

RAC AGENDA – September 2019

Revised August 27, 2019



- | | | |
|----|---|----------------------|
| 1. | Welcome, RAC Introductions and RAC Procedure
- RAC Chair | |
| 2. | Approval of Agenda and Minutes
- RAC Chair | ACTION |
| 3. | Wildlife Board Meeting Update
- RAC Chair | INFORMATIONAL |
| 4. | Regional Update
- DWR Regional Supervisor | INFORMATIONAL |
| 5. | Fishing Informational
- Craig Walker, Aquatics Section Assistant Chief | INFORMATIONAL |
| 6. | R657-59 Private Fish Ponds Rule Amendments
- Randy Oplinger, Coldwater Sportfish Coordinator | ACTION |
| 7. | Bighorn Sheep Unit Management Plans
-Jace Taylor, Bighorn Sheep/Mountain Goat Biologist | ACTION |

Region Specific Items – to be presented in the specified region only.

Meeting Locations

CR RAC – Sept. 3rd **6:30 PM**
Wildlife Resources CR Office
1115 N. Main Street, Springville

NR RAC – Sept. 4th **6:00 PM**
Brigham City Community Center
24 N. 300 W., Brigham City

SR RAC – Sept. 10th 7:00 PM
Hurricane Community Center
63 S. 100 W., Hurricane

SER RAC – Sept. 11th 6:30 PM
John Wesley Powell Museum
1765 E. Main Street, Green River

NER RAC – Sept. 12th 6:30 PM
Wildlife Resources NER Office
318 North Vernal Ave, Vernal

Board Meeting – October 3rd 9:00 AM
DNR - Boardroom
1594 W. North Temple
Salt Lake City, UT



GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

BRIAN C. STEED
Executive Director

Division of Wildlife Resources

MICHAL D. FOWLKS
Division Director

MEMORANDUM

Date: August 26, 2019

To: Regional Advisory Council Member and Wildlife Board

From: Randy Oplinger, Coldwater Sport Fisheries Program Coordinator

SUBJECT: Establishment of Aquaponics Rule under R657-59

The Utah Division of Wildlife Resources (UDWR) is proposing an amendment to the private fish ponds, short term fishing events, private fish stocking, and institutional aquaculture rule (R657-59) that would allow aquaponics facilities to operate without a certificate of registration (COR) provided:

- The aquaponics facility only raises fish for hobby purposes,
- The facility is indoor, receives water from a culinary source, and discharges water into a sewer or septic system,
- No fish leave the facility alive,
- All applicable fish health requirements are met when importing fish, and
- The species of fish raised is from the following list:
 - Bluegill
 - Hybrid Bluegill (Bluegill x Green Sunfish)
 - Green Sunfish
 - Redear Sunfish
 - Striped Bass
 - White Bass
 - Hybrid Striped Bass (Wiper)
 - Largemouth Bass
 - Smallmouth Bass
 - Channel Catfish
 - Fathead Minnow
 - Black Crappie
 - White Crappie
 - Rainbow Trout
 - Cutthroat Trout
 - Brown Trout
 - Brook Trout

- Tiger Trout
- Walleye
- Golden Shiner
- Yellow Perch
- All other species classified as non-controlled for possession and importation under R657-3

The proposed rule amendment provides criteria for when an aquaponics facility can operate without a COR. Facilities that do not meet these criteria will have the option to apply to the UDWR for a COR and may operate if a COR is granted.

R657. Natural Resources, Wildlife Resources.

R657-59. Private Fish Ponds, Short Term Fishing Events, Private Fish Stocking, and Institutional Aquaculture.

R657-59-1. Purpose and Authority.

(1) Under the authority of Sections 23-15-9 and 23-15-10 of the Utah Code, this rule provides the standards and procedures for:

- (a) private fish ponds;
- (b) short term fishing events;
- (c) [aquaponics facilities](#);
- (d) private fish stocking; and
- (e) institutional aquaculture.

(2)(a) This rule does not regulate fee fishing or private aquaculture as provided in Title 4, Chapter 37 of the Utah Code, and Department of Agriculture Rule R58-17.

(b) The display of aquatic wildlife in aquaria for personal, commercial, or educational purposes is regulated by R657-3.

(3) A person engaging in any activity provided in Subsection (1) must also comply with all requirements established by Title 4 of Utah Code and all rules promulgated by the Utah Department of Agriculture, including, but not limited to:

- (a) requirements for the importation of aquaculture products into Utah; and
- (b) requirements for fish health approval for aquaculture products.

(4) Any violation of, or failure to comply with, any provision of Title 23 of the Utah Code, this rule, or any specific requirement contained in a certificate of registration issued pursuant to this rule may be grounds for suspension of the certificate or denial of future certificates, as determined by the division.

R657-59-2. Definitions.

(1) Terms used in this rule are defined in Section 23-13-2.

(2) In addition:

(a) "Aquaculture" means the husbandry, production, harvest, and use of aquatic organisms under controlled, artificial conditions.

(b) "Aquaculture facility" means any facility used for the husbandry, production, harvest, and use of aquatic organisms under controlled, artificial conditions that holds a valid Certificate of Registration from the Utah Department of Agriculture.

(c)(i) "Aquaculture product" means privately purchased, domestically produced aquatic organisms, or their gametes.

(ii) "Aquaculture product" does not include aquatic wildlife obtained from the wild.

(d) ["Aquaponics facility" means a facility rearing aquatic animals for non-commercial purposes where:](#)

[\(i\) all water flowing into or through the facility is completely isolated from any other water source via a self-contained water transport system;](#)

[\(ii\) all water flowing from the facility is discarded into a permitted sewer or septic system;](#)

(iii) the aquatic animals held within the facility are used for hobby purposes only; and

(iv) no aquatic animals are transported from the facility alive.

(e) "Aquatic wildlife" for the purposes of this chapter are aquatic organisms that are conceived and born in public waters.

(f) "Certified sterile salmonid" means any salmonid fish or gamete that originates from a health certified source and is incapable of reproduction due to triploidy or hybridization, and is confirmed as sterile using the protocol described in R657-59-13.

(g) "FEMA" means Federal Emergency Management Administration.

(h)(i) "HUC" or "Hydrologic Unit Code" means a cataloging system developed by the US Geological Survey and the Natural Resource Conservation Service to identify watersheds in the United States.

(ii) HUCs are typically reported at the large river basin (6-digit HUC) or smaller watershed (11-digit and 14-digit HUC) scale.

(iii) HUC maps and other associated information are available at <http://water.usgs.gov/wsc/sub/1602.html>.

(i) "Institutional aquaculture" means aquaculture engaged in by any institution of higher learning, school, or other educational program, or public agency.

(j) "Ornamental aquatic animal species" means any species of fish, mollusk, or crustacean that is commonly cultured and sold in the United States' aquarium industry for display as defined in R657-3-4.

(k) "Private fish pond" means a body of water or any fish culture system which:

(A) is not located on a natural lake, natural flowing stream, or reservoir constructed on a natural stream channel;

(B) is contained entirely on privately owned land; and

(C) is used for holding or rearing fish for a private, noncommercial purpose.

(l) "Purchase" means to buy, or otherwise acquire or obtain through barter, exchange, or trade for pecuniary consideration or advantage.

(m) "Salmonid" means any fish belonging to the trout/salmon family.

(n) "Short-term fishing event" means any event where:

(i) privately acquired fish are held or confined for a period not to exceed ten days in a temporary structure or container;

(ii) for the purposes of providing fishing or recreational opportunity; and

(iii) no fee is charged as a requirement to fish.

(o) "Sterile" means the inability to reproduce.

**R657-59-3. Certificate of Registration Not Required – Private Fish Ponds[
and], Short Term Fishing Events, and Aquaponics Facilities.**

(1) A certificate of registration is not required to stock an aquatic animal in an aquaponics facility, provided:

(a) the aquatic animal meets health certification requirements from Department of Agriculture and Food; and

(b) the aquatic animals to be stocked belong to one of the following species:

[generate list].

(2) A certificate of registration is not required to receive and stock an aquaculture product in a private fish pond, provided:

(a) the private fish pond satisfies the screening requirements established in R657-59-10;

(b) if a screen is required, the aquaculture product received must be of sufficient size to be incapable of escaping the pond through or around the screen;

(c) the species, sub-species, and sterility of the aquaculture product received is authorized for stocking in the area where the private fish pond is located consistent with the requirements in R657-59-11;

(d) the aquaculture product is:

(i) delivered to the pond by a licensed aquaculture facility as defined in Title 4 Chapter 37 of Utah Code; or

(ii) the owner, lessee, or operator of the private pond:

(A) possesses documentation from the aquaculture facility verifying the information itemized in R657-59-6 and R58-17-14 during transport; and

(B) assumes legal responsibility for directly transporting the fish from the aquaculture facility to the private fish pond;

(e) the owner, lessee, or operator of the pond obtains from the aquaculture facility providing the aquaculture product a valid health approval number issued by the Utah Department of Agriculture and Food pursuant to Chapter 4 Title 37 of Utah Code; and

(f) the owner or operator of the private fish pond provides the aquaculture facility a signed written statement that the pond and aquaculture product received are in compliance with this section.

(~~2~~3) A certificate of registration is not required to receive and stock an aquaculture product in a short-term fishing event, provided:

(a) the temporary container or structure to be stocked is entirely separated from any public waterway or waterbody;

(b) the species, sub-species, and sterility of the aquaculture product received is authorized for stocking in the area where the short-term fishing event is located consistent with the requirements in R657-59-11;

(c) the aquaculture product is:

(i) delivered to the pond by a licensed aquaculture facility as defined in Chapter 4 Title 37 of Utah Code; or

(ii) the owner, lessee, or operator of the short-term fishing event:

(A) possesses documentation from the aquaculture facility verifying the information itemized in R657-59-6 and R58-17-14 during transport; and

(B) assumes legal responsibility for directly transporting the fish from the aquaculture facility to the short-term fishing event;

(d) the owner, lessee, or operator of the pond obtains from the aquaculture facility providing the aquaculture product a valid health approval number issued by the Utah Department of Agriculture and Food pursuant to Chapter 4 Title 37 of Utah Code; and

(e) the operator of the short-term fishing event provides the aquaculture facility a signed written statement that the short-term fishing event and aquaculture product received are in compliance with this section.

R657-59-12. Institutional Aquaculture.

(1)(a) A certificate of registration is required for any public agency, institution of higher learning, school, or educational program to engage in aquaculture.

(b) A certificate of registration is not required for any public agency, institution of higher learning, school, or educational program to engage in the hobby of aquaponics, so long as the aquaponics facility complies with the regulations in R657-59-3(1).

(2) Aquatic wildlife or aquaculture products produced by institutional aquaculture may not be:

(a) sold;

(b) stocked; or

(c) transferred into waters of the state unless specifically authorized by the certificate of registration.

(3) The fish health approval requirements of Title 4 Chapter 37 apply.

(4)(a) A certificate of registration for institutional aquaculture may be obtained by submitting an application to the division.

(b) A certificate of registration may be renewed by submitting an application prior to the expiration date of the current certificate of registration.

(c) The application may require up to 30 days for processing.

(d) The division may require a site inspection of the institutional aquaculture facility be performed to confirm compliance with the provisions found in this rule.

(e) The division may deny an application where:

(i) the application is incomplete, filled out incorrectly, or submitted without the appropriate fee;

(ii) operating the institutional aquaculture facility may violate any federal, state or local law or any agreement between the state and another party;

(iii) the application fails to demonstrate an ability to operate the aquaculture facility in a manner that protects Utah's wildlife, their habitats, and other aquaculture facilities from contamination; or

(iv) the applicant has violated any provision of Title 23, Utah Wildlife Resources Code, Administrative Code R657, a guidebook of the Wildlife Board, a certificate of registration, an order of the Wildlife Board, or any other law that bears a reasonable relationship to the applicant's ability to responsibly operate an institutional aquaculture facility.

(5) An application for a certificate of registration may not be denied without the review and consent of the division director or a designee.

(6) A certificate of registration for a institutional aquaculture may remain effective for up to 5 years from the date of issuance as identified on the certificate of registration, unless:

(a) amended by the division at the request of the certificate of registration holder;

(b) terminated or modified by the division pursuant to R657-59-13; or
(c) suspended by the division or a court pursuant to Section 23-19-9.

KEY: wildlife, aquaculture, fish

Date of Enactment or Last Substantive Amendment: March 13, 2017

Notice of Continuation: July 31, 2018

Authorizing, and Implemented or Interpreted Law: 23-15-9; 23-15-10



GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

BRIAN C. STEED
Executive Director

Division of Wildlife Resources

MICHAL D. FOWLKS
Division Director

MEMORANDUM

Date: August 23, 2019

To: Wildlife Board and Regional Advisory Council Members

From: Jace Taylor, Bighorn Sheep & Mountain Goat Biologist

Subject: Unit Management Plans for Bighorn Sheep

The current statewide management plan for bighorn sheep was approved in November 2018. In accordance with that plan, the Utah Division of Wildlife Resources (UDWR) has updated all bighorn sheep unit management plans that have been previously approved by the Wildlife Board, as well as drafted unit management plans for all bighorn sheep units that have not been previously presented. The UDWR will present the unit management plans that have not been previously presented. These units are:

- | | |
|--------------------------------|------------------------------|
| 1) Antelope Island | 10) Nine Mile |
| 2) Book Cliffs, South | 11) Oquirrh-Stansbury, West |
| 3) Box Elder, Newfoundland Mtn | 12) Pine Valley |
| 4) Box Elder, Pilot Mtn | 13) San Juan |
| 5) Central Mtns, Nebo | 14) San Rafael |
| 6) Fillmore, Oak Creek | 15) Uinta Mtns |
| 7) Henry Mtns | 16) Wasatch Mtns, Avintaquin |
| 8) Kaiparowits | 17) Wasatch Mtns, West |
| 9) La Sal, Potash/South Cisco | 18) Zion |

Below is a summary of the information included in each of the bighorn sheep unit management plans:

- 1) Background of bighorn sheep reintroductions and establishment within the unit.
- 2) Unit population objectives and current estimates of abundance.
- 3) Unit boundaries.
- 4) Issues and concerns specific to the bighorn herd within the unit.
- 5) Management objectives and strategies to address:
 - a. Population size
 - b. Disease
 - c. Habitat
 - d. Recreation

BIGHORN SHEEP UNIT MANAGEMENT PLAN
ANTELOPE ISLAND
August 2019

BOUNDARY DESCRIPTION

Davis County – Antelope Island State Park. Antelope Island State Park is approximately 26,880 acres with elevations ranging from 4,200 feet at the shore level to 6,596 feet at Frary Peak. It is the largest island in the Great Salt Lake ecosystem (Figure 1).

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Antelope Island bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Utah State Parks	9,555	94.1%
State Sovereign Land	492	4.9%
Bureau of Land Management	102	1.0%
Totals	10,149	100%

UNIT MANAGEMENT GOALS

In accordance with Utah Code 23-14-21, this population of bighorn sheep is to promote wildlife diversity on Antelope Island for recreational viewing, creating a source herd for transplants within Utah, and some hunting opportunity. This plan will guide future management decisions consistent with the Utah Statewide Bighorn Sheep Management Plan. Specific goals are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including recreational viewing and hunting.
- 2) Balance bighorn sheep management with other recreational uses in accordance to management goals of Antelope Island State Park.
- 3) Maintain a population that is sustainable within the available habitat to use as a source population for transplants to areas within the State of Utah.

HISTORY AND CURRENT STATUS

Bighorn sheep occurred historically on Antelope Island but were extirpated by the early 1900's. Bighorns were reintroduced to Antelope Island beginning in 1996 and the herd on the island was

very successful, growing to approximately 200 animals at its largest and providing over 250 animals to begin and augment three populations in Utah from 2001-2018. The bighorn sheep herd on Antelope Island experienced a disease outbreak in November of 2018. Extensive efforts by Utah Division of Wildlife Resources, Utah Wild Sheep Foundation, and Utah Division of Parks and Recreation to remove the infected herd was successful. Currently, monitoring efforts are continuing to document any sheep that may remain on the island. Future management actions to re-introduce bighorn sheep back to the island is scheduled for January 2020 from source populations of Rocky Mountain bighorn sheep located in Montana and New Mexico. As of August 2019, less than 10 sheep are estimated to be remaining on the island.

ISSUES AND CONCERNS

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of harmful pathogens to bighorns from social contact with domestic sheep (*Ovis aries*), domestic goats (*Capra aegagrus hircus*), or wild sheep that are harboring these pathogens (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from animals harboring harmful pathogens is the most important factor in maintaining overall herd health of this population.

In November of 2018, pneumonia was detected in this bighorn sheep population. The source of infection is unknown; however, it is speculated that the low water levels of the Great Salt Lake provided the opportunity for social interaction on either the north or south ends of Antelope Island. Private property adjacent to either end of the island had the potential to hold domestic animals that could harbor concerning pathogens. It is also possible that domestic sheep or goats were brought to the island as a recreational source (pack goats used for hiking), but there is a park rule that does not allow domestic animals other than horses and dogs on the island.

Antelope Island State Park is working to install a fence around the south end of the island. This will help prevent future bighorn movement off of the island and prevent further interactions between wild and domestic sheep. Current ownership of the most proximate private property north of Antelope Island does not have plans for domestic grazing so no actions to fence the north end of the island has been discussed.

Population management: The goal among management is to regulate population numbers and composition ratios at a healthy level. One hypothesis of why sheep left the island was the high ram ratios. Currently there are two ram permits issued for Antelope Island for harvest. Allowing only two permits per year can be difficult to maintain a lower ratio of rams on the island to prevent wandering. From collar data, it has been observed that

when rams are relocated, they tend to go exploring outside the area increasing the risk of exposure and infecting the new herd. Thus making transplants of rams unfeasible as an option for maintaining a healthy herd. Other options may include culling the herd or relocating male lambs as needed.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of 125 total Rocky Mountain bighorn sheep.
- 2) Strive to maintain a three-year average of under 50 rams per 100 ewes to reduce the risk of wandering rams.

Population Management Strategies:

Transplant Plan: Transplant(s) of wild bighorn sheep will be used to reestablish a sustainable herd on Antelope Island. The goal for the initial transplant will be a minimum of 40 Rocky Mountain bighorns. Bighorns will have a pretesting of diseases before relocation to Utah. If all goes well, scheduled release will be January of 2020 on the island.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine population status, ram-to-ewe ratios, and age plus quantity of rams. This population will likely require 4 hours to conduct and complete trend counts. Additional annual ground classification will be conducted to determine lamb recruitment. Initially, GPS collars will be deployed to monitor the health of the new herd and movements on the island.

Population Management: Per the 2016 Memo of Understanding between Utah Division of Parks & Recreation and Utah Division of Wildlife Resources, there will be an annual meeting every July to, “discuss big game management needs on Antelope Island and determine (if) ...permit numbers and season dates set forth in this Agreement require modification. The Parties will discuss big game population numbers, distribution, population objectives, habitat conditions, hunting success, public safety, wildlife projects to be funded by marketed revenue, and any other matters pertaining to maintaining healthy big game herds and habitat conditions on Antelope Island.”

This is a unique herd that lives in isolation and is managed as a multiple recreational state park throughout the year. Providing multiple recreational opportunities is a primary management goal for the state park thus hunting is currently limited to two permits a year at specific times. Management practices should be taken if the population exceeds objective and/or ram numbers are too high to reduce the risk of disease. Actions will be performed under the direction of UDWR in coordination with Antelope Island State Park management & staff.

Ideally it would be beneficial for population management if sheep permits could be flexible allowing more than 2 ram permits per year depending upon management needs.

This would reduce costs of population management actions and increase public opportunity to harvest a once in a lifetime sheep permit.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep
- 2) Increase education to park visitors of domestic animal restrictions
- 3) Install fence around south end of the island to help prevent bighorn sheep from contacting domestic livestock

Disease Management Strategies:

Disease Monitoring: The source herds used for establishing this population will be tested for concerning pathogens prior to release to ensure healthy source stock.

As a nursery herd for other locations throughout the state, sheep that are captured will be screened for pathogens prior to release.

As part of the population monitoring, visual assessment of sheep will be documented as ground and aerial surveys are performed. If anything appears wrong or in question, actions will move forward to test the population to determine if any disease exists within the herd. The Division of Wildlife Resources may perform periodic live captures to assess herd health.

Education: Work with Antelope Island management to insure information is available to the public about domestic animal restrictions and the risk posed to the bighorn sheep population. This topic will be included in the annual meeting between the two Divisions.

Spatial Separation: Antelope Island State Park will be installing a permanent high fence around the south end of the island to help reduce the risk of contact with domestic livestock. Wild sheep have the propensity to wander when population levels are too high or ram to ewe ratios are unhealthy. The fence will help reduce or eliminate the risk of contact between wild sheep and domestic livestock.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve bighorn sheep habitat to meet population management objectives.

Habitat Management Strategies:

Habitat Management: Antelope Island State Park has a wildlife biologist on staff that monitors and oversees land management practices on the island for wildlife. The DWR will assist park staff in monitoring bighorn habitat to detect changes in habitat quantity

and quality. Per the MOU, this will be a topic of discussion on how revenue funds generated by permit sales are used to improve habitat conditions on the island for bighorn sheep.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide quality hunting opportunities that help meet the population management objectives.
- 2) Increase public awareness of bighorn sheep and viewing opportunities.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations are made in accordance with the Utah Bighorn Sheep Statewide Management Plan and State Parks rules and regulations. A bighorn hunt will be re-instated when there is a healthy surplus of harvestable rams in accordance to population management objectives.

Non-Consumptive Uses: The DWR will work with park staff to increase public awareness and education of bighorn sheep through public outreach.

LITERATURE CITED

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Figure 1. Modeled suitable bighorn sheep habitat on the Antelope Island bighorn sheep unit.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
BOOK CLIFFS, SOUTH (RATTLESNAKE) WMU #10
August 2019

BOUNDARY DESCRIPTION

Emery, Grand and Uintah counties--Boundary begins at the Utah-Colorado state line and the summit and drainage divide of the Book Cliffs; west along this summit and drainage divide to Diamond Ridge; southwest along Diamond Ridge and the Book Cliffs summit (north-south drainage divide) to the Uintah and Ouray Indian Reservation boundary (Hells Hole/head of Sego Canyon); west along this boundary to the Green River; south along this river to Swasey’s Boat Ramp and the Hastings Road; south on this road to SR-19; south and east on SR-19 to Exit 164 on I-70 near the town of Green River; east along I-70 to the Utah-Colorado state line; north along this state line to the summit and drainage divide of the Book Cliffs. EXCLUDES ALL NATIVE AMERICAN TRUST LAND WITHIN THE BOUNDARY. USGS 1:100,000 Maps: Huntington, Moab, Westwater. Boundary questions? Call the Price office, 435-613-3700.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Book Cliffs, South bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	319,419	85.4%
Utah State Institutional Trust Lands	43,675	11.7%
Private	10,528	2.8%
Utah Division of Wildlife Resources	544	0.1%
Tribal	26	<0.1%
State Sovereign Land	3	<0.1%
Totals	374,195	100%

UNIT MANAGEMENT GOALS

The Book Cliffs Rattlesnake Unit is located in east-central Utah in Grand County. It includes the lower elevations of the East Tavaputs Plateau just north of Interstate 70. It consists of relatively dry habitat more indicative of desert bighorn habitat in the state of Utah. The vast majority of the bighorn sheep reside within 2 miles of the Green River along the steep canyons draining in from the east (Figure 1). Occupied habitat also extends eastward approximately 20 miles near the town of Thompson. Most bighorns are found at elevations of 4,000 feet on the desert floor to

7,000 feet in the upper reaches of the canyons. Ram groups have been known to occasionally occupy elevations approaching 8500 feet during the summer months. The vast majority of the habitat is characterized by open grassy slopes with cheatgrass and native grasses with dispersed stands of greasewood, shadscale, and saltbush. Pinyon-Juniper stands begin to predominate at upper elevations and along north facing slopes with sagebrush being the primary browse species. Specific goals are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Bighorn sheep were established in the area in the early 1970's when the Ute Indian Tribe transplanted Rocky Mountain bighorns from Alberta and Wyoming on to the Uintah and Ouray Reservation north of the Rattlesnake Unit. This population established and bighorn sheep began dispersing on to BLM lands to the south. A hunt-able population on public lands was available by the mid 1980's. This population has slowly expanded over the past 30 years. The maximum number of counted bighorns was 235 in 2007 suggesting a population of 400 bighorn. The current population estimate is 230 bighorn sheep.

There is historic and current domestic sheep grazing on and near this unit. Domestic sheep and bighorn sheep likely comingled as the population established on this unit. There were two crucial conversions in the early 1990's that removed domestic sheep from the Rattlesnake and Floy allotments. These were both inside core bighorn use areas. In recent years, as the bighorn sheep population has expanded eastward there have been documented comingling with domestic sheep on winter allotments east of the town of Thompson. This could have significant population level impacts on this herd.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Book Cliffs, South unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Book Cliffs, South unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Manage for up to 450 bighorn sheep throughout suitable habitat west of Thompson, Utah. Bighorn sheep populations should not be allowed to expand east of Thompson to maintain separation between wild and domestic sheep. A population of 450 would be well below the recommended 1.3-1.9 bighorns /sq km (Van Dyke 1983); however if disease issues becomes a concern local densities may be reduced.

Population Management Strategies:

- 1) Conduct transplants on or off the unit as needed to meet population objectives as allowed by disease conditions in source and receiving herds.
- 2) Utilize ewe hunts as needed to target bighorn sheep inhabiting areas with a high potential for comingling with domestic sheep.
- 3) Ewe hunts could also be used as a tool to regulate overall population levels and localized bighorn sheep density issues if disease issues prevent transplants.

- 4) Conduct adequate disease sampling of bighorn sheep on the unit as needed to develop current disease profiles.

Population Monitoring Plan:

Continue aerial surveys of the unit every two years to monitor total population and herd composition. Approximately 12 to 16 hours of flight time are typically needed. Monitor survival, habitat use, and potential disease issues through continued radio telemetry studies on the unit. Conduct ground classification as conditions permit to obtain annual production estimates. This information is highly valuable as an indicator of population health and condition. All population data will be collected and submitted on standardized forms, including all GIS flight and collar data (waypoints, flight paths, etc.).

Trend Count and Classification Data

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
1991	90	55	19	17	19	11	89	100
1993	185	110	48	27	35	16	56	73
1995	135	82	33	22	27	3	67	81
1997	200	118	55	26	37	4	47	67
1999	310	187	87	43	57	22	49	65
2001	180	108	52	23	33	11	44	63
2003	185	111	54	24	33	10	44	61
2005	330	200	89	51	60	16	57	67
2007	400	235	113	44	78	25	39	69
2009	300	174	84	25	65	20	30	77
2011	300	181	101	26	54	17	26	53
2013	250	153	83	27	43	16	32	52
2016	209	138	78	20	40	11	26	51

Population Monitoring Plan:

Due to the current prevalence of bighorns infected with pathogens that contribute to respiratory disease, this herd is not suitable as a source population for transplants. Transplants to the unit may be necessary in future years to augment the existing herd or expand the population if spatial separation with domestic sheep can be ensured.

Predator Management:

The Book Cliffs Rattlesnake bighorn sheep unit is managed under a predator management plan. The unit is designated as a bighorn sheep protection area with a liberal cougar harvest quota and year-round cougar hunting season. Over the past 15 years, 15 total cougars have been harvested on the unit, 9 of which were by sport hunters and the remainder by Wildlife Services personnel.

Cougar harvest is difficult in bighorn sheep habitat as there are relatively few snow days for good tracking, extremely rough terrain, and low cougar densities.

If cougar predation on the unit is shown to have adverse impacts on bighorn sheep, cougar population control will be accomplished through established UDWR policy and procedures.

Research Needs:

- 1) Continued GPS collaring studies are needed to document survival, production, habitat use, and potential comingling with domestic sheep. This will also provide an avenue to collect blood and nasal swabs to maintain an accurate disease profile.
- 2) Document bighorn sheep use (or lack of use) of newly constructed guzzlers.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Book Cliffs, South unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. In 2014, 20 sheep were sampled on this and the adjacent Nine Mile, Gray Canyon unit. Sixty percent of these sheep showed exposure to *Mycoplasma*. An additional 20 sheep in this area were sampled in 2015 (of which 6 were from the Rattlesnake unit), these sheep showed a 90% exposure rate to *Mycoplasma*. There was also evidence of exposure to Parainfluenza and EHD. These findings will influence future management.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. The most likely bighorn dispersal areas will be eastward along the Book Cliffs to the Colorado border. There are 3 primary threats that challenge effective separation:

- 1) Farm flocks on private lands in the Green River Valley – Much of the land immediately adjacent to bighorn sheep habitat near the town of Green River is privately owned and managed for livestock grazing or row crops. Currently none of the landowners closest to bighorn sheep have domestic sheep. Great effort is needed to keep good relationships with landowners.
- 2) Cisco Allotment - This allotment is inside currently occupied bighorn sheep habitat. It includes the desert habitat east of the town of Thompson. Seventeen bighorn sheep were removed by DWR personnel in 2013 on this allotment as direct contact with domestic sheep was likely. While this allotment is 15 miles away from core high density bighorn sheep areas, radio collar studies have

documented that bighorns travel from these areas on to this domestic sheep allotment so there is a very high risk of disease transmission.

- 3) Cisco Mesa Allotment – This allotment is east of the Cisco Allotment and is 16 miles east of most occupied habitat and 33 miles from core use high density bighorn sheep habitat. However, radio telemetry studies have shown that at least one ram has traveled from core bighorn habitat to this allotment. Good bighorn sheep habitat is found on the northern portions of this allotment.

Outreach efforts should take place with private landowners, grazing permittees and BLM employees concerning domestic and wild sheep interactions. Active removal of bighorn sheep and domestics as outlined in UDWR GLN-33 is a priority in this unit

Risk Management and Response Plan:

Areas of greatest concern for dispersing bighorn sheep include all areas east of Thompson, UT along the Book Cliffs. Any bighorn sheep in these areas should be removed immediately. All wandering bighorn sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. The need to test wandering bighorn sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers and private landowners to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.

Current and Potential Bighorn Sheep Distribution:

Bighorn sheep densities are highest along the Green River Corridor from Nefertiti south to Tushar Canyon. Approximately 5 bighorn sheep/square mile were documented in this area when the population was at its peak. Lower densities of bighorn can be found east from Tushar Canyon to as far east as Nash Wash (Figure 1).

Potential Threats to Habitat:

- 1) Human disturbance can result in abandonment or degradation of bighorn habitat. Human use along the Green River is very high in the summer months. To date, no adverse effects to bighorn sheep have been documented by high river runner traffic during the summer months.
- 2) Some oil and gas leases have been approved on bighorn sheep habitat on the eastern portions of the unit near Crescent Junction. Most of the proposed and developed wells are in flat areas away from good bighorn habitat. There is, however, potential that these areas could be abandoned if disturbance is excessive.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Cooperate with the BLM to utilize controlled burns and/or mechanical treatments to remove conifer encroachment on open hillsides to increase and improve bighorn habitat across the unit.
- 3) Promote "let it burn" policies with BLM on all wildfires in bighorn sheep habitat when human safety and human structures are not at risk.
- 4) Identify specific habitat restoration projects to immediately benefit bighorn sheep. No specific projects have been identified. Much of this habitat is found in Wilderness Study Areas and will be difficult to initiate active habitat management.

Water Management Projects:

- 1) Work with the BLM, and private landowners to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
 - 1) Tushar Canyon to Crescent Canyon
- 3) Install new water developments or guzzlers in bighorn habitat where water may be scarce or lacking.
 - 1) Upper Horse Canyon
 - 2) Upper Tushar Canyon
 - 3) Floy Wash

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Book Cliffs, South unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2004	5	7.3	100%	-
2005	5	6.6	100%	4.5
2006	5	5.4	100%	4.8
2007	5	2.2	100%	5.0
2008	8	6.1	100%	3.9
2009	7	3.9	100%	4.7
2010	7	8.7	86%	4.2
2011	8	4.4	100%	4.9
2012	7	5.0	100%	5.0
2013	7	5.9	100%	4.4
2014	5	6	100%	5.0
2015	5	5.8	80%	4.2
2016	5	6.2	100%	4.6
2017	5	5.4	100%	4.8
2018	5	7.2	100%	5.0

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. This is a difficult task considering the remoteness of the habitat currently being used by the bighorn sheep herd. Significant viewing opportunities are available along the Hastings Road north of Green River.

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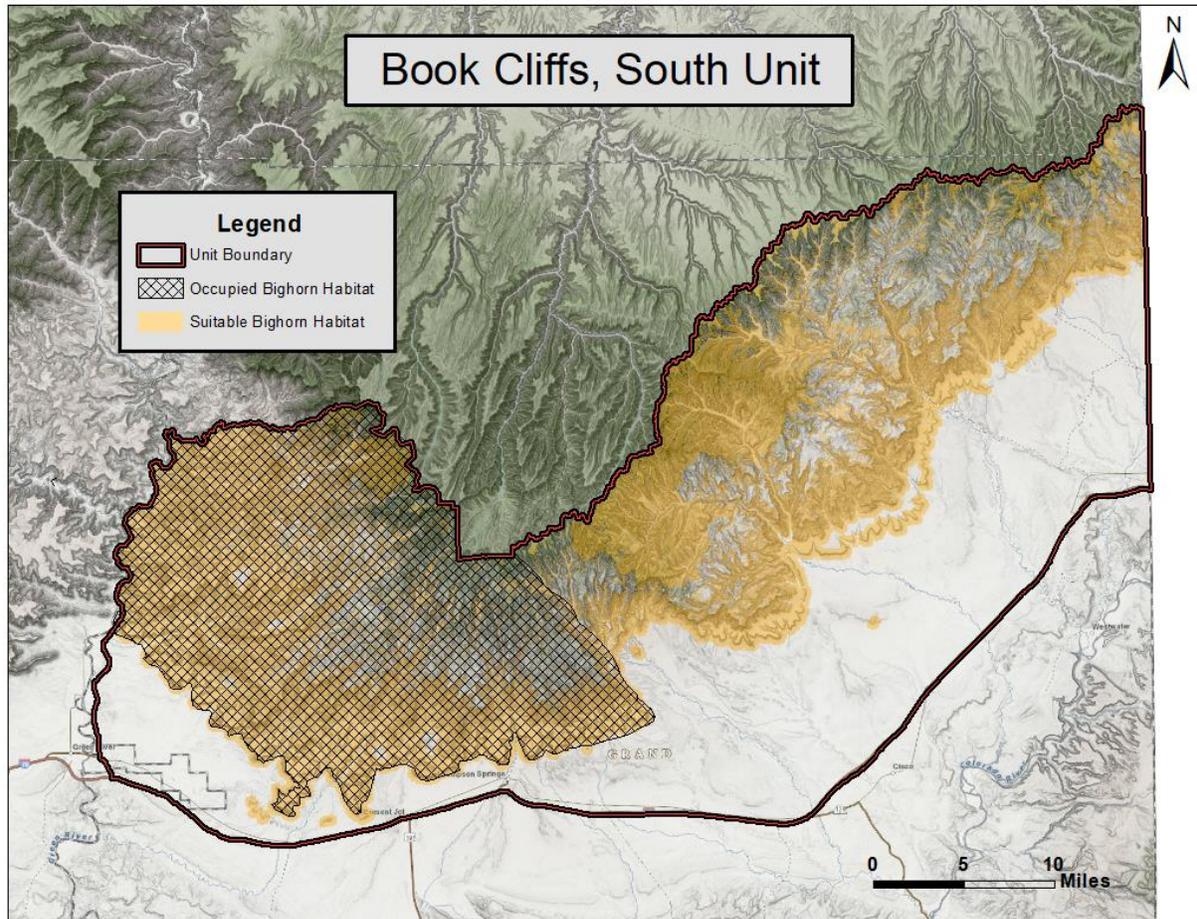


Figure 1. Book Cliffs, South unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
BOX ELDER, NEWFOUNDLAND MOUNTAIN
August 2019

BOUNDARY DESCRIPTION

Box Elder County—Boundary begins at I-80 and the township line separating R15 and R16 West; north on this township line to the township line separating T7 and T8 North; east on this township line to the township line separating R12 and R13 West; south on this township line to the Central Pacific railroad grade; east along this grade to the west shoreline of the Great Salt Lake; south and east along this shoreline to the east side of Stansbury Island and the Stansbury Island East Fork Road; south along this road to Stansbury Island Road; south along this road to I-80 (Exit 84); west on I-80 to the line separating R15 and R16 West. EXCLUDES ALL MILITARY INSTALLATIONS.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Box Elder, Newfoundland Mountain bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	67,388	63.5%
Department of Defense	17,693	16.7%
Private	11,402	10.7%
Utah State Institutional Trust Lands	9,620	9.1%
State Sovereign Land	3	<0.1%
Utah Division of Wildlife Resources	1	<0.1%
Totals	106,107	100%

UNIT MANAGEMENT GOALS

The Newfoundland Mountains subunit is located in south-central Box Elder County and northern Tooele county in north western Utah (Figure 1). This mountain range is approximately 80 air miles west and north of Salt Lake City. The range is an "island" in the middle of the salt flats to the west of Great Salt Lake. The majority of this area is playa or salt flat. The narrow, rugged, rocky range rises from the Great Salt Lake Desert at an elevation of 4,200 feet up to an elevation of 7,060 feet at Desert Peak. This plan will guide future management decisions consistent with the Utah Statewide Bighorn Sheep Management Plan. Specific goals are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized cattle grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Bighorn Sheep historically occupied the Newfoundland Mountains unit. However, they were extirpated from this area for unknown reasons. It is likely that disease and unregulated harvest may have played a role in the loss of bighorns from this area. Following the retirement of domestic sheep allotments on the Newfoundland Mountain Range, transplants of bighorn sheep to this portion of the unit began with 31 animals from Antelope Island, UT and Hart Mt, NV in 2001. Two additional transplants have occurred since that time totaling 34 additional bighorns.

Currently, the population is estimated to be approximately 313 bighorn sheep, all located on the Newfoundland Mountain Range. U.S. Military Lands are located on the southern tip of the subunit. Bighorn sheep are likely to continue using available habitat that includes some U.S. Military lands. As with management of other big game species within the exterior boundary, bighorn sheep management will be in accordance with the Cooperative Agreement between the U.S. Air Force through Hill Air Force Base and the State of Utah.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Newfoundland Mountains Unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the mountain range in suitable rugged locations (Figure 1).

Livestock Competition: Currently there is little to no grazing by domestic cattle or sheep on the Newfoundland Mountains Range where bighorns are found, and so competition with livestock is not a concern. Other portions of the unit not occupied by bighorns are grazed by domestic cattle and sheep. Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by

several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Newfoundland Mountains Unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services. If cougars are found on the Newfoundland mountain ranges they should be pursued aggressively as bighorn sheep would probably be their primary target. Currently there are few, if any, cougars in the areas occupied by bighorns within this unit.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of 300 - 350 total Rocky Mountain bighorn sheep.

Population Management Strategies:

Transplant Plan: There is potential to use the Newfoundland Mountains as a nursery herd. We have transplanted sheep from the Newfoundland Mountains to other areas of the state in the past. Given the difficulty in accessing the Newfoundland range, and the sensitive nature of acquiring air clearance in Department of Defense air space, it has proven to be difficult to capture and transplant sheep from this unit. It should still be considered, but it may prove to be more efficient to manage this unit with ewe hunts.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. This population will likely require 8 - 10 hours to conduct a complete trend count and survey adjacent areas to evaluate wild sheep

dispersal. Coordination with the Department of Defense will need to take place prior to all aerial surveys. Additional ground classification may be conducted as conditions permit. GPS collars with mortality signals are being used to document cause-specific mortality and identify annual survival estimates. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan.

Trend Count Classification Data

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2009	230	173	81	34	58	20	42	72
2012	283	193	78	42	73	43	54	94
2014	232	139	61	29	49	24	48	80
2016	263	158	62	43	53	8	69	85
2018	313	188	71	22	94	9	32	132

Predator Management: Predator management will be coordinated with USDA Wildlife Services. If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Newfoundland Mountain unit.
- 2) Maintain spatial separation from domestic sheep and goats as well as wild bighorns that are believed to be infected.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: Active domestic sheep allotments with domestic sheep will be evaluated for potential overlap with bighorn habitat. The DWR will delineate areas where there is high risk for domestic sheep and goats to come in contact with wild sheep or where wild sheep may stray and come in contact with domestics. These areas will be considered areas of concern. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. The need to test wandering sheep from this unit will

be evaluated on a case by case basis. The BLM and DWR will explore the possibility of using fencing to prevent comingling with trailing domestic sheep.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Improve habitat and water availability where possible. Suitable surface water is a limiting factor on the Newfoundland range and significant effort will be required to maintain sufficient water for a healthy bighorn herd.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with the BLM to utilize seeding, controlled burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and sympatric cattle are given priority.

Water Improvement: The DWR will work with the BLM and private stakeholders to locate and cooperatively modify or improve existing water sources or install new water developments across bighorn habitat.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Newfoundland Mountains range that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. This is a difficult task considering the remoteness of the habitat currently being used by the bighorn sheep herd.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the unit boundary or population objective are to be revised in the future, affected cooperating agencies, local stakeholders, and grazing permittees will be invited to take part in the decision-making process.

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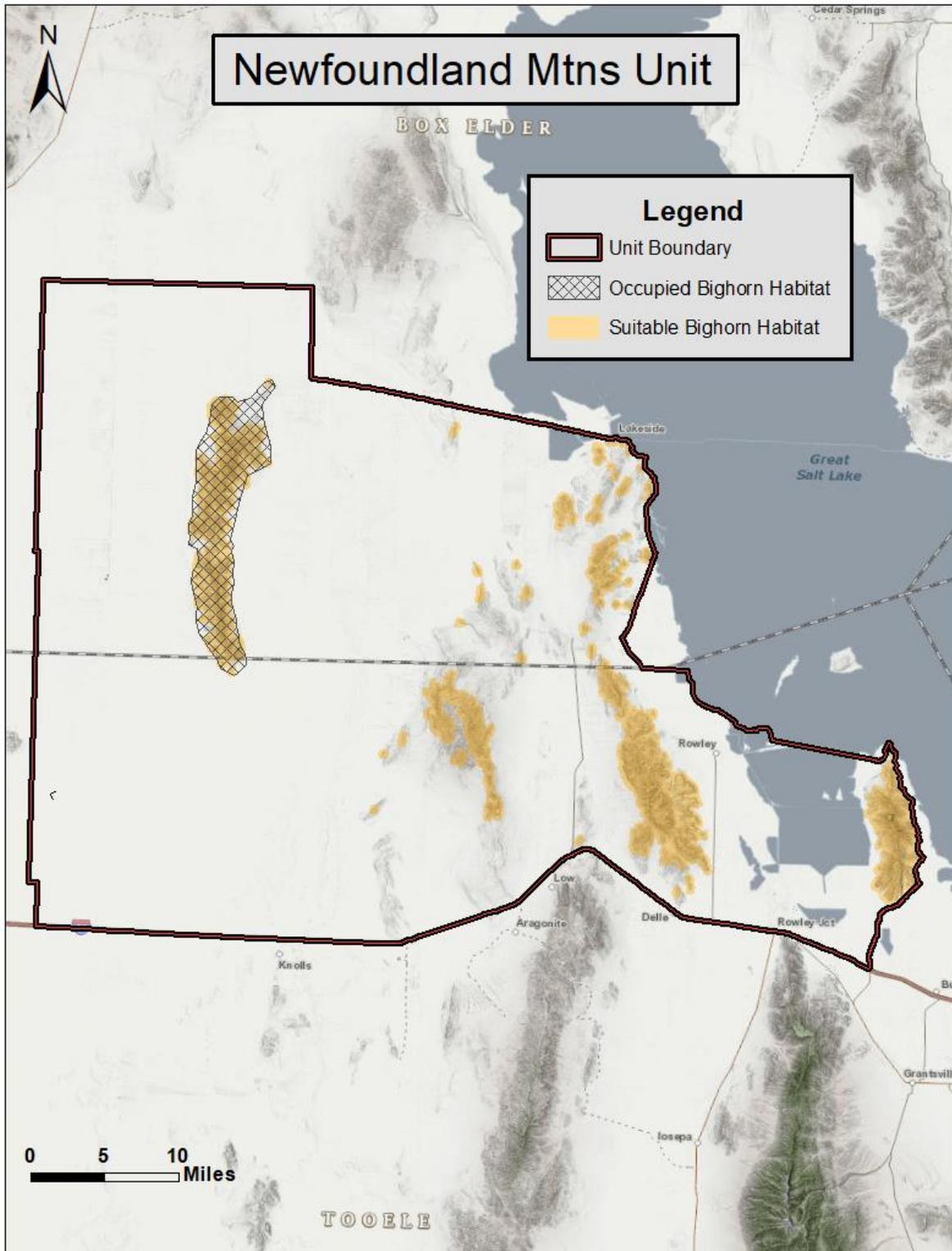


Figure 1. Box Elder, Newfoundland Mountain unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat. Box Elder and Tooele Counties, UT, USA.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
BOX ELDER, PILOT MOUNTAIN WMU #1
August 2019

BOUNDARY DESCRIPTION

Boundary begins at SR-30 and the Utah-Nevada state line; east on SR-30 to the township line separating Range 15 West and Range 16 West; south along this township line to I-80; then west on I-80 to the Utah-Nevada state line; north on this state line to SR-30. Hunters with this permit may hunt Nevada’s portion of this interstate unit (091).

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Antelope Island bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	72,892	85.6%
Private	6,312	7.4%
Utah State Institutional Trust Lands	5,544	6.5%
Utah State Parks	368	0.4%
Utah Department of Transportation	7	<0.1%
Totals	85,123	100%

UNIT MANAGEMENT GOALS

The Pilot Mountain unit is located north of Wendover on the Utah/Nevada state line (Figure 1). The hunt unit is managed together with Nevada. Bighorn sheep have been on the Pilot Mountain range since February 1987 when 20 bighorn sheep were released. Specific goals are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

The Utah Division of Wildlife Resources (DWR) and Nevada Department of Wildlife (NDOW) have both engaged in translocating Rocky Mountain bighorn sheep to the Pilot Mountain range starting as early as 1987. The DWR translocated a total of 58 bighorns to this unit between the

years 1987 and 1998. This bighorn herd grew to approximately 100 animals by 2010, but suffered from respiratory disease shortly thereafter and has fluctuated between 40 and 70 animals since that time. The herd continues to struggle with respiratory disease and as a result, experiences low lamb recruitment and an inability to increase in size. The herd currently occupies the southern portion of Pilot Mtn, the Leppy Hills, and the Silver Island Mtns.

This herd is regularly surveyed via helicopter in conjunction with NDOW with the most recent survey being performed in 2018. The current population estimate for the Pilot Mtn bighorn herd is 58 bighorn sheep.

Trend Count Classification Data

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2003	27	16	7	4	5	-	11	89
2005	8	5	2	2	1	-	100	50
2010	102	61	23	22	16	3	96	70
2011	52	31	14	0	17	9	0	121
2012	70	42	25	1	16	6	4	64
2013	65	39	27	2	10	4	7	37
2014	47	28	17	4	7	5	23	41
2016	40	24	13	1	10	10	8	77
2018	58	35	29	5	10	10	17	3

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Pilot Mountains using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the mountain range (Figure 1).

Livestock Competition: Interactions of bighorn sheep with domestic cattle and domestic sheep are anticipated seasonally. Dietary overlap between cattle and bighorns has not surfaced as a concern with other bighorn populations in the state and is not expected for the Pilot Mountain herd. Bighorn annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987), which also minimizes competition for water. Bighorn sheep have the ability to utilize metabolic water formed by oxidative metabolism, preformed water found in food, and surface water, including dew. The amount of surface water required by bighorns is dependent on many factors, including body size, activity, forage moisture content, temperature, and humidity (Monson and Sumner 1980). In hot, dry periods, bighorns will water daily if possible but

have remained independent of surface water for periods of 5-8 days (Blong and Pollard 1968, Turner and Boyd 1970, Turner 1973, Welles and Welles 1961, 1966). Across all seasons, bighorns drink on average every 10-14 days (Welles and Welles 1961). It has been reported, in extreme cases, that bighorns did not drink for a period of several months (Monson 1958, Mendoza 1976). Koplín (1960) found that a captive herd of bighorn sheep that were fed a dry ration and provided unlimited water drank an average of 4.9 liters (1.3 gal) per day.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Pathogens are known to be in this herd. The DWR is not looking to augment this herd until spatial separation with domestic sheep is solved.

Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off of their ranges or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns on the Pilot Mountains. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of 125 total Rocky Mountain bighorn sheep.

Population Management Strategies:

Transplant Plan: There are no plans to transplant bighorn sheep into the unit unless domestic sheep grazing is discontinued on the adjacent allotments and prevalence of infected individuals is significantly decreased. Likewise, this population is not suitable to be used as a source herd for transplants because of the high prevalence of infected individuals.

Monitoring: Monitoring of bighorn sheep will be conducted every 2 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. This population will likely require 8 hours to conduct a complete trend count and survey adjacent areas to evaluate wild sheep dispersal. Additional ground classification may be conducted as conditions permit. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan.

Predator Management: Cougars are likely to be the primary predator of bighorns in this unit. Pilot Mountain is part of a harvest object cougar unit. Very few cougars are harvested in this unit. Predator management will be coordinated with USDA Wildlife Services prior to bighorn release. If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of bighorn sheep on the Pilot Mountains range.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Spatial Separation: There are active domestic sheep allotments with domestic sheep in this unit boundary. The bighorn sheep have been in contact with pathogens and currently there are not efforts to introduce new bighorn sheep until domestic allotments are resolved. DWR is interested in voluntary actions by individual grazers that promote spatial separation.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.

- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects on the Pilot Mountains.
- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be considered on a case by case basis. The DWR will cooperate with the BLM to utilize seeding, controlled burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and sympatric cattle are given priority. Until there is no longer domestic sheep grazing lots there is not a high priority to do habitat projects for bighorn sheep. However, if projects come up that can help bighorn sheep and other wildlife species these will be considered. There are portions of Pilot Mountain that are susceptible to juniper encroachment. The majority of the Leppy Hills and Silver Island Mountains are susceptible to short fire cycles and cheat grass monocultures. Areas where habitat improvement projects would immediately improve bighorn habitat include Bettridge Canyon, Miner's Canyon, and Raven's Roost.

Water Improvement: The DWR will work with the BLM and private stakeholders to locate and cooperatively modify or improve existing water sources or install new water developments across bighorn habitat. Current waters that could be improved include Raven's Roost, Leppy Pass overflow tank, and the Silver Island guzzlers.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide quality hunting opportunities on the Pilot Mountains.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan and in conjunction with NDOW.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. Significant viewing opportunities exist at Leppy Pass and Miners Canyon.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the population objective or other key components of this plan are to be revised in the future, affected cooperating agencies, local stakeholders, and grazing permittees will be invited to take part in the decision-making process.

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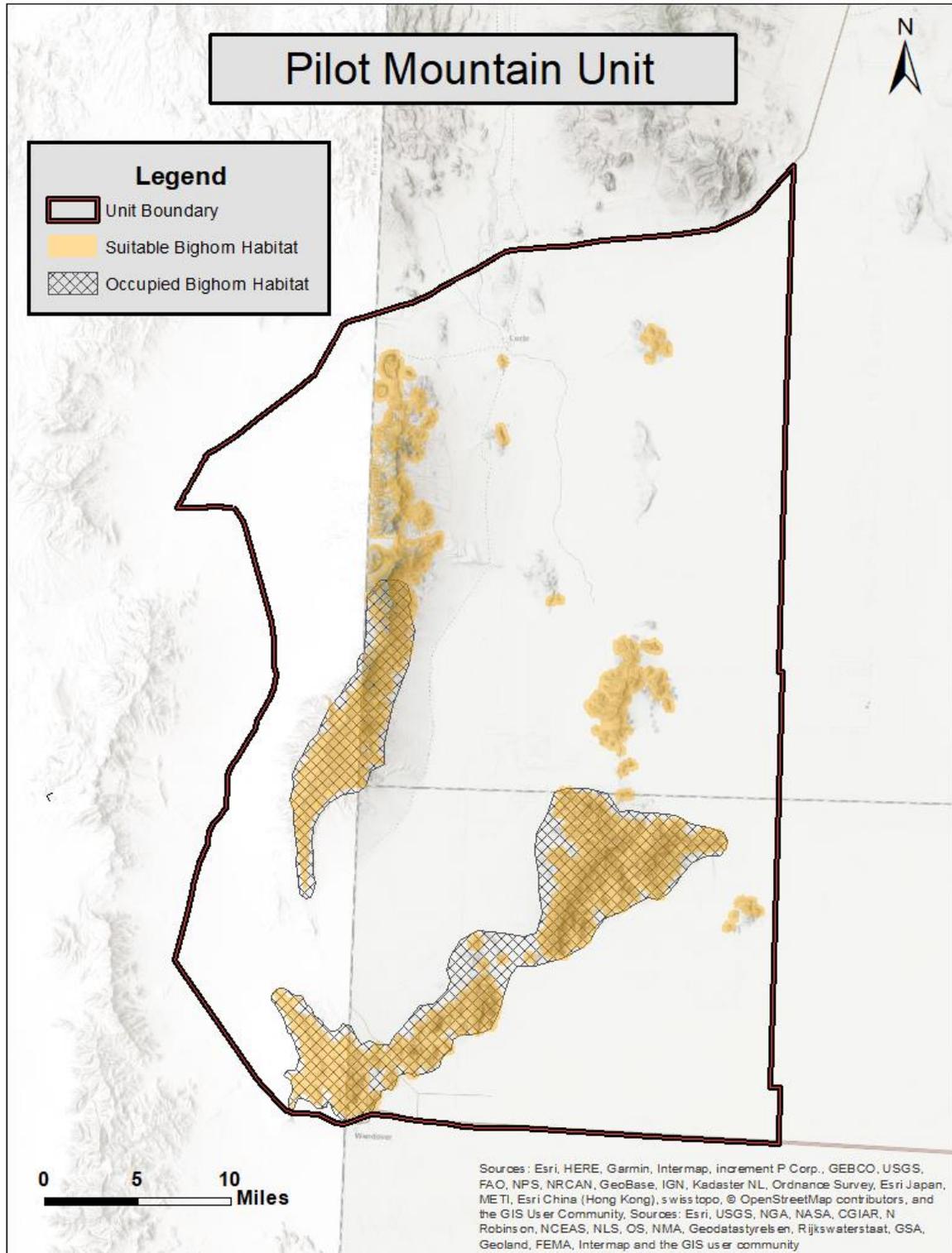


Figure 1. Box Elder, Pilot Mountain unit management boundary (including Nevada portion for hunting), modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

**BIGHORN SHEEP UNIT MANAGEMENT PLAN
CENTRAL MOUNTAINS, NEBO
August 2019**

BOUNDARY DESCRIPTION

Juab, Millard, Sanpete, Sevier and Utah counties—Boundary begins at US-6 and I-15 at Spanish Fork; southeast on US-6 to US-89 near Thistle; south on US-89 to US-50 at Salina; northwest on US-50 to I-15 at Scipio; north on I-15 to US-6 at Spanish Fork. Excludes all CWMUs. USGS 1:100,000 Maps: Maps: Delta, Manti, Nephi, Provo, Salina. Boundary questions? Call the Springville office, 801-491-5678.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Central Mountains, Nebo bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Private	88,254	29.3%
National Forest	81,512	27.1%
Tribal	49,832	16.6%
Bureau of Land Management	49,028	16.3%
Utah Division of Wildlife Resources	29,074	9.7%
Utah State Institutional Trust Lands	2,889	1.0%
Utah State Parks	442	0.1%
Totals	301,031	100%

HISTORY AND CURRENT STATUS

Bighorn sheep are native to Mount Nebo and existed on the mountain as late as 1927 (Dalton and Spillet 1971), but were finally extirpated. In a two-year period from 1981 to 1982 a total of 48 bighorn sheep from Whiskey Basin, WY were released into a fenced paddock on Mount Nebo. When lambs were born, the sheep were released from the enclosure and appeared to do well initially. However, the severe winters in 1983 and 1984, coupled with other factors, precipitated a steady decline. By 1987, five ewes were all that remained (Smith et al. 1988). In 2004, another attempt was made to restore Rocky Mountain bighorn to the Nebo unit with a transplant of 18 bighorns from Augusta, MT. A supplemental transplant of 25 bighorns from the same source herd was conducted in 2007. Since then, domestic sheep allotments have been converted to cattle

allotments, and mountain lion permits have been increased to reduce risk of disease and predation on bighorn sheep. However, domestic sheep have been observed with bighorns or in bighorn habitat multiple times (up to 6 times per year), and disease risk continues to threaten the persistence of this population (Shannon et al. 2008). Multiple disease events have been documented (Shannon et al. 2014), and the population typically hovers between 30 and 60 individuals.

ISSUES AND CONCERNS

Habitat: We modeled potential bighorn sheep habitat on the Central Mtns, Nebo unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit (Figure 1). Additional habitat exists in areas that have become dominated by old growth vegetation that have reduced value to bighorns. Fire would help return these areas into productive early successional stages and would allow bighorn sheep to expand their range throughout the Central Mtns, Nebo unit.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off of their ranges or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, mountain goats, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). Cougars are the main predator of bighorns on the Central Mtns, Nebo unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services. Predator reduction work already occurs on the unit in conjunction with livestock losses, and therefore any additional work that may be done would be mutually beneficial to both livestock and other big game species.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of 125 total Rocky Mountain bighorn sheep.

Population Management Strategies:

Transplants: Given the exposure of this herd to pneumonia related pathogens, it is not anticipated that transplants to or from this unit will occur unless repeated testing shows that the pathogens are cleared from the population. This is to protect naïve bighorns from being exposed to disease and to prevent disease outbreaks.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. This population will likely require 4-6 hours to conduct a complete trend count. Additional ground classification may be conducted as conditions permit. GPS collars with mortality signals may be used to document cause-specific mortality and identify annual survival estimates. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan.

Predator Management: Predator management will be coordinated with USDA Wildlife Services on an as-needed basis. If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Central Mtns, Nebo unit.
- 2) Maintain spatial separation from domestic sheep and goats as well as other bighorns thought to be infected.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: Active domestic sheep allotments and farm flocks with domestic sheep will be evaluated for potential of disease risk. The DWR may delineate areas where there is high risk for domestic sheep and goats to come in contact with wild sheep or where wild sheep may stray and come in contact with domestics. These areas will be considered areas of concern. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. Likewise, wandering domestic sheep or goats found near bighorn where not permitted may be removed in

accordance with DWR guidelines GLN-33. The need to test wandering sheep or domestics from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects on the Central Mtns, Nebo unit.
- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with land management agencies to utilize seeding, prescribed burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and other species are given priority.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Increase hunting opportunities while maintaining quality hunting experiences.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Permit recommendations will be made based on 12-25% of the counted ram population (yearling and older) or 30-60% of the counted rams 6 years of age or older. Hunting seasons will be recommended to provide maximum recreational opportunity while not imposing on UDWR management needs. Hunting may be used as a tool to regulate density of bighorn sheep to reduce risk of pathogen transmission. Size and age class of harvested rams will be monitored. Ewe hunts may be utilized as a tool for maintaining population objective.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

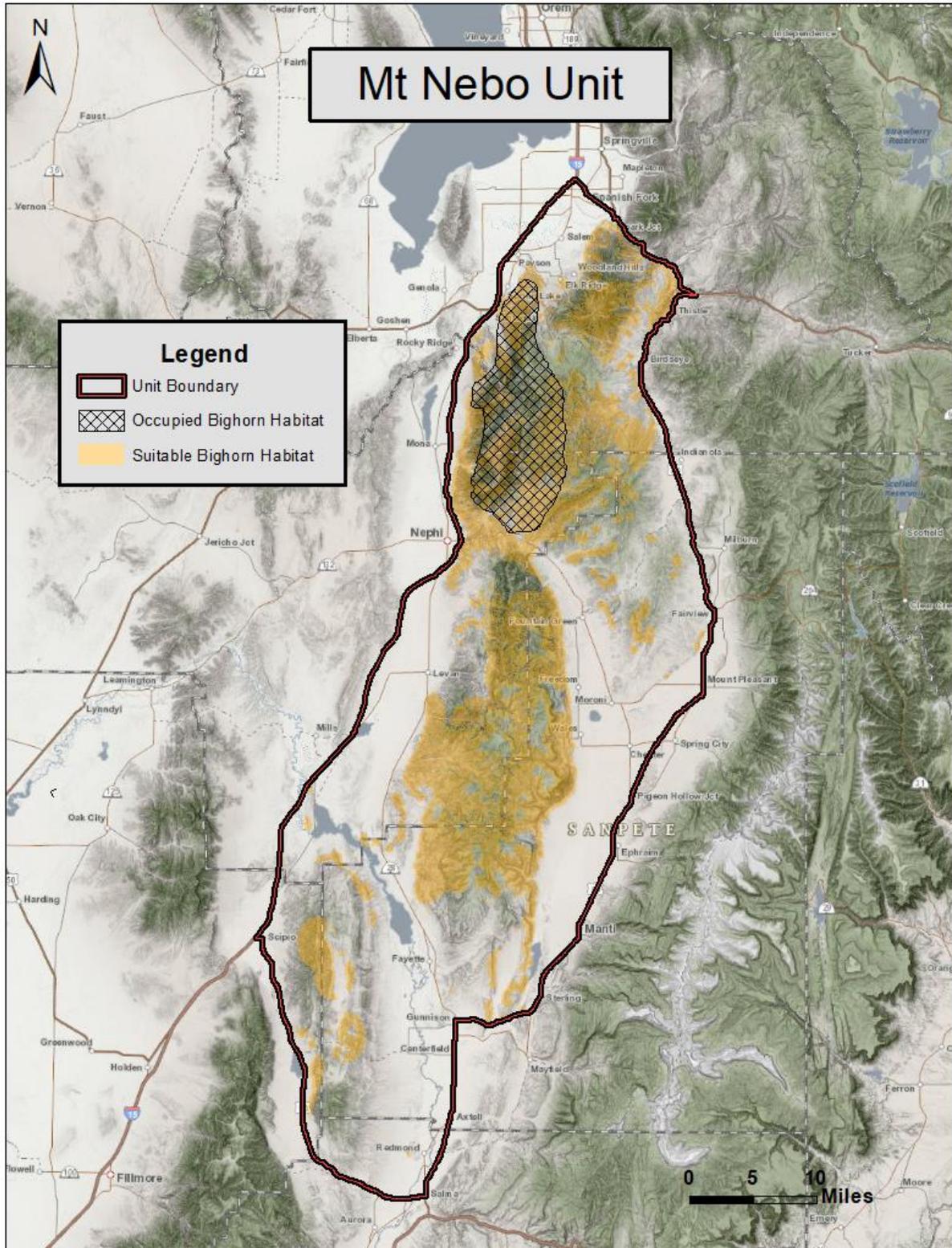
Plan Revision: If the population objective or unit boundary are to be revised in the future, the public will be allowed to be included in the decision making process through public RAC and board meetings.

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Figure 1. Central Mtns, Nebo bighorn sheep unit management unit boundary, suitable habitat, and occupied habitat. Juab, Millard, Sanpete, Sevier and Utah counties, UT, USA.



BIGHORN SHEEP UNIT MANAGEMENT PLAN
FILLMORE, OAK CREEK
August 2019

BOUNDARY DESCRIPTION

Juab, Millard, Sanpete, Sevier and Utah counties—Boundary begins at Black Rock Road and I-15(Exit 135); west on Black Rock Road to SR-257; north on SR-257 to US-6/50; east on US-6/50 to US-6; northeast on US-6 to Santaquin and I-15; south on I-15 to Exit 135 and Black Rock Road. Boundary questions? Call the Cedar City office, 435-865-6100.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Fillmore, Oak Creek bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	59,429	37.4%
National Forest	53,272	33.5%
Private	38,473	24.2%
Utah State Institutional Trust Lands	7,104	4.5%
Utah Division of Wildlife Resources	777	0.5%
Totals	159,055	100%

UNIT MANAGEMENT GOALS

The Oak Creek unit is located west of Scipio and east of Delta (Figure 1). Bighorn sheep were transplanted to the Oak Creek unit in an effort to reestablish sheep to their native ranges (Buechner 1960, Dalton and Spillet 1971) and promote wildlife diversity in the area for hunting and viewing. Bighorn were first transplanted to the unit in January 2014, with subsequent transplants in January 2015 and 2016. This plan will guide future management decisions consistent with the Utah Statewide Bighorn Sheep Management Plan. Specific goals are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized cattle grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Bighorn sheep are native to the Oak Creek Mountains (Dalton and Spillett 1971), but were finally extirpated. In January 2014, 33 sheep were transplanted from Antelope Island and the Newfoundland Mountains to the Oak Creek unit. Sixty-five more sheep were transplanted from Antelope Island to the Oak Creek unit in January 2015 and January 2016. The unit was last surveyed in November 2017 and resulted in a population estimate of 134 bighorns.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Fillmore, Oak Creek unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the mountain range (Figure 1). In 2012, the Clay Springs fire burned over 100,000 acres resulting in substantially improved bighorn sheep habitat. Additional habitat exists in other areas that have become dominated by old growth pinyon and juniper forests that have reduced value to bighorn. Aggressive habitat restoration efforts to return these areas into productive early successional stages will further expand bighorn sheep habitat throughout the Oak Creek unit.

Livestock Competition: Interactions of bighorn sheep with domestic cattle are anticipated seasonally. Dietary overlap between cattle and bighorns has not surfaced as a concern with other bighorn populations in the state and is not expected for the Oak Creek herd. Bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987).

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns on the Oak Creek

unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of up to 300 Rocky Mountain Bighorn Sheep within suitable habitat across the unit.

Population Management Strategies:

Transplant/Hunting Plan: If the population reaches or exceeds the population objective, management practices including transplants and ewe hunts may be incorporated to maintain the population at objective.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. Additional ground classification may be conducted as conditions permit. GPS and VHF collars with mortality signals will be used to document cause-specific mortality and identify annual survival estimates. Monitor radio collars at least 6 times per year. GPS collars may be added to the population as the original collars complete their usable lifespan. If conditions exist where disease concerns or other issues are evident, the population objective may be reduced to ensure population viability. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan.

Predator Management: A predator management plan is currently in place for this unit since populations levels are well below objective. If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of rocky mountain bighorn sheep on the Fillmore, Oak Creek unit.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: Manage for spatial separation between wild sheep and active domestic sheep allotments. The DWR will delineate areas where there is high risk for domestic sheep and goats to come in contact with wild sheep or where wild sheep may stray and come in contact with domestics. These areas will be considered areas of concern. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. The need to test wandering sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects.
- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality as well as identify and protect crucial bighorn sheep habitats.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with land management agencies to utilize seeding, controlled burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and sympatric cattle are given priority.

Water Improvement: The DWR will work with the USFS and private stakeholders to locate and cooperatively modify or improve existing water sources or install new water developments across bighorn habitat.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide high quality opportunities for hunting and viewing of bighorn sheep.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the population objective or other key components of this plan are to be revised in the future, affected cooperating agencies, local stakeholders, and grazing permittees will be invited to take part in the decision-making process.

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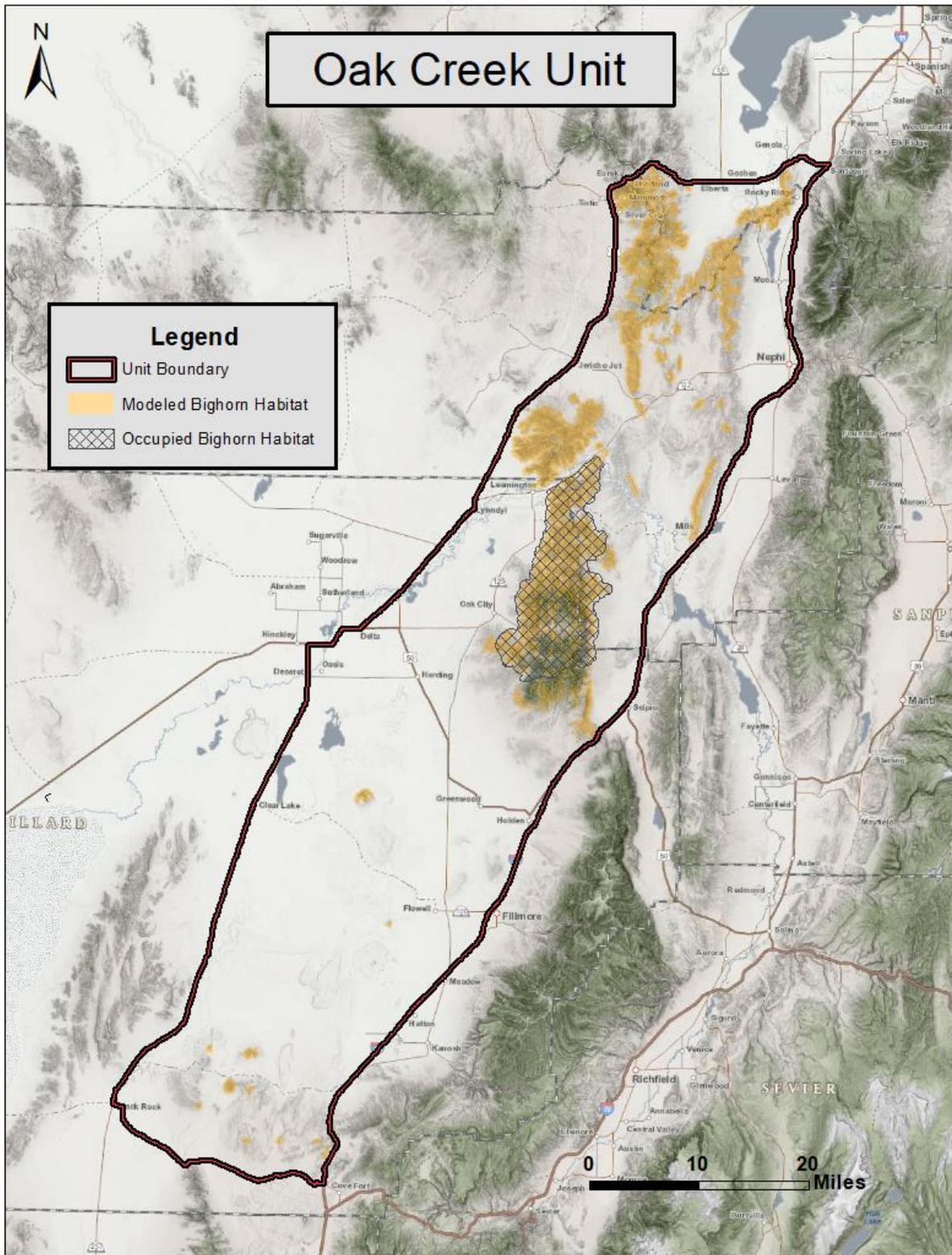


Figure 1. Fillmore, Oak Creek unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat. Millard and Juab Counties, UT, USA.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
HENRY MOUNTAINS WMU #15
August 2019

BOUNDARY DESCRIPTION

Garfield, Kane and Wayne counties--Boundary begins on SR-95 at a point two miles south of Hanksville; south on SR-95 to Lake Powell; south along the west shore of Lake Powell to SR-276 at Bullfrog; north on SR-276 to the Burr Trail-Notom road; north on this road to the Capitol Reef National Park boundary; north on this boundary to the Burr Trail-Notom road at The Narrows and Divide Canyon; north on this road to a point two miles south of SR-24; east along a line that is two miles south of SR-24 to SR-95. EXCLUDES ALL NATIONAL PARKS. USGS 1:100,000 Maps: Escalante, Hanksville, Hite Crossing, Loa. Boundary questions? Call the Price office, 435-613-3700.

LANDOWNERSHIP IN BIGHORN SHEEP HABITAT

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Henry Mountains bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	296,784	77.2%
National Parks	51,497	13.4%
Utah State Institutional Trust Lands	34,117	8.9%
Private	1,912	0.5%
State Sovereign Land	2	<0.1%
Totals	384,311	100%

UNIT MANAGEMENT GOALS

The Henry Mountains Wildlife Management Unit is in the high desert of southeastern Utah and is part of the Colorado Plateau. The unit reaches from the western banks of Lake Powell to the Burr trail road and eastern border of Capital Reef National Park with elevations from 3700 feet to 11500 feet. Desert bighorns are native to this area, were hunted by indigenous people, and have been noted by explorers from the 1700's and 1800's. Early residents of the area also saw bighorns into the 1900's. UDWR personnel saw two bighorn on Mt. Ellen in 1964 and 24 more in 1967 (BLM, Henry Mountain Desert Bighorn Habitat Management Plan). Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Desert bighorn sheep were first transplanted to the Henry Mountains unit in 1985 and the first hunt was held eleven years later in 2006 with three hunters afield. The highest count was recorded in 2016 with 92 sheep observed. Hunters have encountered coughing sheep and in 2017 a disease assessment was performed on the herd which indicated exposure to bacterial pneumonia. The most recent survey was performed in 2016 and the current estimate of abundance is 153 bighorn sheep. These bighorns occupy the Little Rockies, Trachyte, and eastern portion of Mt Hillers where habitat is suitable (Figure 1).

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Henry Mountains unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social structuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is

to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Henry Mountains. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Manage for a population objective of 200 desert bighorn sheep within suitable habitat across the unit. If this objective were achieved, wild sheep densities would be 0.08/sq km which is well below the recommended 1.3-1.9/sq km (Van Dyke 1983).

Population Management Strategies:

- 1) Monitor the bighorn sheep population using aerial surveys and GPS collared animals to assess population trends and health.
- 2) Augment the population as needed through transplant efforts matching disease profiles of the source herd with the resident herd.
- 3) Initiate predator management as specified in predator and bighorn sheep unit management plans. Wildlife Services or other contracted personnel may be needed in remote or hard to access areas to help reduce cougar numbers.
- 4) Document instances of interaction between wild sheep and domestic sheep and goats to allow conflicts to be evaluated and dealt with in a timely manner. Follow established guidelines for dealing with domestic sheep and goats that wander into bighorn sheep units.

Population Monitoring Plan:

- 1) Continue flight surveys on the unit on a three-year rotation in conjunction with the Dirty Devil unit.
- 2) This population will likely require 12 hours to conduct a complete trend count.
- 3) Conduct ground classification as conditions permit to obtain annual production estimates.
- 4) Monitor any GPS-collared bighorns to generate annual estimates of survival and when possible determine cause-specific mortality.
- 5) All population data will be collected and submitted on standardized forms, including all GIS data (waypoints, flight paths, etc.).

Trend and Classification Data:

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2008	90	54	30	3	21	10	10	70
2010	40	24	13	6	5	4	46	38
2012	105	63	25	13	25	12	52	100
2014	122	73	34	14	25	7	41	74
2016	153	92	46	14	32	7	30	70

Transplant Plan

- 1) This unit should be managed to increase the current population. Based upon the results of the population disease profile, augmentations may be warranted in the future to achieve population goals, improve genetic diversity, and expand herd distribution.
- 2) Favorable areas for transplants include Mount Hillers, Pennell, and Ellen, Tarantula Mesa, Clay Point, Clay Canyon, Granite Creek, Fourmile Canyon, and Bullfrog Creek below Eggnog.
- 3) If the population is above objective, it may be considered for a source population but is unlikely given its current population and disease status.
- 4) Predator management prior to transplants should occur and be coordinated with Wildlife Services.

Predator Management

- 1) The Henry Mountain unit is managed under a predator management plan and is a harvest objective unit.
- 2) If necessary, the Henry Mountains unit could be managed as a Bighorn Sheep Cougar Management Area with a Harvest Objective management strategy and no minimum harvest.
- 3) Over the last three years, the average amount of cougars killed per year on this unit is 4.
- 4) During a 2 year BYU bighorn research study on the North San Rafael unit, cougar predation has been shown to adversely impact the bighorn population. Fifty percent of collared bighorn sheep mortalities were attributed to cougar predation. Cougar populations should be managed at levels which will allow for the establishment of sustainable bighorn populations and allow bighorn population objectives to be met.
- 5) Managing cougars on this unit is difficult because of topography, remoteness, and access. Reasonable but aggressive efforts to harvest cougars and protect this big game herd are being taken and should continue along with the previously mentioned bighorn management strategies, coordination with Wildlife Services, and through established UDWR policy and procedures provided in the statewide bighorn sheep and cougar management plans.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of desert bighorn sheep on the Henry Mountains unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. A disease assessment was conducted in 2017 on this unit. A total of 15 female and 4 male bighorn sheep were sampled on the Henry Mountains for disease testing. The animals were captured at Hillers (4), North Wash (1), Peshliki (4), and Trachyte (10). This population is positive for *Mycoplasma ovipneumoniae*, which is considered an important pathogen in the bighorn sheep respiratory disease complex.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. One of the greatest disease risks posed to the Henry Mountains unit for desert bighorns is from escaped or wandering domestic sheep and goats from nearby "hobby farms" along SR276. Correspondingly the same risk is posed from desert bighorns wandering into domestic sheep and goat areas, being exposed, then returning to a bighorn herd. There is 1 BLM domestic sheep grazing allotments that challenges effective separation

- 1) Trachyte – This BLM allotment is directly adjacent to occupied wild sheep habitat. Currently this is only grazed by cattle which is supported; however sheep may be grazed under a previous BLM management plan.

Outreach efforts should take place with permittees and BLM employees concerning domestic and wild sheep interactions. To protect the Henry Mountain and Dirty Devil desert bighorn populations, active removal of bighorn sheep within or close to the Trachyte allotment should be a priority if domestic sheep are ever permitted on the Trachyte allotment.

Risk Management and Response Plan:

All wandering wild sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. Mapping of wild sheep removal zones for the Henry Mountain unit are included as an appendix to this guideline. The need to test wandering sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers to

protect these areas.

- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.
- 5) Work with land management agencies to implement agency guidelines for management of domestic sheep and goats in bighorn areas to minimize the risk of disease transmission.

Current and Potential Wild Sheep Distribution:

A map of the currently occupied habitat is included in Figure 1. Potential additional habitat includes Mount Hillers, Pennell, and Ellen, Tarantula Mesa, Clay Point, Clay Canyon, Fourmile Canyon, Granite Creek, and Bullfrog Creek below Egnog.

Potential Threats to Habitat:

- 1) Human disturbance including, vehicular off-road travel, natural resource extraction, organized competitive athletic events, and camping near springs and water sources can result in abandonment or degradation of bighorn habitat. Due to the rugged nature and lack of roads near sheep habitat, human disturbance of bighorn is lessened. If disturbance becomes an issue, UDWR will work with and support federal agencies (BLM, USFS) on travel management plans and other land use plans, and outreach efforts will be made as well to get local support to reduce human disturbance to bighorn sheep habitat
- 2) Severe and long-term drought has likely affected bighorn habitat ultimately impacting population trend and distribution on the unit.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Cooperate with the BLM and SITLA to utilize controlled burns and/or mechanical treatments to remove conifer encroachment and improve bighorn habitat across the unit.
- 3) Identify specific habitat restoration projects to benefit bighorn sheep

Water Management Projects:

- 1) Work with the BLM, SITLA, and permittees to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
- 3) Identify areas in otherwise favorable habitat where water developments/guzzlers would benefit desert bighorns by expanding their range, improving production, and possibly decrease drought related stressors.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Henry Mountains unit that are a quality experience.

- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

- 1) Recommend permit numbers based on 12-25% of the counted ram population (yearling and older) or 30-60% of the counted rams 6 years of age or older.
- 2) When feasible, use subunits and multiple seasons to maximize hunting opportunities, distribute hunters, and minimize hunter conflicts.
- 3) Recommend hunting seasons to provide maximum recreational opportunity while not imposing on DWR management needs.
- 4) Use hunting as a tool to regulate density of bighorn sheep to reduce risk of pathogen transmission.
- 5) Monitor size and age class of all harvested rams.
- 6) Work with federal land management agencies' local access coordinators to maintain and improve access for hunting and viewing of bighorn sheep. Explore seasonal openings, modified motorized boat rules, and administrative access for surveys or maintenance.
- 7) Explore providing a greater variety of hunting opportunities by utilizing more primitive weapons, variation in season length, and more variable season dates.
- 8) Use ewe hunts to establish lower densities that will reduce the risk of pathogen transmission as well as provide recreational opportunity.

10 Year Harvest Statistics

Year	Permits	Mean Days Hunted	Success	Satisfaction
2009	1	8.0	100%	5.0
2010	2	14.0	50%	4.5
2011	2	7.0	100%	5.0
2012	2	12.5	50%	2.5
2013	2	13.5	100%	4.5
2014	3	10.0	66.7%	4.0
2015	3	10.3	66.7%	3.7
2016	3	25.3	100%	2.3
2017	4	18.5	100%	4.3
2018	4	18.8	75%	4.5

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. This is a difficult task considering the remoteness of the habitat currently being used by the bighorn sheep herd. Significant viewing opportunities are available along the Hastings Road north of Green River.

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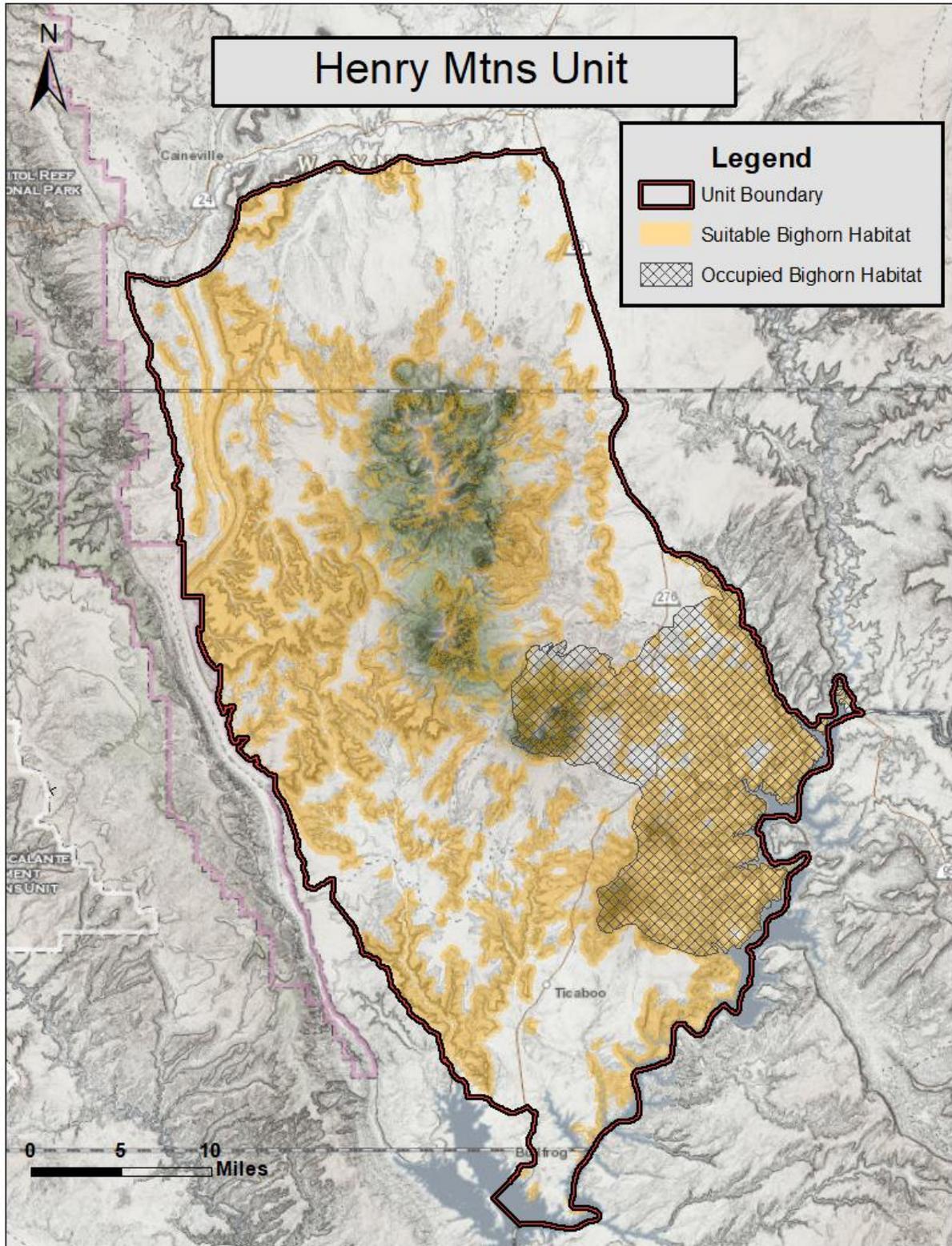


Figure 1. Henry Mountains unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
KAIPAROWITS WMU #26
East / West / Escalante
August 2019

BOUNDARY DESCRIPTIONS

Kane and Garfield Counties -

Kaiparowits, East - Boundary begins at the north shore of Lake Powell and the Utah-Arizona state line; west on this state line to US-89; north and west along US-89 to the Smoky Mountain road; north on this road to SR-12; east on SR-12 to the Hole-in-the-Rock road; southeast on this road to the north shore of Lake Powell; southwest along this shore to the Utah-Arizona state line.

Kaiparowits, West - Boundary begins at US-89 and the Utah-Arizona state line; west on this state line to the Cockscomb-House Rock Valley road; north on this road to US-89; west on US-89 to the Johnson Canyon road; north on this road to the Skutumpah road; northeast on this road to the Cottonwood Canyon road; north on this road to SR-12; east on SR-12 to the Smoky Mountain road; south on this road to US-89; southeast on US-89 to the Utah-Arizona state line.

Kaiparowits, Escalante - Boundary begins at SR-12 and the Burr Trail road in Boulder, Utah; southeast along the Burr Trail road to the north shore of Lake Powell; southwest along the north shore of Lake Powell to the Hole-in-the-Rock road; northwest along this road to SR-12; northeast along this road to the Burr Trail road in Boulder, Utah.

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the Kaiparowits bighorn sheep management sub-units.

Kaiparowits, East

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	257,910	68.4%
National Parks	118,600	31.4%
Utah State Institutional Trust Lands	570	0.2%
Private	159	<0.1%
State Sovereign Land	1	<0.1%
Totals	377,239	100%

Kaiparowits, West

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	489,244	94.3%
Utah State Institutional Trust Lands	9,008	1.7%
Private	8,104	1.6%
National Parks	6,069	1.2%
National Forest	4,329	0.8%
Utah State Parks	1,777	0.3%
Utah Division of Wildlife Resources	150	<0.1%
Totals	518,681	100%

Kaiparowits, Escalante

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
National Parks	246,069	64.7%
Bureau of Land Management	131,147	34.5%
Utah State Institutional Trust Lands	1,628	0.4%
Private	1,003	0.3%
National Forest	205	0.1%
Utah Department of Transportation	2	<0.1%
Totals	380,055	100%

UNIT MANAGEMENT GOALS

The Kaiparowits unit is located in south-central Utah and includes the Kaiparowits Plateau. Prominent features of the area are the Grand Staircase and the Escalante Canyons. Much of the area is administered by the Bureau of Land Management’s Grand Staircase Escalante National Monument (GSENM) whereas the National Park Service administers the Glen Canyon National Recreation Area. Lake Powell serves as the southern boundary for much of the unit where most bighorn sheep occupy the canyons along the lake shore (Figure 1). Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

This area includes historical accounts of large numbers of bighorn sheep prior to pioneer settlement. The first record of bighorn sheep documented in Utah was by Father Escalante in 1776, who reported bighorns were abundant along the Colorado River and the frequency of their tracks was comparable to large flocks of domestic sheep (Dalton and Spillet 1971). Since the general extirpation of bighorn sheep in Utah, the Utah Division of Wildlife Resources has restored many populations through an aggressive transplant program. The Kaiparowits unit was largely repopulated from desert bighorn herds in Arizona, Nevada and other sources in Utah (Appendix A).

The need to distribute hunters and provide additional hunting opportunities resulted in the creation of the 3 subunits: East, West, and Escalante (Figure 1). Hunters tended to focus on areas with greater access and areas in the East and Escalante units were not generating any harvest. Although these areas are referred to as separate populations, the subunits have extensive habitat connectivity. Past radio collar data suggests there are movements across much of this area and the riparian areas, particularly Escalante River, do not serve as barriers to movement.

Currently, populations are stable to increasing, especially in areas with recent transplants. Pathogens have been detected in these herds but substantial die offs have not been documented at this time. Since this area is remote and observations of sheep are often limited to aerial surveys, continued monitoring of GPS collared animals will assist in annual survival estimates and detection of any disease events. The creation of additional water sources may alleviate disease concerns by distributing sheep into lower densities and thus mitigate or reduce any negative impacts from disease transmission.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Kaiparowits unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the Utah Division of Wildlife Resources (DWR) to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Kaiparowits. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

1) Manage for up to 1,350 desert bighorn sheep across all subunits with the following distribution and densities:

- Kaiparowits, East: 400 bighorn sheep
- Kaiparowits, West: 550 bighorn sheep
- Kaiparowits, Escalante: 400 bighorn sheep

All population objectives are well below the recommended 1.9 bighorn sheep/square km (Van Dyke 1983). These objectives can be reasonably achieved at this time and populations should be evaluated for disease transmission prior to any further population objective increases.

Population Management Strategies:

There are two areas with potential for bighorn sheep expansion. These areas should be evaluated for potential disease issues and local support for bighorn sheep.

- 1) The Gulch: Boundary begins at the junction of SR 12 and the Burr Trail; north along SR 12 to the Garfield County line; east along this County line to the Capitol Reef National Park Boundary; south along the park boundary to the Burr Trail; west along the Burr Trail to SR 12.
 - This area already has dispersing sheep from either or both the Capitol Reef National Park and the Kaiparowits, Escalante populations. A regular survey of this area should be considered to evaluate occupancy in order to facilitate decisions on hunting opportunities and maintaining spatial separation.
 - Manage for no more than 50 bighorn sheep in this area to discourage substantial forays from this area.
 - If this area is occupied by a bighorn sheep population capable of sustaining harvest, consider inclusion into the Kaiparowits, Escalante hunt boundary.
 - The area to the north in Wayne County is not a suitable area for bighorn sheep due to its proximity to the infected bighorn sheep in Capitol Reef National Park. Wandering sheep should always be immediately removed to promote spatial separation and protect sheep populations within Capitol Reef National Park.
- 2) Box Death Hollow: Boundary begins at the junction of SR 12 and the North Creek Road; north along the North Creek Road to the Whites Flat USFS 152 road; east along this road to the Hells Backbone USFS rd 153; east and south to SR 12; west along SR 12 to the North Creek Road.
 - This area will continue to be evaluated for potential expansion and/or reintroduction. Source herds would have to consider disease and/or prior pathogen exposure.
 - If this area is found to be acceptable for bighorn sheep, population numbers should be kept low to promote separation between wild and domestic sheep.
 - Any sheep discovered in this area should be GPS collared if possible to determine movements within the area.

Population Monitoring Plan:

Monitor population size and composition alternating between the three subunits every 2-3 years by helicopter. The Kaiparowits East and West are typically flown together and the Kaiparowits Escalante is typically flown individually. Efforts should be made to ensure data can be separated and herd performance evaluated amongst subunits.

The Escalante unit will require approximately 35 hours of flight time. The Kaiparowits East and West will also collectively require approximately 35 hours of flight time. The Gulch area and areas north of Burr Trail within Capitol Reef National Park should be surveyed at least every 2-3

years to determine occupancy and will require approximately 15 hours of survey time. Box Death Hollow does not likely require aerial surveys at this time but may be completed opportunistically if conditions warrant.

Conduct ground classification as conditions permit. This data can be valuable in monitoring herd health and easily obtained in areas near Coyote Creek, Paria River, Tibbets Canyon, Wiregrass Canyon, and Smokey Mountain. A shoreline survey has also proven to be effective in Rock Creek and Dangling Rope.

Monitor bighorn sheep using GPS collars to obtain annual survival estimates and when possible cause-specific mortality.

All population data will be collected and submitted on standardized forms, including all GIS data (waypoints, flight paths, etc.).

Trend Count and Classification Data

Table 1. Summary of recent aerial trend counts and classification surveys on Kaiparowits East.

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Lambs/100 Ewes	Rams/100 Ewes
2003	63	38	20	11	7	55	35
2005	92	55	31	11	13	35	42
2007	45	27	11	7	9	64	82
2009	83	50	29	11	10	38	34
2011	140	84	39	22	23	56	59
2013	238	143	88	28	27	32	31
2018	370	222	113	49	60	43	53

Table 2. Summary of recent aerial trend counts and classification surveys on Kaiparowits West.

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Lambs/100 Ewes	Rams/100 Ewes
2003	75	45	18	13	14	72	78
2005	135	81	37	22	22	59	59
2007	128	77	32	19	26	59	81
2009	148	89	36	12	41	33	114
2011	193	116	64	19	33	30	52
2013	327	196	115	35	46	30	40
2018	437	262	126	40	96	32	76

Table 3. Summary of recent aerial trend counts and classification surveys on Kaiparowits Escalante.

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Lambs/100 Ewes	Rams/100 Ewes
2004	252	151	67	37	47	55	70
2006	165	99	47	22	30	47	64
2008	192	115	59	15	41	25	69
2010	145	87	45	11	30	24	67
2012	118	71	41	9	21	22	51
2014	153	92	51	18	23	35	45
2017	147	88	48	10	30	21	62

Transplant Plan:

This unit has vast amounts of unoccupied habitat and therefore has received a number of supplemental transplants in recent years (Table 4). Due to the extensive network of connective habitat, disease profiles of source herds and destination herds should be undertaken prior to any additional transplants.

As augmentations take place, a representative sample of sheep should be fitted with GPS collars. An analysis of their survival and general movements should be evaluated, and the data should be evaluated when considering future transplant decisions.

The Kaiparowits Escalante has tested positive for *Mycoplasma* sp. (see Appendix B). There have been 2 transplant efforts on the Escalante that were intended to create new herds on the periphery of occupied habitat; however surveys have shown some individuals have wandered into occupied habitat. It is therefore necessary that this herd and the recently transplanted sheep be monitored for a few years prior to any additional transplant efforts.

The Kaiparowits West has also tested positive for *Mycoplasma* sp. (see Appendix C-D). Since this herd has been increasing, transplants within this unit may be appropriate once all analyses are complete. Potential release sites on the Kaiparowits West include:

- John Henry and Wesses Canyons (Ship Mountain)
- Upper portions of Hackberry and Paria River

The Kaiparowits East has received a few transplants from Nevada. *Mannehaemia* sp were detected in some of the 25 sheep released in Cave Point/Sooner Slide in 2012. Some of these transplanted sheep have been observed in the Rock Creek area, which is a densely populated portion of this unit. Since this population is surrounded by areas where *Mycoplasma* sp. has been detected, it is not recommended to continue transplants into this area at this time.

Table 4. Recent transplants and ear tag colors for desert bighorn sheep on the Kaiparowits unit.

	Year	Source	Release Site	Ear Tag Color	Number
Kaiparowits, West	2006	Fallon, NV	Tibbets Canyon	Green	20
	2014/15	Residents	Residents	White	12
Kaiparowits, East	2009	Lake Mead, NV	Croton Canyon	Orange	20
	2012	River Mtns, NV	Cave Pt/Sooner Slide	Yellow	25
	2012	Muddy Mtns, NV	Last Chance Creek	Blue	24
Kaiparowits, Escalante	2013	Residents	Residents	White	17
	2013	Muddy Mtns, NV	Long Cyn/Annie's Cyn	Orange	49
	2014	Muddy Mtns, NV	Silver Falls	Green	37
	2014	Muddy Mtns, NV	25 Mile Wash	Red	34

*Only resident captures have been given white ear tags.

Predator Management:

- 1) All 3 of the Kaiparowits subunits are managed as an unlimited harvest on lions despite limited harvest results (Table 5).
- 2) If lion predation is shown to have adverse impacts on bighorn sheep establishment, lion management may be accomplished through established DWR policy and procedures. Lion removal efforts may be conducted by DWR personnel, and Wildlife Services.
- 3) Lions have been suspected to have an adverse impact on sheep in the Escalante; however due to the remote and rugged nature of the unit, lion harvest has been challenging. In recent years, Wildlife Services has removed lions for bighorn sheep predation on the Smokey Mountain and 50 Mile Mountain on the Kaiparowits East. Continued efforts to address lions on the Escalante using Wildlife Services are recommended.
- 4) A predator management plan is in place for the Kaiparowits subunits since the population is below 90% of objective and the area serves as a transplant site. All options for predator control should be included in this plan.

Table 5. Lion harvest over the past 10 years on the Kaiparowits unit.

Year	Harvest Objective Quota	Males	Females	Total Harvest	Average Age
2004	10	1	0	1	1.0
2005	10	0	1	1	-
2006	10	1	1	2	3.5
2007	10	0	1	1	3.0
2008	7	0	1	1	2.0
2009	7	1	0	1	6.0
2010	7	4	1	5	2.0
2011	6	1	1	2	4.0
2012	7	1	1	2	3.0
2013	7	0	0	0	-
2014	Unlimited	3	0	3	4.0
2015	Unlimited	0	1	1	3.0
2016	Unlimited	2	0	2	-
2017	Unlimited	0	0	0	-
2018	Unlimited	1	0	1	4.0
2019	Unlimited	1	3	4	3.0
Total	151	19	10	29	3.5

Research Needs:

- 1) Regularly sample resident bighorns to upkeep health profiles throughout all subunits.
- 2) GPS data from collared sheep may be used to evaluate movements and annual survival and facilitate future transplant decisions.
- 3) Determining the peak lambing periods may provide insight to future transplant decisions, particularly on the Kaiparowits West.
- 4) Cause-specific mortality from GPS collars and/or track surveys on the Kaiparowits Escalante may prove useful in evaluating predator management programs.
- 5) Disease testing of bighorn sheep east of Torrey would be beneficial to assess disease risks to the greater populations to the south and facilitate transplant decisions on the Henry Mountains. Increased GPS collars on rams would also be beneficial to evaluate the extent of connectivity and movement between these areas.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of desert bighorn sheep on the Kaiparowits unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. Live captures have been performed in each of the sub-units (see appendices B-D). Pathogens causing respiratory disease have been found in each sub-unit.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in areas likely to be occupied by bighorn sheep.

Domestic sheep grazing allotments pose little risk to this unit, where the nearest active allotments are over 30 miles away from occupied habitat. The Box Death Hollow and The Gulch areas will be in closer proximity to active allotments. Manage for spatial separation between wild and domestic sheep and goats.

Farm flocks in the small communities surrounding bighorn sheep habitat also pose a risk for disease transmission. These areas include Big Water, Church Wells, Escalante, Boulder, and Kanab. Outreach efforts and potential double-fencing projects may increase understanding and implementation of spatial separation. Additionally, Johnson Canyon has several private properties where domestic sheep are grazed. Due to the connective habitat along the Vermillion Cliffs, all wild sheep should be immediately removed west of Johnson Canyon to US89 north of Kanab to protect wild sheep from comingling with domestics and prevent continued pathogen transmission

Risk Management and Response Plan:

Feral domestic goats and sheep pose the greatest risk to spatial separation. If stray animals are reported, every reasonable effort should be made to remove the disease threat as per UDWR GLN-33. All wandering wild sheep will be handled following the UDWR GLN-33. The need to test wandering bighorn sheep from this unit will be evaluated on a case by case basis. All feral or stray domestic animals should be tested.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats, and work with land managers to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in

- habitat quantity or quality.
- 4) Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas.

Potential Threats to Habitat:

Human disturbance can result in abandonment or degradation of bighorn habitat. Due to the rugged nature and low density of roads in sheep habitat, human disturbance of bighorn on this unit is expected to be low. If disturbance becomes an issue, the DWR will work with and support federal agencies (BLM, GSENM, USFS, NPS) on travel management plans, oil and gas exploration, and other land use plans.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts. Cooperate with the USFS, BLM, and GSENM to utilize controlled burns and/or mechanical treatments to remove conifer encroachment on open hillsides to increase and improve bighorn sheep habitat across the subunit.
- 2) The northern portion of this unit has a higher density of pinion and juniper trees in bighorn sheep habitat. This has been identified in previous unit management plans as a limiting factor to bighorn sheep expansion. Substantial escape terrain exists and a “let burn” prescription would promote bighorn habitat throughout these areas. A few examples of specific areas include the following:
 - 50 Mile Mountain
 - Sunday and Monday Canyons
 - Drip Tank
 - Upper Coyote Canyon
 - Upper Wahweap Creek
 - Hackberry Canyon
 - Paria River
 - Collet Canyon

Water Management Projects:

- 1) Work with GSENM, NPS, and SITLA to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
 - Croton Canyon
 - Burning Hills
 - Navajo Valley

- 50 mile Mountain
 - Smokey Mountain
 - Rim of Last Chance Creek
 - Nipple Bench
 - Tibbet Canyon
 - Brigham Plains
- 3) Develop natural waters that may be beneficial to bighorn sheep.
- Tibbet Canyon
 - Smokey Hollow
- 4) Install new water developments or guzzlers in bighorn habitat where water may be lacking. This is particularly advantageous to promote bighorn sheep distribution and potentially mitigate disease concerns from high densities of sheep on limited water resources. The impact of humans to this area and the creation of the lake have already provided unnatural conditions and therefore additional steps must be taken to protect this native species. A few specific areas for new water developments include but are not limited to:
- Southern end of Smokey Mountain
 - Middle Warm Creek Point
 - Croton Canyon
 - Little Valley Canyon
 - Sunday and Monday Canyon
 - John Henry and Wesses Canyons
 - West Bench
 - Tibbet Bench

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Kaiparowits unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics

Year	Kaiparowits, East			Kaiparowits, West			Kaiparowits, Escalante		
	Permits	Mean Days	Harvest	Permits	Mean Days	Harvest	Permits	Mean Days	Harvest
2002	5	-	100%	5	-	100%	5	-	100%
2003	2	9.5	100%	4	3	100%	7	11	86%
2004	4	11.8	100%	1	3	0%	7	7	100%
2005	5	6.6	100%	1	2	100%	6	13.5	100%
2006	2	15	100%	1	6	100%	8	9.6	67%
2007	3	18	100%	2	13.5	100%	7	16.6	50%
2008	3	6.7	100%	2	13	50%	7	7.7	100%
2009	3	9.7	100%	2	2	100%	6	15.8	100%
2010	4	8.3	100%	2	4	100%	5	9.6	80%
2011	4	6.5	75%	3	3.7	100%	6	7.4	67%
2012	4	6.8	100%	3	3	100%	5	14.2	67%
2013	4	7.3	100%	3	10.3	100%	2	11.5	50%
2014	2	5.5	100%	4	5.5	100%	2	10	100%
2015	3	2.3	100%	7	9	100%	2	10	50%
2016	5	3.4	100%	5	11.2	100%	2	12	100%
2017	8	2.5	100%	7	5.1	100%	2	10.5	100%
2018	8	4.5	100%	6	3.2	100%	5	6	75%

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. Significant viewing opportunities are available in Lone Rock Canyon, Wiregrass Canyon, Rock Creek Bay, Dangling Rope Marina.

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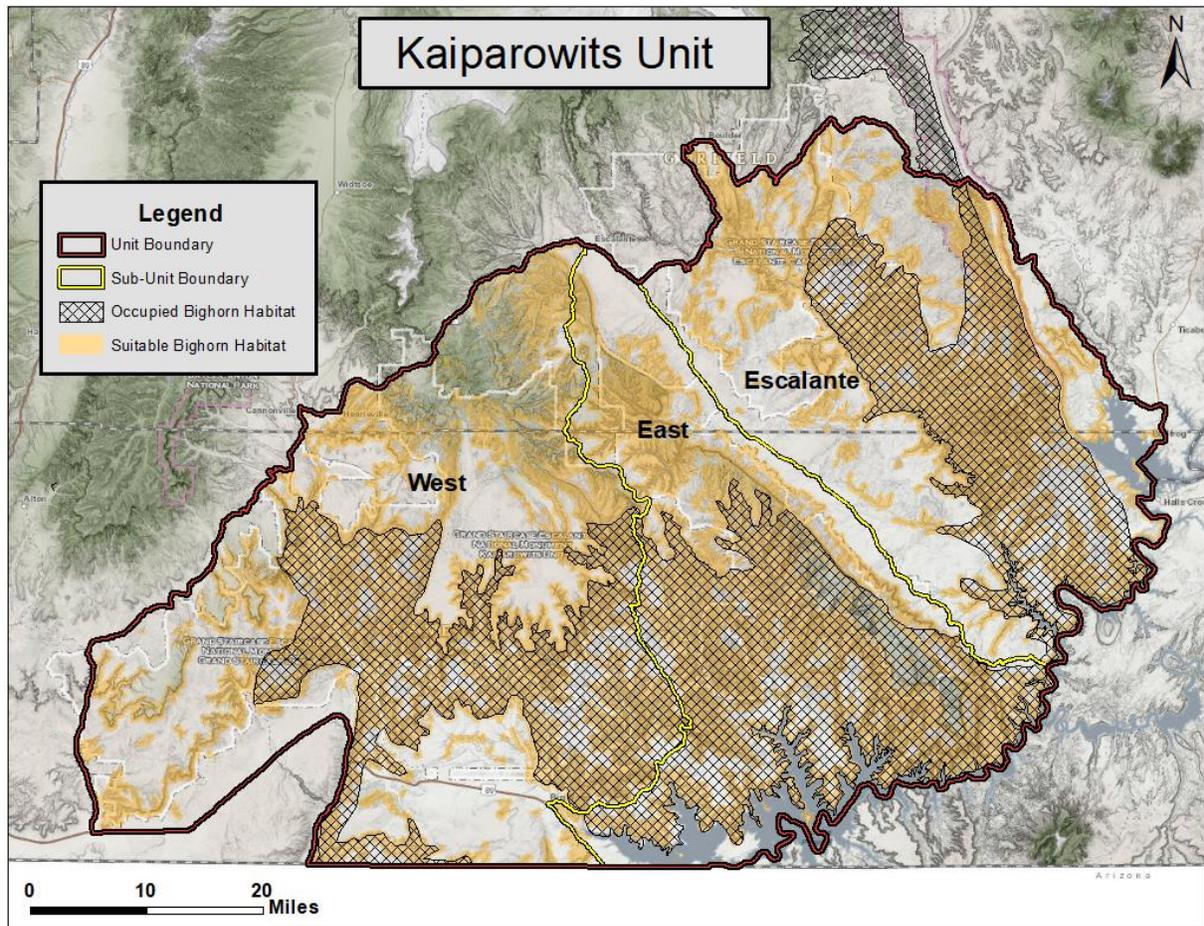


Figure 1. Kaiparowits unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

Appendix A. Summary of bighorn sheep transplant efforts into the Kaiparowits.

Release Unit / Area	Year	# Released	Source
Kaiparowits, East	1980	20	Cataract/White Canyons, UT
Kaiparowits, East	1982	12	Canyonlands NP, UT
Kaiparowits, East	1993	13	Escalante, UT
Kaiparowits, East	1995	17	Escalante, UT
Kaiparowits, East	2009	20	Lake Mead, NV
Kaiparowits, East	2012	25	River Mountains, NV
Kaiparowits, East	2012	25	Muddy Mountains, NV
Kaiparowits, West	1995	21	Black Mountains, AZ
Kaiparowits, West	1995	2	Escalante, UT
Kaiparowits, West	1996	20	Lake Mead, NV
Kaiparowits, West	1999	21	Lake Mead, AZ
Kaiparowits, West	2000	20	Lake Mead, NV
Kaiparowits, West	2006	20	Fallon, NV
Kaiparowits, Escalante	1975	4	Gypsum Canyon, UT
Kaiparowits, Escalante	1976	12	Gypsum Canyon, UT
Kaiparowits, Escalante	1978	7	Cataract Canyon, UT
Kaiparowits, Escalante	1986	4	Canyonlands NP, UT
Kaiparowits, Escalante	1995	6	Escalante, UT
Kaiparowits, Escalante	1995	18	Escalante, UT
Kaiparowits, Escalante	1998	7	Escalante, UT
Kaiparowits, Escalante	2013	49	Muddy Mountains, NV
Kaiparowits, Escalante	2014	37	Muddy Mountains, NV
Kaiparowits, Escalante	2014	34	Muddy Mountains, NV

Escalante Bighorn Sheep Disease Profile

SEROLOGY

Whole blood was collected from 17 bighorn sheep and tested for antibodies for the following respiratory and viral diseases:

- Bovine Respiratory Syncytial Virus (BRSV) – 4 of 17 (24% prevalence rate) samples had titres for BRSV. All titres in this population were detected at low levels meaning that at some point they were exposed to this virus but there is not likely an active infection.
- Infectious Bovine Rhinotracheitis (IBR) – All 17 samples were negative for titres to IBR.
- Parainfluenza III (PI3) – 5 of 17 (29%) samples had titres for PI3. Most titres were less than 1:4 which indicates previous exposure but not active infection.
- *Mycoplasma ovipneumonia* ELISA – Antibodies for *Mycoplasma ovipneumonia* were detected in 15 of the 17 (88%) samples and two were indeterminate. The test is designed for classification of populations, not individuals. Populations not exposed to *M. ovipneumonia* will have 0-10% of the population with detected antibodies, whereas exposed populations will have 30-100% of animals with detected antibody.
- Bluetongue virus (BTV) – 9 of 17 samples (53%) were positive for bluetongue antibodies. The positive result is only an indication of exposure not a current infection.
- Epizootic hemorrhagic disease (EHD) – 10 of 17 (59%) of the samples were positive for EHD. This only indicates exposure not a current infection.

FECAL

Fecal samples were collected from 17 of 17 animals. *Nematode* ova were detected in only one sample. Nematode spp. belong to the phylum of roundworms and include the superfamily *metastrongyloidea* (lungworms). Unfortunately, we can't get more specific than phylum using the submitted samples.

Oropharyngeal and Nasal Swabs - Oropharyngeal and nasal swabs were collected from all 17 animals, 2 per animal, with a total of 34 swabs.

- *Mycoplasma ovipneumonia* – 34 swabs were collected, 2 per sheep and placed in *Mycoplasma* broth and submitted for PCR screening to detect presence of *mycoplasma ovipneumonia* antibodies. *Mycoplasma* was detected in 4 of the 17 samples and two were classified as indeterminate.

Another 34 swabs were collected, 2 per sheep and placed into a port-a-cul media that supports growth of aerobic and anaerobic microorganisms.

- *Mannheimia* species – *Mannheimia* species were isolated from 8 of 17 (47%) animals. Three species of *Mannheimia* were detected and included *M. haemolytica*, *glucosida*, and *ruminalis*. What is important with these bacteria is if they are beta-hemolytic and have the ability to produce leukotoxin and result in damage to leukocytes in tissue in the lungs during a pneumonia infection. All 3 strains were beta-hemolytic and were reported at low to moderate frequencies.
- *Bibersteinia trehalosi* – previously known as *pasteurella trehalosi*. *Bibersteinia trehalosi* was detected in 13 of 17 swabs samples (76%) and several were classified as beta-hemolytic and ranged from low to very high frequencies.
- *Pasteurella multocida* – *P. multocida* was isolated from 2 of 17 samples (11%) with frequency low to very high.
- *Truperella (Arcanobacter pyogenes)* – *Truperella*, also known as *Arcanobacter pyogenes* is a common bacteria associated with abscesses and wound related infections. It is often found within the respiratory system and is usually of no consequence until something happens that triggers formation of a pneumonia event, such as a stressor. *Truperella* was isolated from 5 of 17 (29%) samples.
- *Mycoplasma* culture – The lab attempted to grow *mycoplasma* spp from the port-a-cul swabs that were submitted for bacterial testing. *Mycoplasma* was grown in culture from 3 of the 17 samples (18%).
- *Mycoplasma* PCR and genetics – The lab also takes the swabs and tests the samples using PCR to detect for mycoplasma and then tries to speciate it to either *Ovipneumonia* or *marginalis*. The 3 strains were identified as *marginalis* and 2 others were classified as suspect for *mycoplasma ovipneumonia*.

Kaiparowits West bighorn sheep disease testing

A total of 12 female bighorn sheep were sampled for disease testing in the West Kaiparowits Mountains on November 18th, 2014. Ten of the 12 bighorn sheep were aged between 3 and 8 years, whereas the age was not reported for 2 animals. Blood was collected for serology, and nasal and oropharyngeal swabs were collected for PCR and culture. Captured animals were treated with an antiparasitic (Ivermectin), an anti-inflammatory drug (Flunixin meglumine), and an antibiotic (Florfenicol).

Highlight of the most important findings:

Bighorn sheep in this population have been exposed and are shedding to *Mycoplasma ovipneumoniae*, which is considered an important pathogen in the bighorn sheep respiratory disease complex. Although no clinically diseased sheep were reported during the capture, the population can be considered exposed to respiratory pathogens that may have negative population effects. In the future, it cannot be recommended that bighorn sheep from this population be moved to other areas, or that this population be augmented with bighorn sheep from other populations.

Detailed results:

Serology:

- Bovine Respiratory Syncytial Virus (BRSV) – 3 of 12 samples had low titers (1:4 and 1:8) for BRSV. This only indicates previous exposure. The remaining 8 samples were negative for BRSV, which means no antibodies were detected.
- Infectious Bovine Rhinotracheitis (IBR) – 9 of 9 samples were negative for IBR which means no antibodies were detected.
- *Mycoplasma ovipneumoniae* (*M. ovi*) ELISA – 9 of 12 samples (75%) of samples tested positive. The ELISA test is designed for classifying populations, not individuals. Populations not exposed to *M. ovi* will have 0-10% of animals with detected antibody, whereas exposed populations will have 30-100 % of animals with detected antibody. Hence, this population can be classified as exposed.
- Bluetongue virus (BTV) – 7 of 12 (58%) of samples were positive for antibodies to BTV. The presence of antibodies indicates previous exposure. The BTV test can cross-react with antibodies to EHD virus.
- Epizootic hemorrhagic disease (EHD) – 8 of 12 (67%) samples were positive for antibodies to EHD. The presence of antibody indicates previous exposure. The EHD test can cross-react with antibodies to BTV virus.
- Bovine Viral Diarrhea (BVD) – 12 of 12 (100%) samples were negative for BVD.

- Parainfluenza Type 3 (PI3) – 1 of 12 (8.3%) of samples were positive for antibodies to PI3 at a titer of 1:16. This is a low titer that indicates previous exposure, not recent or current infection.
- *Brucella ovis* – not done

Fecal:

Fecal samples were not collected.

Oropharyngeal and Nasal Swabs

- Two oropharyngeal and 2 nasal swabs were collected from all 12 captured sheep. One nasal and one oropharyngeal swab per sheep and placed in media that promotes the growth of *Mycoplasma* spp. These swabs were cultured and tested with PCR for the presence of *Mycoplasma ovipneumoniae*. One nasal and 1 oropharyngeal swab per sheep was placed into a port-a-cul media that supports growth of aerobic and anaerobic microorganisms.

Swabs in Mycoplasma medium:

- *Mycoplasma ovipneumoniae* was detected by PCR in 1 of 12 (8.3%) bighorn sheep.

Swabs in Port-a-cul medium:

- *Mannheimia* species – *Mannheimia* species were isolated from 4 of 12 samples at high frequency. Three strains were betahemolytic strains. Beta hemolytic means that the bacterium's hemolytic enzymes can completely break down cells.
- *Bibersteinia trehalosi* – *Bibersteinia trehalosi* was detected in 7 of 12 (58.3%) samples and all were nonhemolytic strains.
- *Pasteurella* spp – This bacterium was not isolated from any of the samples.
- *Trueperella* (previously *Arcanobacter pyogenes*) – *Trueperella* is a common bacterium associated with abscesses and wound related infections. It is often found within the respiratory system and is usually of no consequence until something happens that triggers formation of a pneumonia event, such as a stressor. This bacterium was found in 10 of 12 (83.3%) of samples at low to moderate frequency.
- Various other bacteria were isolated but they are considered of little to no consequence.

Kaiparowits bighorn sheep disease testing, 2016

A total of 24 female and 6 male bighorn sheep were sampled in the Kaiparowits for disease testing on December 13 – 15, 2016. The animals were captured at Kelly Grade (9), Last Chance (6), Wahweap (14), and Rock Creek Bay (1). The ages ranged from 1 to 8 years of age. Blood was collected for serology and trace minerals, nasal and tonsillar swabs were collected for PCR and culture, ear swabs were collected to test for ear mites, and fecal samples were collected for parasites. Captured animals were treated with an antiparasitic (Long Range), Selenium and Vitamin E, and an anti-inflammatory drug (Flunixin meglumine). Animals with ear tick infestations were further treated topically with Catron antiparasitic spray on the ears. All animals were released on site after processing.

One mortality occurred during the capture. The animal was not sampled. One additional bighorn sheep died a few weeks after the capture. No other significant injuries occurred.

Highlight of the most important findings:

This population is positive for *Mycoplasma ovipneumoniae*, which is considered an important pathogen in the bighorn sheep respiratory disease complex. Multiple animals also cultured positive for *Mannheimia hemolytica* and *Bibersteinia trehalosi* and were leukotoxin A positive on the tonsillar swabs. Leukotoxin producing *M. hemolytica* or *B. trehalosi* is known to contribute to bighorn sheep respiratory disease. The seroprevalences for respiratory viruses such as parainfluenza type 3, infectious bovine rhinotracheitis, and bovine respiratory syncytial virus were low. Forty percent were seropositive for bluetongue virus and epizootic hemorrhagic disease virus. Fecal parasite loads were low, and no significant trace mineral deficiencies were detected.

Detailed results:

Serology:

- Bovine Respiratory Syncytial Virus (BRSV) – 3 of 30 (10%) samples had titers (one at 1:32 and two at 1:64) for BRSV. The titers only indicate previous exposure.
- Infectious Bovine Rhinotracheitis (IBR) – 0 of 30 (0%) of samples were positive for IBR.
- *Mycoplasma ovipneumoniae* (*M. ovi*) ELISA – 17 of 30 (57%) were seropositive for *M. ovi*, indicating that the population previously has been exposed.
- Bluetongue virus (BTV) – 12 out of 30 (40%) were seropositive for antibodies to BTV. The BTV test can cross-react with antibodies to the EHD virus.
- Epizootic hemorrhagic disease (EHD) – 12 out of 30 (40%) were seropositive for antibodies to EHD.
- Bovine viral diarrhea (BVD) – 0 of 30 (0%) were seropositive for BVD.
- Parainfluenza Type 3 (PI3) – 3 of 30 (10%) of samples were seropositive for antibodies to PI3 at a titer ranging from 1:8 - >1:512. Low titers only indicate previous exposure, whereas high titers could indicate recent exposure or current infection.

Fecal:

Fecal floats were run on 16 samples. Strongyle ova were detected in one of 16 (6%) of samples.

Ear swabs:

- Ear mites (*Psoroptes ovis*) were detected in 4 of 30 (13%) of samples. One tick (*Dermacentor* spp.) was identified as well.

Tonsilar and Nasal Swabs

- Two tonsilar and 1 nasal swab was collected from all captured bighorn sheep. One nasal swab per sheep was tested with PCR for the presence of *Mycoplasma ovipneumoniae*. One tonsilar swab was placed into a cryogenic medium that preserves aerobic and anaerobic microorganisms. One tonsilar swab was placed into an empty red top blood tube for a leukotoxinA PCR test.

Nasal swabs in Mycoplasma medium:

- *Mycoplasma ovipneumoniae* was detected in 3/30 (10%) of bighorn sheep on PCR. Strain typing is pending.

Tonsilar swabs in cryogenic medium:

- *Mannheimia hemolytica* – was isolated at low frequency in 5 of 30 (17%) of samples. Other species of *Mannheimia* were detected at low frequency in 12/30 (40%) of animals. Some strains of this bacterium are known to play a role in the bighorn sheep respiratory disease complex.
- *Bibersteinia trehalosi* – *Bibersteinia trehalosi* was detected in 20 of 30 (67%) of the bighorn sheep. Four of these exhibited betahemolysis. Betahemolytic strains are considered more pathogenic than non-betahemolytic strains, which may naturally occur in the respiratory tract of healthy animals.
- *Pasteurella multocida* – Was not isolated from these sheep. Some strains of this bacterium are of concern in the bighorn sheep respiratory disease complex.
- *Truperella pyogenes* – was detected in 8/30 (27%) of samples. *Truperella pyogenes* is a common bacterium associated with abscesses and wound related infections. It is often found within the respiratory system and is usually of no consequence in otherwise healthy animals.

Leukotoxin A PCR from tonsilar swabs:

- Leukotoxin A was detected in 4/30 (13%) of samples by PCR. A positive PCR test for leukotoxin A only indicates the presence of the leukotoxin A gene, not that it necessarily is expressed by the bacterium carrying the gene.
- Leukotoxin expressing *Mannheimia hemolytica* or *Bibersteinia trehalosi* are of concern for respiratory disease in bighorn sheep.
- One of the positive animals cultured positive for both betahemolytic *Mannheimia hemolytica* and *Bibersteinia trehalosi*. One animal cultured positive for betahemolytic *M. hemolytica* and

non-hemolytic *B. trehalosi*, one cultured positive for non-hemolytic *M. hemolytica* and *B. trehalosi*, and the last animal was only culture positive for non-hemolytic *B. trehalosi*. Again, it is not certain that these bacteria actually were expressing the leuktoxin gene.

Trace mineral analysis:

Mineral (ug/g)	Mean	Median	Range	Ref range (ug/g) Puls (1994)	Ref range (ug/g) Poppenga et al. (2012)
Calcium	91.2	94.2	73.3 - 103	80 - 100	81 - 122
Phosphorus	47.2	46.4	27.9 - 68,3	35 - 82	27 - 104
Copper	0.67	0.65	0.48 - 1.1	1.17 - 2.56	0.49 - 1.39
Iron	1.1	1.1	0.51 - 1.7	1.60 - 2.20	0.61 - 3.20
Magnesium	26.3	26.00	22 - 33	10 - 33	23.2 - 49
Selenium	0.27	0.21	0.11 - 0.79	0.13 - 0.23	-
Zinc	0.80	0.81	0.55 - 1.00	0.9 - 1.84	0.32 - 1.52
Manganese	Below detection limit			-	-

Reference ranges for minerals in bighorn sheep have not been conclusively established. The two cited references are the best available. The Poppenga et al. ranges are based on data from bighorn sheep populations in California.

Overall, there do not appear to be any significant mineral deficiencies in this population. Several bighorn sheep have copper concentrations below the reference range proposed by Puls et al., but when using the ranges proposed by Poppenga et al., only one animal falls outside the range.

References:

Poppenga et al., 2012 Journal of Veterinary Diagnostic Investigation 24(3):531-538.
Puls R. 1994. Mineral Levels in Animal Health Diagnostics: Diagnostic Data. 2nd ed. Clearbrook, British Columbia, Canada: Sherpa International.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
LA SAL, POTASH/SOUTH CISCO WMU #13
August 2019

BOUNDARY DESCRIPTION

Grand and San Juan counties--Boundary begins at I-70 and Green River; east along I-70 to the Utah-Colorado state line; south along the state line to the Colorado River; southwest along the Colorado River to the confluence with the Green River; north along the Green River to I-70. EXCLUDES ALL NATIONAL PARKS.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the La Sal, Potash/South Cisco bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	163,835	47.9%
Department of Defense	147	0.0%
State Sovereign Land	2,382	0.7%
National Parks	146,780	43.0%
Private	6,572	1.9%
Utah State Institutional Trust Lands	19,051	5.6%
Utah State Parks	2,951	0.9%
Totals	341,718	100%

HISTORY AND CURRENT STATUS

The La Sal, Potash/South Cisco unit is located south of I-70, between the Green and Colorado rivers (Figure 1). Desert bighorn sheep habitat within the unit consists primarily of the rugged, deep canyons along the east side of the Green River corridor and the north side of the Colorado River corridor. There is approximately 100 square miles of excellent bighorn habitat along these river corridors outside the national park boundaries. Numerous side canyons provide high quality bighorn habitat characterized by steep talus slopes and open canyon bottoms. Most of the mesa tops are covered with pinyon-juniper, but there is good bighorn habitat in the Blue Hills north of Moab. Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.

- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Bighorn sheep are native residents to the majority of the area. However, transplanted bighorn sheep have been added to a portion of the unit (Professor Valley), to promote genetic diversity, and to augment and expand the existing population for hunting and viewing opportunities.

Currently, this population is under its population objective and increased monitoring efforts are needed to make appropriate management decisions. Domestic sheep grazing allotments do exist in the northeast segment of the unit, and immigration of native sheep and emigration of domestic sheep from allotments is a concern.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the La Sal, Potash/South Cisco unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the La Sal, Potash/South Cisco unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Achieve a population of 300 desert bighorn sheep throughout suitable habitat within the unit boundary. With the abundant bighorn sheep habitat within this unit, a population of this size would be well below the 1.3-1.9 bighorns per square kilometer recommended by Van Dyke (1983). This objective was selected since it is a population level that can be reasonably achieved given the habitat requirements of desert bighorn sheep and what is available within the unit.

Population Management Strategies:

- 1) Monitor the bighorn sheep population using aerial surveys and GPS telemetry to assess population trends and health.
- 2) Initiate predator management as specified in predator and bighorn sheep unit management plans. Wildlife Services or other contracted personnel may be needed in remote or hard to access areas to help reduce cougar numbers.
- 3) Document instances of interaction between wild sheep and domestic sheep and goats to allow conflicts to be evaluated and dealt with in a timely manner. Follow established guidelines (UDWR GLN-33) for dealing with domestic sheep and goats that wander into bighorn sheep units.

Population Monitoring Plan:

Monitor population size and herd composition every 2 to 3 years by helicopter. This unit will require approximately 15 hours conducting a complete trend count. Work with NPS to monitor bighorn sheep in nation parks within the unit. Conduct ground classification, if needed, to obtain annual production estimates. All population data will be collected and submitted on standardized forms, including all GIS data (waypoints, flight paths, etc.).

Trend Count and Classification Data

Year	Pop Est.	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2008	175	105	53	17	35	10	32	66
2010	200	118	72	9	37	10	13	51
2012	115	69	36	7	26	8	19	72
2014	135	81	44	20	17	5	45	39
2017	223	134	69	30	35	6	43	51

Transplant Plan:

This unit should be managed to maintain and protect established bighorn sheep numbers and achieve unit population objectives without any transplant efforts. If this population shows severe declines, transplants may be considered if deemed beneficial. This population will not likely serve as a source herd in the immediate future due to its current population size and disease status.

Predator Management:

The La Sal, Potash/South Cisco bighorn sheep unit is within the La Sal cougar hunt unit. This unit is managed as a Harvest Objective unit. Over the last three years the average number of cougars killed per year is 6.7. The 2019 quota for cougars on the unit is 15.

A predator management plan is currently in place for this unit for bighorn sheep and mule deer. If cougar predation is shown to have adverse impacts on bighorn sheep, cougar management will be accomplished through established UDWR policy and procedures.

Research Needs:

Primary objectives for research on the unit should focus on disease issues and low lamb survival. Secondary objectives should focus on recreational activities and energy/mineral development impacts on bighorn populations. There have been 3 extensive studies conducted on this herd, which were extremely influential in implementing the 'No Surface Occupancy' stipulation identified in the BLM's 2008 Resource Management Plan.

DISEASE MANAGEMENT

Disease Management Objective:

- Maintain a healthy population of desert bighorn sheep on the La Sal, Potash/South Cisco unit.
- Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. This herd has experienced low lamb production and a population decline in previous years. The specific cause(s) are unknown but is believed that disease has been a factor.

Current exposures to pathogens are likely from wild sheep crossing back and forth along the Colorado River, where domestics reside. Additionally, interactions with other bighorn sheep population that have various pathogens have been documented and could be a source.

Conduct adequate disease sampling of bighorn sheep on the unit as needed to develop a disease profile. This unit is scheduled to be tested during winter 2019-2020.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. There are 3 BLM domestic sheep grazing allotments that challenge effective separation:

- 1) Cisco: The BLM allotment is located on the northeast stretch of the unit. The Cisco allotment is approximately 7 miles north of occupied bighorn habitat.
- 2) Little Hole: The BLM allotment is located on the northeast stretch of the unit. The Pipeline allotment is approximately 14 miles north of occupied bighorn habitat.
- 3) Pipeline: The BLM allotment is located on the northeast stretch of the unit. The Pipeline allotment is approximately 18 miles north of occupied bighorn habitat.

Outreach efforts should take place with grazing permittees and BLM employees concerning domestic and wild sheep interactions. Active removal of wild sheep within or close to these allotments should be a priority.

Risk Management and Response Plan:

All wandering wild sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. The area of greatest concern for dispersing bighorns occurs along the Colorado River, northeast of Moab. Any wild sheep on the south side of the river should be removed immediately. The need to test wandering bighorn sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers and private landowners to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.

Current and Potential Wild Sheep Distribution:

Bighorn sheep have established throughout this unit, but densities are highest near the major river corridors and side canyons. A map of occupied habitat is included in Figure 1.

Potential Threats to Habitat:

Human disturbance can result in abandonment or degradation of bighorn habitat. Human recreational activities in the area have increased dramatically and may have significant effects on bighorns. If disturbance becomes an issue, UDWR will work with and support federal agencies (BLM, NPS) on travel management plans and other land use plans to minimize impacts from high use recreation in critical bighorn habitat. Furthermore, the public will be made aware through town council and other local meetings in an effort to get local support to reduce human disturbance to bighorn sheep.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Collaborate with the BLM to utilize controlled burns and/or mechanical treatments to remove pinyon-juniper cover on mesa tops, in order to increase and improve bighorn habitat across the unit.
- 3) Identify specific habitat restoration projects to immediately benefit bighorn sheep:
 - Blue Hills
 - Bull Canyon / Day Canyon

Water Management Projects:

- 1) Work with the BLM, and private landowners to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
- 3) Continue to support DWR and BLM's collaborative effort to fund guzzler installation, repair and maintenance.
- 4) Install new water developments or guzzlers in bighorn habitat where water may be lacking.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the La Sal, Potash/South Cisco unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2009	3	13.7	100%	4.3
2010	3	7.7	100%	4.3
2011	3	7.3	100%	4.7
2012	3	11.3	100%	5.0
2013	3	1.3	100%	5.0
2014	2	14.0	100%	4.0
2015	2	14.0	100%	4.5
2016	2	3.5	100%	4.5
2017	2	10.0	100%	5.0
2018	3	14.7	100%	5.0

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. Significant viewing opportunities are available in the Potash, Blue Hills and Dead Horse Point area of the unit, as well as in the National Parks.

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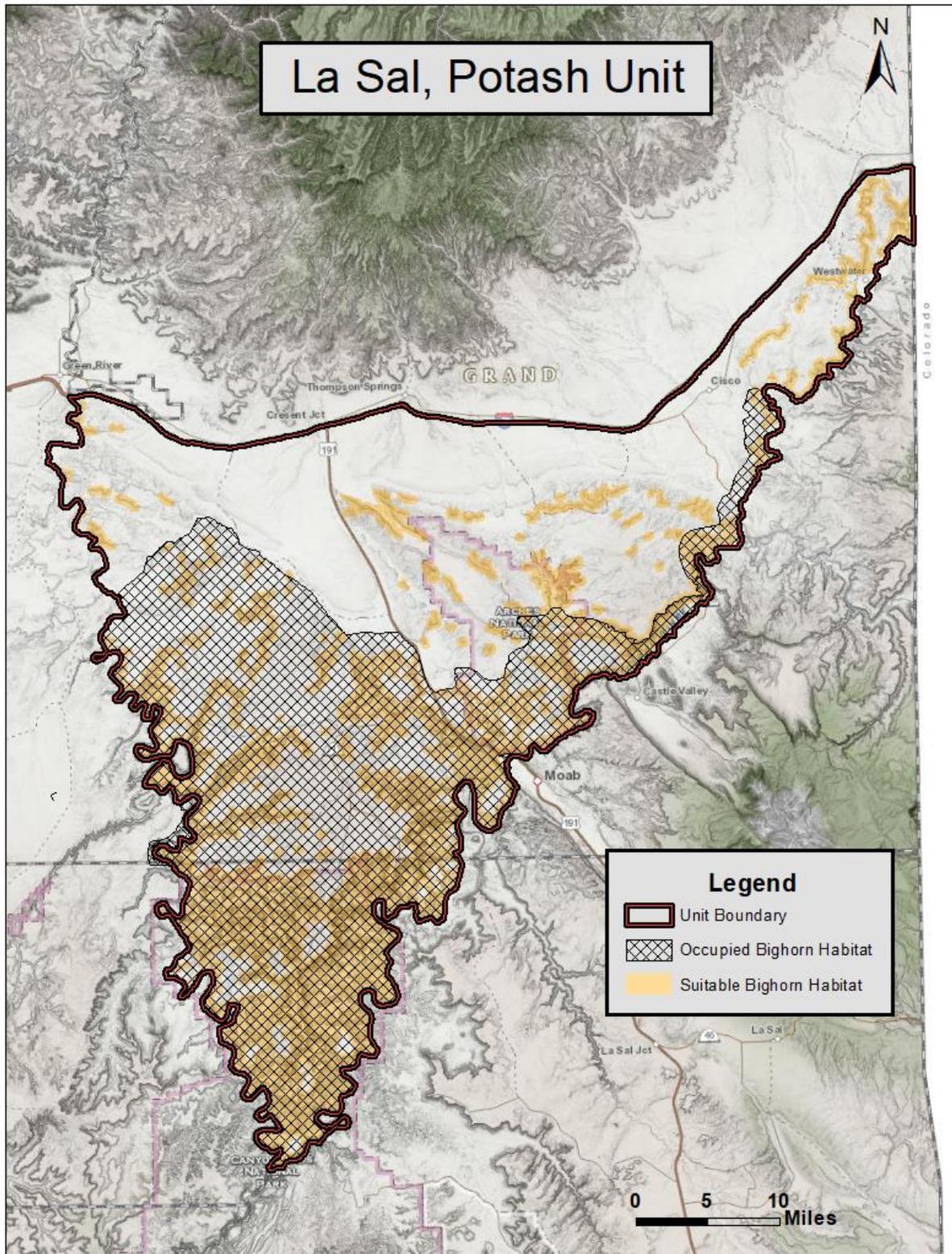


Figure 1. La Sal, Potash/South Cisco unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
NINE MILE WMU #11
Gray Canyon / Jack Creek
August 2019

BOUNDARY DESCRIPTIONS

Carbon, Duchesne, Emery, and Uintah -

Gray Canyon - Carbon, Duchesne, and Emery counties--Boundary begins at exit 164 on I-70 near the town of Green River; west on I-70 to US-6; north and west on US-6 to SR-123; east and north on SR-123 through the town of Sunnyside to the Water Canyon/Bruin Point Road; northeast on this road to the summit at Bruin Point and the headwaters of Range Creek; southeast along the Range Creek drainage bottom to the Green River; south along the Green River to Swasey's Boat Ramp and the Hastings Road; south on this road to SR-19; south and east on SR-19 to Exit 164 on I-70 near the town of Green River. Excludes all CWMUs.

Jack Creek - Carbon, Duchesne, Emery and Uintah counties--Boundary begins at US-40 and US-191 in Duchesne; southwest on US-191 to US-6; southeast on US-6 to SR-123; east and north on SR-123 through the town of Sunnyside to the Water Canyon/Bruin Point Road; northeast on this road to the summit at Bruin Point and the headwaters of Range Creek; southeast along the Range Creek drainage bottom to the Green River; south along this river to Coal Creek and the Uintah and Ouray Indian Reservation boundary; east along this boundary to the drainage divide at Hells Hole/Head of Sego Canyon; northeast along the drainage divide and summit to Diamond Ridge; northeast continuing along the drainage divide and summit to the Seep Ridge Road; northwest along the Seep Ridge Road to the White River; west along this river to the Green River; north along this river to the Duchesne River; west along this river to US-40 at Myton; west on US-40 to US-191 in Duchesne. EXCLUDES ALL NATIVE AMERICAN TRUST LANDS WITHIN THIS BOUNDARY. Excludes all CWMUs. USGS 1:100,000 Maps: Duchesne, Huntington, Price, Seep Ridge, Vernal, Westwater. Boundary questions? Call the Price office, 435-613-3700

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the Nine Mile bighorn sheep management unit.

Gray Canyon

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	132,401	84.4%
Utah State Institutional Trust Lands	16,882	10.8%
Private	7,453	4.8%
State Sovereign Land	48	<0.1%
Totals	156,785	100%

Jack Creek

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	355,218	39.2%
Tribal	280,130	30.9%
Private	117,853	13.0%
Utah State Institutional Trust Lands	107,672	11.9%
National Forest	38,857	4.3%
Utah Division of Wildlife Resources	6,554	0.7%
State Sovereign Land	454	0.1%
Utah Department of Transportation	2	<0.1%
Totals	906,740	100%

UNIT MANAGEMENT GOALS

The Nine Mile Bighorn Sheep Unit is located in eastern Carbon and Emery Counties and is centered primarily along the Green River and Price River corridors. It consists of relatively dry habitat more indicative of desert bighorn habitat in the state of Utah. The vast majority of the bighorn sheep reside in the lower reaches of Gray Canyon near the town of Green River. The northern reaches of this part of the population goes as far north as the town of Sunnyside. Bighorn sheep were moved in to Jack Creek in upper Desolation Canyon in 2000 and 2001. These bighorns exist approximately 60 miles north of the main core herd in Gray Canyon with presumably very little interchange (Figure 1). Most bighorns are found at elevations of 4,000 feet on the desert floor to 7,000 feet in the upper reaches of the canyons. Ram groups have been

known to occasionally occupy elevations approaching 8500 feet during the summer months. The vast majority of the habitat is characterized by open grassy slopes with cheatgrass and native grasses with dispersed stands of greasewood, shadscale, and saltbush. Pinyon-juniper stands begin to predominate at upper elevations and along north facing slopes with sagebrush being the primary browse species. Winters are mild on this unit with green forage available throughout much of late winter and spring. Lush vegetation and water availability during the hot, dry summer months may be more of a limiting factor. Specific goals are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Rocky Mountain bighorn sheep were established on this unit by transplants to the Price River and Range Creek drainages in 1993 and 1995 from Colorado. These bighorn sheep adapted well to the dry conditions and thrived. A hunt-able population was established by the year 2000. This population has expanded quickly over the past 20 years. The first helicopter survey in 1998 found 56 total bighorns. By 2011, there were 418 sheep observed suggesting the herd had increased eightfold in a 13 year period. In recent years this population has been exposed to pathogens that have resulted in respiratory disease that have caused declines in bighorn abundance. The current population estimate is 345 bighorn sheep based on a 2016 helicopter survey count of 207 animals. As previously mentioned, bighorns were moved in to the Upper Desolation Canyon in 2000 from Bare Top Mountain, UT and the Bitterroot Valley, MT. This portion of the herd is now approximately 95 sheep. A Jack Creek subunit was formed and was hunted for the first time in 2017. An additional transplant was attempted in 2009 when 40 bighorn were captured in the Price River area and flown 30 miles north to the Trail Canyon area in lower Desolation Canyon. These bighorns promptly returned to where they were captured within six months.

Significant efforts were made by the BLM, DWR and UFNAWS in the late 1980's to assure that domestic sheep grazing issues were resolved prior to the original transplant. As a result of this and later efforts to accommodate and expanding bighorn population, there are no active domestic sheep allotments on the Nine Mile unit. However, this unit has an abundance of private land managed for livestock grazing that is adjacent to bighorn habitat. Some of these landowners graze sheep on their properties. Binding agreements to not graze sheep on private lands have been made with some landowners. Future agreements are necessary to facilitate bighorn herd protection in core areas and expansion in to the Nine Mile Canyon area.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Nine Mile unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility

(Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Nine Mile unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Manage for up to 1,000 bighorn sheep throughout suitable habitat on the Nine Mile Unit of which no more than 650 sheep should be in the main core area on the Gray Canyon subunit. A population of 1000 sheep would be below the recommended density of 1.3-1.9 bighorns/sq km (Van Dyke 1983); however if disease issues becomes a concern local densities may be reduced.

Population Management Strategies:

- 1) Conduct transplants on or off the unit as needed to meet population objectives as allowed by disease conditions in source and receiving herds.
- 2) Utilize ewe hunts as needed to target bighorn sheep inhabiting areas with a high potential for comingling with domestic sheep.
- 3) Ewe hunts could also be used as a tool to regulate overall population levels and localized bighorn sheep density issues if disease issues prevent transplants.
- 4) Conduct adequate disease sampling of bighorn sheep on the unit as needed to develop a disease profile.

Population Monitoring Plan:

Continue aerial surveys of the unit every three years to monitor total population and herd composition. Approximately 8 hours are required to fly Jack Creek and an additional 20 – 25 hours for Gray Canyon. Monitor survival, habitat use, and potential disease issues through continued radio telemetry studies on the unit. Conduct ground classification as conditions permit to obtain annual production estimates. This information is highly valuable as an indicator of population health and condition. This is typically done via a Desolation Canyon float trip conducted every other year. All population data will be collected and submitted on standardized forms, including all GIS flight and collar data (waypoints, flight paths, etc.).

Trend Count and Classification Data

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
1997	90	56	20	20	16	-	100	80
1998	175	106	49	23	34	5	47	69
2000	210	128	57	30	41	16	52	72
2001	300	179	80	43	56	24	54	70
2003	350	213	105	39	69	16	37	65
2005	500	293	135	60	98	33	44	73
2007	600	346	156	80	110	35	51	70
2009	650	384	190	47	147	43	25	77
2011	700	418	206	69	143	51	33	69
2013	600	333	165	57	111	42	34	67
2016	440	264	153	29	82	26	19	54
(Gray Cyn)	345	207	119	20	68	20	17	57
(Jack Cr)	95	57	34	9	14	6	26	41

Transplant Plan:

This unit should be managed to maintain and protect established bighorn sheep numbers and achieve unit population management goals. The disease profile of the herd and the relative health of the herd based on composition should be carefully evaluated prior to any transplant.

Transplants to the unit may be necessary in future years to augment the existing herd or to expand the population if spatial separation from domestic sheep can be ensured. Potential future transplant areas should include:

- Nine Mile Canyon
- Rock Creek
- Trail Canyon

Predator Management:

The Nine Mile bighorn sheep unit is managed under a predator management plan. The unit is designated as a bighorn sheep protection area with a liberal cougar harvest quota and a year-round cougar hunting season. Sport harvest averages 16 cougars/year. A total 166 cougars have been removed from the unit over the past 10 years. However, the vast majority of cougar harvest occurs well away from most bighorn sheep habitat. Cougar harvest is difficult in bighorn sheep habitat as there are relatively few snow days for good tracking, extremely rough terrain, and low cougar densities. A year-round hunt unit focusing on bighorn sheep habitat on the Gray Canyon and Book Cliffs, South units was established in 2017. To date, only 1 cougar has been harvested by sport hunters on this portion of the unit in the past 3 years. If cougar predation on the unit is shown to have adverse impacts on bighorn sheep, cougar population control will be accomplished through established UDWR policy and procedures.

Research Needs:

- 1) Continued GPS collar studies are needed to document survival, production, habitat use, and potential comingling with domestic sheep. This will also provide an avenue to collect blood and nasal cultures to maintain an accurate disease profile.
- 2) Document bighorn sheep use (or lack of use) of newly constructed guzzlers.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Nine Mile unit.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. Exposure to *Mycoplasma sp.* has been documented in this herd. Twelve out of 20 (60%) sheep showed exposure to *Mycoplasma sp.* in 2014. An additional 20 sheep were sampled in 2015. In this study, 90% of the bighorns showed exposure to *Mycoplasma sp.* These studies also showed moderate exposure to Parainfluenza and EHD. Exposure rates appeared consistent across Jack Creek, Gray Canyon, and the adjacent Book Cliffs, South unit. These findings will influence future management.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. The most likely dispersal areas will be eastward along the Book Cliffs to the Colorado border. There are 4 primary threats that challenge effective separation:

- 1) Farm flocks on private lands in the Green River Valley - Much of the land immediately adjacent to bighorn sheep habitat near the town of Green River is privately owned and managed for livestock grazing or row crops. Some landowners own small flocks of sheep and occasionally these sheep escape and are found in bighorn habitat. Currently none of the landowners closest to bighorn sheep have domestic sheep. Great effort is needed to keep good relationships with landowners.
- 2) Farm flocks on private lands in Nine Mile Canyon – Some landowners in Nine Mile Canyon have small bands of sheep that reside on private lands in the canyon. Bighorn sheep have been documented comingling with these sheep Bighorn sheep are typically within 6 miles of the nearest domestic sheep in Nine Mile Canyon.
- 3) Farm flocks on private lands near Sunnyside and Columbia - Landowners in these areas occasionally have domestic sheep on their properties. Some sheep have escaped over the years and have been found comingling with bighorn in bighorn habitat. Public education, double fencing, and binding agreements are necessary to avoid future comingling. Bighorn sheep are within 1 mile of some domestic sheep in this area.
- 4) Wild Horse Bench, Big Pack, and Oil Shale Allotments east of the Green River- Several BLM domestic sheep allotments exist approximately 15 miles northeast of occupied bighorn habitat on the northeast corner of the unit.

Outreach efforts should take place with private landowners, grazing permittees and BLM employees concerning domestic and wild sheep interactions. Active removal of bighorn sheep within or close to these allotments and properties should be a priority.

Risk Management and Response Plan:

Areas of greatest concern for dispersing bighorn sheep include all areas north of C Canyon near the town of Sunnyside as well as bighorn sheep in lower Nine Mile Canyon near domestic sheep flocks. Any bighorn sheep in these areas should be removed immediately. All wandering bighorn sheep, stray domestic sheep and goat issues will be handled following the UDWR GLN-33 and the UDWR Statewide Bighorn Sheep Management Plan. The need to test wandering bighorn sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers and private landowners to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in

habitat quantity or quality.

- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.

Current and Potential Bighorn Sheep Distribution:

Bighorn sheep high density core use areas are primarily in Gray Canyon along the Green River and lower Price River as well as the area surrounding Jack Creek in upper Desolation Canyon. Sheep could expand in to the middle and lower portions of Desolation Canyon, westward in to Nine Mile Canyon, and the upper elevations throughout the West Tavaputs Plateau. A map of wild sheep distribution and modeled habitat is provided in Figure 1.

Potential Threats to Habitat:

- 1) Human disturbance can result in abandonment or degradation of bighorn habitat. Human use along the Green River is very high in the summer months. To date, no adverse effects to bighorn sheep have been documented by high river runner traffic during the summer months.
- 2) Significant oil and gas leases have been approved and developed on bighorn sheep habitat near the Jack Creek area. Most of the proposed and developed wells are in flat areas above good bighorn habitat. There is, however, potential that these areas could be abandoned if disturbance is excessive.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Cooperate with the BLM to utilize controlled burns and/or mechanical treatments to remove conifer encroachment on open hillsides to increase and improve bighorn habitat across the unit.
- 3) Promote "let it burn" policies with BLM on all wildfires in bighorn sheep habitat when human safety and human structures are not at risk.
- 4) Much of the bighorn habitat is found in Wilderness Study Areas and will be difficult to initiate active habitat management.
- 5) Identify specific habitat restoration projects to immediately benefit bighorn sheep.
 - Pinyon-juniper removal at Little Park and Lila Canyon

Water Management Projects:

- 5) Work with the BLM, and private landowners to locate and improve water sources across bighorn habitat.
- 6) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
 - Elliot Mesa guzzler needs rebuilt
- 7) Install new water developments or guzzlers in bighorn habitat where water may be scarce or lacking.
 - Horse Bench

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Nine Mile unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2004	4	9.0	100%	-
2005	4	14.0	100%	2.3
2006	7	9.4	86%	4.7
2007	7	4.7	100%	5.0
2008	10	10.1	100%	4.4
2009	9	13.0	100%	5.0
2010	13	7.3	100%	4.8
2011	12	8.6	100%	4.8
2012	17	5.2	100%	4.9
2013	17	6.2	100%	4.6
2014	17	4.9	100%	4.8
2015	16	6.8	100%	4.3
2016	16	4.3	100%	4.7
Gray Canyon Subunit				
2017	7	4.6	100%	4.9
2018	8	8.8	100%	4.8
Jack Creek Subunit				
2017	2	3.5	100%	4.5
2018	2	4.5	100%	5.0

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. Significant viewing opportunities are available along the Hastings Road north of Green River.

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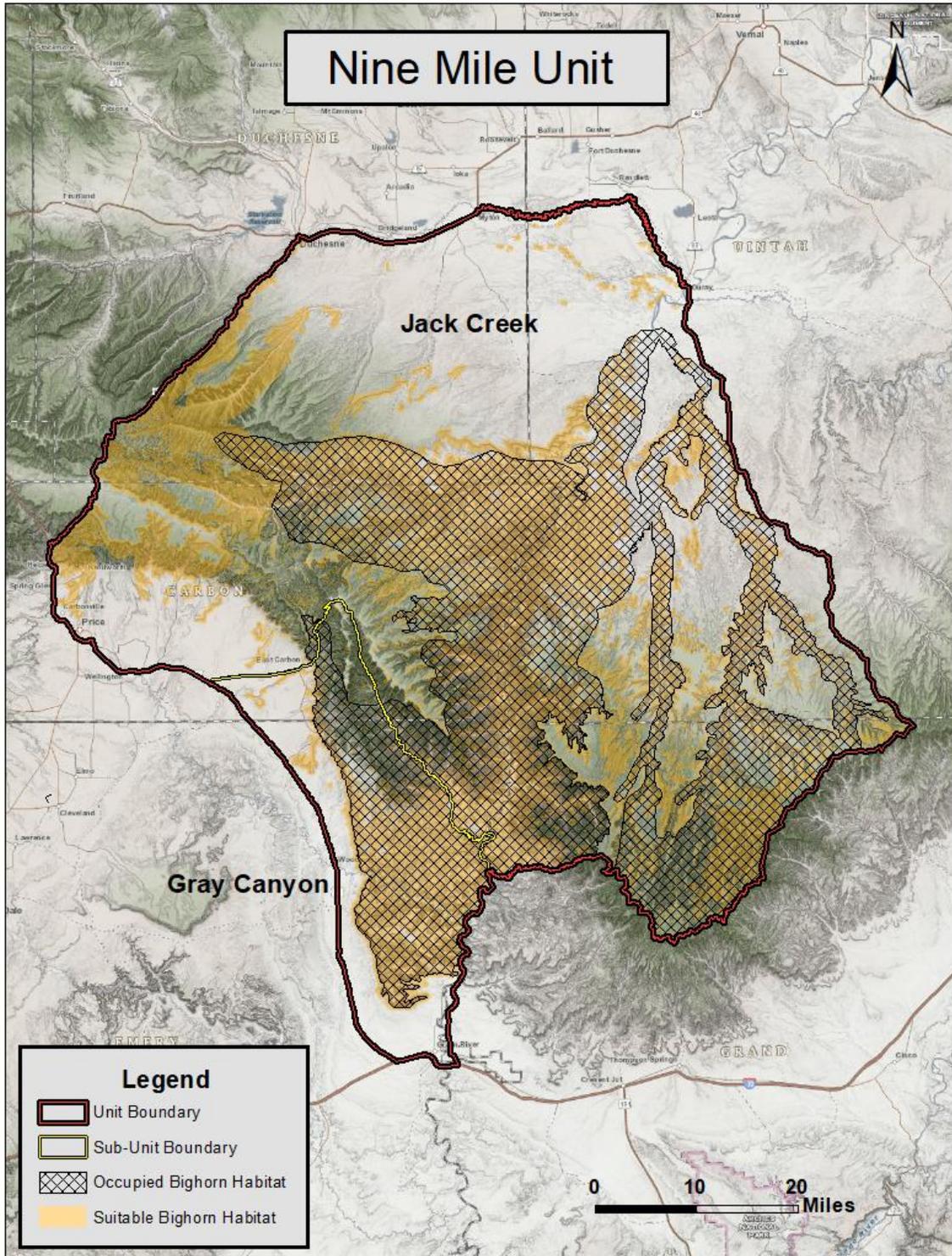


Figure 1. Nine Mile unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

**BIGHORN SHEEP UNIT MANAGEMENT PLAN
OQUIRRH-STANSBURY, WEST (STANSBURY MTNS)
August 2019**

BOUNDARY DESCRIPTION

Tooele County--Boundary begins at I-80 and SR-36; south on SR-36 to Pony Express Road; west on this road to the Skull Valley road; north on this road to I-80 at Rowley Junction; east on I-80 to SR-36. EXCLUDES ALL NATIVE AMERICAN TRUST LANDS WITHIN THIS BOUNDARY. Excludes all CWMUs. USGS 1:100,000 Maps: Provo, Rush Valley, Salt Lake City, Tooele. Boundary questions? Call the Springville office, (801) 491-5678.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Oquirrh-Stansbury, West bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	48,084	41.7%
National Forest	42,687	37.0%
Private	16,795	14.6%
Utah State Institutional Trust Lands	7,179	6.2%
Tribal	550	0.5%
Department of Defense	5	<0.1%
Totals	115,300	100%

HISTORY AND CURRENT STATUS

Bighorn sheep are native to the Great Basin of Utah and Nevada. Bighorns were extirpated from the Great Basin region of Utah in the early 1900s. It was proposed to transplant bighorn sheep in historic ranges in an effort to reestablish bighorns to their native ranges (Buechner 1960, Dalton and Spillet 1971) and to promote wildlife diversity for hunting and viewing, in accordance with Utah Code 23-14-21. In an effort to reestablish bighorns in the Stansbury Mountains in the Great Basin region of Utah, 54 bighorn sheep were transplanted and released in January 2006 and with an additional 19 transplanted in February 2007 from Antelope Island. In the summer 2013 and again in 2014, there appeared to be an outbreak of pneumonia. Several adult rams and ewes were taken in for necropsy. It was undetermined what specific pathogens caused the mortalities. There were no lambs found in surveys conducted in 2013. The population crashed in 2014, and all bighorn sheep were extirpated by 2016.

In January 2018, 18 bighorns were transplanted from Antelope Island, and in January/February 2018, 41 bighorns from the Newfoundland Mountains were released to reestablish the population. All these bighorns were released in the Muskrat Canyon area. In February 2019, 20 bighorns were transplanted from Washington State and released in the Big Creek Canyon area, west of Deseret Peak. An additional 25 bighorns from Oregon state are planned to be released in December 2019.

Currently there are an estimated 90 bighorn sheep on the Stansbury Mountains.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Stansbury Mountains using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the mountain range (Figure 1).

Livestock Competition: Interactions of bighorn sheep with domestic cattle are anticipated seasonally. Dietary overlap between cattle and bighorns has not surfaced as a concern with other bighorn populations in the state and is not expected for the Stansbury Mountain herd. Bighorn annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987), which also minimizes competition for water. Bighorn sheep have the ability to utilize metabolic water formed by oxidative metabolism, preformed water found in food, and surface water, including dew. The amount of surface water required by bighorns is dependent on many factors, including body size, activity, forage moisture content, temperature, and humidity (Monson and Sumner 1980). In hot, dry periods, bighorns will water daily if possible but have remained independent of surface water for periods of 5-8 days (Blong and Pollard 1968, Turner and Boyd 1970, Turner 1973, Welles and Welles 1961, 1966).

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or domestic goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population or domestic species (i.e. sheep or goats), due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Besser et al. 2017, Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators from their ranges or out of business. Rather, the intent is to look

for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns on the Stansbury Mountains. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services. Predator reduction work already occurs on the Stansbury Mountains in conjunction with livestock losses, and therefore any additional work that may be done would be mutually beneficial to both livestock and other big game species.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of 500 total Rocky Mountain bighorn sheep.

Population Management Strategies:

Transplant Plan: Transplant(s) of wild bighorn sheep will be used to establish a sustainable herd. Transplant efforts were initiated in 2018, and again in 2019. Newly transplanted bighorns will be monitored for general movements and annual survival. Interested parties have been notified and given opportunity for discussion. If the population reaches or exceeds the population objective, management practices including transplants and ewe hunts may be incorporated to maintain the population at objective.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. This population will likely require 6 hours to conduct a complete trend count and survey adjacent areas to evaluate bighorn sheep dispersal. Additional ground classification may be conducted as conditions permit. GPS collars with mortality signals will be used to document cause-specific mortality and identify annual survival estimates. Space use will be monitored to assess potential overlap and competition with cattle. GPS collars may be added to the population as the original collars complete their usable lifespan. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan and UDWR GLN-33.

Predator Management: Predator management will be coordinated with USDA Wildlife Services prior to bighorn release. If predation becomes a limiting factor on bighorns,

predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Stansbury Mountain range.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: Source herds used for establishing this population will be tested for pneumonia related pathogens prior to release to ensure healthy source stock. The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: Active domestic sheep allotments and hobby farms with domestic sheep may be evaluated for potential overlap with bighorn habitat. The DWR will delineate areas where there is high risk for domestic sheep to come in contact with bighorn sheep or where bighorn sheep may stray and come in contact with domestic sheep. These areas will be considered areas of concern. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. The need to test wandering bighorn sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects on the Stansbury Mountains.
- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn sheep habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with the BLM and USFS to utilize seeding, controlled burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure

that projects that are beneficial to both bighorn sheep and sympatric cattle are given priority.

Areas identified as priorities for habitat improvement are as follows:

- Muskrat Canyon
- Timpie Springs

Water Improvement: The DWR will work with the BLM, USFS, and private stakeholders to locate and cooperatively modify or improve existing water sources or install new water developments across bighorn habitat.

Areas identified as priorities for water improvement are as follows:

- Muskrat Canyon
- Timpie Springs

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities in accordance with the Utah Bighorn Sheep Statewide Management Plan.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. The male portion of this population will be hunted aggressively in an attempt to reduce the incentive for males to foray into areas with an elevated risk of pathogen transmission. Ewe hunts may be utilized as a tool for maintaining population objective.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the population objective or other key components of this plan are to be revised in the future, affected cooperating agencies, local stakeholders, and grazing permittees will be invited to take part in the decision-making process.

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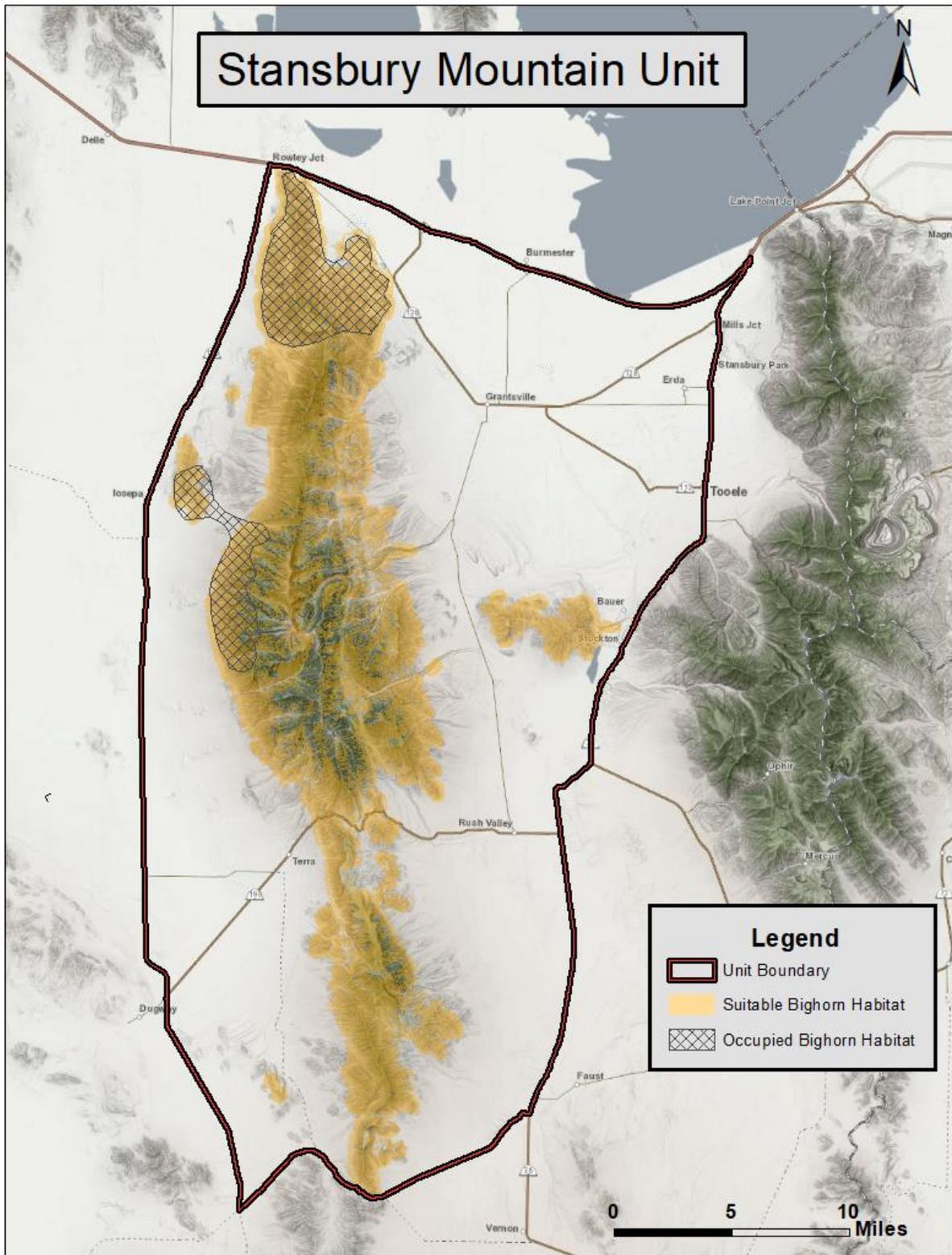


Figure 1. Oquirrh-Stansbury, West unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
PINE VALLEY
Virgin River / Beaver Dam / Red Cliffs / Pine Valley North
August 2019

BOUNDARY DESCRIPTIONS

Iron and Washington Counties -

Virgin River - Washington County—Boundary begins at SR-18 and I-15 in St. George; northwest on SR-18 to US-91; southwest on US-91 to the Arizona-Utah state line; east along this state line to I-15; north on I-15 to St. George. USGS 1:100,000 Map: Saint George. Boundary questions? Call the Cedar City office, 435-865-6100.

Beaver Dam - Washington County--Boundary begins at SR-18 (Bluff Street) and I-15; north on SR-18 to Sunset Blvd; west on this blvd to Santa Clara Drive; north on this drive to SR-91; north on SR-91 to Gunlock Road; north on this road to the Manganese Wash road; west on this road to the Motoqua road; north on this road to the Utah-Nevada state line; south then east on this stateline to I-15; north on I-15 to SR-18 (Bluff Street).

Red Cliffs - Washington County--Boundary begins at Ash Creek and I-15; west along this creek to Sawyer Canyon bottom; west along this canyon canyon bottom to the drainage divide; west along this divide over Mount Baldy to Leap Creek Trail; north along this trail to Anderson Valley Trail; west along this trail to Mill Flat and Summit Trail; though Anderson Valley to the Summit Trail at Mill Flat; southwest along this trail to the Cottonwood Creek drainage near Burger Peak; south along this drainage to the Cottonwood Creek road; south along this road to the Cedar Bench road; west along this road to Diamond Valley road; west along the this road to SR-18; north on SR-18 to the Sand Cove Reservoir road; west along this road to the Gunlock Road; south on this road to SR-91; south on SR-91 to Santa Clara Drive; south on this drive to Sunset Blvd; east on this blvd to SR-18 (Bluff Street); south on SR-18 to I-15; north on I-15 to Ash Creek.

Pine Valley North - Iron and Washington counties--Boundary begins at Ash Creek and I-15; west along this creek to Sawyer Canyon bottom; west along this canyon canyon bottom to the drainage divide; west along this divide over Mount Baldy to Leap Creek Trail; north along this trail to Anderson Valley Trail; west along this trail to Mill Flat and Summit Trail; though Anderson Valley to the Summit Trail at Mill Flat; southwest along this trail to the Cottonwood Creek drainage near Burger Peak; south along this drainage to the Cottonwood Creek road; south along this road to the Cedar Bench road; west along this road to Diamond Valley road; west along the this road to SR-18; north on SR-18 to the Sand Cove Reservoir road; west along this road to the Gunlock Road; south along this road to the Manganese Wash road; west along this road to the Motoqua road; north along this road to the Utah-Nevada state line; north on this state line to the Union Pacific railroad tracks near Uvada; northeast along these tracks to the Lund highway; northeast along this highway to SR-56; east on SR-56 to I-15; south on I-15 to Ash Creek. Boundary questions? Call Cedar City office, 435-865-6100.

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the Pine Valley bighorn sheep management sub-units.

Virgin River

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	36,691	77.0%
Tribal	5,843	12.3%
Utah State Institutional Trust Lands	3,420	7.2%
Private	1,689	3.5%
Utah Department of Transportation	34	0.1%
Totals	47,677	100%

Beaver Dam

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	43,232	76.8%
Tribal	7,815	13.9%
Utah State Institutional Trust Lands	4,305	7.7%
Private	902	1.6%
Utah State Parks	5	<0.1%
Totals	56,259	100%

Red Cliffs

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
National Forest	51,881	49.6%
Bureau of Land Management	38,702	37.0%
Utah State Parks	6,257	6.0%
Private	3,337	3.2%
Utah State Institutional Trust Lands	2,179	2.1%
Tribal	1,984	1.9%
Utah Division of Wildlife Resources	329	0.3%
Totals	104,669	100%

Pine Valley North

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
National Forest	147,262	53.2%
Bureau of Land Management	104,569	37.8%
Private	17,158	6.2%
Utah State Institutional Trust Lands	7,498	2.7%
Utah State Parks	121	<0.1%
Tribal	8	<0.1%
Totals	276,616	100%

UNIT MANAGEMENT GOALS

It is proposed to expand the range of desert bighorns sheep in the Pine Valley unit in an effort to reestablish bighorns to their native ranges (Buechner 1960, Dalton and Spillet 1971) and to promote wildlife diversity in the area for hunting and viewing, in accordance with Utah Code 23-14-21. Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized cattle grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Desert bighorn sheep historically inhabited much of the available habitat on the southern end of the Pine Valley WMU near the Arizona and Nevada borders (Buechner 1960). As with most areas in Utah, they were nearly extirpated and eventually reintroduced to many areas throughout the state. In 1988, it was estimated that about 20 bighorn sheep occupied the Beaver Dam Mountain area of Utah. It was thought that these sheep had moved north from the Virgin Mountains of Arizona following a reintroduction into that area in 1979-80. During that time, no releases were planned in Utah because domestic sheep were still being grazed on the Utah side of the range.

In 1989, an MOU between the BLM, Utah Division of Wildlife, and the Arizona Game and Fish Department was signed to protect areas that were inhabited by bighorn sheep from changing livestock grazing management from cattle to sheep. Additionally, the Apex sheep allotment on the Beaver Dam Mountains was converted to cattle in 1994 which provided an opportunity to reintroduce wild sheep into the area. At that time, 25 sheep were transplanted to the Beaver

Dam Mountains from Lake Mead, AZ. Radio collared transplanted sheep (n=10) were monitored every couple of months until the collars stopped functioning in 1999. The telemetry data from these initial releases showed considerable movement across the Utah and Arizona state line.

There is extensive habitat available throughout the Pine Valley WMU which allows for more opportunity to reintroduce sheep into historical areas. Habitat for bighorn sheep was improved north of Highway 91 on the Beaver Dam Mountains when several wildfires occurred in 2006 and removed several thousand acres of old growth pinion and juniper. Additionally, the Pine Valley bighorn sheep unit was changed in 2013 to the same boundaries as the mule deer unit to provide for more transplants and wild sheep expansion.

Currently, the population is estimated to be approximately 100 sheep along the Virgin River. The newly expanded boundaries and a surplus of sheep on the Zion WMU have provided an opportunity to reintroduce new populations onto this unit. In November 2014, 26 desert bighorn sheep from the Zion unit were transplanted to the Beaver Dam subunit to create a new population. An additional 10 sheep were relocated to the Beaver Dam unit in November of 2015. A map of the Pine Valley sub-units, modeled habitat, and current bighorn sheep distribution is provided in Figure 1.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Pine Valley unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Interactions of bighorn sheep with domestic cattle are anticipated seasonally. Dietary overlap between cattle and bighorns has not surfaced as a concern with other bighorn populations in the state and is not expected for the Pine Valley herd. Desert bighorn annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987), which also minimizes competition for water. Desert bighorn sheep have the ability to utilize metabolic water formed by oxidative metabolism, preformed water found in food, and surface water, including dew. The amount of surface water required by desert bighorns is dependent on many factors, including body size, activity, forage moisture content, temperature, and humidity (Monson and Sumner 1980). In hot, dry periods, bighorns will water daily if possible but have remained independent of surface water for periods of 5-8 days (Blong and Pollard 1968, Turner and Boyd 1970, Turner 1973, Welles and Welles 1961, 1966). Across all seasons, desert bighorns drink on average every 10-14 days (Welles and Welles 1961). It has been reported, in extreme cases, that desert bighorns did not drink for a period of several months (Monson 1958, Mendoza 1976). Koplín (1960) found that a captive herd of desert bighorn sheep that were fed a dry ration and provided unlimited water drank an average of 4.9 liters (1.3 gal) per day.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off of their ranges or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns on the Pine Valley unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services. Predator reduction work already occurs on the Pine Valley unit in conjunction with livestock losses, and therefore any additional work that may be done would be mutually beneficial to both livestock and other big game species.

POPULATION MANAGEMENT

Population Management Objective:

- 1) The Pine Valley Unit will be managed as four separate sheep sub-units with a total population objective of 650. Bighorn sheep currently occupy only the Virgin River and Beaver Dam sub-units.
 - Virgin River: 125 bighorn sheep
 - Beaver Dam: 200 bighorn sheep
 - Red Cliffs: 200 bighorn sheep
 - Pine Valley North: 125 bighorn sheep

Population Management Strategies:

Transplant Plan: Transplant(s) of wild bighorn sheep will be used to establish herds into sub-units that are currently not occupied by bighorn sheep. Initial transplant should ideally occur with a minimum of 40 bighorns. Newly transplanted bighorns will be monitored for general

movements and annual survival. Interested parties will be notified and given opportunity for discussion. This includes the Washington County Commission, BLM, USFS, and grazing permittees. If the population reaches or exceeds the population objective, management practices including transplants and ewe hunts may be incorporated to maintain the population at objective.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. The current population will likely require a minimum of 12 hours to conduct a complete trend count and survey adjacent areas to evaluate wild sheep dispersal. Additional ground classification may be conducted as conditions permit. GPS collars with mortality signals will be used to document cause-specific mortality and identify annual survival estimates. Space use will be monitored to assess potential overlap and competition with cattle. GPS collars will be added to the population as the original collars complete their usable lifespan. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan and UDWR GLN-33.

Trend Count and Classification Data for the Virgin River sub-unit.

Year	Pop Est.	Total Count	Lambs/100 Ewes	Rams/100 Ewes
2002	144	72	33	167
2004	110	55	46	12
2007	76	38	29	52
2008	46	23	15	62
2010	72	36	22	76
2012	108	54	31	69
2014	104	52	21	59
2016	103	62	29	49

Trend Count and Classification Data for the Beaver Dam sub-unit.

Year	Pop Est.	Total Count	Lambs/100 Ewes	Rams/100 Ewes
2016	68	41	30	22

Predator Management: Predator management will be coordinated with USDA Wildlife Services prior to bighorn releases. If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of desert bighorn sheep on the Pine Valley unit.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: Source herds used for establishing this population will be tested for pneumonia related pathogens prior to release to ensure healthy source stock. The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: Active domestic sheep allotments and farm flocks with domestic sheep will be evaluated for potential overlap with bighorn habitat prior to a bighorn transplant. The DWR will delineate areas where there is high risk for domestic sheep and goats to come in contact with wild sheep or where wild sheep may stray and come in contact with domestics. These areas will be considered areas of concern. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. The need to test wandering sheep from this unit will be evaluated on a case by case basis.

- Virgin River Sub-unit – There are no domestic sheep grazing allotments on federal land within this sub-unit. There are approximately 1,700 acres of private property in bighorn sheep habitat. Outreach efforts should continue with landowners about the need for spatial separation between wild and domestic sheep and goats.
- Beaver Dam Sub-unit – There are no domestic sheep grazing allotments on federal land within this subunit. There are approximately 900 acres of private property in bighorn sheep habitat. Efforts should continue with landowners to maintain spatial separation between wild and domestic sheep and goats. Expanding sheep onto the range along the Nevada border where private property exists should be avoided.
- Red Cliffs Sub-unit – Most domestic sheep grazing is several (>10 miles) to the north of this sub-unit. There is one BLM grazing allotment that may challenge effective separation. Manage for spatial separation between wild and domestic sheep.
 - There are approximately 3,300 acres of private property interspersed throughout this sub-unit. Private in-holdings within the USFS should be evaluated for domestic sheep grazing and all municipalities contacted about farm flocks prior to transplants and to help maintain effective separation between wild and domestic sheep and goats.
- Pine Valley North Sub-unit – There are several BLM grazing allotments that are available to domestic sheep in the northern portions of this sub-unit. There are more than 17,000 acres of private property in bighorn sheep habitat. While this sub-unit is the least ready for bighorn sheep reintroduction, outreach efforts should continue with landowners about the need for spatial separation between wild and domestic sheep and goats.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects on the Pine Valley unit.

- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with the BLM to utilize seeding, controlled burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and sympatric cattle are given priority.

Water Improvement: The DWR will work with the BLM and any private stakeholders to locate and cooperatively modify or improve existing water sources or install new water developments across bighorn habitat.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide high quality hunting opportunities on the Virgin River and Beaver Dam sub-units as well as the Red Cliffs and Pine Valley North sub-units when that population is established.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. A bighorn hunt will continue to be proposed on this unit. When sub-unit populations reach a population level that they can stand on their own, they will be proposed to be managed separately. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics for the Pine Valley, Virgin River Unit

Year	Permits	Mean Days Hunted	Harvest
2004	2	16.5	100%
2005	2	6.5	100%
2006	2	11.0	100%
2007	2	22.0	100%
2008	2	4.0	100%
2009	2	4.0	100%
2010	2	8.5	100%
2011	3	2.7	100%
2012	2	7.5	100%

2013	3	4.7	100%
2014	2	8.5	100%
2015	2	5.5	100%
2016	2	6	100%
2017	4*	3	100%
2018	3	5.3	100%

*includes statewide conservation permit

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the population objective or other key components of this plan are to be revised in the future, affected cooperating agencies, local stakeholders, and grazing permittees will be invited to take part in the decision-making process.

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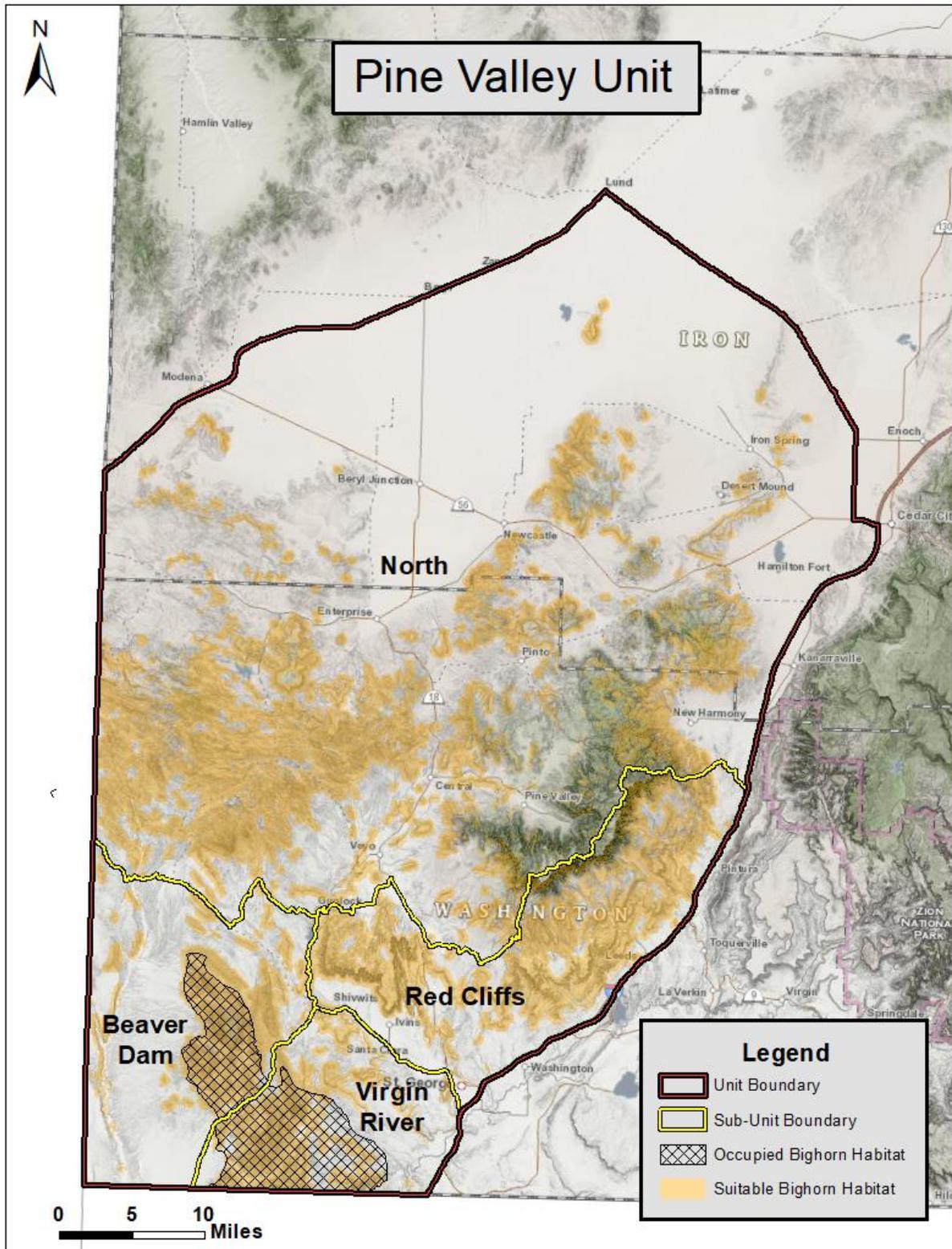


Figure 1. Pine Valley unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
SAN JUAN WMU #14
Lockhart / North / South / San Juan River
August 2019

BOUNDARY DESCRIPTIONS

Grand and San Juan counties -

Lockhart – Grand and San Juan counties-Boundary begins at the Colorado River and US-191 at Moab; south on US-191 to SR-211; west on SR-211 to the Canyonlands National Park boundary; north on this boundary to the Indian Creek and Colorado River confluence; north on the Colorado River to US-191 at Moab. EXCLUDES ALL NATIONAL PARKS.

North – San Juan County-Boundary begins at the Colorado River and Dark Canyon drainage bottom; north along the Colorado River to the confluence with Indian Creek; southeast along Indian Creek to the Canyonlands National Park boundary; south along this boundary to SR-211 at Canyonlands National Park entrance; south on SR-211 to the Bridger Jack Road; west on this road to the North Cottonwood Creek; south on this creek to the USFS boundary line; west on the USFS boundary line to Dark Canyon drainage bottom; west along this drainage bottom to the Colorado River. EXCLUDES ALL NATIONAL PARKS.

South – San Juan County-Boundary begins at the Colorado River and the mouth of Dark Canyon; east along the bottom of Dark Canyon to USFS boundary; south along this boundary to the Bears Ears road; south along this road to SR-275; south on this road to SR-95; west on SR-95 to SR-276; west on SR-276 to the eastern shoreline of Lake Powell at Halls Crossing; north on this shoreline and the Colorado River to Dark Canyon. Boundary questions? Call the Price office, 435-613-3700.

San Juan River – San Juan County-Boundary begins at the eastern shoreline of Lake Powell and SR-276 at Halls Crossing; east on SR-276 to SR-95; east on SR-95 to SR-261; south on SR-261 to US-163; south on US-163 to the San Juan River at Mexican Hat; west along the San Juan River to the eastern shoreline of Lake Powell; north on this shoreline to SR-276 at Halls Crossing.

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the San Juan bighorn sheep management sub-units.

Lockhart

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	160,167	83.1%
Utah State Institutional Trust Lands	23,034	12.0%
National Parks	5,731	3.0%
Private	3,632	1.9%
State Sovereign Land	61	<0.1%
Utah State Parks	28	<0.1%
Utah Division of Wildlife Resources	17	<0.1%
Totals	192,670	100%

North

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	120,332	49.4%
National Parks	112,037	46.0%
Utah State Institutional Trust Lands	10,566	4.3%
Private	874	0.4%
Totals	243,813	100%

South

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	277,602	72.9%
National Parks	74,699	19.6%
Utah State Institutional Trust Lands	28,090	7.4%
Private	274	0.1%
National Forest	5	<0.1%
Totals	380,669	100%

San Juan River

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	115,916	53.4%
National Parks	92,830	42.8%
Utah State Institutional Trust Lands	8,012	3.7%
Private	218	0.1%
Tribal	131	0.1%
Utah State Parks	10	<0.1%
Totals	217,118	100%

UNIT MANAGEMENT GOALS

The San Juan unit is located primarily south of Moab, between the Colorado River and US-191, and north of the San Juan River (Figure 1). Desert bighorn habitat within the San Juan unit consists primarily of the rugged, deep canyons along the east side of the Colorado River corridor. There is over 200 square miles of excellent bighorn habitat along this river corridor excluding the national park. The river corridor and its numerous side canyons provide high quality bighorn habitat characterized by steep talus slopes, open canyon bottoms and broad mesa tops. The bighorn populations in the North San Juan and Lockhart subunits are contiguous with the sheep herd in the adjacent national park. The north side of the San Juan River is historical desert bighorn habitat, but until 2008, was not believed to be occupied by bighorns. There is a sustainable bighorn population on the south side of the San Juan River on the Navajo Indian Reservation. Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Bighorn Sheep are native residents to the majority of the area. However, bighorns have been transplanted to portions of the unit in order to promote genetic diversity and to augment and expand the existing population for hunting and viewing opportunities.

Currently, all subunits in this population are under population objective and increased monitoring efforts are needed to make appropriate management decisions. Transplant efforts of wild sheep from the Zion and Potash units have recently occurred on the San Juan, North and

San Juan River subunits. A disease assessment was conducted recently on all of the San Juan subunits which indicated exposure to *Mycoplasma ovipneumoniae*.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the San Juan unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the San Juan unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Achieve a population of 750 desert bighorn sheep distributed throughout suitable habitat on the subunits as follows:
 - San Juan, Lockhart: 200 bighorn sheep
 - San Juan, North: 125 bighorn sheep
 - San Juan, South: 300 bighorn sheep
 - San Juan, San Juan River: 125 bighorn sheep

These population objectives were selected based on what can reasonably be achieved, given the habitat requirements of desert bighorn sheep and what is available within the unit, and are well within the recommended densities of 1.3-1.9 sheep per square kilometer (Van Dyke 1983).

Population Management Strategies:

- 1) Monitor the bighorn sheep population using aerial surveys and GPS telemetry to assess population trends and health.
- 2) Initiate predator management as specified in predator and bighorn sheep unit management plans. Wildlife Services or other contracted personnel may be needed in remote or hard to access areas to help reduce cougar numbers.
- 3) Document instances of interaction between wild sheep and domestic sheep and goats to allow conflicts to be evaluated and dealt with in a timely manner. Follow established guidelines in UDWR GLN-33 for dealing with domestic sheep and goats that wander into bighorn sheep units.

Population Monitoring Plan:

Monitor population size and composition every 2 to 3 years by helicopter. This unit will likely require approximately 30 hours to conduct a complete trend count. Work with NPS to monitor bighorn sheep within adjacent nation parks. Conduct ground classification as conditions permit to obtain annual production estimates. All population data will be collected and submitted on standardized forms, including all GIS data (waypoints, flight paths, etc.).

Trend Count and Classification Data

San Juan, Lockhart

Year	Pop Est.	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2008	118	59	33	6	20	6	18	61
2010	92	46	25	8	13	8	32	52
2012	80	40	26	6	8	3	23	31
2014	140	84	54	12	18	4	22	33
2017	92	55	32	9	14	6	28	44

San Juan, North

Year	Pop Est.	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2008	-	-	-	-	-	-	-	-
2010	34	17	11	1	5	3	9	45
2012	14	7	3	2	2	0	67	67
2014	23	14	8	3	3	0	38	38
2017	57	34	18	5	11	3	28	61

San Juan, South

Year	Pop Est.	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2008	244	122	64	20	38	7	31	59
2010	114	57	40	1	16	5	3	40
2012	78	39	24	2	13	5	8	54
2014	75	45	27	8	10	0	30	37
2017	103	62	38	8	16	3	21	42

San Juan, San Juan River

Year	Pop Est.	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2012	26	13	9	2	2	0	22	22
2014	63	38	24	5	9	1	21	38
2017	70	42	33	2	7	1	6	21

Transplant Plan:

These units should be managed to maintain and protect established bighorn sheep numbers and achieve unit population objectives. Augmentation priorities will be:

- San Juan River near Nokai Dome
- North San Juan subunit
- South San Juan south of Red Canyon near Lake Powell

All transplanted bighorns should be tested for disease at time of capture. All initial transplanted sheep will be monitored via GPS collars for general movements and annual survival. As transplants progress, only ear tags may be used to evaluate success of transplants. These subunits will not likely serve as source populations for at least the next 5 years or the life of this plan. UDWR will maintain working relationships with all

interested parties and invite them to participate in bighorn sheep related activities, regarding transplant efforts.

Predator Management:

The San Juan bighorn sheep subunits are within the San Juan cougar hunt subunits (Desert & Mountains). These subunits are managed as Harvest Objective units. Over the last three years the average number of cougars killed per year is 0.7 on the Desert subunit and 18 on the Mountains subunit. The 2019 quota for cougar on the Desert subunit is unlimited and 25 for the Mountains subunit. A predator management plan is currently in place for this unit for bighorn sheep and mule deer. If cougar predation is shown to have adverse impacts on bighorn sheep, cougar management will be accomplished through established UDWR policy and procedures.

Research Needs:

- 1) Primary objectives for research on the unit should focus on disease issues and low lamb survival.
- 2) Secondary objectives should focus on dispersal movements of newly transplanted bighorns.
- 3) The San Juan River population should be monitored to assess the possibility of wild sheep crossing the San Juan River and potentially being exposed to pathogens from domestics.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of desert bighorn sheep on the San Juan unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. This herd has experienced low lamb production and population declines in previous years. The specific cause(s) are unknown but is believed that disease has been a factor. This area and subunits are a high priority for disease testing and monitoring as potential transplant sites and also has herds with low lamb recruitment. Disease assessments have been conducted throughout these units between 2012 and 2019, wherein a total of 103 bighorns have been sampled. All subunits were found to be positive for *Mycoplasma ovipneumoniae*, which is considered an important pathogen in the bighorn sheep respiratory disease complex. All newly transplanted sheep should be tested and the results stored in the statewide database. Once disease profiles are established for source herds, disease testing of transplanted sheep to these subunits may decrease.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. In addition to the high risk of pathogen transmission between bighorn across the subunits, there is 1 area of concern that challenges effective separation:

- Bighorn sheep and farm flocks on the Navajo Indian Reservation on the south side of the San Juan River: The Navajo bighorn herd on the south side of the river have most likely been exposed to domestic sheep and goats from scattered farm flocks on the reservation. This bighorn herd has been thriving for many years. However, there has been some recent indication that disease may be causing low lamb survival in this herd. This is a considerable concern for exposure to bighorns on the San Juan River unit near Johns Canyon.

Risk Management and Response Plan:

All wandering wild sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. The area of greatest concern for dispersing bighorns occurs along the San Juan River. Any wild sheep dispersing from the north side to the south side of the river should be removed immediately. The need to test wandering bighorn sheep from these subunits will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers and private landowners to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.

Current and Potential Wild Sheep Distribution:

Bighorn sheep have established throughout these subunits, but densities are highest near the major river corridors and side canyons. A map of modeled and occupied habitat is included in Figure 1.

Potential Threats to Habitat:

Human disturbance can result in abandonment or degradation of bighorn habitat. Human disturbance of bighorn on these subunits is expected to be low to moderate. If disturbance becomes an issue, UDWR will work with and support federal agencies (BLM, NPS) on travel management plans and other land use plans. Furthermore, the

public will be made aware through town council and other local meetings in an effort to get local support to reduce human disturbance to bighorn sheep.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Cooperate with the BLM, on their administered lands, to utilize controlled burns and/or mechanical treatments, to remove pinyon-juniper cover on mesa tops, in order to increase and improve bighorn habitat across subunits.
- 3) Identify specific habitat restoration projects to immediately benefit bighorn sheep:
 - Found Mesa
 - Lone Butte
 - Wingate Mesa
 - Jacob's Chair
 - Piute Pass

Water Management Projects:

- 1) Work with the BLM, and private landowners to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
- 3) Install new water developments or guzzlers in bighorn habitat where water may be lacking.
 - Dripping Spring
 - John's Canyon

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the San Juan unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics

San Juan, Lockhart

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2009	2	13.0	100%	5.0
2010	2	6.5	100%	4.5
2011	2	16.5	50%	3.5
2012	2	19.0	50%	3.5
2013	1	5.0	100%	5.0
2014	1	4.0	100%	5.0
2015	1	5.0	100%	5.0
2016	1	10.0	100%	5.0
2017	2	10.0	100%	4.5
2018	2	7.5	100%	4.5

San Juan, North

Currently this subunit is not hunted; there are no recent harvest data available.

San Juan, South

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2009	3	7.7	100%	5.0
2010	3	6.7	100%	5.0
2011	2	11.0	100%	2.5
2012	2	4.5	100%	5.0
2013	2	2.5	100%	4.5
2014	2	11.5	100%	4.5
2015	1	7.0	100%	5.0
2016	1	11.0	100%	5.0
2017	2	19.5	100%	3.5
2018	1	4.0	100%	5.0

San Juan, San Juan River

This is a new subunit and was combined with the San Juan, South subunit for hunting previously, but will likely be hunted as an independent subunit during the life of this plan.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. This is a difficult considering the remoteness of the habitat currently being used by the bighorn sheep herd. Viewing opportunities do exist in John's Canyon, The Goosenecks State Park, Red Canyon, Lockhart Basin, as well as in the National Parks.

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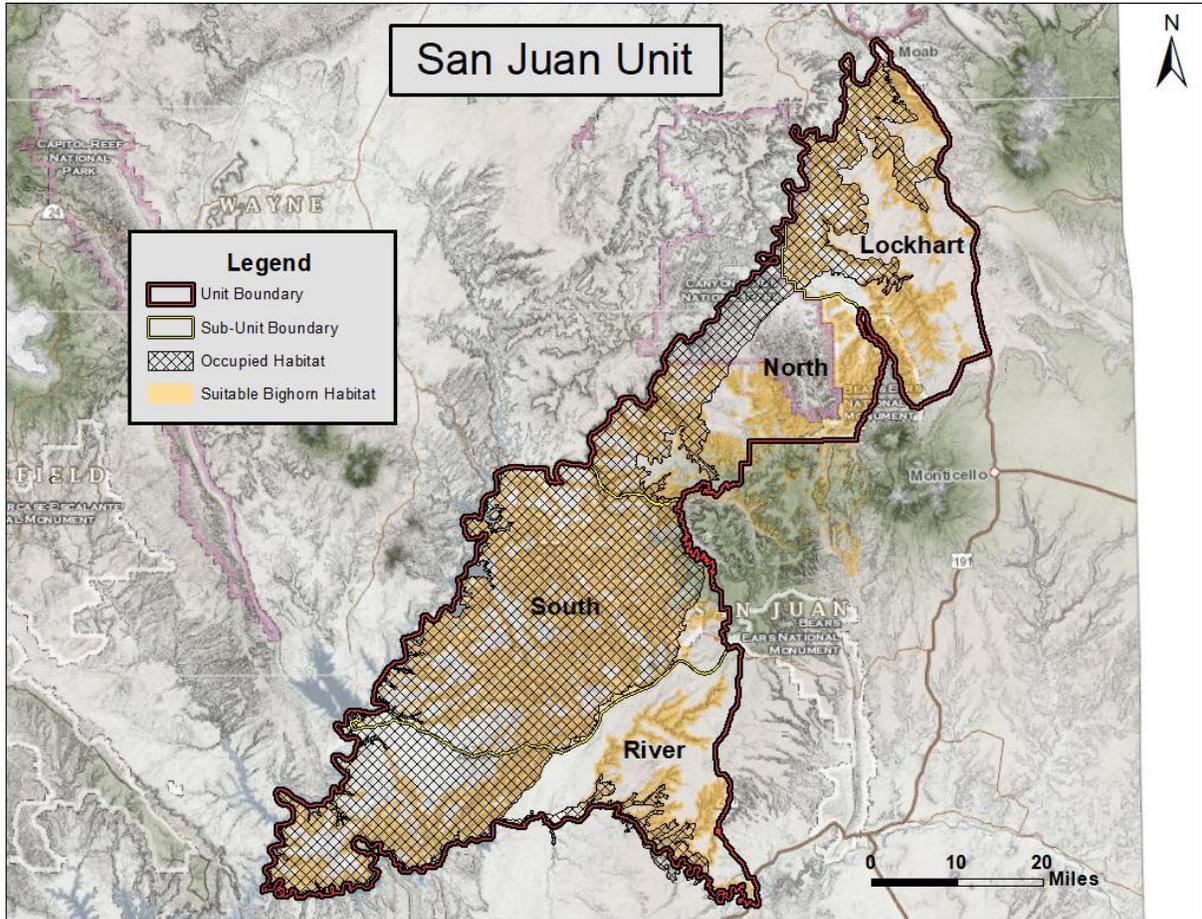


Figure 1. San Juan unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
SAN RAFAEL WMU #12
North / South / Dirty Devil
August 2019

BOUNDARY DESCRIPTION

Carbon, Emery, Wayne, Garfield, and Sevier counties –

San Rafael, North - Carbon, Emery and Sevier counties--Boundary begins at SR-10 and US-6 at Price; east and south on US-6 to I-70; west on I-70 to SR-10; north on SR-10 to US-6. Excludes all CWMUs. USGS 1:100,000 Maps: Huntington, Manti, Price, Salina, San Rafael Desert.

San Rafael, South - Emery and Wayne counties—Boundary begins at the junction of I-70 and SR-24; south and west on SR-24 to Caineville and the Caineville Wash road; north along the Caineville Wash road to the Cathedral Valley road; west on the Cathedral Valley road to Rock Springs Bench and the Last Chance Desert road; north on the Last Chance Desert road to the Blue Flats road; north and east on the Blue Flats road to the Willow Springs road; north on the Willow Springs road towards Windy Peak and the Windy Peak road; west on the Windy Peak road to SR-72; north on SR-72 to Fremont Junction and I-70; east on I-70 to SR-24. EXCLUDES ALL NATIONAL PARKS. USGS 1:100,000 Maps: Loa, Hanksville, Salina, San Rafael Desert.

Dirty Devil - Emery, Garfield and Wayne counties—Boundary begins at the junction of I-70 and the Green River; south along the Green River to the Colorado River; south along the Colorado River and the west shore of Lake Powell to SR-95; north on SR-95 to SR-24 in Hanksville; north on SR-24 to I-70; east on I-70 to the Green River. EXCLUDES ALL NATIONAL PARKS. USGS 1:100,000 Maps: Hanksville, Hite Crossing, San Rafael Desert.

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the San Rafael bighorn sheep management sub-units.

San Rafael, North

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	290,573	86.6%
Utah State Institutional Trust Lands	40,292	12.0%
Private	4,543	1.4%
Utah Division of Wildlife Resources	117	<0.1%
Utah Department of Transportation	107	<0.1%
Totals	335,631	100%

San Rafael, South

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	334,521	88.1%
Utah State Institutional Trust Lands	41,501	10.9%
Utah State Parks	1,366	0.4%
Private	1,326	0.3%
National Parks	665	0.2%
Utah Department of Transportation	61	<0.1%
Utah Division of Wildlife Resources	53	<0.1%
Totals	379,493	100%

San Rafael, Dirty Devil

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	285,107	52.8%
National Parks	220,718	40.9%
Utah State Institutional Trust Lands	32,938	6.1%
Private	592	0.1%
State Sovereign Land	418	0.1%
Utah Division of Wildlife Resources	100	<0.1%
Totals	539,872	100%

UNIT MANAGEMENT GOALS

The San Rafael wildlife management unit is in the high desert of southeastern Utah and is part of the Colorado Plateau. The San Rafael Swell anticline was formed by an enormous uplift in the earth's crust where erosion formed deep canyons and mesas providing high quality desert bighorn habitat. Elevation ranges from 4200 to 7900 feet. Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Desert Bighorn sheep are native to this area. They were hunted by indigenous people, and have been noted by early explorers. Early residents of the Dirty Devil area also saw bighorns into the 1900's (BLM, Henry Mountain Desert Bighorn Habitat Management plan). Desert bighorns on the San Rafael were believed to have been extirpated somewhere between the late 1800's and early to mid-1900s. After pioneer settlement thousands of domestic sheep grazed in desert bighorn habitats. Domestic sheep allotment AUM's on the San Rafael were eventually converted to cattle AUM's, however there are some nearby allotments as well as authorized allotments where sheep may trail through.

San Rafael, North- Desert bighorn sheep were reintroduced to the north San Rafael Swell in 1978 and the first hunt was held ten years later on the San Rafael, North unit in 1988 with two hunters afield. Between the years of 2005 and 2011 the bighorn numbers observed on the unit during the aerial surveys declined from 442 bighorns to 86 bighorns. Disease and possibly predation were suspected. Research to determine why the population was declining was initiated in 2012 when the Utah Division of Wildlife Resources (DWR) contracted with BYU to conduct a graduate study which confirmed the population had respiratory disease and that predation particularly by cougars was impacting local bighorn sheep bands.

San Rafael, South- Desert bighorn sheep were reintroduced to the south San Rafael Swell in 1983 and the first hunt was held ten years later on the San Rafael, South unit in 1993 with two hunters afield. During the most recent survey in 2018 population numbers had declined 39% from the 2015 survey. A subsequent survey will be conducted in November of 2019 targeting the most populated areas on the unit to verify the previous year's survey. A disease assessment is scheduled on the unit during the winter of 2019/2020 and will help determine if this decline in part due to respiratory disease.

San Rafael, Dirty Devil- The Dirty Devil River begins near Hanksville where the Muddy and Fremont Rivers join and is where the subunit gets its name. Most hunting and occupied sheep habitat is between the west Canyon Lands National Park boundary and along the Dirty Devil drainage with the associated canyons and mesas. Desert bighorn sheep were reintroduced to the Dirty Devil in 1991 and the first hunt was held ten years later on the unit in 2003 with two hunters afield. The highest count was recorded in 2008 with 115 sheep observed. Numbers declined to 66 in 2012. Hunters have reported coughing sheep on the unit. In 2015 the herd was tested on the unit for disease and it was confirmed that they carry pathogens that can cause respiratory disease.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the San Rafael unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the San Rafael unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Manage for a population objective of 1200 desert bighorn sheep within suitable habitat across the entire San Rafael unit. Population objectives for each subunit were chosen as a realistic number to achieve and maintain spatial separation between wild and domestic sheep. These objectives are well below the recommended densities of 1.3-1.9 sheep / sq km (Van Dyke 1983). Objectives for each subunit will be:
 - San Rafael, North: 500 bighorn sheep
 - San Rafael, South: 500 bighorn sheep
 - San Rafael, Dirty Devil: 200 bighorn sheep

Population Management Strategies:

- 1) Monitor the bighorn sheep population using aerial surveys and GPS collar technology in order to assess population trends and health.
- 2) Augment the population as needed through transplant efforts.
- 3) Initiate predator management as specified in predator and bighorn sheep unit management plans. Wildlife Services or other contracted personnel may be needed in remote or hard to access areas to help reduce cougar numbers.
- 4) Document instances of interaction between wild sheep and domestic sheep and goats to allow conflicts to be evaluated and dealt with in a timely manner. Follow established guidelines for dealing with domestic sheep and goats that wander into bighorn sheep units as outlined in UDWR GLN-33.
- 5) Conduct adequate disease sampling of bighorn sheep on the unit as needed to maintain a current disease profile.
- 6) Assess results and management recommendations of the recent BYU research and implement useful recommendations when possible.

Population Monitoring Plan:

Continue aerial surveys on the unit on a 2-3 year rotation surveying the San Rafael North and South subunits together, which will likely require 22-24 hours on the North and 20-22 hours on the South to conduct a complete trend count. The Dirty Devil will also be flown on a 2-3 year rotation with the Henry's Unit and will take 20-22 hours to conduct a complete trend count. Conduct ground classification as conditions permit to obtain annual production estimates. Monitor radio-collared bighorns 4-6 times per year to generate annual estimates of survival following DWR guidelines. All population data will be collected and submitted on standardized forms, including all GIS data (waypoints, flight paths, etc.).

Trend Count and Classification Data

San Rafael, North

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2008	250	150	82	18	50	19	22	61
2011	132	86	52	15	19	8	29	37
2012	168	101	55	26	20	1	47	36
2013	157	94	51	16	27	1	31	53
2015	207	124	60	25	39	6	42	65
2018	170	102	43	17	42	10	40	98

San Rafael, South

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2007	430	258	134	22	103	36	16	77
2009	305	183	82	31	70	28	37	85
2011	367	220	115	33	71	27	29	62
2013	313	188	100	37	51	15	37	51
2015	360	216	110	35	71	19	32	65
2018	222	133	60	15	58	14	25	97

San Rafael, Dirty Devil

Year	Pop Est	Total Count	Total Ewes	Total Lambs	Total Rams	Rams > 6 yrs old	Lambs/100 Ewes	Rams/100 Ewes
2006	127	76	33	18	25	14	54	75
2008	192	115	68	7	40	17	10	59
2010	112	67	40	12	15	7	30	37
2012	110	66	36	14	15	3	39	42
2014	100	60	32	12	16	8	38	50
2016	143	86	44	17	25	3	39	57

Transplant Plan:

These units should be managed to maintain and protect established bighorn sheep numbers and achieve unit population objectives. At this time, there are no transplants to these units scheduled. Augmentations may be warranted in the future to re-establish sheep numbers and achieve unit population management goals. Transplant priorities will be based upon disease profiles, densities, habitat, and overall potential for herd expansion. Initial transplanted sheep will be monitored for general movements and annual survival. The DWR will maintain working relationships with all interested parties and invite them to participate in bighorn sheep related activities, regarding transplant efforts.

Predator Management:

The San Rafael units are managed under a predator management plan. The unit is designated as a bighorn sheep protection area with a liberal cougar harvest quota and a year-round cougar hunting season. Mountain lions are the most significant predators of bighorns in Utah. Coyotes, bobcats, and golden eagles may also take bighorn sheep. Over the last three years, an average of 7 cougars was killed per year on the San Rafael unit. During the 2 year BYU field research project, cougar predation has been shown to adversely impact the North San Rafael sheep population. Fifty percent of collared bighorn sheep mortalities were attributed to cougar predation. The cougar population on this unit should be managed to allow bighorn population to increase if efforts to reach the population objective. Cougar harvest on this unit is difficult because of topography, remoteness, and access. Increased efforts to take or harvest cougars and

protect this bighorn herd are being taken and should continue through established DWR policy and procedures provided in the statewide bighorn sheep and cougar management plans.

Research Needs:

- 1) Primary objectives for research on the unit should focus on disease issues and low lamb survival.
- 2) Secondary objectives should focus on dispersal movements of newly transplanted bighorns.
- 3) Recreationists are attracted to the San Rafael Swell area mainly as a result of social media and tourism marketing. Recreation is increasing substantially particularly on the San Rafael, North unit around Buckhorn Wash and the Wedge areas. At the Wedge there is currently a user created trail which follows along the Goodwater Canyon Rim and has become a destination trail particularly for mountain biking. This trail is of concern because of the local bighorn herd uses this canyon to lamb in. The numbers of recreationist will impact this herd long term if considerations are not made to limit recreation in this area. The BLM is working to designate this trail in order to manage off trail use, designate camping areas, and install restrooms to mitigate crowding use. These efforts will help somewhat but the sheep population in this area may potentially be affected by the increasingly high human impacts. It is an ideal area to begin research and build upon the research performed in the recent past.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of desert bighorn sheep on the San Rafael unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. Disease testing should be a priority to guide future transplant efforts in these subunits. The presence of pneumonia pathogens in the population may likely lead to future outbreaks, and recovery is unlikely to be enhanced by translocating native, healthy animals into the population (Plowright et al. 2013). These units are a mid-level priority for statewide disease testing as units with low lamb recruitment and potential transplant sites. A total of 16 bighorn sheep were disease-tested on the North San Rafael unit in 2012, and 19 bighorns were sampled in the Dirty Devil area in 2015. These populations have experienced mortalities due to respiratory disease in the past. Several of the bighorns tested were positive for *Mycoplasma ovipneumoniae* (M.ovi). M.ovi is considered an important pathogen in the bighorn sheep respiratory disease complex. More information on the San Rafael, South sub-unit would help make a more complete health profile and hopefully will help in making management decisions.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. The following are the primary threats that challenge effective separation

- 1) Active sheep and trailing allotments - The South Wolf Hollow and the Rock Canyon allotments are the closest to occupied bighorn sheep habitat. There are also active trail allotments which include trailing sheep from Cleveland to Castle Dale through the Cleveland Winter allotment, the Red Seeps Allotment and the Buffalo and Hadden Hills pastures (north and west of Buckhorn Reservoir) of the Buckhorn Allotment.
- 2) Farm flocks on private lands along the SR-10 corridor - One of the greatest disease risks posed to the San Rafael desert bighorns are from escaped or wandering domestic sheep and goats from the nearby agricultural communities. Correspondingly, the same risk is posed from desert bighorns wandering into domestic sheep and goat areas, being exposed, then returning to a bighorn herd.

Outreach efforts should take place with permittees and BLM employees concerning domestic and wild sheep interactions. Active removal of bighorn sheep within or close to these allotments, trailing areas, and private lands should be a priority.

Risk Management and Response Plan:

High risk areas will be within the domestic allotments and trailing areas. Wild sheep that are in close contact with domestics should be removed immediately. All wandering wild sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. The need to test wandering sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain and improve bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers and private landowners to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.

Current and Potential Wild Sheep Distribution:

Bighorn sheep have established throughout bighorn habitat in these subunits. Desert bighorns are primarily associated with canyons, mesas, and slopes of the San Rafael Swell and the Dirty Devil River corridor. Areas where bighorns have declined, there is potential for sheep to reoccupy favorable habitat. Bighorns have generally not been centrally distributed within the Swell. A map of occupied habitat is included in Figure 1.

Potential Threats to Habitat:

- 1) Human disturbance including vehicular off-road travel, natural resource extraction, organized competitive athletic events, biking trails, and camping near springs and water sources can result in abandonment or degradation of bighorn habitat. Due to the rugged nature and lack of roads in much of sheep habitat, human disturbance from vehicular recreation is lessened. But some areas where desert sheep are accessible, for example Goodwater Canyon, disturbance will be heavier as more people look to recreate in lesser used accessible areas as is happening on the San Rafael Swell. If disturbance becomes an issue, DWR will work with and support federal agencies (e.g. BLM and NPS) on travel management plans and other land use plans and outreach efforts may be made to gain local support to reduce human disturbance to bighorn sheep habitat.
- 2) Severe and long-term drought may affect bighorn habitat ultimately impacting population trend and distribution on the unit.

Vegetation Management Projects:

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Cooperate with the BLM and SITLA to utilize controlled burns and/or mechanical treatments to remove pinyon-juniper encroachment and improve bighorn habitat across the subunit.
- 3) Identify specific habitat restoration projects to benefit bighorn sheep.
 - 1) Some areas to consider for PJ removal:
 - 2) NSR- along canyon rims (outside of WSA) between the head of Nates/Spring Canyon and Buckhorn Wash and the Wedge.
 - 3) SSR: canyons rims along Reds Canyon, Copper Globe area, and the Head Of Sinbad.
 - 4) Dirty Devil: Canyon rims and flats in areas around Twin Corral Flats, and Twin Corral Box, Sams Mesa Box, and French Spring canyons.

Water Management Projects:

- 1) Work with the BLM, SITLA, and permittees to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
- 3) Identify areas in otherwise favorable habitat where water developments/guzzlers would benefit desert bighorns by expanding their range, improving production, and possibly decrease drought related stressors. Identify projects on SITLA first then identify areas on BLM.
- 4) There are some concerns that providing an artificial water source in an otherwise dry environment may negatively impact kit fox populations in the area. Artificial water sources can increase coyote densities and coyotes are a natural predator of kit fox. Prior to establishing an artificial water source, it must be known if kit fox are in the area and if so alternatives may need to be found and/or the project mitigated.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the San Rafael unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics

San Rafael, North

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2009	5	7.2	100%	4.8
2010	5	8.8	100%	4.4
2011	5	14.4	80%	4.2
2012	3	9.5	67%	3.5
2013	1	20.0	100%	4.0
2014	1	6.0	100%	5.0
2015	1	4.0	100%	5.0
2016	2	21.5	50%	3.5
2017	3	9.3	100%	4.7
2018	3	6.0	100%	5.0

San Rafael, South

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2009	8	10.8	75%	3.3
2010	9	10.2	100%	4.8
2011	9	11.1	79%	3.9
2012	8	10.0	100%	4.8
2013	9	10.6	100%	4.4
2014	6	11.0	100%	4.8
2015	6	11.0	100%	4.8
2016	7	8.4	85.7%	4.6
2017	8	13.4	100%	4.5
2018	7	8.3	85.7%	4.9

San Rafael, Dirty Devil

Year	Permits	Mean Days Hunted	Harvest	Satisfaction
2009	5	11.0	80%	3.6
2010	6	8.8	83%	4.3
2011	6	10.2	83%	3.5
2012	3	3.0	67%	4.3
2013	3	12.0	100%	5.0
2014	2	9	100%	5.0
2015	1	20	100%	5.0
2016	1	11.0	100%	3.0
2017	2	4.5	100%	5.0
2018	1	20	100%	5.0

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

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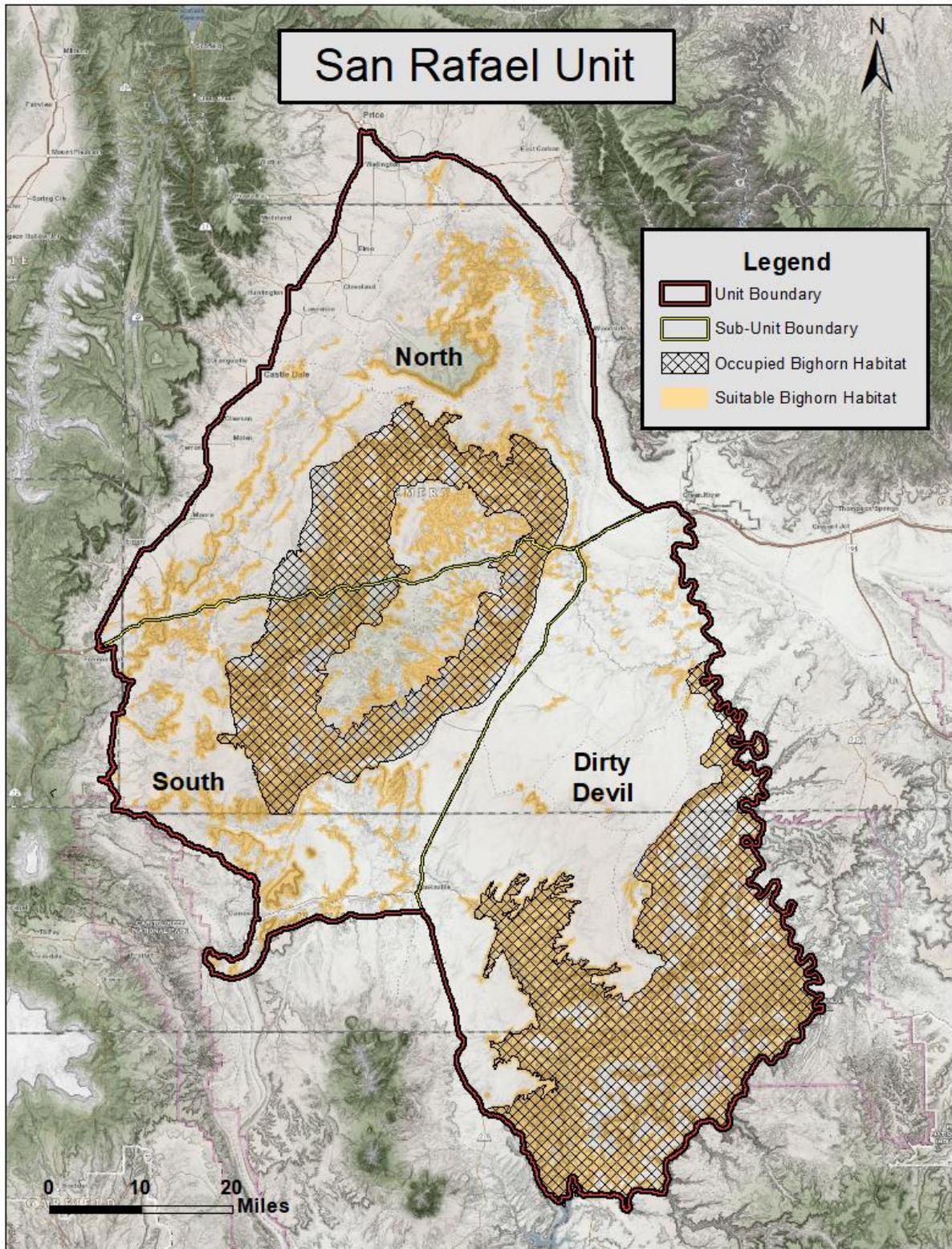


Figure 1. San Rafael unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
UINTA MOUNTAINS, NORTH SLOPE / SOUTH SLOPE, WMUs #8 & 9
August 2019

BOUNDARY DESCRIPTION

Boundary begins at the Junction of Highway US-40 and Highway SR-87 in Duchesne; then north on SR-87 to Highway SR-35; northwest on SR-35 to the Provo River; north along this river to North Fork Provo River; north along this river to SR-150; north along SR-150 to the Utah-Wyoming state line; east along this state line to the Utah-Wyoming-Colorado state line (Three Corners); south along the Utah-Colorado state line to the White River; west along the White River to the Green River; north along the Green River to the Duchesne River; west along the Duchesne River to US-40 at Myton; west along US-40 to SR-87 in Duchesne. EXCLUDING ALL INDIAN TRUST LANDS WITHIN THIS BOUNDARY.

The Utah Division of Wildlife Resources does not have management jurisdiction on Dinosaur National Monument or Ute Tribal Trust lands inside this boundary. Therefore, this plan does not address the management of Rocky Mountain Bighorn Sheep on Dinosaur National Monument or Ute Tribal Trust lands.

SUBUNIT BOUNDARY DESCRIPTIONS (Figure 1):

8a-The North Slope Summit subunit is west of the Burnt Fork- Birch Creek drainage divide and includes the Hoop Lake sub-population. A large portion of this subunit's population currently summers in the Gilbert Peak area (upper Henry's Fork Basin).

8b-The North Slope West Daggett subunit is south and west of Flaming Gorge Reservoir to the Burnt Fork-Birch Creek drainage divide, and includes the Sheep Creek and Carter Creek / South Red Canyon subpopulations. Rams from the Sheep Creek herd migrate west and south to the High Uinta Mountains, south of Hoop Lake, to summer, then return to Sheep Creek for the rut in November.

8c-The North Slope Three Corners subunit is east and north of Flaming Gorge Reservoir and the Green River, and includes the Bare Top and Goslin Mountain sub-populations.

9a-The South Slope Yellowstone subunit is the western two thirds of the South Slope and includes the drainages of the North Fork of the Duchesne, Rock Creek, Lake Fork, Yellowstone, Uinta, Farm Creek and Whiterocks. This subunit includes the summering bighorn near Gilbert Peak and Gilbert Basin.

9b- The South Slope Vernal subunit is north of the Green River between the Whiterocks River and Diamond Mtn. and includes the drainages of Dry Fork, Ashley Gorge, Brush Creek Gorge, Gorge Creek and Little Brush Creek. This subunit includes the Dinosaur National Monument bighorn and some high country use by Sheep Creek bighorn.

9c- The South Slope Diamond Mountain subunit includes the drainages of Tolliver Creek, Sears Creek, Crouse Creek, and the south side of the Green River Corridor from Little Hole east to the Colorado state line. This subunit includes a few of the Dinosaur

National Monument bighorn. 9d- The South Slope Bonanza subunit includes Blue and Split Mountains, and Dinosaur National Monument. It is mostly desert habitat. Other than the Green River corridor there is very little bighorn habitat in the rest of the subunit.

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the Uinta Mountains bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
National Forest	717,013	65.3%
Bureau of Land Management	159,857	14.6%
Private	93,011	8.5%
Tribal	48,402	4.4%
National Parks	35,111	3.2%
Utah State Institutional Trust Lands	31,720	2.9%
Utah Division of Wildlife Resources	10,260	0.9%
Utah State Parks	1,614	0.1%
State Sovereign Land	393	<0.1%
National Wildlife Refuge	391	<0.1%
Totals	1,097,772	100%

UNIT MANAGEMENT GOALS

The Utah Statewide Bighorn Management plan was approved by the Utah Wildlife Board in 2018. In accordance with that plan an MOU between the state and the US Forest service was signed in 2019 that identifies management responsibilities and areas of cooperation between the state and US Forest Service (Appendix A). This plan identifies the status and management direction specific to this unit under those documents.

HISTORY AND CURRENT STATUS

Bighorn sheep were historically abundant and found across all of the Uinta Mountains. Bighorn habitat is located within the steep rocky canyons and hillsides as well as the high alpine habitat above timberline in the High Uintas. Native bighorn sheep were abundant on the Uintas in the 1800's but by 1915 they had become less common. Bighorn were documented in 1946 near Granddaddy Basin and a bighorn was photographed in Dry Fork Canyon as late as 1967.

Bighorns were reintroduced in the Uintas starting in 1983 near Flaming Gorge. Numerous transplants have occurred since then (Table 1). The most recent transplant occurred in Jan. 2014 to Goslin Mountain in the Three Corners subunit. Five sites have received transplants and despite challenges and several disease related set-backs, bighorn have persisted across the Uinta Mountains since these restoration efforts began. The current population is estimated at 150 to 200 sheep (Table 1). A map of current known and potential distribution is depicted in Figure 1.

On two occasions bighorns have been removed to serve as transplant stock to other units in the state (Table 2). Providing transplant stock from Utah bighorn herds only occurs from healthy herds and has been rare, thus highlighting the success and importance of this bighorn unit to the state early on.

This unit receives significant recreational use of the bighorn herd through both hunting and viewing. The first ram hunt was in 1993. Hunting currently continues at a very conservative rate (Table 3).

The bighorn sheep in the herds within this unit harbor pathogens that can cause respiratory disease. Respiratory infections were found to decrease lamb survival during the mid-1990s. Subpopulations were subsequently medicated to reduce this infection rate. During the winter of 2009-2010, sick and dead sheep were detected in the Goslin Mountain herd. Disease samples were taken from these sheep and came back positive for pneumonia and mycoplasma. The Goslin Mountain herd was subsequently culled to reduce the potential for the pneumonia and mycoplasma to spread to the other herds in the area, specifically Bare Top. A total of 50 bighorn sheep were culled from the ground and by helicopter. It is unknown if this stopped the spread of the pneumonia and mycoplasma to Bare Top. The Bare Top sheep population experienced a suspected disease-related mortality event in 2013 but viable disease samples were not obtained from the dead bighorn sheep due to warm weather conditions and time lags between death, detection and sampling. Subsequent disease sampling during capture efforts has found mycoplasma in all the herds. There are currently mycoplasma positive domestic sheep and bighorn on the unit.

Predator management plans are in place for the Uinta Mountains units which include a year round harvest objective for cougar hunting to encourage cougar harvest.

ISSUES AND CONCERNS

Potential Habitat: We modeled potential bighorn sheep habitat on the Uinta Mountains unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Uinta Mountains unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Maintain a bighorn sheep population on the Uinta Mountains. The population objective for the unit will be to manage for 450 Rocky Mountain bighorn sheep within the areas currently occupied by bighorn sheep. Currently, bighorn sheep occupy much of the rugged terrain east of the ridge running northeast from Gilbert Peak (Figure 1). The population objective of 450 was determined based on a density of 1.3-1.9 sheep/sq km (Van Dyke 1983). In the future, if comingling and disease

transmission conflicts are resolved creating opportunities to expand bighorn sheep distribution/populations the population objective will be adjusted accordingly.

Population Management Strategies:

- 1) Augment existing populations where needed to improve herd distribution, connectivity and genetic diversity. A representative sample of transplanted adults will be fitted with GPS satellite transmitter collars. Transplants of 40+ animals are preferred.
- 2) Monitor herds for disease related mortality and provide treatment if possible.
- 3) Cooperation and collaboration with domestic livestock operators will continue.

Population Monitoring Plan:

Monitor population size and composition every 2-3 years by helicopter and/or by annual ground surveys. Conduct pre and post-season ground classification (Table 4). Monitor collared sheep throughout the year and generate annual estimates of survival and population size. All population data will be collected and submitted on standardized forms, including all GIS data (waypoints, flight paths, etc.). Maintain an adequate sample of bighorn sheep with GPS satellite collars to monitor survival, distribution, habitat use, and migration patterns at a sub-population level.

Transplants:

There is great potential for bighorn sheep restoration and population expansion in the Uinta Mountains. However, the risk of comingling and pathogen transmission between domestic and wild bighorn sheep is cause for proceeding with caution, applying best available science and working with all interested and potentially affected parties collaboratively. The UDWR recognizes, understands and accepts the risk of failure associated with any future transplant efforts.

Bighorn sheep transplants to start new wild sheep populations in the Uinta Mountains are unlikely unless they are preceded by changes to current domestic sheep grazing practices and/or new technologies are developed which will allow comingling between domestic sheep and bighorns without either species experiencing adverse effects. The only mechanism acceptable to the UDWR for altering domestic sheep grazing practices to avoid comingling on public or private lands is through voluntary actions undertaken by individual domestic livestock operators and/or landowners.

Within approved areas population augmentation transplants may occur to improve herd distribution, link small populations when deemed beneficial, and to improve genetic diversity.

The Uinta Mountains bighorn herds will not likely serve as a source population for other areas due to disease concerns. When transplants are appropriate, source animals should come from populations with similar disease profiles. .

Any transplanted sheep will be monitored for general movements and annual survival. Predator management prior to and after transplants should occur and be coordinated with Wildlife Services.

The following transplant sites were approved in the 2018 Utah Statewide Bighorn Sheep management plan. Reintroduction sites will only be considered if comingling concerns are addressed and resolved and/or new technology becomes available to prevent disease incidents which may adversely affect the bighorn sheep.

1. Augmentations to existing populations/management units to meet objectives
 - a. North Slope – Summit, Three Corners and West Daggett subunits
2. Potential reintroduction areas to establish new populations:
 - a. South Slope Uintas, potential sites include:
 - i. Brush Creek Gorge, Ashley Gorge and Dry Fork complex: Excellent bighorn habitat already exists in Brush Creek Gorge. The limiting factor at this site is potential for comingling and pathogen transmission on private property in lower Brush Creek and Dry Fork Canyon.
 - ii. Diamond Mountain complex: Includes Crouse Canyon, Sears Creek, Mail Draw, Warren Draw and Tolliver Creek. The limiting factor at this site is the potential for comingling and pathogen transmission on private property on Diamond Mountain.
 - iii. Whiterocks and Uinta Canyon complex: Excellent bighorn habitat exists in Uinta and Whiterocks Canyons. The limiting factor at this site may be potential for comingling and pathogen transmission in the head of Uinta Canyon or on private property at the mouth of the canyon.
 - iv. Lake Fork and Yellowstone Complex: Prescribed burning will further enhance bighorn habitat in this complex. The limiting factor at this site may be potential for comingling and pathogen transmission in the high country.
 - v. Rock Creek and North Fork of the Duchesne Complex: Additional burning will enhance bighorn habitat throughout this complex. The limiting factor at this site may be potential for comingling and pathogen transmission in the high country and to the west.

Predator Management:

The Uinta Mountains units are currently managed as year round Harvest Objective cougar units with a generous quota to encourage cougar harvest.

Predator management plans for cougar and coyotes are currently in place for the Uinta Mountains units.

If cougar predation is shown to have adverse effects bighorn sheep, cougar management will be accomplished through established UDWR policy and procedures.

Cougar removal efforts should take place prior to any bighorn transplant.

Research Needs

- 1) Determine bighorn sheep distribution and habitat use in high elevation areas.
- 2) GPS data from collared sheep will be used to evaluate distribution, movements and annual survival.

- 3) Continue to increase our understanding of how harmful pathogens are transmitted to bighorn sheep, what animals can act as vectors, and how transmission can be prevented.
- 4) Look for new technology such as vaccinations which may provide immunity to the pathogens causing respiratory diseases in the bighorn sheep and whether this immunity could be passed on to their lambs.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Unita Mountains unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. The Uinta Mountains herds are a high priority unit for disease testing since they have been previously documented to have suffered disease events. The disease history in the Goslin Mountain area and suspected disease event in 2013 suggest the need for additional disease monitoring efforts. It is uncertain as to how the bighorns in the Goslin Mountain area contracted the pathogens that precipitated the disease event. Pursue disease testing for all live captured bighorn and attempt to collect samples from hunter-harvested animals.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. Utilize the strategies in the statewide bighorn management plan and in accordance with the MOU with the US Forest Service to work with land management agencies, permittees, and private landowners to reduce the risk of contact with domestic sheep and goats. Spatial separation is difficult to maintain in portions of the bighorn range that are near active domestic sheep grazing allotments (Figure 2). The DWR will work with grazing permittees to maximize separation to the extent possible. The DWR will use approved management tools to reduce the likelihood of commingling between bighorn and domestics, including lethal removal by DWR employees as well as approved livestock operators when DWR deems it is appropriate.

Risk Management and Response Plan:

All wandering bighorn sheep and stray domestic sheep and goat issues will be handled according to policy UDWR GLN-33 and the guidelines in statewide bighorn management plan.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with land managers and private landowners to protect these areas.
- 3) Focus habitat improvements for bighorn to the east of Gilbert Peak to reduce potential interaction between bighorn and domestics. The primary focus area for clearing bighorn migration routes should be to the east end of the Uintas.
- 4) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 5) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.
- 6) Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas.
- 7) Support conservation groups' efforts to pursue voluntary buy outs and conversions of domestic sheep grazing allotments by working with willing permittees in bighorn areas to minimize the risk of disease transmission.
- 8) Inform and educate the public concerning the needs of bighorn sheep including the effects of human disturbance and the need for habitat improvements.

Potential Threats to Habitat:

Human disturbance can result in abandonment or degradation of bighorn habitat. Due to the rugged nature and lack of roads near sheep habitat, human disturbance of bighorn on this unit is expected to be low. If disturbance becomes an issue, UDWR will work with and support federal agencies (BLM, USFS) on travel management plans and other land use plans. Furthermore, the public will be made aware through town council and other local meetings in an effort to get local support to reduce human disturbance to bighorn sheep. Bare Top will remain closed to motorized vehicles to reduce human disturbance.

Vegetation Management Projects:

- 1) Initiate or support vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts. Mechanical treatments and controlled burning is proposed along Flaming Gorge Reservoir and is highly supported by UDWR.
- 2) Cooperate with the USFS and BLM to utilize controlled burns, wildfire management and/or mechanical treatments to remove conifer encroachment on open hillsides to increase and improve bighorn habitat across the unit.
- 3) Identify specific habitat restoration projects to immediately benefit bighorn sheep:
 - Reduce conifer around Hoop Lake.
 - Conifer removal in Carter Creek and along the south side of Flaming Gorge Reservoir.
 - Reduce conifer along migration corridors to the High Uintas.

Water Management Projects:

- 1) Work with USFS, the BLM, and private landowners to locate, protect and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
- 3) Install new water developments or guzzlers in bighorn habitat where water may be lacking.
- 4) Continue to improve existing guzzlers for bighorn sheep on Bare Top(8c), Rifle Canyon(8c), Dowd Mountain(8b), and Death Valley(8b) all of these have been replaced in the past 4 years except for rifle canyon

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Uinta Mountains unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. Significant viewing opportunities are available at Sheep Creek or near the Red Canyon overlook.

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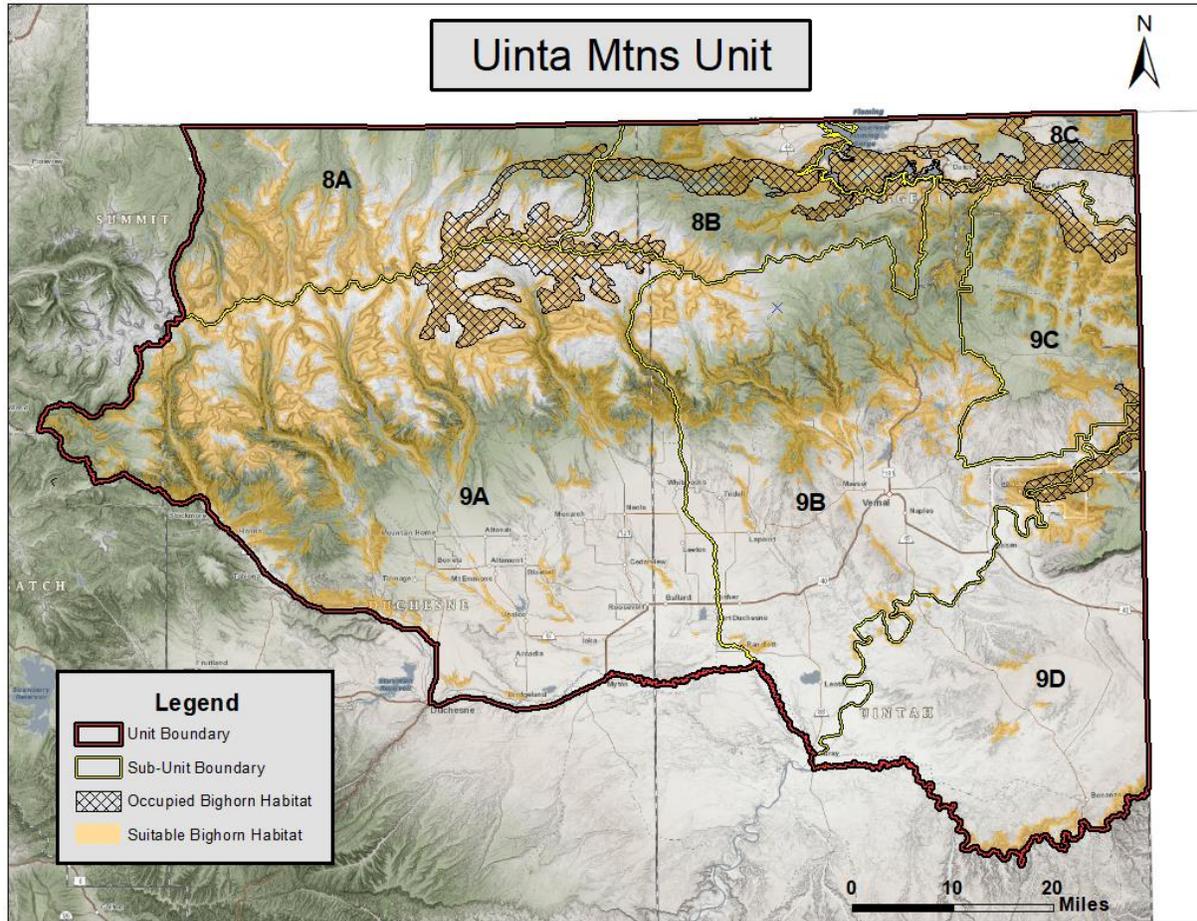


Figure 1. Uinta Mountains unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

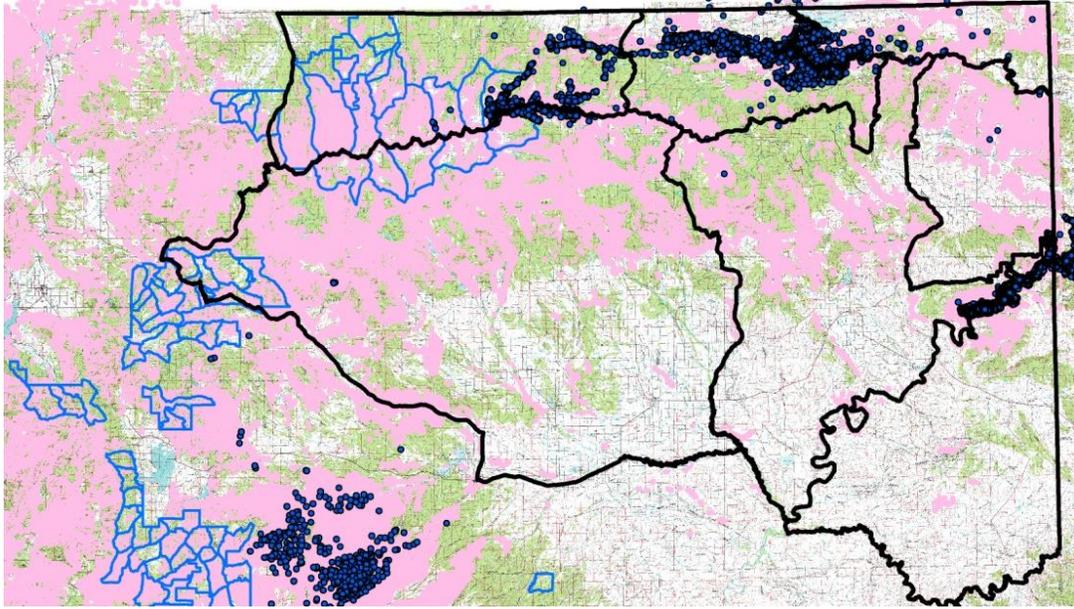


Figure 2. Bighorn sheep distribution on the Uinta Mountains and active USFS domestic sheep allotments.

Table 1. Transplant History and Population Status of bighorn sheep on the Uinta Mountains.

Area Released	Source	Year Released	Number Released	2000 Population Estimate	2004 Population Estimate	2013 Population Estimate	2018 Population Estimate	Current Trend
Bare Top Mountain	Whiskey Basin, WY	1983	19					Down
	Whiskey Basin, WY	1984	17	80 – 110	60 - 80	65-85	45-65	
	Almont Triangle, CO*	2000	6					
	Basalt, CO**	2001	4					
Sheep Creek	Whiskey Basin, WY	1989	21					Stable
	Almont Triangle, CO	2000	6	35 – 45	50 - 60	35-45	40-55	
	Basalt, CO **	2001	1					
Carter Creek / South Red Canyon	Almont Triangle, CO*	2000	11					Down
	Basalt, CO **	2001	17	17 (new transplant)	40 - 50	40-50	30-45	
	Desolation Canyon, UT	2003	6					
Hoop Lake	Whiskey Basin, WY	1989	23 Total	35 – 45	15 - 20	15-20	15-25	Stable

Goslin Mountain	Thompson Falls, MT	2005	34					
	Bonner, MT	2007	42				10-15	
	Desolation Canyon, UT	2014	23					
Total			230	165 - 215	175 - 210	150 - 200	140-205	Stable

* Six sheep moved to Bare Top from the Carter Creek transplant

** Four sheep moved to Bare Top and one to Sheep Creek from the South Red Canyon transplant

Table 2. Removal history of bighorns translocated to other units.

Year	Subpopulation	Number	Transplant Location
1992	Bare Top	2 (rams)	Desolation Canyon, UT
1992	Bare Top	2 (rams)	Pilot Mountain, UT
2000	Bare Top	15	Desolation Canyon, UT
Total		19	

Table 3. Bighorn Harvest, North Slope Unit.

Year	North Slope, 3 Corners, Bare Top				North Slope, West Daggett, Sheep Creek			
	Permits	Mean Days	Harvest	Satisfaction	Permits	Mean Days	Harvest	Satisfaction
2004	2	2.5	100%					
2005	2	5.5	100%	5	2	9	100%	5
2006	2	16	100%	4.5	2	4.5	100%	5
2007	3	10.3	100%	5	3	8	100%	5
2008	3	6.7	100%	5	3	15.7	100%	5
2009	3	4.3	100%	5	3	7	100%	5
2010	2	4	100%	5	3	4	100%	5
2011	3	6.7	100%	4	3	4.3	100%	5
2012	3	8	100%	4.7	3	5.7	100%	5
2013	3	4	100%	4.7	3	2.7	100%	4.3
2014	1	-	100%	-	3	3.5	100%	4.5
2015	1	15	100%	5	2	8.5	100%	5
2016	1	3	100%	4	2	6	100%	4
2017*	4	6.5	100%	4.8				
2018*	3	16.7	67%	3.7				

*West Daggett, Sheep Creek and 3 Corners, Bare Top hunt units were combined into 1 hunt.

Table 4. Post-season classification data from 2009-2018 for the West Daggett and Bare Top Rocky Mountain bighorn sheep herds.

North Slope, Three Corners, Bare Top							
	Rams	Ewes	Lambs	Unclassified	Total	Rams/100 Ewes	Lambs/100 Ewes
2009*	37	15	7	17	76	247	47
2010	23	33	10	0	66	70	30
2011	46	24	2	0	72	192	8
2012	9	18	8	0	35	50	44
2013	11	17	3	16	47	65	18
2014	9	20	10	0	88	45	50
2015	15	25	4	0	44	60	16
2016	12	13	3	0	28	92	23
2017	12	9	6	0	27	133	67
2018	13	13	5	0	31	100	39

North Slope, West Daggett, Sheep Creek							
	Ram s	Ewes	Lambs	Unclassified	Total	Rams/100 Ewes	Lambs/100 Ewes
2009*	16	33	15	0	64	49	46
2010	22	41	5	0	68	54	12
2011	17	48	19	0	84	35	40
2012	20	42	21	2	85	30	52
2013	19	38	9	0	66	50	24
2014	19	41	19	0	79	46	46
2015	15	27	10	0	52	56	37
2016	16	24	11	0	51	67	46
2017	8	17	8	0	33	47	47
2018	22	34	13	0	69	65	38

*Pre-season data reported.

Appendix A. Memorandum of Understanding between the State of Utah, Utah Division of Wildlife Resources, Utah Department of Agriculture and Food, and the USDA Forest Service Intermountain Region.

FS Agreement Number: 19-MU-11046000-028

MEMORANDUM OF UNDERSTANDING
Between The
STATE OF UTAH
And The
UTAH DIVISION OF WILDLIFE RESOURCES
And The
UTAH DEPARTMENT OF AGRICULTURE AND FOOD
And The
USDA, FOREST SERVICE INTERMOUNTAIN REGION

This MEMORANDUM OF UNDERSTANDING (MOU) is hereby made and entered into by and between the State of Utah, referred to as "State of Utah", the Utah Division of Wildlife Resources, hereinafter referred to as "UDWR", the Utah Department of Agriculture and Food, hereinafter referred to as "UDAF", and the USDA Forest Service Intermountain Region, hereinafter referred to as "Forest Service". The State of Utah, UDWR, and UDAF are collectively referred to as the "State."

Title: Memorandum of Understanding for the Management of bighorn sheep on National Forest System (NFS) lands in the State of Utah.

I. PURPOSE

The purpose of this MOU is to document the cooperative efforts of the parties to manage bighorn sheep herds and their habitats on NFS lands in the State of Utah, to the extent consistent with federal law and regulation.

II. STATEMENT OF MUTUAL BENEFITS AND INTERESTS

The Forest Service has authority to enter into and engage in the activities described in this MOU under the laws of the United States and the regulations of the Secretary of Agriculture. The Forest Service administers NFS land and manages natural resources on those lands, including wildlife and fish habitat, in accordance with federal law and regulation.

The State of Utah, UDWR, and UDAF have authority to enter into this MOU under the laws of the State of Utah. In Title 23 of the Utah Code, UDWR is created and charged with responsibility to, among other things, perpetuate and manage the fish and wildlife resources of the State in balance with the social and economic activities of man. UDWR carries out the policies and programs of the Utah Wildlife Board (Board). UDWR manages activities related to the distribution, abundance

and sustainability of bighorn sheep in Utah, as determined by the Board and Utah statutes. In Title 4 of the Utah Code, UDAF is created and charged with responsibility to, among other things, regulate livestock and agricultural products, and to promote programs designed to determine the best means and methods for the control of disease among domestic and wild animals.

It is the mutual desire of all parties to this MOU to cooperate in managing bighorn sheep while providing opportunities for domestic sheep grazing in Utah. The Forest Service, State of Utah, UDWR, and UDAF acknowledge that each party has important management responsibilities relating to wildlife, habitat, livestock, and/or range resources and will endeavor to work cooperatively to fulfill these responsibilities, consistent with the applicable laws and regulations.

In consideration of the above premises, the parties agree as follows:

III. THE UDWR WILL:

- A. Maintain close cooperation, as needed, in matters of mutual interest including management of bighorn sheep habitat and populations and management of areas of potential bighorn sheep/domestic sheep contact.
- B. Work collaboratively to incorporate Forest Service and UDAF input and recommendations relative to bighorn sheep management objectives and actions developed by UDWR.
- C. Consult and confer with UDAF and/or the Utah State Veterinarian when appropriate.
- D. Provide public information and education outreach assistance for increasing public awareness of the interactions between domestic and bighorn sheep populations.
- E. Recognize the jurisdiction and responsibilities of the Forest Service to manage public and commercial use, wildlife habitat, and livestock grazing on NFS lands.

IV. THE UDAF WILL:

- A. Maintain close cooperation with the parties, as needed, in matters of mutual interest including management of bighorn sheep habitat and populations and management of areas of potential bighorn sheep/domestic sheep contact.
- B. Work collaboratively with UDWR to implement the strategies, goals, and objectives in the Utah Bighorn Sheep Statewide Management Plan, attached hereto and incorporated as Appendix A.

- C. Provide public information and education outreach assistance for increasing public awareness of the interactions between domestic and bighorn sheep populations.
- V. THE U.S. FOREST SERVICE WILL:
- A. Maintain close cooperation, as needed, in matters of mutual interest including management of bighorn sheep habitat, bighorn sheep populations, and potential bighorn sheep/domestic sheep contact from domestic sheep authorized on NFS lands.
 - B. Work collaboratively to provide input and recommendations to UDWR and Board relative to bighorn sheep management objectives and actions on NFS lands. The Forest Service recognizes the jurisdiction and responsibilities of the State of Utah and UDWR with respect to wildlife and fish on NFS lands.
 - C. Collaborate with the State of Utah, UDWR, and UDAF on its implementation of the population and habitat objectives identified in the Utah Bighorn Sheep Statewide Management Plan, attached hereto and incorporated as Appendix A, on NFS lands to the extent consistent with federal laws and regulations.
 - D. Consult with UDAF and/or the Utah State Veterinarian when appropriate.
 - E. Provide public information and education outreach assistance for increasing public awareness of the interactions between domestic and bighorn sheep populations. Any commitment of Forest Service funds will require a separate agreement.
- VI. IT IS MUTUALLY UNDERSTOOD AND AGREED BY AND BETWEEN THE PARTIES THAT:
- A. SPECIFIC AREAS OF COOPERATION. To the extent permitted by applicable law, the parties agree to collaborate in managing bighorn sheep population and habitat objectives identified in the Utah Bighorn Sheep Statewide Management Plan attached as Appendix A.
Notwithstanding any other provision in this MOU, the State will manage bighorn sheep on all lands in Utah consistent with and as prescribed in the Utah Bighorn Sheep Statewide Management Plan attached as Appendix A.
 - B. PRINCIPAL CONTACTS. Individuals listed below are authorized to act in their respective areas for matters related to this MOU.

State Contacts:

State Contact
Name: Carmen Bailey Title: Deputy Director, Public Lands Policy Coordinating Office Address: 5100 State Office Building Salt Lake City, Utah 84114 Phone: (801) 341-9641 Email: carmenbailey@utah.gov
UDWR Contact
Name: Justin Shannon Title: Wildlife Section Chief Address: 1594 West North Temple, Suite 2110 Salt Lake City, Utah 84114 Phone: (801) 538-4881 Email: justinshannon@utah.gov
UDAF Contact
Name: Troy Forrest Title: Grazing Improvement Program Manager Address: 350 North Redwood Road Salt Lake City, Utah 84114 Phone: (435) 279-3603 Email: tforrest@utah.gov

U.S. Forest Service Contacts:

U.S. Forest Service Program Manager Contact
Name: John Shivik Title: Wildlife Biologist Address: 324 25 th Street Ogden 84401 Phone: (801) 625-5667 Email: john.shivik@usda.gov

U.S. Forest Service Administrative Contact

Name: Tim Wagoner
Title: Grants Management Specialist
Address: 325 25th Street
Ogden, UT 84401
Phone: (801) 625-5796
Email: Timothy.Wagoner@usda.gov

- C. NOTICES. Any communication affecting the operations covered by this MOU given by any party to another party is sufficient only if in writing and delivered in person, mailed, or transmitted electronically by e-mail, as follows:

To the U.S. Forest Service Program Manager Contact, at the address specified in the MOU.

To the State of Utah Contact, at the address in the MOU.

To the UDWR Contact, at the address specified in the MOU.

To the UDAF Contact, at the address specified in the MOU.

Notices are effective when delivered in accordance with this provision, or on the effective date of the notice, whichever is later.

- D. PARTICIPATION IN SIMILAR ACTIVITIES. This MOU in no way restricts any of the parties from participating in similar activities with other public or private agencies, organizations, and individuals.
- E. ENDORSEMENT. Any contribution made by the Forest Service under this MOU does not by direct reference or implication convey endorsement of the State of Utah's products or activities.
- F. NONBINDING AGREEMENT. This MOU creates no right, benefit, or trust responsibility, substantive or procedural, enforceable by law or equity. The parties shall manage their respective resources and activities in a separate, coordinated and mutually beneficial manner to meet the purpose(s) of this MOU. Nothing in this MOU authorizes any of the parties to obligate or transfer anything of value.

Specific, prospective projects or activities that involve the transfer of funds, services, property, and/or anything of value to a party requires the execution of separate agreements and are contingent upon numerous factors, including, as applicable, but not limited to: availability of appropriated funds and other resources; administrative and legal requirements (including statutory

authorizations); etc. This MOU neither provides, nor meets these criteria. If the parties elect to enter into an obligation agreement that involves the transfer of funds, services, property, and/or anything of value to a party, then the applicable criteria must be met. Additionally, under a prospective agreement, each party operates under its own laws, regulations, and/or policies, and any obligation is subject to the availability of appropriated funds and other resources. The negotiation, execution, and administration of these prospective agreements must comply with all applicable law.

Nothing in this MOU is intended to alter, limit, or expand the agencies' statutory and regulatory authority.

- G. USE OF U.S. FOREST SERVICE INSIGNIA. In order for the State to use the U.S. Forest Service insignia on any published media, such as a Web page, printed publication, or audiovisual production, permission must be granted from the U.S. Forest Service's Office of Communications. A written request must be submitted and approval granted in writing by the applicable Forest Service prior to use of the insignia.
- H. MEMBERS OF U.S. CONGRESS. Pursuant to 41 U.S.C. 22, no U.S. member of, or U.S. delegate to, Congress shall be admitted to any share or part of this MOU, or benefits that may arise therefrom, either directly or indirectly.
- I. FREEDOM OF INFORMATION ACT (FOIA). Public access to this MOU or agreement records must not be limited, except when such records must be kept confidential and would have been exempted from disclosure pursuant to Freedom of Information regulations (5 U.S.C. 552) and/or the Utah Government Records Access and Management Act (Utah Code §§ 63G-2-101, et seq.).
- J. TEXT MESSAGING WHILE DRIVING. In accordance with Executive Order (EO) 13513, "Federal Leadership on Reducing Text Messaging While Driving," any and all text messaging by Federal employees is banned: a) while driving a Government owned vehicle (GOV) or driving a privately-owned vehicle (POV) while on official Government business; or b) using any electronic equipment supplied by the Government when driving any vehicle at any time. The State, its employees, volunteers, and contractors are encouraged to adopt and enforce policies that ban text messaging when driving company owned, leased or rented vehicles, POVs or GOVs when driving while on official Government business or when performing any work for or on behalf of the Government.
- K. PUBLIC NOTICES. It is the U.S. Forest Service's policy to inform the public as fully as possible of its programs and activities. The State is encouraged to give

public notice of the receipt of this MOU and, from time to time, to announce progress and accomplishments.

- L. ACKNOWLEDGEMENT IN PUBLICATIONS AUDIOVISUALS AND ELECTRONIC MEDIA. Each party shall acknowledge the other parties' support in any publications, audiovisuals, and electronic media developed. Prior to acknowledgement of another party's support to this agreement in any publication the author of the publication will provide sufficient time to the other parties to review the content of the publication and determine whether support is appropriate.

- M. NONDISCRIMINATION STATEMENT - PRINTED ELECTRONIC OR AUDIOVISUAL MATERIAL. The State shall include the following statement, in full, in any printed, audiovisual material, or electronic media for public distribution developed or printed with any Federal funding.

In accordance with Federal law and U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. (Not all prohibited bases apply to all programs.)

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

If the material is too small to permit the full statement to be included, the material must, at minimum, include the following statement, in print size no smaller than the text:

"This institution is an equal opportunity provider."

- N. TERMINATION. Any of the parties, in writing, may terminate this MOU in whole or in part at any time before the date of expiration, upon 30 days advance written notice to the other parties.
- O. DEBARMENT AND SUSPENSION. The State shall immediately inform the U.S. Forest Service if it or any of its agencies are presently excluded, debarred, or suspended from entering into covered transactions with the federal government according to the terms of 2 CFR Part 180. Additionally, should the State or any of its agencies receive a transmittal letter or other official Federal notice of debarment or suspension, then they shall notify the U.S. Forest Service without undue delay. This applies whether the exclusion, debarment, or suspension is voluntary or involuntary.

- P. ENTIRETY OF AGREEMENT. This MOU represents the entire and integrated agreement between the parties and supersedes all prior negotiations, representations and agreements, whether written or oral.
- Q. SOVEREIGN IMMUNITY. The State of Utah and all its agencies do not waive sovereign immunity by entering into this MOU and specifically retain immunity and all defenses available to them as sovereigns pursuant to applicable law. Designations of venue, choice of law, enforcement actions, and similar provision should not be construed as a waiver of sovereign immunity. The parties agree that any ambiguity in this MOU shall not be strictly construed, either against or for either party, except that any ambiguity as to sovereign immunity shall be construed in favor of sovereign immunity.
- R. THIRD PARTY BENEFICIARY RIGHTS. The parties do not intend to create in any other individual or entity the status of third-party beneficiary and this MOU shall not be construed so as to create such status. The rights, duties and obligations contained in this MOU shall operate only between the parties to this MOU, and shall inure solely to the benefit of such parties. The provisions of this MOU are intended only to assist the parties in determining and performing their respective responsibilities under this MOU. The parties to this MOU intend and expressly agree that only the parties signatory to this MOU shall have any legal or equitable right to seek to enforce this MOU, to seek any remedy arising out of a party's performance or failure to perform any term or condition of this MOU, or to bring an action for the breach of this MOU.
- S. MODIFICATIONS. Modifications within the scope of this MOU must be made by mutual consent of the parties, by the issuance of a written modification signed and dated by all properly authorized, signatory officials, prior to any changes being performed. Requests for modification should be made, in writing, at least 30 days prior to implementation of the requested change. Notwithstanding the foregoing or any other provision in this MOU to the contrary, future modifications by UDWR to the Utah Bighorn Sheep Statewide Management Plan included as Attachment A will not automatically act to terminate this MOU. Should UDWR propose to modify the plan in the future, it will provide each party a copy of any proposed modification no less than thirty (30) days prior to its submission to the Board for approval. Each party will have the opportunity to review and offer comments on the proposed modifications for consideration by UDWR and the Board. Upon approval by the Board, the modified plan will automatically incorporate into this MOU as Attachment A and replace the former version of the plan. Any party opposed to the approved modifications may immediately terminate its participation in the MOU upon written notice to the other parties.

- T. COMMENCEMENT/EXPIRATION DATE. This MOU is executed as of the date of last signature and shall remain effective until 5 years from said date, at which time it will expire.
- U. AUTHORIZED REPRESENTATIVES. By signature below, each party certifies that the individuals listed in this document as representatives of the individual parties are authorized to act in their respective areas for matters related to this MOU.

In witness whereof, the parties hereto have executed this MOU as of the last date written below.



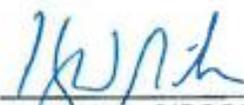
SPENCER J. COX, Lieutenant Governor
State of Utah, Office of the Governor

5-29-19
Date



MICHAL FOWLKS, Director
Utah Division of Wildlife Resources

5-28-19
Date



KERRY W. GIBSON, Commissioner
Utah Department of Agriculture and Food

5-28-19
Date



NORA B. RASURE, Regional Forester
U.S. Forest Service, Intermountain Region

5-28-19
Date

**BIGHORN SHEEP UNIT MANAGEMENT PLAN
WASATCH MOUNTAINS, AVINTAQUIN WMU #17C
August 2019**

BOUNDARY DESCRIPTION

Carbon, Duchesne, Utah and Wasatch counties Boundary begins at US-40 and the Soldier Creek Dam road; south along this road to Soldier Creek Dam and the Strawberry River; east along this river to Beaver Creek; southwest along Beaver Creek to Big Beaver Spring and USFS Road 081 (Reservation Ridge Road); southeast on this road to the Right Fork of White River road; southwest on this road to US-6; southeast on US-6 to US-191; north on US-191 to US-40; west along US-40 to the Soldier Creek dam road. **EXCLUDES ALL NATIVE AMERICAN TRUST LANDS WITHIN THIS BOUNDARY.** Excludes all CWMUs. USGS 1:100,000 Maps: Duchesne, Nephi, Price. Boundary questions? Call Vernal office, 435-781-9453.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Wasatch Mountains, Avintaquin bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Private	88,254	33.4%
National Forest	81,512	30.8%
Tribal	49,832	18.9%
Utah Division of Wildlife Resources	29,074	11.0%
Bureau of Land Management	12,341	4.7%
Utah State Institutional Trust Lands	2,889	1.1%
Utah State Parks	442	0.2%
Totals	264,344	100%

UNIT MANAGEMENT GOALS

The Utah Statewide Bighorn Management plan was approved by the Utah Wildlife Board in 2018. In accordance with the plan an MOU between the state and the US Forest service was signed in 2019 that identifies management responsibilities and areas of cooperation between the state and US Forest Service. This plan identifies the status and management direction specific to this unit under those documents. The Avintaquin Subunit of the Wasatch Mountains is located south of the Strawberry River between Duchesne and Strawberry Reservoir. Bighorn habitat is

located within the long steep rocky canyons, hillsides and windblown ridges. Significant habitat exists, and will continue to be enhanced by future habitat projects in areas where currently thick brush, pinyon-juniper and conifer reduce the value to bighorn. Specific goals for this unit are to:

- 1) Manage for a healthy population of Rocky Mountain bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.
- 2) Balance bighorn sheep impacts with other uses such as authorized grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Rocky Mountain bighorn sheep are known to be historic residents of the area. Evidence of bighorn sheep has been found on and around the subunit (Avintaquin Canyon, the Strawberry River corridor, Currant Creek Mtn., etc...).

In January of 2009 the UDWR reintroduced 60 sheep that were captured from two different areas in Montana, the Benchmark/Willow Creek area and the Sun River area. There were a total of 44 ewes, 6 lambs, and 10 rams. The sheep were released at two different sites on the Avintaquin unit, 30 were released in Lake Canyon and 30 in the Right Fork of Indian Canyon. Eight of the original transplanted sheep had to be euthanized to prevent them from potentially spreading disease back to the rest of the transplant stock after they left the unit and went into areas with high probability of contact with domestic sheep.

Of the 60 sheep released, 33 of them were equipped with VHF radio collars in order to monitor movements and survival. The radio collared animals are also used to conduct ground surveys for production rates and population estimates. In 2012 and 2014-2019 many additional sheep were captured and collared to replace collared sheep that had died. The UDWR will continue to capture and collar additional sheep as needed to strive to maintain enough active collars to monitor the population effectively.

Currently, this population is below its population objective. This population experienced a respiratory disease related die off beginning in late 2015. Many sheep were found dead, with many others observed coughing. The population went from an estimated 120-150 sheep in 2014 to an estimation of only 20-30 sheep in 2019.

Tribal Trust Lands are located across the subunit. Bighorn sheep are likely to continue using available habitat that includes some Tribal Trust Lands. As with management of other big game species within the exterior boundary, bighorn sheep management will be in accordance with the Cooperative Agreement between the Ute Tribe and the state of Utah.

ISSUES AND CONCERNS

- Potential Habitat: We modeled potential bighorn sheep habitat on the Wasatch Mountain, Avintaquin unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability,

ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit in suitable rugged locations (Figure 1).

Livestock Competition: Bighorn sheep annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987). For these reasons, competition between cattle and bighorns should not be a significant concern within this unit. Because of the risk of pathogen transmission between bighorns and domestic sheep, the areas where domestic sheep are present are not suitable for bighorn sheep.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off public lands or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry and individual grazers.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes a limited amount of mule deer. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns in the Wasatch Mountain, Avintaquin unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Manage for a population of 125-350 bighorn sheep throughout suitable habitat within the unit boundary. The population objective is well below the recommended 1.3-1.9 sheep / km² (Van Dyke 1983).

Population Management Strategies:

- 1) Conduct ground classification once each year in late November and early December to obtain annual production estimates and population estimates. Early summer classification will be done each year on an opportunistic basis.
- 2) Since this population is primarily monitored from the ground through the use of GPS collars, DWR will strive to maintain between 10 and 20 active collars depending on the size of the population to monitor the status of the herd and generate annual estimates of survival. The primary method for deploying collars on this population will be done through ground tranquilization and helicopter capture.
- 3) All population data will be collected and submitted on standardized forms, including all GIS flight and collar data (waypoints, flight paths, etc.).

Predator Management:

The Avintaquin Unit is a Harvest Objective cougar unit. Over the last 4 years the average number of cougars killed per year is 13. The current total quota for lions on the unit is 20. A predator management plan is currently in place for this subunit. Lion management will be accomplished through established UDWR policy and procedures for bighorn sheep units. Additional lion removal efforts should take place prior to any transplant efforts.

Research Needs:

- 1) There are no new research needs at this time specific to this unit. The population monitoring plan calls for 10-20 collars to be maintained in the population. These collars will serve as a tool to improve ground classification and generate annual estimates of survival. Additional objectives could be assessed as needs arise, but primary objectives for GPS collars should be focused on general population status.

DISEASE MANAGEMENT

Disease Management Objective:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the unit.
- 2) Strive for spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead. This unit was disease tested in 2016 and 2017 during helicopter capture work. Six sheep were captured and tested in 2016 and nine in 2017. All captured sheep tested positive for *Mycoplasma ovipneumonia*. If possible, all sheep captured in the future will be tested to aid in the development of a current disease profile.

Spatial Separation: Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas. There are several USFS domestic sheep grazing allotments west of the unit and one allotment on the unit:

Avintaquin – This Ashely National Forest allotment is south of Strawberry and under two miles from documented wild sheep locations

- Removal of wild sheep found within the boundary of this allotment or outside of the bighorn sheep management unit boundary is recommended to maintain separation and protect wild sheep.
- Outreach efforts will continue to occur with domestic operators.

Risk Management and Response Plan:

High risk areas are within the USFS domestic allotment boundaries described above. Additionally, wild sheep have wandered to the north near the county line by Deep Creek Canyon. Any wild sheep found within these areas north of Highway 40 should be immediately removed. A “geofence” for GPS collared bighorn will be established to alert the Division if collared bighorn leave the unit or stay too close to the domestic allotment. There is substantial habitat connectivity with the Nine Mile bighorn sheep unit. Monitoring of these connective habitats and potential removal of sheep within these areas will be considered to protect both herds. All wandering wild sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. Mapping of wild sheep removal zones for the Avinatquin Unit is included as an appendix to this guideline. The need to disease test wandering sheep from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objectives.
- 2) Continue to identify crucial bighorn sheep habitats and work with the Forest Service, private landowners, and the Ute Tribe to protect these areas.
- 3) Assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity or quality.
- 4) Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.

Current and Potential Wild Sheep Distribution:

Bighorn sheep have established 4 core areas of use on the Avintaquin unit, the highest densities of sheep are in the Right Fork of Indian Canyon, followed by Lake Canyon, and Avintaquin Canyon. A map of modeled and occupied bighorn sheep habitat is included in Figure 1.

Potential Threats to Habitat

Human disturbance can result in abandonment or degradation of bighorn habitat. Human disturbance of bighorn on this unit is expected to be high in most areas do to energy development activity. This includes UDWR lands, Tribal Lands, private lands, and USFS lands.

Vegetation Management Projects

- 1) Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
- 2) Cooperate with Forestry, Fire and State Lands and the USFS to utilize controlled burns and/or mechanical treatments to remove conifer encroachment on open hillsides to increase and improve bighorn habitat across the unit.
- 3) Identify specific habitat restoration projects to immediately benefit bighorn sheep:
 - Timber Canyon
 - Lake Canyon
 - Avintaquin Canyon
 - Right Fork of Indian Canyon

Water Management Projects:

- 1) Work with the USFS, and private landowners to locate and improve water sources across bighorn habitat.
- 2) Cooperatively modify or improve existing water developments and guzzlers for bighorns.
- 3) Install new water developments or guzzlers in bighorn habitat where water may be scarce or lacking in the following canyons.
 - Timber Canyon
 - Lake Canyon
 - Avintaquin Canyon
 - Right Fork of Indian Canyon

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide hunting opportunities on the Wasatch Mountain, Avintaquin unit that are a quality experience.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Ewe hunts may be utilized as a tool for maintaining population objective. Offer maximum opportunity for hunting while not imposing on DWR management needs. Monitor size and age class of harvested rams through the horn measuring and plugging program.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach. Significant viewing opportunities are available along in Right Fork of Indian Canyon, and Lake Canyon. Work to make public more aware of these opportunities.

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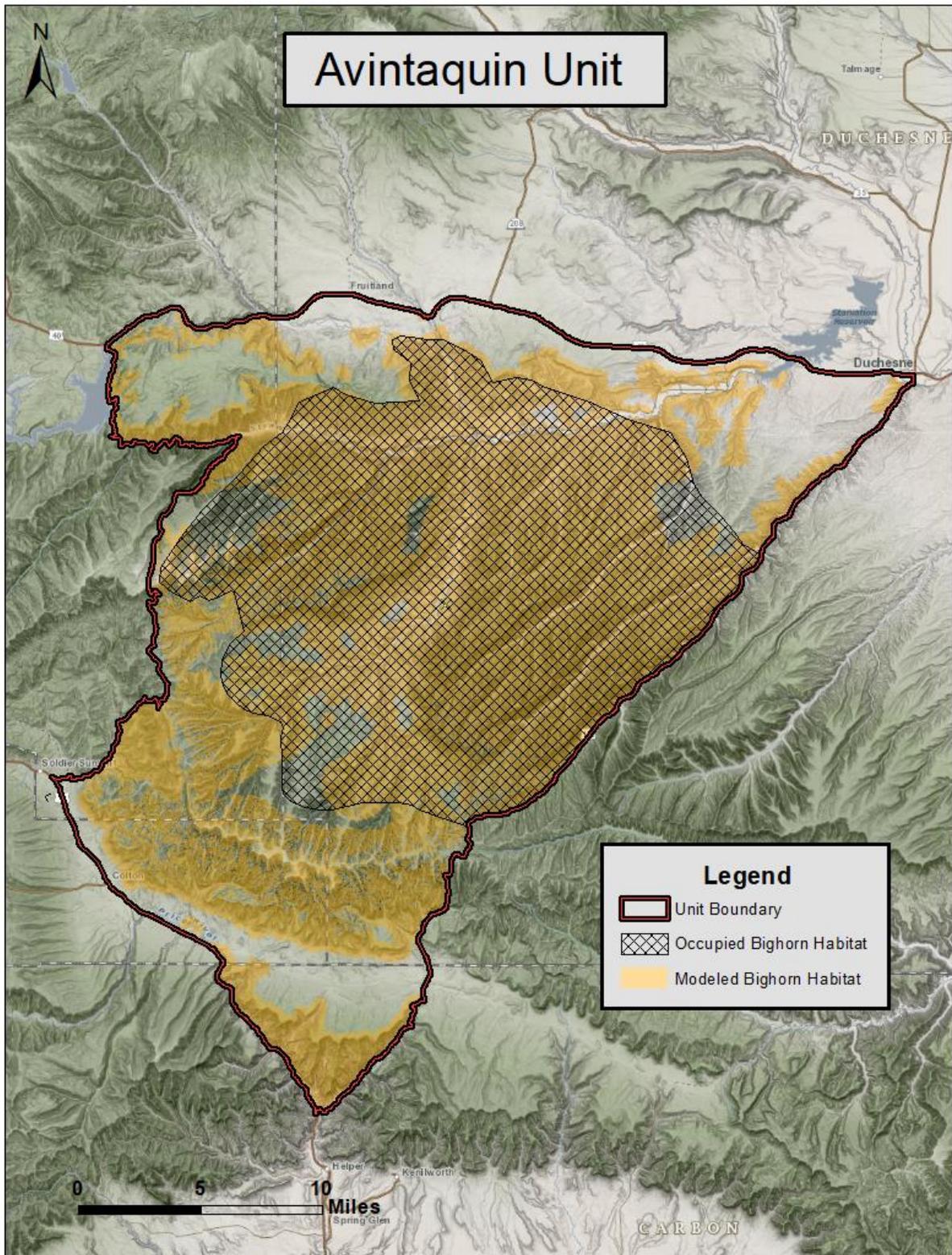


Figure 1. Wasatch Mountains, Avintaquin unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

**BIGHORN SHEEP UNIT MANAGEMENT PLAN
WASATCH MOUNTAINS, WEST
Provo / Timpanogos
August 2019**

BOUNDARY DESCRIPTION

Salt Lake, Summit, Utah and Wasatch counties –

Provo – Utah and Wasatch counties--Boundary begins at US-189 and US-40 in Heber; south on US-40 to the Strawberry Bay Marina road; south on this road to USFS Road 042 (Indian Creek road); south and west on this road to USFS Road 051; south on this road to US-6; northwest on US-6 to I-15; north on I-15 to I-80 in Salt Lake City.

Timpanogos – Salt Lake, Summit, Utah and Wasatch counties—Boundary begins at I-80 and I-15 in Salt Lake City; east on I-80 to US-40; south on US-40 to US-189; southwest on US-189 to 800 N in Orem; west on 800 N to I-15; north on I-15 to I-80.

LAND OWNERSHIP

Land ownership and approximate area of modeled bighorn sheep habitat for the Wasatch Mountains, West bighorn sheep management sub-units.

Provo

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
National Forest	132,436	78.1%
Private	29,633	17.5%
Utah Division of Wildlife Resources	6,500	3.8%
Utah State Institutional Trust Lands	513	0.3%
Bureau of Land Management	451	0.3%
Utah State Parks	123	0.1%
Utah Department of Transportation	3	<0.1%
Totals	169,659	100%

Timpanogos

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
National Forest	71,298	58.2%
Private	37,568	30.7%
Utah State Parks	10,587	8.6%
Utah Division of Wildlife Resources	1,927	1.6%
Bureau of Land Management	409	0.3%
Bureau of Reclamation	265	0.2%
National Parks	205	0.2%
Utah State Institutional Trust Lands	171	0.1%
Utah Department of Transportation	43	<0.1%
Department of Defense	21	<0.1%
Totals	122,495	100%

BACKGROUND AND CURRENT STATUS

Bighorn Sheep are native to the Wasatch Mountains (Dalton and Spillett 1971). Bighorns were reported in 1926 and 1927 on Mount Timpanogos, which was one of the last sightings prior to extirpation from Utah, and skeletal remains have also been found at various locations across the Wasatch Mountains (Dalton and Spillett 1971). Between 2000 and 2007, eighty-two bighorn sheep were released on Mount Timpanogos. The first release was 25 individuals from Desolation Canyon, UT in 2000. Ten from Hinton, AB were released the following year. Nine bighorns from Sula, MT were released in 2002. Twenty from Sula and 18 from Alomosa, CO were transplanted in 2007 (Shannon et al. 2008). Additional transplants were conducted in Rock Canyon east of Provo, 22 from Hinton, AB in 2001 and 10 from Sula, MT in 2007. Cause specific mortality studies conducted in this unit have identified cougar predation, automobile collisions, and disease as the main causes of mortality (Shannon et al. 2008). Commingling of bighorn sheep with domestic sheep and goats has been documented multiple times with resulting die-offs (Shannon et al. 2014) and subsequent poor lamb recruitment. Due to this herd's proximity to urban interface and domestic farm flocks, disease risk remains the biggest threat to the persistence of this population. The estimated population size typically hovers between 40 and 60 individuals with a recent uptick to approximately 80 individuals.

ISSUES AND CONCERNS

Habitat: We modeled potential bighorn sheep habitat on the Wasatch Mtns, West unit using methodology outlined by O'Brien et al. (2014). Bighorn sheep select habitat based on the proximity of steep-sloped escape terrain, forage availability, ruggedness, and horizontal visibility (Bleich et al. 1997, Valdez and Krausman 1999, Sappington et al. 2007). Bighorn sheep habitat is located throughout the unit (Figure 1). Additional habitat exists in areas that have become

dominated by old growth vegetation that have reduced value to bighorns. Fire would help return these areas into productive early successional stages and would allow bighorn sheep to expand their range throughout the Wasatch Mtns, West unit.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off of their ranges or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, mountain goats, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). Cougars are the main predator of bighorns on the Wasatch Mtns, West unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services. Predator reduction work already occurs on the unit in conjunction with livestock losses, and therefore any additional work that may be done would be mutually beneficial to both livestock and other big game species.

POPULATION MANAGEMENT

Population Management Objectives:

- 1) Achieve and maintain a population objective of 250 total Rocky Mountain bighorn sheep, ideally with 125 animals in each subunit.

Population Management Strategies:

Transplants: Given the exposure of this herd to pneumonia related pathogens, it is not anticipated that transplants to or from this unit will occur unless repeated testing shows that the pathogens are cleared from the population. This is to protect naïve bighorns from being exposed to disease and to prevent disease outbreaks.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages

and quantity of rams. This population will likely require 4-6 hours to conduct a complete trend count. Additional ground classification may be conducted as conditions permit. GPS collars with mortality signals may be used to document cause-specific mortality and identify annual survival estimates. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan.

Predator Management: Predator management will be coordinated with USDA Wildlife Services on an as-needed basis. If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of Rocky Mountain bighorn sheep on the Wasatch Mtns, West unit.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: Active domestic sheep allotments and farm flocks with domestic sheep will be evaluated for potential of disease risk. The DWR may delineate areas where there is high risk for domestic sheep and goats to come in contact with wild sheep or where wild sheep may stray and come in contact with domestics. These areas will be considered areas of concern. A major source of potential pathogen transmission for the bighorns in this unit is commingling with farm flocks in the residential areas directly beneath the suitable bighorn habitat. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. Likewise, wandering domestic sheep or goats found near bighorn where not permitted may be removed in accordance with DWR guidelines GLN-33. The need to test wandering sheep or domestics from this unit will be evaluated on a case by case basis.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects on the Wasatch Mtns, West unit.
- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with land management agencies to utilize seeding, prescribed burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and other species are given priority.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Increase hunting opportunities while maintaining quality hunting experiences.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. Permit recommendations will be made based on 12-25% of the counted ram population (yearling and older) or 30-60% of the counted rams 6 years of age or older. Hunting seasons will be recommended to provide maximum recreational opportunity while not imposing on UDWR management needs. Hunting may be used as a tool to regulate density of bighorn sheep to reduce risk of pathogen transmission. Size and age class of harvested rams will be monitored. Ewe hunts may be utilized as a tool for maintaining population objective.

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the population objective, unit boundary, or other key components of this plan are to be revised in the future, the public will be allowed to be included in the decision making process through public RAC and board meetings.

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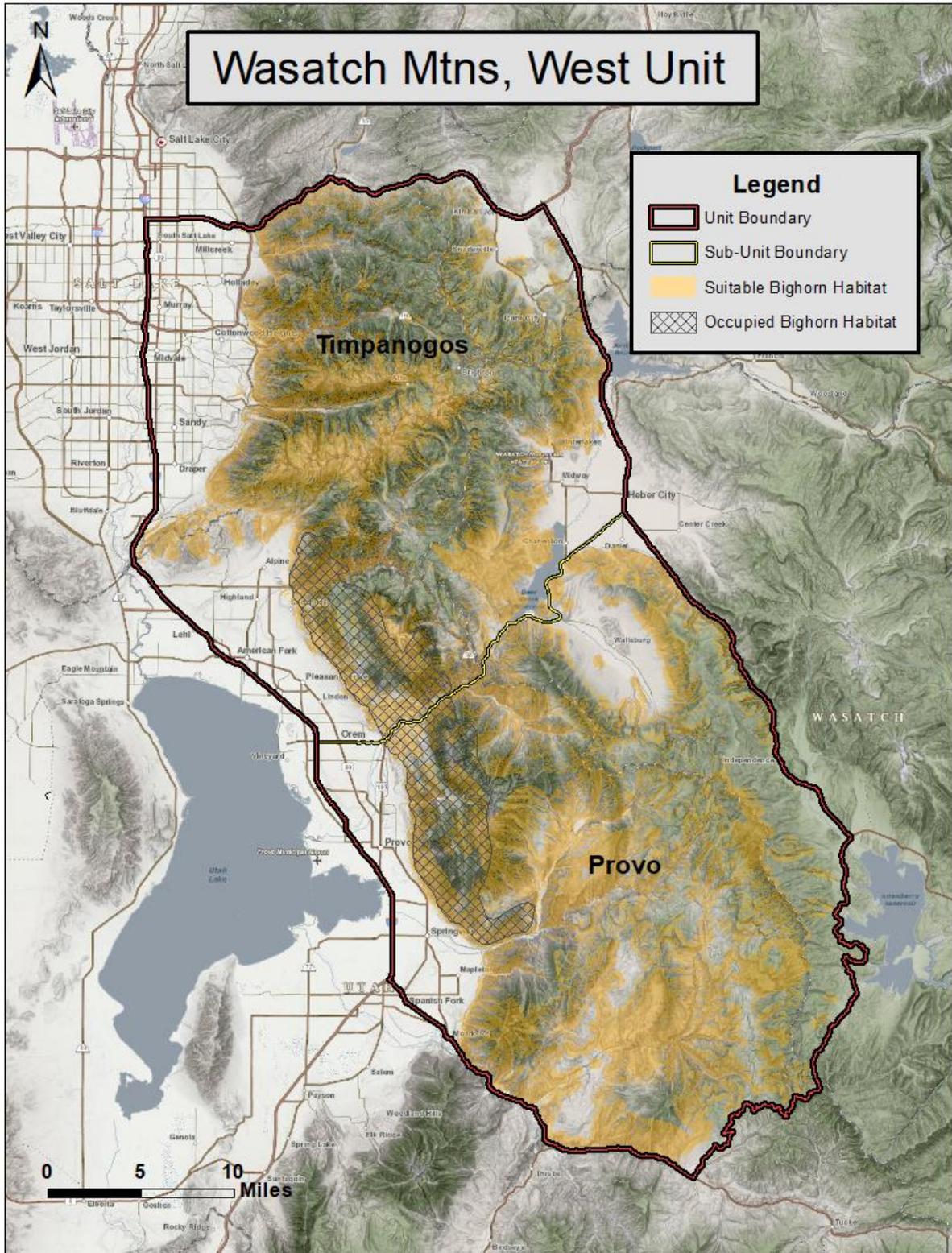


Figure 1. Wasatch Mountain, West unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat.

BIGHORN SHEEP UNIT MANAGEMENT PLAN
ZION
August 2019

BOUNDARY DESCRIPTION

Iron, Kane and Washington counties—Boundary begins at the Utah-Arizona state line and I-15; north on I-15 to SR-14; east on SR-14 to US-89; south on US-89 to US-89A; south on US-89A to the Utah-Arizona state line; west on this state line to I-15. This hunt is comprised of all or largely private property. Excludes Zion National Park. **EXCLUDES ALL NATIVE AMERICAN TRUST LANDS WITHIN THIS BOUNDARY.** Excludes all CWMUs. USGS 1:100,000 Maps: Cedar City, Kanab, Panguitch, Saint George. Boundary questions? Call the Cedar City office, 435-865-6100.

LAND OWNERSHIP

Table 1. Land ownership and approximate area of modeled bighorn sheep habitat for the Zion bighorn sheep management unit.

Ownership	MODELED BIGHORN HABITAT	
	Area (acres)	%
Bureau of Land Management	243,026	46.2%
National Parks	125,882	24.0%
Private	116,411	22.2%
Utah State Institutional Trust Lands	28,431	5.4%
National Forest	9,438	1.8%
Utah State Parks	1,220	0.2%
Tribal	1,063	0.2%
Utah Division of Wildlife Resources	51	<0.1%
Utah Department of Transportation	20	<0.1%
Totals	525,542	100%

UNIT MANAGEMENT GOALS

Maintain desert bighorn sheep on the unit in an effort to keep bighorns to their native ranges (Buechner 1960, Dalton and Spillet 1971) and to promote wildlife diversity in the area for hunting and viewing, in accordance with Utah Code 23-14-21. Specific goals are to:

- 1) Manage for a healthy population of desert bighorn sheep capable of providing a broad range of recreational opportunities, including hunting and viewing.

- 2) Balance bighorn sheep impacts with other uses such as authorized cattle grazing and local economies.
- 3) Maintain a population that is sustainable within the available habitat in the unit boundary.

HISTORY AND CURRENT STATUS

Historically, bighorn sheep were thought to be abundant in the Zion area. By the 1950's bighorn sheep were extirpated from Zion National Park (ZNP) and adjacent areas. A variety of factors were likely responsible for the extirpation. A map of the Zion hunt unit boundary and current bighorn sheep distribution is provided in Figure 1.

In 1973, a group of 12 animals were transplanted in a cooperative agreement between UDWR and ZNP from Lake Mead and were placed in a 32.28 hectare holding pen. Management responsibilities of these sheep are shared between these two regulatory agencies. In 1976, the original 12 had reproduced and the sheep then numbered 22. Twelve of those 22 animals were released from the enclosure into Parunuweap Canyon (five air miles to the southeast). This release was considered to be a failure due to disease and predation. In 1978, the number of sheep in the enclosure had increased to 19. All these sheep were released from the enclosure by opening the gates. From 1979 to 1990, it was felt that the herd was dwindling. In 1991, a helicopter survey was conducted, and 35 bighorns were observed in ZNP. In 1995, the herd was estimated to be between 50 and 75 animals.

Since 1991, telemetry data has been collected in conjunction with various studies in ZNP. In 2008, increased sightings of bighorn sheep from ZNP, Barracks, Hildale, and Kanab areas were being reported to the UDWR. In December 2008, UDWR was asked to assist ZNP by doing an aerial survey in the predicted highest density areas in ZNP. During this survey it was determined that the population in ZNP was over 180 sheep.

This population has had good lamb production, high survival rates, and has the potential to expand its range into areas where domestic sheep grazing occurs on private lands. There is concern about stress and disease transmission due to high population densities. Habitat degradation may also become an issue in some localized areas.

Transplant summary:

Year	Number of sheep moved	Destination
Jan. 2014	19	Cottonwood Canyon, west of Kanab, Zion unit
Nov. 2014	23	Nokai Dome, San Juan unit
Nov. 2014	26	Horse Canyon, Beaver Dam Mountains, Pine Valley Unit
Nov. 2015	10	Horse Canyon, Beaver Dam Mountains, Pine Valley Unit
Dec. 2017	50	South San Juan unit

In June of 2018 coughing sheep were found in Zion National Park. A coughing sheep was euthanized and tested positive for *Mycoplasma ovipneumoniae* (M.ovi). Throughout

the summer and fall, symptomatic sheep were sighted both in ZNP and on BLM lands to the east of ZNP. Test results show that the strain of *M.ovi* is the same as that found in the Kaiparowits bighorn herd. This leads us to believe that the most likely source of *M.ovi* for the Zion herd is some type of commingling with bighorn(s) from the Kaiarowits bighorn herd. The population is currently being monitored for lamb production, sheep survival and dispersal using GPS collars.

ISSUES AND CONCERNS

Livestock Competition: Interactions of bighorn sheep with domestic cattle are anticipated seasonally. Dietary overlap between cattle and bighorns has not surfaced as a concern with other bighorn populations in the state and is not expected for the Pine Valley herd. Desert bighorn annual use of forage classes, when compared to cattle, differ significantly (Dodd and Brady 1988). Likewise, bighorn sheep generally avoid areas where cattle are present (Bissonette and Steinkamp 1996), and also select areas with a much higher degree of slope (Ganskopp and Vavra 1987), which also minimizes competition for water. Desert bighorn sheep have the ability to utilize metabolic water formed by oxidative metabolism, preformed water found in food, and surface water, including dew. The amount of surface water required by desert bighorns is dependent on many factors, including body size, activity, forage moisture content, temperature, and humidity (Monson and Sumner 1980). In hot, dry periods, bighorns will water daily if possible but have remained independent of surface water for periods of 5-8 days (Blong and Pollard 1968, Turner and Boyd 1970, Turner 1973, Welles and Welles 1961, 1966). Across all seasons, desert bighorns drink on average every 10-14 days (Welles and Welles 1961). It has been reported, in extreme cases, that desert bighorns did not drink for a period of several months (Monson 1958, Mendoza 1976). Koplín (1960) found that a captive herd of desert bighorn sheep that were fed a dry ration and provided unlimited water drank an average of 4.9 liters (1.3 gal) per day.

Disease: Disease, especially bacterial pneumonia, has been responsible for numerous declines in bighorn populations throughout North America (Cassirer and Sinclair 2007). Pneumonia outbreaks typically affect all age/sex cohorts and are usually followed by several years of annual pneumonia outbreaks in lambs that dramatically reduce population growth (Spraker et al. 1984, Ryder et al. 1992, George et al. 2008). These events are attributed to the transfer of pathogens from domestic sheep (*Ovis aries*) or goats (*Capra aegagrus hircus*) to wild sheep through social contact (Singer et al. 2000, Monello et al. 2001, Cassirer and Sinclair 2007). Disease-induced mortality rates in bighorn sheep vary substantially by population due to multiple processes including contact rates, social substructuring, pathogen virulence, and individual susceptibility (Manlove et al. 2014, 2016). Therefore, spatial separation from domestic sheep and goats is the most important factor in maintaining overall herd health. It is not the intent of this plan or the DWR to force domestic sheep operators off of their ranges or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations while working with the domestic sheep industry.

Predation: Cougar predation may limit bighorn sheep in locations where predator populations are largely supported by sympatric prey populations (Hayes et al. 2000, Schaefer et al. 2000, Ernest et al. 2002), which, in this case, includes mule deer, domestic cattle, and elk. It has been hypothesized that declines in sympatric ungulate populations can increase predation on bighorn sheep as cougars switch to bighorns as an alternate prey source (Kamler et al. 2002, Rominger et al. 2004). It is anticipated that cougars will be the main predator of bighorns on the Pine Valley unit. If predation becomes a limiting factor, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management is coordinated with USDA Wildlife Services. Predator reduction work already occurs on the Pine Valley unit in conjunction with livestock losses, and therefore any additional work that may be done would be mutually beneficial to both livestock and other big game species.

POPULATION MANAGEMENT

Population Management Objective:

- 1) Manage for 500-600 bighorn sheep within the core habitat area. Managing for approximately 550 sheep through this area (175 sheep inside NPS lands and 375 outside NPS lands) is within the recommended 1.9 bighorns / km² (Van Dyke 1983).

Population Management Strategies:

Transplant Plan: In the past this population has been used as a source herd for establishing new sheep populations in Utah. Sheep were moved from both BLM lands and National Park lands to establish populations on the San Juan and the Pine Valley units. With the positive M. Ovi diagnosis in June of 2018, it is unlikely that this herd will be suitable to serve as a source population in the near future. If the population reaches or exceeds the population objective, management practices including ewe hunts may be incorporated to maintain the population at objective.

Monitoring: Monitoring of bighorn sheep will be conducted every 2-3 years by aerial survey to determine lamb recruitment, population status, ram-to-ewe ratios, range distribution, and ages and quantity of rams. The current population will likely require a minimum of 30 hours to conduct a complete trend count and survey adjacent areas to evaluate wild sheep dispersal. Additional ground classification may be conducted as conditions permit. GPS collars with mortality signals will be used to document cause-specific mortality and identify annual survival estimates. Space use will be monitored to assess potential overlap and competition with cattle. GPS collars will be added to the population as the original collars complete their usable lifespan. If bighorn sheep are found wandering into areas where there is high risk of contact with domestic sheep or goats, the DWR may remove these animals in accordance with the Utah Bighorn Sheep Statewide Management Plan. Surveys of NPS lands are essential to understanding population dynamics of the Zion bighorn sheep herd. UDWR will continue to partner with ZNP in data collection and sharing. Coordination with the Zion National Park,

Kanab and St. George BLM will need to take place prior to all aerial survey efforts due to wilderness areas and the NPS sound-scape management. Kane and Washington County Sherriff's Offices will also need to be coordinated prior to flights if removal of feral domestics is needed (see spatial separation). Conduct ground classification as conditions permit to obtain annual production estimates. Sheep can easily be viewed in Zion National Park along Highway 9. This information is highly valuable as an indicator of population health and condition.

Trend Count and Classification Data

Year	Pop Est.	Total Count	ZNP	BLM	Lambs/100 Ewes	Rams/100 Ewes
2008	150	75	75	*	45.0	42.5
2009	460	230	116	114	38.2	37.4
2011	400	200	*	200	27.5	56
2013	840	504	243	261	32.7	63.4
2015	830	494	316	178	30.3	41.4
2018	807	484	333	150	40.2	43.2

*No survey conducted in that portion of the occupied habitat.

Predator Management: If predation becomes a limiting factor on bighorns, predator control work will be administered within the guidelines of the DWR Predator Management Policy. Predator management will be coordinated with USDA Wildlife Services.

DISEASE MANAGEMENT

Disease Management Objectives:

- 1) Maintain a healthy population of desert bighorn sheep on the Zion unit.
- 2) Maintain spatial separation from domestic sheep and goats.

Disease Management Strategies:

Disease Monitoring: The DWR may perform periodic live captures to assess herd health, as well as take advantage of opportunistic sampling of hunter harvested bighorns or bighorns that are found dead.

Spatial Separation: The DWR will delineate areas where there is high risk for domestic sheep and goats to come in contact with wild sheep or where wild sheep may stray and come in contact with domestics. These areas will be considered areas of concern. Lethal or non-lethal removal of bighorns may be warranted in these areas to prevent comingling. The need to test wandering sheep from this unit will be evaluated on a case by case basis. Working with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas should be a priority. There is significant domestic sheep grazing on private lands and USFS lands north of the area that bighorn sheep inhabit. Wild sheep should be removed if found within these areas. Farm flock sheep and private sheep grazing are known to be present in

Springdale, Hildale, Mt Carmel, and Kanab and pose the greatest risks at this time. Outreach efforts have been enacted to educate private stock holders of the risk of contact between bighorn and domestic sheep. These efforts should continue and expand to all the surrounding operators and communities. Feral domestic sheep and goats also pose a threat to spatial separation. There have been at least five documented feral goats from the town of Hildale in the past 8 years. Prior to aerial surveys, the local Sheriff's Office (Washington and Kane Counties) should be contacted to acquire permission for removal of feral domestics that pose a disease threat to wild sheep as per Utah Code 4-25-5. Manage for spatial separation between wild sheep and active domestic sheep allotments. Removal of wild sheep found near these areas is recommended to maintain separation and protect wild sheep. Outreach efforts should occur with domestic operators and private landowners.

Risk Management and Response Plan:

Historic areas Zion bighorn sheep have wandered from the core habitat area and been removed includes:

- Cedar Canyon
- Kanarraville
- Bear Valley near SR-20

High risk areas include private lands and USFS lands north of the park. Ashdown Gorge and the Vermillion Cliffs along the Parowan Front includes suitable bighorn sheep habitat and should be monitored periodically. All wandering wild sheep and stray domestic sheep and goat issues will be handled following the UDWR GLN-33. The need to disease test wandering bighorn sheep from this unit will be evaluated on a case by case basis. The DWR supports double fencing and other methods to maintain spatial separation where appropriate.

HABITAT MANAGEMENT

Habitat Management Objectives:

- 1) Maintain or improve sufficient bighorn sheep habitat to achieve population objective.
- 2) Support and encourage regulated livestock grazing and maintain/enhance forage production through range improvement projects on the Zion unit.
- 3) Improve habitat and water availability where possible.

Habitat Management Strategies:

Monitoring: The DWR will assist land management agencies in monitoring bighorn habitat to detect changes in habitat quantity and quality.

Habitat Improvement: Vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts will be sought out and initiated. The DWR will cooperate with the BLM to utilize seeding, controlled burns, and/or mechanical treatments for conifer removal in order to increase and improve bighorn habitat across the unit. Habitat restoration projects will be planned and executed through the Utah

Watershed Restoration Initiative program, allowing for public input to ensure that projects that are beneficial to both bighorn sheep and sympatric cattle are given priority.

Water Improvement: The DWR will work with the BLM and any private stakeholders to locate and cooperatively modify or improve existing water sources or install new water developments across bighorn habitat.

RECREATION MANAGEMENT

Recreation Management Objectives:

- 1) Provide high quality hunting opportunities on the Zion unit.
- 2) Increase public awareness and expand viewing opportunities of bighorn sheep.

Recreation Management Strategies:

Hunting: Hunting and permit allocation recommendations will be made in accordance with the Utah Bighorn Sheep Statewide Management Plan. A bighorn hunt will continue to be proposed on this unit. When sub-unit populations reach a population level that they can stand on their own, they will be proposed to be managed separately. Ewe hunts may be utilized as a tool for maintaining population objective.

Harvest Statistics for the Zion Unit

Year	Draw Permit Harvest	Conservation Permit Harvest	Mean Days Hunted	Harvest
2010	5	2	8.2	100%
2011	7	2	7.4	100%
2012	8	2	6.8	100%
2013	9	3	9.7	100%
2014	12	2	10.8	100.0%
2015	12	3	5.9	92.3%
2016	9	2	4.6	90.0%
2017	9	3	6.5	100%
2018	10	4	6.6	100%

Non-Consumptive Uses: The DWR will look for opportunities to increase public awareness and expand viewing opportunities of bighorn sheep through viewing events and public outreach.

PUBLIC INVOLVEMENT

Public Involvement Objective:

- 1) Provide opportunities for local stakeholders and cooperating agencies to be involved in the management process and to jointly resolve potential issues involving bighorn sheep.

Public Involvement Strategies:

Plan Revision: If the population objective or other key components of this plan are to be revised in the future, affected cooperating agencies, local stakeholders, and grazing permittees will be invited to take part in the decision-making process.

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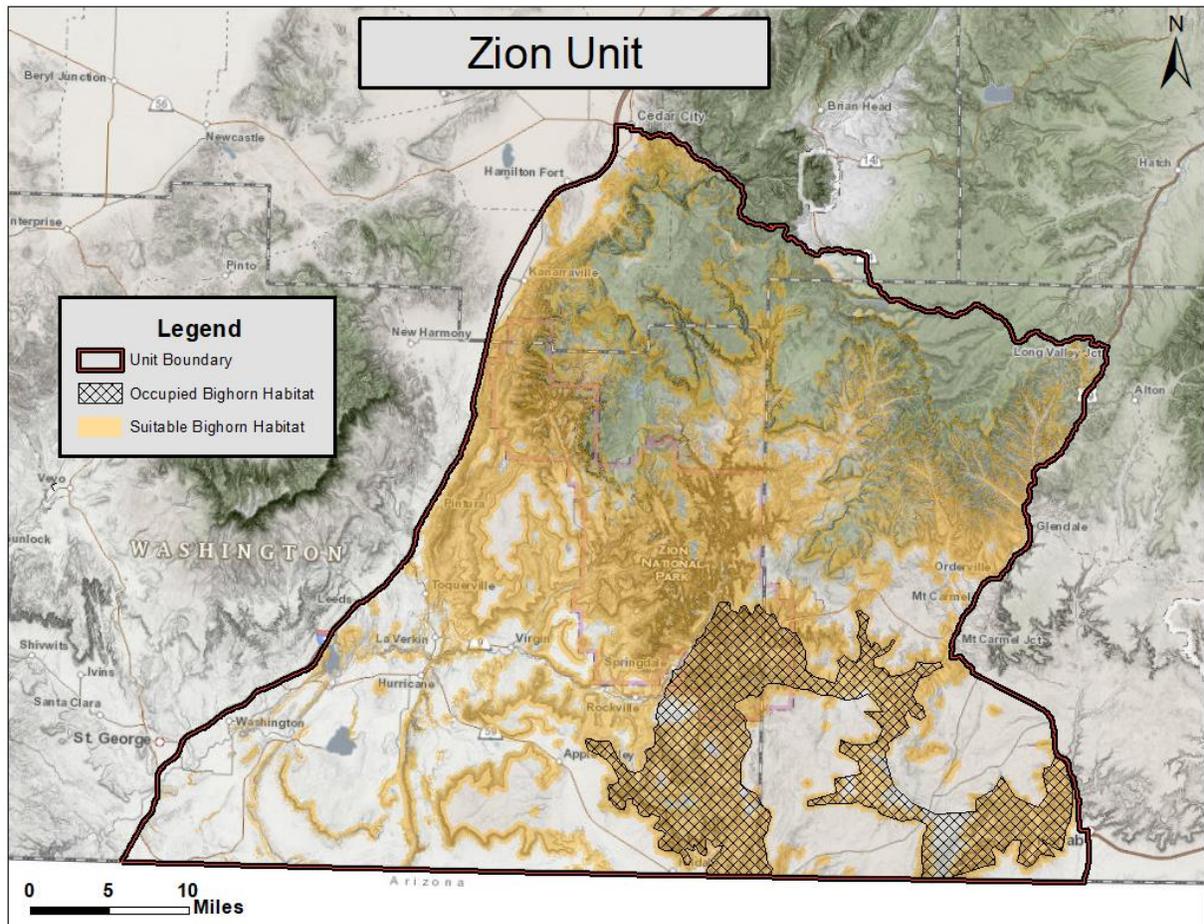


Figure 1. Zion unit management boundary, modeled suitable bighorn sheep habitat, and currently occupied bighorn habitat. Washington and Iron Counties, UT, USA.