mg/kg of tolazoline (100 mg/ml). Approximately ½ of the naltrexone will be administered intravenous (IV) or IM and the remainder will be delivered SQ. Tolazoline will be administered IV or IM. Animals will be observed until they regain their feet and move off under their own power (usually 1-2 minutes). They will also be observed periodically over the next 24-48 hours as feasible.

Chemical immobilizing agents can cause respiratory depression and can reduce the ability to thermoregulate during the induction, handling and recovery period. Special attention should be paid to monitoring respiratory rate and temperature. If the

animal shows signs of distress, it will be cooled (see above) and the immobilizing agent will be reversed immediately and the animal will be released

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# APPENDIX F

## Bighorn Sheep Hunter Attitude Survey

Concurrent with the bighorn sheep planning effort, IDFG conducted a survey in fall 2008 to determine hunters' thoughts about multiple issues facing wildlife managers. We mailed 2,001 questionnaires as follows: 1,000 hunters who had not applied for sheep hunts in the past; 493 residents and 508 nonresidents who had applied for sheep hunts in the past. Hunters were randomly selected from IDFG databases based on the strata described above. The response rate (n = 750, 38%) was relatively low and no assessment of non-response bias was conducted. Additionally, the survey was made available on the IDFG website, which generated 593 responses.

Nine questions were directed towards capturing attitudes (strongly agree, agree, neutral, disagree, or strongly disagree) toward wild sheep management issues. To provide context for respondents, the survey included brief statements about 4 harvest management issues: timing of ram hunts, lifetime harvest limits, special-weapon hunts, and ewe harvest. Demographic information (residence, hunting application history) was derived from licensing data (mailed survey) or direct questions (on-line poll).

In general, hunters tended to support existing harvest management structure and procedures and responses

were similar among demographic groups (unless noted otherwise). A summary of results from the random mailed survey is included in the Harvest Management section and complete results are displayed below.

Respondents were supportive (62%) of the current practice of allowing a hunter to harvest 2 rams in a lifetime. However, support was more evenly split when asked if hunters should only be allowed to harvest only 1 ram in lifetime (41% agreed, 48% disagreed). Limiting hunters to only 1 tag per lifetime was not supported by 60% of hunters. Residents who had applied for sheep tags were most adamant about maintaining the current rules. Hunters opposed (60%) exchanging opportunity for increased hunt success during the rut.

Levels of support for providing special-weapon hunts, extending seasons because of forest fire closures, and ewe harvest were mixed, with no clear majorities. Most (54%) random-survey respondents supported moving the opening date of seasons from Aug 30 to Sep 15 to avoid most fire closures. However, this support was strongest for nonresident sheep tag applicants (66% agreed) and less so among Idaho hunters (~47% agreed). Support for allowing hunters impacted by fire closures to defer hunts to the following year was high (66%).

### Survey Results

Number of Survey Responses

Source	Residence	No. in pop.	No. mailed	% sampled	No. respond	% respond	No. refuse	% refuse
On-line	Res				480			
On-line	Nonres				113			
On-line, total	Total				593			
Mail, applied sheep	Res	2,161	493	22.8	264	53.5	3	0.6
Mail, applied sheep	Nonres	2,649	508	19.2	269	53.0	11	2.2
Mail, applied sheep, total	Total	4,810	1,001	20.8	533	53.2	14	1.4
Mail, not applied	Res	169,863	1,000	0.6	217	21.7	64	6.4
Mail, total	Total		2,001		750	37.5	78	3.9

**1. Current regulations for lifetime harvest in Idaho should be maintained (1 Rocky Mountain and 1 California bighorn ram). Percent by agreement level.**

Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	67	16	3	6	7	1
On-line	Nonres	113	46	17	5	16	16	0
On-line, total	Total	593	63	16	3	8	9	1
Mail, applied sheep	Res	264	51	23	3	10	12	0
Mail, applied sheep	Nonres	269	36	20	5	15	22	2
Mail, not applied	Res	217	28	27	12	21	11	0
Mail, total	Total	750	39	23	6	15	15	1

**2. Hunters should be allowed to harvest only one Idaho ram in a lifetime (either sub-species, Rocky Mountain or California). Percent by agreement level.**

Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	17	4	5	21	52	1
On-line	Nonres	113	36	13	5	16	29	0
On-line, total	Total	593	21	6	5	20	48	1
Mail, applied sheep	Res	264	17	12	7	19	44	1
Mail, applied sheep	Nonres	269	37	12	8	22	19	2
Mail, not applied	Res	217	27	19	15	23	15	1
Mail, total	Total	750	27	14	10	21	27	1

**3. Hunters should be allowed to draw only one Idaho ram tag in a lifetime (either sub species, Rocky Mountain or California). Percent by agreement level.**

Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	11	4	5	19	60	0
On-line	Nonres	113	27	10	8	22	34	0
On-line, total	Total	593	14	5	5	20	55	0
Mail, applied sheep	Res	264	9	5	8	26	51	1
Mail, applied sheep	Nonres	269	29	10	9	25	24	3
Mail, not applied	Res	217	16	15	15	29	24	2
Mail, total	Total	750	18	10	10	26	33	2

<b>4. I want to hunt sheep in the rut even if that means fewer tags are available.</b>								
Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	7	14	13	20	45	1
On-line	Nonres	113	10	16	18	23	32	2
On-line, total	Total	593	8	15	14	20	43	1
Mail, applied sheep	Res	264	10	11	16	26	36	1
Mail, applied sheep	Nonres	269	13	10	20	22	34	0
Mail, not applied	Res	217	7	13	17	32	30	0
Mail, total	Total	750	11	11	18	27	34	0

<b>5. I want IDFG to offer some special-weapon hunting opportunity. Percent by agreement level.</b>								
Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	21	16	11	10	41	1
On-line	Nonres	113	29	18	15	12	26	1
On-line, total	Total	593	23	17	12	10	38	1
Mail, applied sheep	Res	264	19	13	19	17	32	0
Mail, applied sheep	Nonres	269	21	19	13	19	28	0
Mail, not applied	Res	217	13	30	17	19	21	0
Mail, total	Total	750	18	20	16	19	27	0

<b>6. I support ewe hunts rather than moving sheep out of Idaho, if there is a need to control populations and in-state movement is not possible. Percent by agreement level.</b>								
Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	23	24	12	12	28	1
On-line	Nonres	113	17	19	15	16	32	2
On-line, total	Total	593	21	23	12	13	29	1
Mail, applied sheep	Res	264	22	27	14	20	18	0
Mail, applied sheep	Nonres	269	13	18	16	19	33	1
Mail, not applied	Res	217	35	38	12	7	8	0
Mail, total	Total	750	22	27	14	16	20	0

**7. (Option A) I support changing the early bighorn sheep hunting season to start September 15, to avoid the vast majority of fire-related access closures. Percent by agreement level.**

Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	15	21	15	19	30	1
On-line	Nonres	113	21	31	17	13	13	4
On-line, total	Total	593	16	23	15	18	27	2
Mail, applied sheep	Res	264	15	30	14	22	15	4
Mail, applied sheep	Nonres	269	23	43	13	10	8	3
Mail, not applied	Res	217	10	39	17	16	11	8
Mail, total	Total	750	16	37	14	16	11	5

**8. (Option B) I support allowing hunters to defer their hunt until the following year, if access is restricted by fire. Percent by agreement level.**

Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	21	27	9	15	27	1
On-line	Nonres	113	27	24	14	14	13	8
On-line, total	Total	593	22	26	10	15	24	3
Mail, applied sheep	Res	264	29	37	6	15	12	2
Mail, applied sheep	Nonres	269	25	42	10	9	8	6
Mail, not applied	Res	217	22	44	11	8	10	5
Mail, total	Total	750	26	41	9	11	10	4

**9. (Option C) I support extending early bighorn sheep hunting seasons into late October, even with the potential of fewer tags being available in subsequent years, if access is restricted by fire. Percent by agreement level.**

Source	Residence	Total	SA	A	N	D	SD	Blank
On-line	Res	480	7	33	14	19	26	1
On-line	Nonres	113	16	27	19	15	16	8
On-line, total	Total	593	8	32	15	18	24	3
Mail, applied sheep	Res	264	8	24	13	29	20	6
Mail, applied sheep	Nonres	269	13	26	14	25	16	6
Mail, not applied	Res	217	7	27	16	24	18	9
Mail, total	Total	750	10	25	14	26	18	7

## Demographic Questions

10. Are you a Resident of Idaho?			
	Total	Yes (%)	No (%)
On-line, Idaho	480	100	
On-line, nonresident	113		100
On-line, total	593	81	19
Mail, applied sheep	1001	49	51
Mail, not applied, resident	1000	100	
11. Have you hunted in Idaho before?			
	Total	Yes (%)	No (%)
On-line, Idaho	480	99	1
On-line, nonresident	113	81	19
On-line, total	593	96	4
12. Are you interested in hunting bighorn sheep in Idaho?			
	Total	Yes (%)	No (%)
On-line, Idaho	480	98	2
On-line, nonresident	113	96	3
On-line, total	593	97	2
13. Have you applied for a bighorn sheep tag in Idaho before?			
	Total	Yes (%)	No (%)
On-line, Idaho	480	64	36
On-line, nonresident	113	59	41
On-line, total	593	63	37
Mail, applied sheep	1001	100	
Mail, not applied, resident	1000		100
14. Have you drawn a bighorn sheep tag in Idaho before?			
	Total	Yes (%)	No (%)
On-line, Idaho	480	27	72
On-line, Nonresident	113	13	85
On-line, total	593	25	74
Mail, applied sheep	1001	8	92
Mail, not applied, resident	1000		100
15. Have you harvested a bighorn sheep in Idaho before?			
	Total	Yes (%)	No (%)
On-line, Idaho	480	20	80
On-line, nonresident	113	9	88
On-line, total	593	18	81
Mail, applied sheep	1001		
Mail, not applied, resident	1000	100	



# Survey Questions with Associated Background Information

## Bighorn Sheep Hunter Opinion Questionnaire

The Idaho Department of Fish and Game is revising the state's Bighorn Sheep Management Plan and is seeking the opinions of hunters to guide biologists in making recommendations for the new plan.

Changes in the applications rules, season dates and weapon types may affect drawing odds, tag numbers and success rates. The goal is to learn how hunters feel about these and other issues in bighorn sheep management.

### Changes being considered include:

- Limiting hunters to drawing only one tag, in a lifetime, to increase drawing odds.
- Limiting hunters to harvesting only one bighorn sheep in Idaho, in a lifetime, to increase drawing odds.
- Extending some hunts into November, to provide for a different type of hunting opportunity, with increased harvest rates, but with decreased drawing odds.
- Adding some primitive-weapon opportunity to provide for additional hunting opportunity and increased drawing odds.
- Allowing ewe harvest when populations need to be reduced.
- Modifying seasons to avoid conflicts with wildfire and associated area closures.

**Background:** Hunters are limited to harvesting 2 bighorn sheep rams in Idaho in a lifetime, as long as 1 is taken south of Interstate 84 (California subspecies) and the other is taken north of I-84 (Rocky Mountain subspecies). Hunters who do not harvest a sheep may reapply for a tag after a 2-year waiting period. Demand for sheep tags has risen significantly over the past 5-6 years, and overall chances to draw a tag have fallen from 10-11 percent to 7-8 percent for residents.

Each year, about 5 people draw a tag for their second lifetime opportunity to hunt sheep (of 84 tags available).

If the rules were changed so a hunter in Idaho could harvest only one sheep (Rocky Mountain or California) or draw only one sheep tag in a lifetime, regardless of success, the drawing odds for resident hunters would change as follows: Based on 2008

applicant and draw numbers, if those who have already harvested a sheep were removed, overall the chance of drawing a tag would increase from 7.7 percent to 8 percent; removing those who had previously drawn a bighorn sheep tag would increase the resident chance of drawing to 8.6 percent.

(1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree, 5=Strongly Disagree)

1. Current regulations for lifetime harvest in Idaho should be maintained (1 Rocky Mountain and 1 California bighorn ram).
2. Hunters should be allowed to harvest only 1 Idaho ram in a lifetime (either sub-species, Rocky Mountain or California).
3. Hunters should be allowed to draw only 1 Idaho ram tag in a lifetime (either sub species, Rocky Mountain or California).
4. Idaho's current management plan does not allow rams to be hunted in the rut (November). The majority of sheep hunts begin August 30 and end on October 8 or 13. Three late hunts run October 13 through October 31. If the seasons were extended into November, success rates would likely increase. Increased success rates would require a reduction in the number of tags offered and would reduce chances of drawing a tag.
5. I want to hunt sheep in the rut even if that means fewer tags are available.
6. All bighorn sheep hunts in Idaho are "any-weapon" hunts. Hunters can use a weapon other than a rifle if they desire. Hunter success rates for "any-weapon" hunts typically average 50-65 percent. It has been proposed to add special-weapon hunts (archery or muzzleloader only) for bighorn sheep. It is likely that harvest success rates would be lower during a special-weapon hunt; therefore more tags could be allocated. Additionally, it is anticipated that fewer hunters would apply for these special-weapon sheep hunts so the chance of drawing would be higher. This would also mean fewer tags would be offered for rifle hunts.
7. I want IDFG to offer some special-weapon hunting opportunity.

8. When bighorn sheep populations exceed habitat capacity, wildlife agencies typically reduce populations by either moving ewes to other areas (in or out of state) or establishing ewe hunts. Opportunities for moving bighorns within Idaho are limited.

9. I support ewe hunts rather than moving sheep out of Idaho, if there is a need to control populations and in-state movement is not possible.

7. 8. 9. Periodically, extensive wildfires can result in the U.S. Forest Service closing areas to human entry, which can affect access to bighorn sheep hunting early in the season. Most of these closures are generally lifted by mid-September. These options cover only cases where a fire has restricted access significantly. Potential options include:

**Option A.** Permanently shorten all the early bighorn sheep hunting seasons to start September 15, rather than August 30, which would still allow four weeks of hunting opportunity.

**Option B.** If a fire restricts access in one particular unit, allow hunters to defer their hunt until the following year.

**Option C.** If a fire restricts access in one particular unit, extend the early hunting seasons into late October, overlapping existing late hunting seasons, which could potentially cause hunter congestion, increased harvest and ultimately reduced tags in following years.

**7. (Option A)** I support changing the early bighorn sheep hunting season to start September 15, to avoid the vast majority of fire-related access closures.

**8. (Option B)** I support allowing hunters to defer their hunt until the following year, if access is restricted by fire.

**9. (Option C)** I support extending early bighorn sheep hunting seasons into late October, even with the potential of fewer tags being available in subsequent years, if access is restricted by fire.