

***BIGHORN SHEEP MANAGEMENT PLAN
DATA ANALYSIS UNIT RBS-1
Poudre/Rawah/Lone Pine
Game Management Units S1, S18, S40 & S58***

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DAU RBS-1 (Poudre/Rawah/Lone Pine Bighorn Sheep)
EXECUTIVE SUMMARY

GMUs: S1, S18, S40, S58 (parts of Larimer and Jackson Counties)
Land Ownership: 32% Private, 46% USFS, 5 % State LB, 10% CPW, 6% BLM

Posthunt Population: Previous Objective: NA 2011 Estimate- 160 bighorn sheep
Current Population Objective: 175-225 bighorn sheep

Posthunt Sex Ratio: Previous Objective: NA 2011 Observed- 59 rams:100 ewes
Current Sex Ratio Objective: 50-70 rams:100 ewes

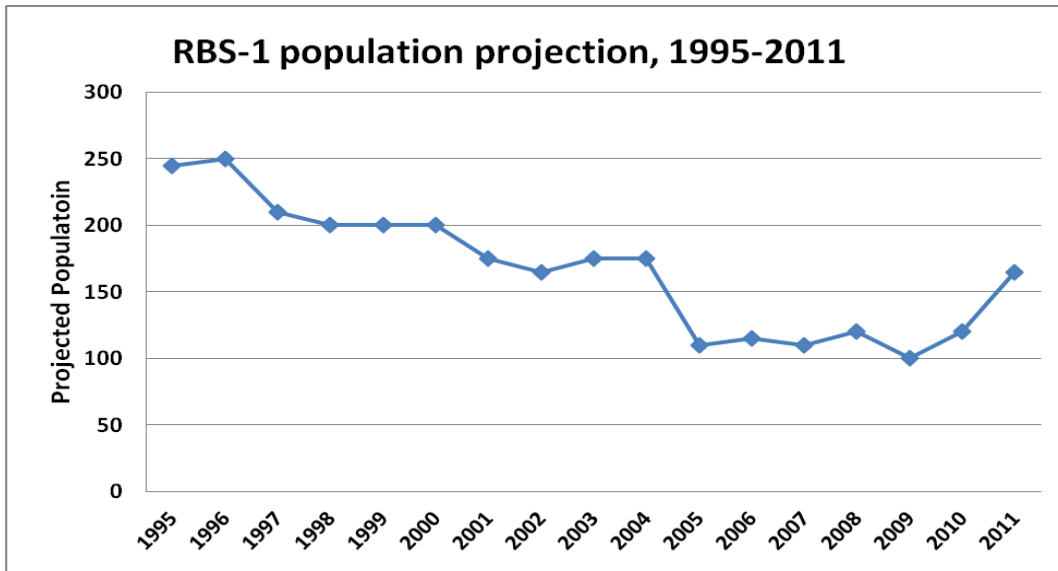


Figure 1: RBS-1 bighorn posthunt population projection from 1995 to 2011.

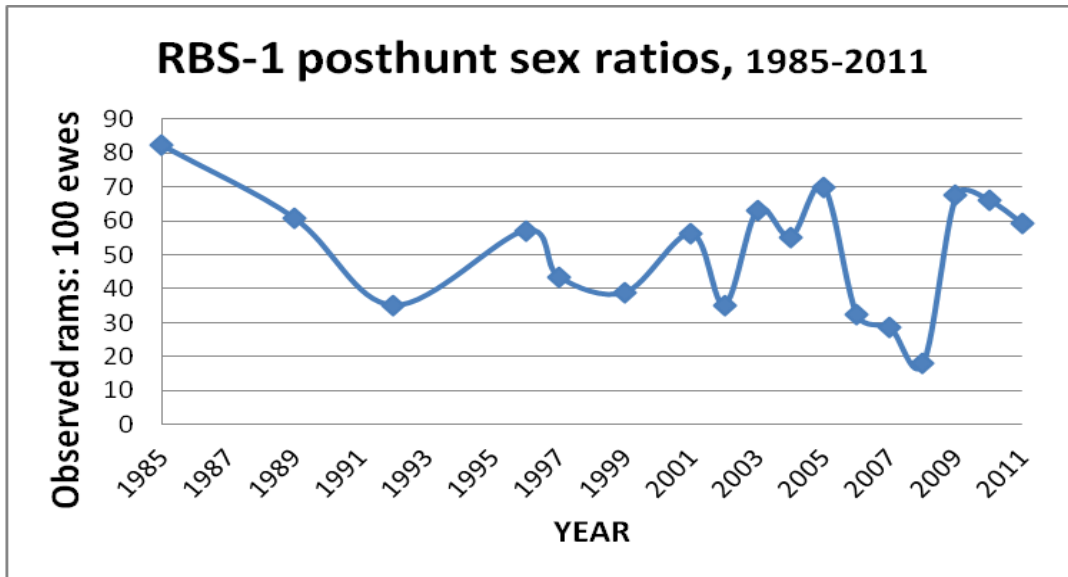


Figure 2: Observed posthunt sex ratios for RBS-1 from 1985 to 2011.

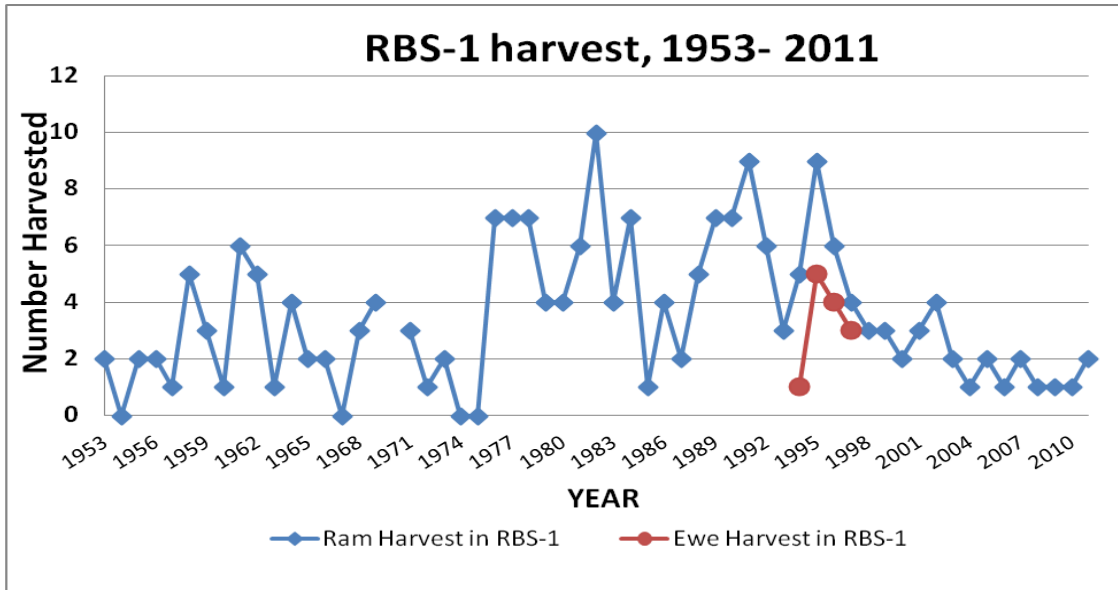


Figure 3: RBS-1 harvest from 1953 to 2011.

Background Information

The Poudre/Rawah/Lone Pine Bighorn Sheep herd (Rocky Mountain Bighorn Sheep Data Analysis Unit (DAU) RBS-1) is located in north-central Colorado. The DAU consists of Game Management Units (GMUs) S1, S18, S40 and S58. It encompasses 1,349 square miles (3,494 square kilometers) in northern Larimer and eastern Jackson Counties. The lands in this DAU are 32% in private ownership, with the remaining 68% managed as public lands by multiple agencies. The United States Forest Service (USFS) is the largest land manager with 46% of the DAU. Only 297 square miles of the DAU is currently mapped as occupied bighorn sheep range.

The current RBS-1 herd is largely the result of a 1946 transplant into the Upper Poudre (S1). The small population in S18 is believed to be indigenous in origin, while the modern S40 and S58 herds are results of transplant operations. Population numbers fluctuated within each herd; currently the portion of the herd that is mark-resight surveyed is estimated at 120 bighorn (S1 and S58). Sheep unit S18 is projected to be about 15 individuals with another 25 in S40, giving a 2011 posthunt projection of 160 bighorns in the DAU. Populations appear to be growing in S1, S40 and S58. The 2011 posthunt DAU population estimate is 160 bighorn. The current observed sex ratio objective is 59 rams:100 ewe. In the fall of 2012 there will be 2 ram licenses and one ewe license available for S1/S18/S40 hunters. Sheep unit S58 is currently closed to hunting.

Potential threats to this herd include disease epidemics following contact with domestic sheep and goats, habitat degradation from fire suppression and habitat fragmentation resulting from human development and recreation.

Population Objective Alternatives

This DAU plan presents 3 population alternatives. Alternative 1 would call for a small ~5% decrease from current numbers to a herd range of 125-175. Alternative 2, 175-225 bighorn, represents an approximately 25% increase from the current population to account for the improving recruitment currently being observed in this herd.

Alternative 3, 225-275 bighorn is a larger increase from current numbers, growing the herd about 50%.

Sex Ratio Objective Alternatives

This DAU plan presents 3 sex ratio objective alternatives. Alternative 1, 30-50 rams per 100 ewes, is a decrease from the current observed ratio and would require an approximately 20 % reduction. This range is lower than naturally occurring sex ratios in bighorn herds. Alternative 2, 50-70 rams per 100 ewes, overlaps the current observed sex ratio. This range is thought to be at the lower end of natural sex ratio of bighorn herds. This alternative would attempt to balance age/horn size of rams, with some of the negative aspects of higher ram:ewe ratios. Alternative 3, 70-90 rams per 100 ewes is an increase from the current observed ratio. Under this alternative, the sex ratio would increase about 35% from the current observed level.

Preferred Alternatives

The preferred alternatives both provide a reasonable balance between increasing bighorn numbers to utilize available habitat while also guarding against increased extra-range movements and potential for disease events at higher densities. Population Alternative 2, (175-225 bighorns) represents a moderate increase in population from current levels and is the preferred alternative by CPW as well as the majority of surveyed public respondents. The preferred sex ratio alternative is Alternative 2, where RBS-1 would be managed for a ratio of 50-70 rams:100 ewes. This range overlaps the currently observed ratio and with a larger population should allow for a modest increase in ram and ewe hunting opportunity. This alternative was also preferred by the majority of public survey respondents. Both these alternatives were supported in the land management agency comments received as well.

This plan was approved by the Colorado Parks and Wildlife Commission on July 13, 2012

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INTRODUCTION AND PURPOSE

Colorado Parks and Wildlife (CPW) manages Rocky Mountain bighorn sheep for the use, benefit and enjoyment of the people of the state and its visitors, in accordance with CPW’s Strategic Plan, the Colorado Bighorn Sheep Management Plan (George et al. 2009), and mandates from the Parks and Wildlife Commission and Colorado Legislature. In 2011 CPW became a merged agency encompassing two previously separate Divisions, State Parks and Wildlife. Citations and references in this document previous to 2011 will refer to the Colorado Division of Wildlife (CDOW). Colorado’s wildlife resources require careful and increasingly intensive management to accommodate the many and varied public demands and growing impacts from people. To manage the state’s big game populations, CPW uses a “management by objective” approach (Figure 1). Big game populations are managed to achieve specific objectives that are outlined within Data Analysis Unit (DAU) plans. Each DAU generally represents a geographically discrete big game herd which includes the year-round range of the population. When delineating DAU boundaries, managers assume that there is minimal interchange of animals between adjacent DAU’s. A DAU may be divided into several Game Management Units (GMU’s) in order to distribute hunters and harvest throughout a DAU, or to take into consideration specific local management issues.

COLORADO’S BIG GAME MANAGEMENT BY OBJECTIVE PROCESS

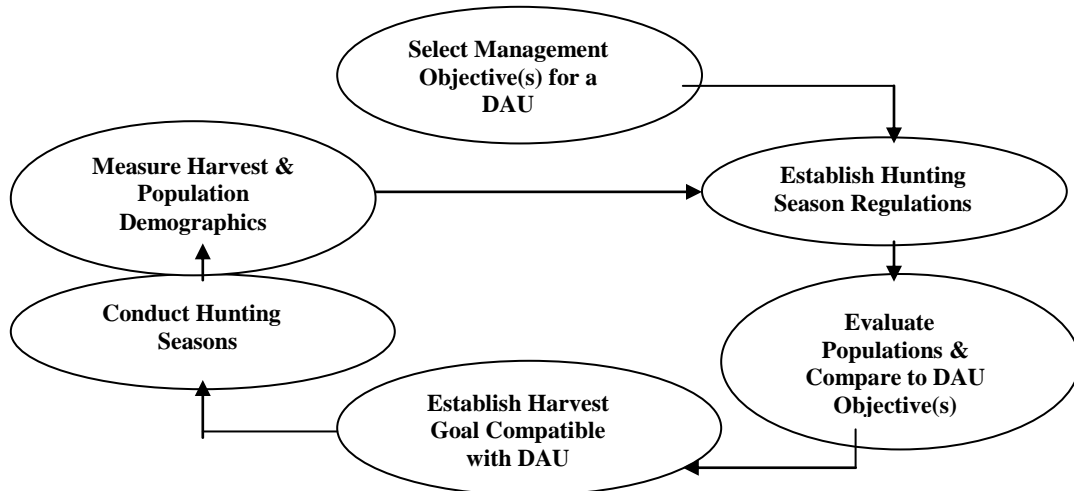


Figure 1. Management by objectives process used by the CPW to manage big game populations on a DAU basis.

The DAU planning process incorporates public input, habitat capabilities, and herd considerations into management objectives for each of Colorado’s big game herds. The general public, sportsmen, federal land management agencies, landowners, outfitters, and agricultural interests are involved in determining DAU plan objectives through questionnaires, public meetings, comments on draft plans, and input to the Colorado Parks and Wildlife Commission. Limited license numbers and season recommendations result from this process.

Bighorn sheep management in Colorado has some differences relative to other big game management. Sheep populations are typically much smaller and often more geographically isolated than deer, elk, or pronghorn herds. Limited hunting opportunities exist in some herds which are closely scrutinized on an annual basis. Bighorn populations may be influenced to a greater degree by factors such as disease or severe winters that may be outside of the management influence of local CPW staff. Furthermore, annual monitoring of bighorn sheep in Colorado has been variably dependent on budgetary constraints, habitat and weather patterns. Some sheep herds are not comprehensively surveyed every year, and may only be surveyed once every three or more years. For these reasons, some sheep DAU plans may rely on objectives that are atypical of Colorado management plans and will not include male:female or population objectives. Based on the best available science and constituent input, managers will strive to establish tangible DAU plan objectives that will promote sustainable bighorn sheep populations and objective management on an annual basis. RBS-1 currently doesn't have a DAU plan (or long-term objectives), but population and sex ratio goals will be approved as part of this DAU plan process.

DESCRIPTION OF DAU

Location

Bighorn Sheep DAU RBS-1 is located in north-central Colorado in Larimer and eastern Jackson Counties. Game Management Units S1, S40 and S58 are entirely within Larimer County, while GMU S18 straddles the Larimer-Jackson county line. The DAU is bounded by the Wyoming state line on the north, on the west by Colorado Highways 125 and 127, on the south by Colorado Highway 14, Larimer Co Rd 52E (Rist Canyon Rd), Stove Prairie Rd (Larimer Co Rd 27), and Larimer Co Rd 44H (Buckhorn Rd) and on the east by Larimer Co Rd 37, South Branch Boxelder Creek, Boxelder Creek, Larimer Co Rd 19, US Highway 287 and Larimer County Rd 54G.

Below are the bighorn sheep GMU boundary descriptions as defined by 2011 Regulations.

GMU S1- Upper Poudre River - That portion of Larimer Co bounded on the north by Larimer Co Rd 80C and Deadman-Red Feather Rd; on the east by Larimer Co Rd 68C (Boy Scout Ranch Road) and Elkhorn Creek; on the south by Colo 14; and on the west by the Laramie River Rd.

GMU S18- Rawah - Those portions of Larimer and Jackson counties bounded on the north by the Wyoming state line; on the east by Larimer Co Rd 103 (Laramie River Rd); on the south by Colo 14; and on the west by Colo 125 and Colo 127.

GMU S40- Lone Pine - That portion of Larimer Co bounded on the north by Larimer Co Rds 80C and 59 (Cherokee Park Rd), the Wyoming state line; on the east by Larimer Co Rd 37, South Branch Boxelder Creek, Boxelder Creek, Larimer Co Rd 19; on the south by Larimer Co Rd 80, and US 287; and on the south and west by Larimer Co Rds 74E and 162 (Red Feather Lakes-Deadman Rd).

GMU S58- Lower Poudre - That portion of Larimer Co bounded on the north by Larimer Co Rd 74E (the Red Feather Lakes Rd) on the east by US 287 and Larimer Co Rd 54G; on the south by Larimer Co Rd 52E (Rist Canyon Rd), Stove Prairie Rd (Larimer Co Rd 27), and Larimer Co Rd 44H (Buckhorn Rd); and on the west by Larimer Co Rd 63E (Pingree Park Rd), Colo 14, Elkhorn Creek, and Larimer Co Rd 68 (Boy Scout Ranch Rd).

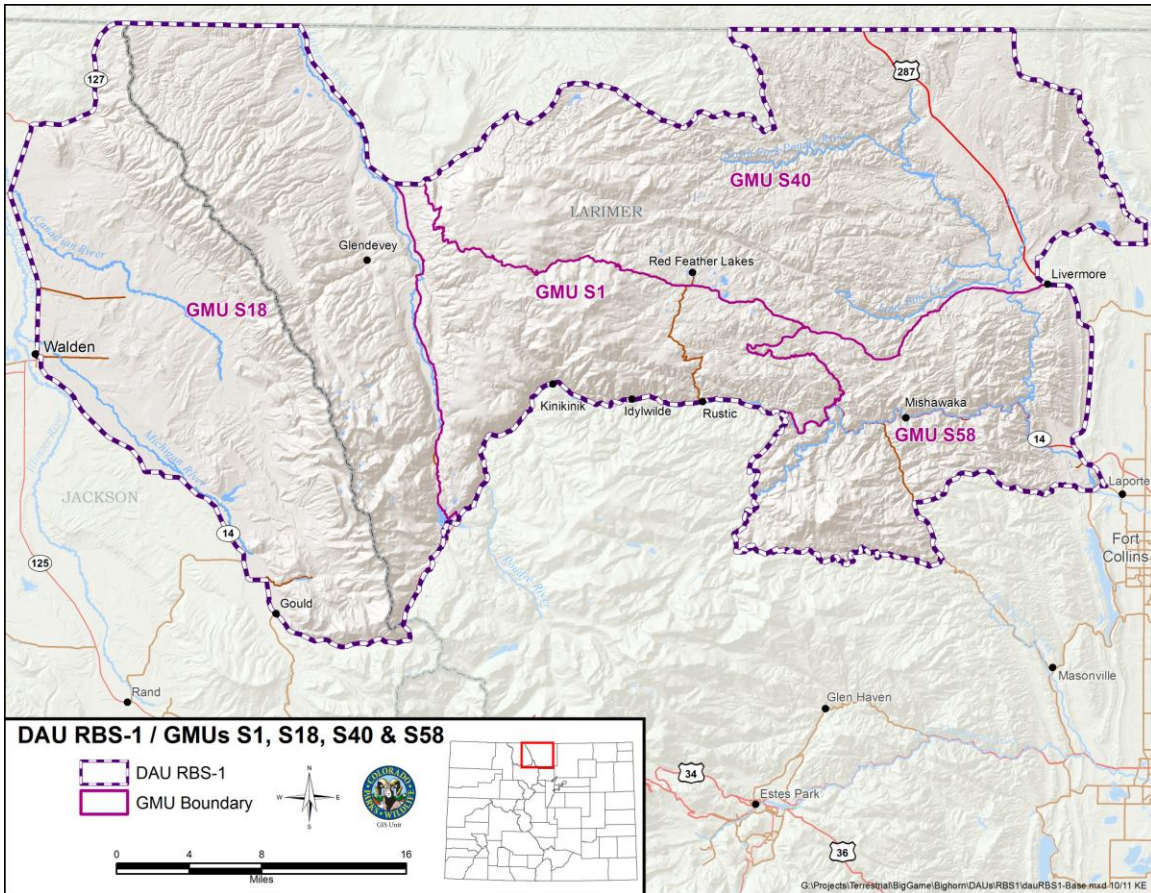


Figure 2: Geographic location of bighorn sheep Data Analysis Unit (DAU) RBS-1 and Game Management Units (GMUs) S1, S18, S40 and S58.

Physiography

Climate

The overall climate in RBS-1 is relatively dry with low humidity. Climate varies across the DAU as a function of elevation. Conditions on the eastern edge of S40 are standard for the foothills/short grass prairie interface, with relatively mild winters, smaller snow accumulations and hotter summers. The higher elevation portions of S1 and S18 experience a harsher climate, with long, cold winters, abundant snowfall, and short, cool summers. Many west and south-facing slopes are typically clear of snow all year, with occasional spring and late winter storms depositing accumulations which quickly melt off. Weather-related winter bighorn mortality is usually not a factor in most

of the DAU. The possible exception to this could be for portions of the S18 herd that winter in the Rawah wilderness at elevations of around 12,000 feet.

Elevations range from 12,950 feet at the highest point in the southwestern part of the DAU (Clark Peak) to just over 5,000 feet along the Highway 287 corridor northwest of Fort Collins. The DAU covers much of the northern part of the Arapaho/Roosevelt National Forest.

Vegetation

Plant communities are diverse in RBS-1 and vary depending on many factors including elevation, aspect, precipitation, and soils. Given the largely non-migratory nature of each of the 4 sheep herds in RBS-1 many sheep in the DAU occupy relatively similar habitat types year round.

Vegetation on the eastern side of the DAU bordering Boxelder Creek and Highway 287 is composed of shortgrass prairie, pasture, and mountain mahogany/ponderosa hillsides. Native grasses, non-native grasses and some croplands are present as well. Riparian areas are comprised of cottonwoods, along with alders and willows. Sheep in S40, which is the eastern-most unit, do occasionally appear in the shortgrass prairie community, but mostly stay in the mixed ponderosa pine/mountain mahogany complexes which provide more contour relief.

Foothills vegetation from approximately 5,500 to 7,000 feet is characterized by various shrub types and ponderosa pine. Shrubs such as mountain mahogany, juniper, antelope bitterbrush, and skunkbush sumac all are present, although the localized diversity varies greatly.

Moving higher in elevation from the foothills one enters a new ecological region, the montane zone. Ponderosa pine forests may continue to elevations above 8,000 feet, but often Douglas-fir stands begin at middle elevations and continue up to 9,000 feet. Both aspen and lodgepole pine appear as early colonizers, inhabiting areas of disturbance.

Areas on the far western and southwestern portion of the DAU represent the subalpine region. Aspen is present at the lower end of the zone, giving way to lodgepole stands as elevation increases. Spruce/fir communities are the standard forest type through the subalpine until 11,500 feet, at which point timberline is reached and tree growth is nearly impossible given the cold, snow and wind. Above timberline, the landscape is dominated by tundra vegetation such as cushion plants, willow species and small groups of krumholtz trees.

Land Management

DAU RBS-1 encompasses 1,349 mi² (3,494 km²) of north-central Colorado (Figure 3). Approximately 46% or 617 mi² is owned and managed by the United States Forest Service (USFS). Nearly all of the USFS total falls in the Arapaho/Roosevelt National Forest with only 17 mi² of USFS lands outside in the Routt National Forest. The next largest land ownership category in RBS-1 is private lands, accounting for 32%, or 431 mi² of the DAU. Colorado Parks and Wildlife manages 10% of the DAU with 141 mi² of property. These are primarily encompassed by Lory State Park, State Forest State Park and the various units of Cherokee State Wildlife Area (SWA). The Bureau of Land Management (BLM) manages 6% of the DAU with 75 mi² of property which is nearly all in S-18. The State Land Board manages an additional 5% or 63 mi² of the DAU.

Only 297 mi² (769 km²) of this DAU is currently mapped as occupied bighorn sheep range. Of this occupied range, approximately 59% (175 mi²) is managed by the USFS. Seventy square miles or 24% of the occupied range is in private ownership and the third remaining significant landowner is CPW with 13% or 40 mi² of occupied habitat. Based on current mapping 72% of RBS-1 occupied bighorn range is on public land.

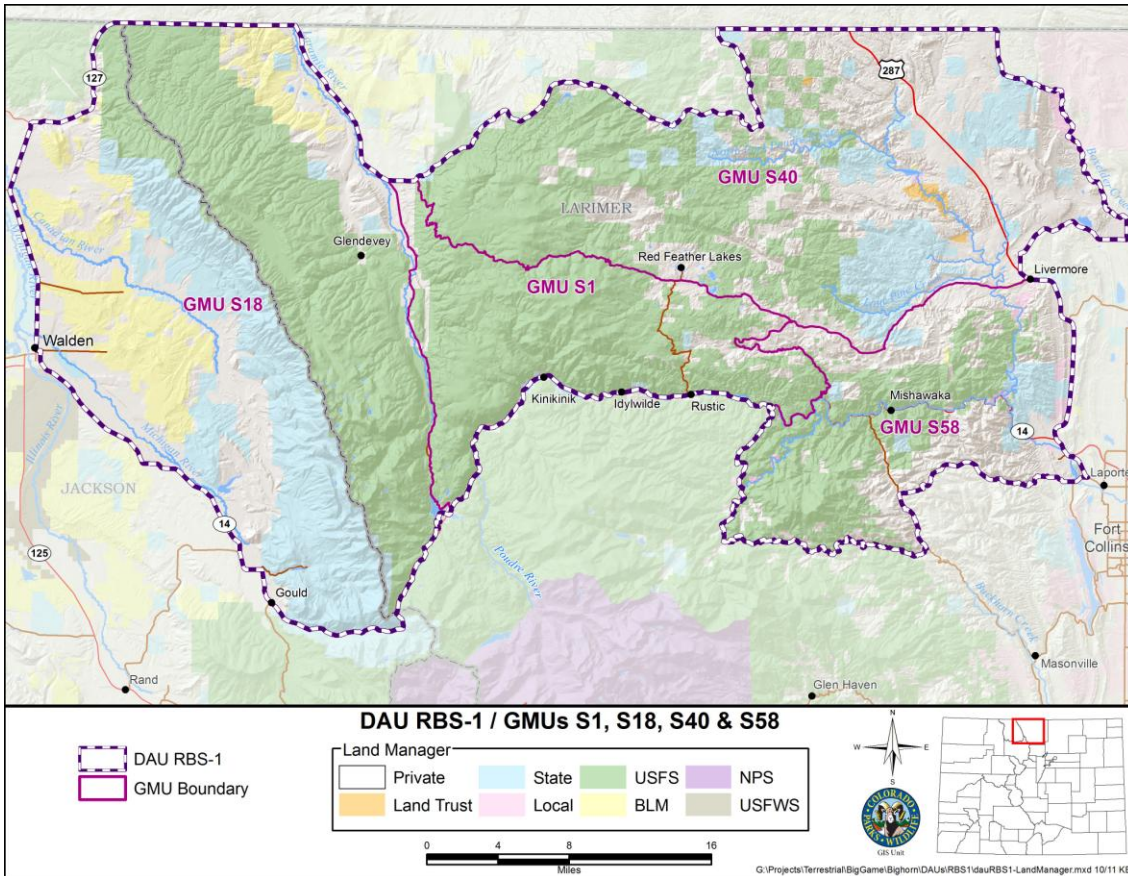


Figure 3: Property by land manager status in bighorn sheep DAU RBS-1

Habitat Resources

The amount of available bighorn sheep habitat in DAU RBS-1 was estimated through a spatial analysis as outlined in the Colorado Bighorn Sheep Capture Guidelines (George and Miller 2008). This analysis identified the areas topographically suitable as bighorn sheep habitat and then removed areas that were known to be unsuitable due to vegetative characteristics.

Bighorn sheep escape terrain was defined as those areas with slopes greater than or equal to 60% (i.e., approximately 27 degrees). All areas within 300m of escape terrain were considered topographically suitable habitat. Areas within 500m of escape terrain were also included if escape terrain occurred on at least 2 sides. Areas that contained unsuitable vegetation (e.g., spruce fir containing areas) were removed from the topographically suitable area in order to estimate the amount of suitable bighorn habitat.

Using this definition, DAU RBS-1 contains 575 mi² (1,490 km²) of suitable bighorn habitat (Figure 4). One hundred and ninety four mi² (504 km²) of this occurs within the currently occupied overall range of the herd (Figure 4). This spatial analysis is useful for generating a map of the areas that may be suitable for use by bighorn and for calculating the amount of habitat that may be available to them.

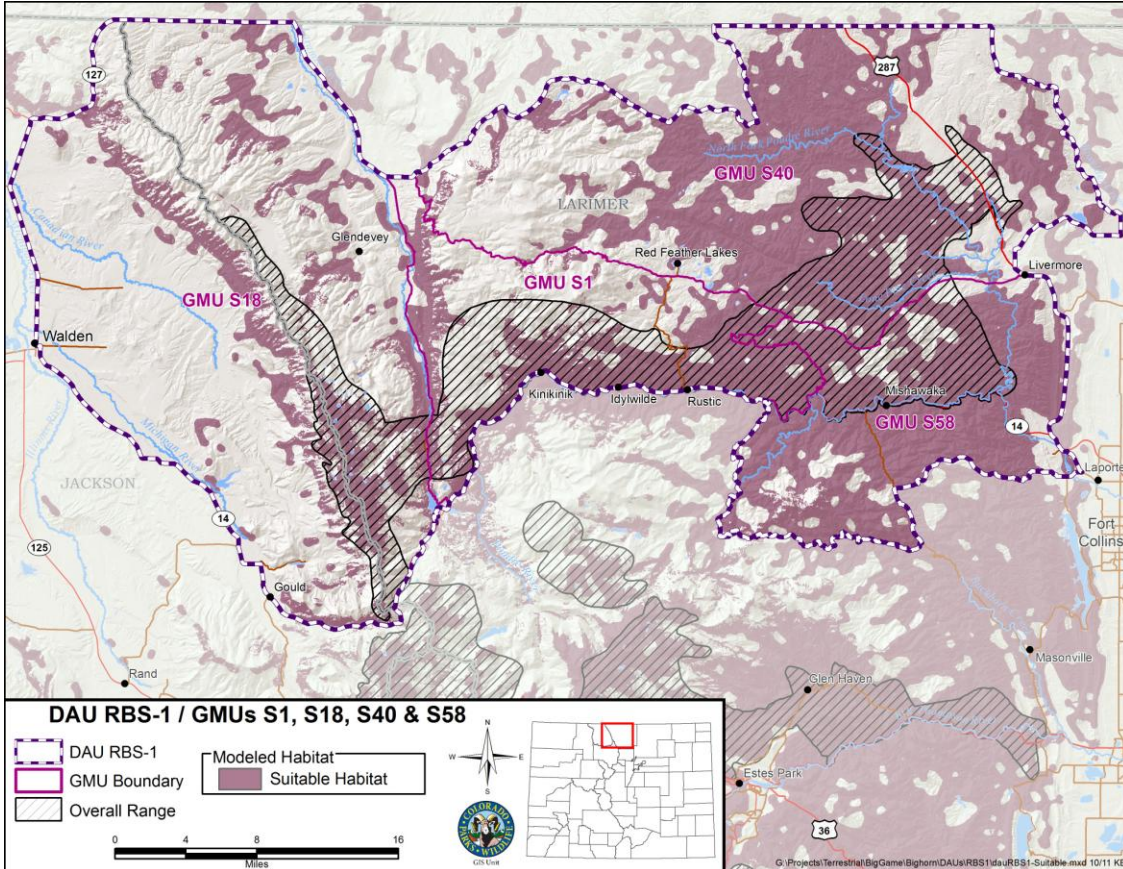


Figure 4: Modeled suitable bighorn sheep habitat and occupied range in DAU RBS-1.

The amount of suitable winter range was estimated as suitable habitat with a southerly aspect. DAU RBS-1 contains 234 mi² (607 km²) of suitable winter range (Figure 5). Eighty five mi² (220 km²) of this occurs within the currently occupied range of the herd.

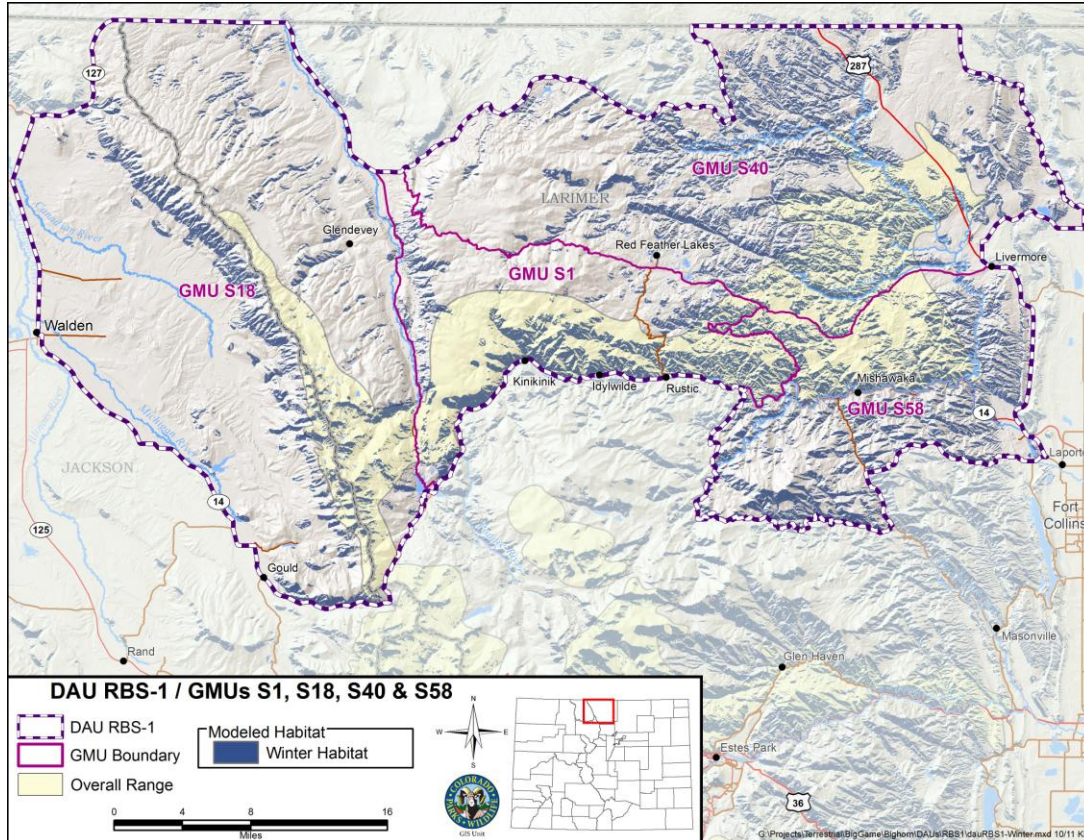


Figure 5: Modeled winter habitat and occupied range in DAU RBS-1

Lambing habitat was defined as suitable habitat in patches of at least 2 ha in size with slopes $\geq 60\%$ and southerly, easterly or westerly aspects (Figure 6). DAU RBS-1 contains 67 mi² (174 km²) of suitable lambing habitat. Of this, 32 mi² (84 km²) of lambing habitat is within the currently occupied range.

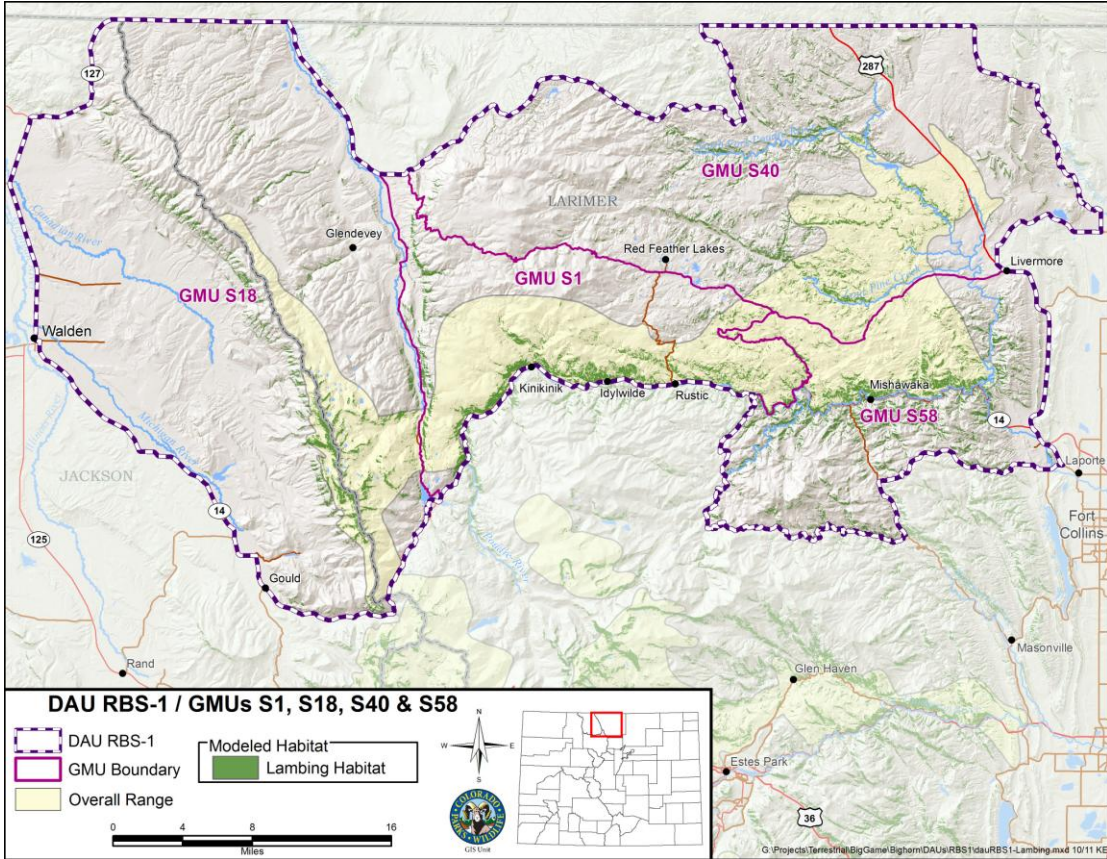


Figure 6: Modeled lambing habitat and overall range in DAU RBS-1

BIGHORN SHEEP POPULATION HISTORY

Population History

Historical Occurrence, Numbers and Distribution

Bighorn sheep presumably were native to RBS-1 and the Poudre Canyon area. Unfortunately, there is a lack of information and clear documentation on their presence before 1946. The Poudre River drainage is considered historical sheep range, but there were no known sheep in Poudre Canyon when introductions were made on December 6, 1946 (Bear & Jones 1973). There are two reports of bighorn sheep in S-18; the first is based on a report from Gil Hunter who cites a third party as seeing a large band of sheep in the Clark Peak area in 1905-1906 (Sheperd 1977). The second report, also in Sheperd (1977) references the North Park Bohlender family as summering cattle around Clark Peak in S-18 and routinely seeing bighorn sheep around Kelly and Jewel Lakes in the 1920s.

The initial RBS-1 population was created solely from the transplant effort of 16 sheep in 1946 from the Tarryall Mountains. By 1949 the annual census recorded 29 sheep; this was considered a sizable increase over the initial herd (Bear and Jones, 1973). In 1956 the Poudre herd was estimated at 60 sheep while the S18 herd around Clark Peak was estimated at 35 sheep (Moser 1962). The estimate in 1970, based on local field officer observations placed the entire Poudre and Rawah herd at 65-75 animals (Bear and Jones, 1973). In 1982 the herd was estimated at between 125-175 individuals and their

range had expanded to reach from Poudre Falls to Stove Prairie Landing (Wakelyn 1984). Bear and Jones (1973) reported a steady increase in herd growth since the early 1970s, and both continued range expansion and population growth were predicted (Wakelyn 1984). In 1988, the Upper Poudre (S1) herd was estimated at 100 sheep. These numbers apparently followed a die-off during 1986-1987 in which the herd in the Upper Poudre experienced significant lamb loss, as well as adult mortality associated with lungworm/pneumonia (Insight, CSU Veterinary Medicine and Biomedical Sciences, 1986).

In 1988 the Lower Poudre (S58) herd numbered 60 (Bailey 1990). In 1991 there was a supplement to the Lower Poudre of 20 sheep from Estes Park. The Lower Poudre suffered its own low survival and recruitment problems during 1997-1998 for unclear reasons. The CDOW survey in 1997 marked the last time a surviving lamb was documented during the winter in the Lower Poudre for the next 13 years. This decade of zero lamb recruitment greatly decreased the size and distribution of the sheep in S58. Until 2005 it was undocumented how much overlap between these herds existed, or how much range expansion occurred on the eastern end of the Lower Poudre herd.

Bailey (1990) indicates that the sheep transplanted into the Lone Pine area (north of the Poudre) in 1977 grew quickly from the original 19 transplants, but by 1988 was only 20 sheep. These sheep wandered significantly using the Lower Cherokee Park SWA, Phantom Canyon below Halligan Reservoir and private lands on either side of the SWA. The only site which was used with annual fidelity was the south facing slopes below the Lone Pine release site (CDOW memo, 1984). During the late 1990s until around 2004 it was rare to observe any significant number of sheep in S40. While small groups were occasionally seen during aerial big game helicopter inventories or observed along Highway 287, no significant "herd" was believed to be present. As more intensive monitoring efforts began in January 2005 as part of the Poudre Population Estimation and Lamb Survival project, more frequent observations were made of sheep in S40. During the winters of 2005 and 2006 a significant wintering herd of bighorn sheep estimated at 15 could reliably be located on private lands adjacent to the Lone Pine SWA. By 2009, a high count of 28 sheep was observed during a winter classification survey.

Current Occurrence and Distribution

The current southern extent of the S1 and S18 sheep herds is Highway 14 along Poudre Canyon (Figure 7). The western boundary of their range appears to be the alpine bowls on the west side of the Rawah Range, overlooking North Park, particularly the Clear and Kelly Lakes drainages. These sheep venture north out of the Poudre Canyon only until the point where the vegetation changes from open ponderosa, juniper and shrub habitat into solid lodgepole forest. In much of the Upper Poudre this creates a very thin, linear piece of sheep habitat along the north side of the canyon. Ewe radiotelemetry data from 2005-2010 indicate that at least the maternal bands of sheep in S1 don't move east of the Indian Meadows/Pingree Park bridge area.

Sheep in S58 currently use the Lower Poudre Canyon from Gateway Park (where the North fork of the Poudre joins the mainstem) upstream to near Stove Prairie Landing (Figure 7). The Poudre River and Highway 14 seem to form the southern boundary for sheep in S58. Given the more open nature of the upper slopes on the north side of the

river, it appears from recent radiocollar data that sheep in S58 at times use the hillsides further north towards the Red Feather Road.

Sheep that are part of S40 have been seen as far north as Middle Cherokee Park SWA and the Phantom Canyon area (Figure 7). Sheep have been observed east of Highway 287 along Stonewall Creek and on prominent escarpments in that area. They also use ranchlands east of the Lone Pine SWA and areas south of the Red Feather Rd towards the Poudre.

Based on 2005-2010 radiocollar data and animal observations it seems that female sheep inhabiting the upper Poudre from Grandpa's Bridge to the Laramie River Tunnel seem to move significantly within that overall range, but with little seasonal fidelity. The majority of S1/S18 rams on the other hand appear to winter in the Upper Poudre between Rustic /Spencer Heights and summer along the ridgeline of the Rawah Wilderness area between Grassy Pass/Clear Lake/Kelly Lake. Rams making this seasonal movement appear to leave for summer range in July and move through significant stands of dark timber between the Laramie River Tunnel burn and Cameron Peak in the Rawahs. They cross the ridgeline of the Rawah mountain range and drop down on the west side to summer above Kelly and Clear Lakes in Jackson County. This ram movement from wintering grounds along the Poudre River to summer grounds on the west side of the Rawahs was documented through aerial monitoring of radiocollared rams that were captured near Rustic on their winter range.

Key lambing grounds in RBS-1 appear to be the area north of Mishawaka/Tunnel in the Lower Poudre, the area on the north side of Highway 14 between Big South trailhead and the Laramie River Tunnel burn, and the eastern boundary of the Lower Cherokee SWA (Figure 7). Lambing grounds in S18 are still largely unknown as access to those alpine basins is still limited in May/June, but the two years of location data from one resident radiocollared ewe suggest lambing areas are in the open, leese side basins of the southern Rawahs including Carey and Twin Crater Lakes drainages.

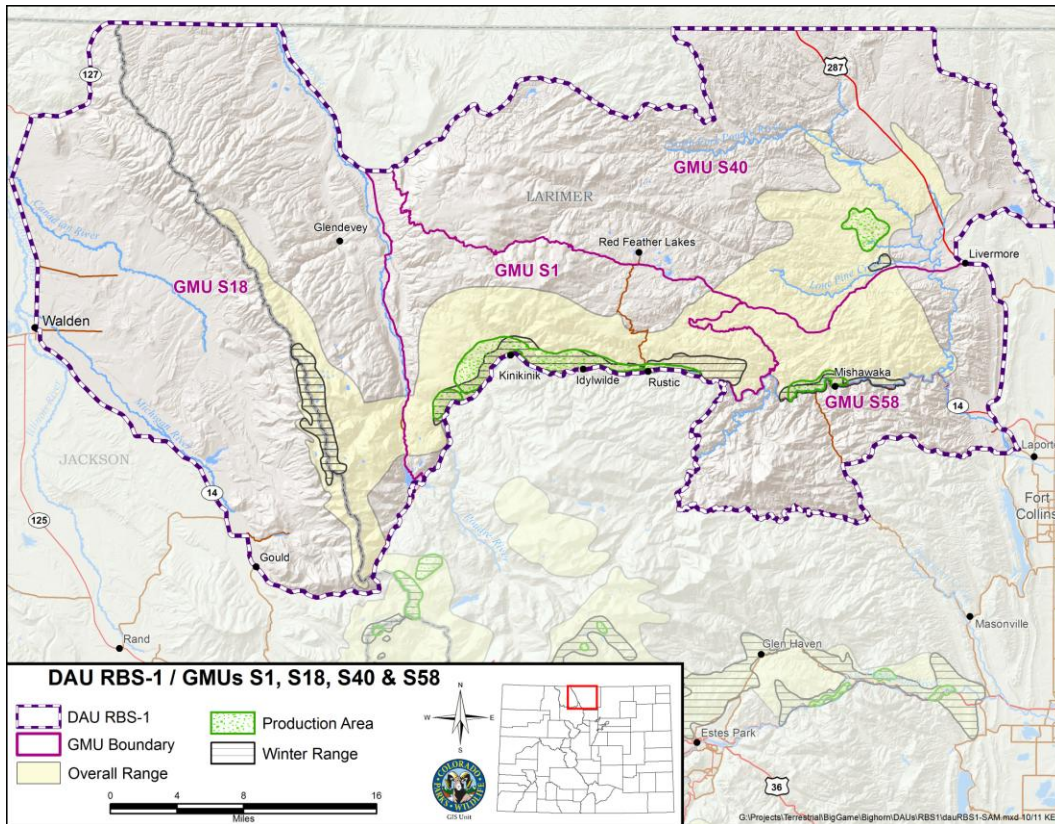


Figure 7: Current distribution of bighorn sheep in DAU RBS-1.

Movement

Interaction of Subherds within the DAU

The most clearly documented interaction within RBS-1 is the annual fall movement of a proportion of the rams that summer in S18 east into S1 for the winter. Based on a number of radio and GPS-collared rams during the late 1990s and early 2000s a movement pattern was observed where rams move from their summer range on the alpine in S18 east towards the Laramie River Valley, cross up onto Green Ridge (approximately following the path of the Laramie/Poudre Tunnel) and then descend into the Upper Poudre around Poudre Falls/Laramie River Tunnel. Based on radiocollar data, this migration appears to be accomplished quickly in 1-2 days. These rams winter in the Upper Poudre and then in early summer follow the snowline back west into the Rawahs. No evidence of this movement was observed in radiocollared ewes in the Upper Poudre or Rawahs during this time. During the course of the 2005-2010 radiocollaring project no movement of marked animals was observed between S18 and S58. Additionally, radiocollared bighorns in S58 and S40 have never been observed interacting. However, there are anecdotal reports that at least some ram bands have been observed moving from S40 around the Lone Pine SWA to the south via Hewlett Gulch/ North Fork Poudre and interacting with sheep in the Lower Poudre (S58). These reports seem largely specific to the breeding season or early winter time period.

Interaction with other DAUs

There are limited data to draw definite conclusions about interaction between RBS-1 and surrounding sheep DAUs, but in general interactions are relatively few. There are no known sheep herds immediately east or west of RBS-1. Habitat east of RBS-1 quickly becomes shortgrass prairie with no potential for sheep use. The nearest sheep herd to the west is S73 (Zirkels), but sheep from western S18 would have to cross the flat and relatively unsuitable North Park basin to interact with them. This movement has never been documented. The Wyoming state line forms the northern boundary of RBS-1 and while there are sheep herds in southern Wyoming the distances between herds are large and are buffered by contiguous stretches of non-suitable lodgepole and other habitat types.

The unit with the most potential for interaction with RBS-1 is S19 (Never Summers), which occupies the alpine ranges south of S1 and S18. The known occupied range of S1/S18/S19 bighorns come the closest to touching near Cameron Pass on Highway 14. Documented interaction via radiocollar data does not exist, but the proximity of suitable habitat suggests this might be the most likely area for interactions, if they do occur.

During the summer of 2009 and 2010 a small group of bighorn sheep were observed by numerous members of the public in the southeast corner of S58. These sheep were reported moving farther and farther north along the western edge of Horsetooth Reservoir, just west of Fort Collins. The fates of at least some of these sheep are known. Two were live-captured by CPW and one found interacting with domestic goats was euthanized as a preventative measure against domestic/wild sheep disease transmission. Given likelihood of dispersals being made by younger animals it is not surprising that at least the 3 bighorns handled by CPW were yearling sheep.

Herd Management History

Inventory Methods

Posthunt surveys have occurred in portions of RBS-1 since at least 1985. There are records of a few documented counts in 1970 and in the 1980s but it is unclear what area was being surveyed. From 1985 to present both the classification inventory and population estimation surveys have been conducted from the ground, without the use of airplanes or helicopters. Sheep in S1, S40 and S58 are relatively available for observation during the late fall from road or hiking based observation points. Sheep units S1 and S58 have been surveyed annually during the posthunt bighorn breeding season (late November-December) using CPW staff and interested members of the public. The Upper and Lower Poudre Canyon is broken into driving routes and assigned to teams, who survey from the road at all available pullouts. These surveys produce sex and age classification ratios, as well as minimum population counts and/or population estimates.

Sex and Age Classification

Ram: ewe ratios during summer surveys are highly variable due to the spatial separation of rams and ewes during this time. Ram: ewe ratios are more reliable during the posthunt surveys when rams and ewes are together. The observed number of rams per 100 ewes during the posthunt survey in RBS-1 has ranged from 18 to 82 (Figure 8). Posthunt lamb to ewe ratios are a commonly used measure of herd recruitment. Since

RBS-1 Bighorn Sheep Management Plan

1985, in surveyed portions of RBS-1 (S1/S58 1985-2008, S1/S40/S58 2009-present) they have ranged from 14 to 67 lambs per 100 ewes (Figure 9). Lamb to ewe ratios fluctuate from year to year, however the sustained low level observed between 1999 and 2005 has been concerning.

YEAR	UNIT	RAM	EWE	LAMB	R:E ratio	L:E ratio
1985	combined S1 & S58	37	45	10	0.82	0.22
1989	combined S1 & S58	28	46	31	0.61	0.67
1992	combined S1 & S58	20	57	30	0.35	0.53
1996	combined S1 & S58	40	70	26	0.57	0.37
1997	combined S1 & S58	20	46	26	0.43	0.57
1999	combined S1 & S58	28	72	10	0.39	0.14
2001	combined S1 & S58	27	48	8	0.56	0.17
2002	combined S1 & S58	19	54	7	0.35	0.13
2003	combined S1 & S58	24	38	10	0.63	0.26
2004	combined S1 & S58	21	38	7	0.55	0.18
2005	combined S1 & S58	21	30	5	0.70	0.17
2006	combined S1 & S58	10	31	9	0.32	0.29
2007	combined S1 & S58	10	35	7	0.29	0.20
2008	combined S1 & S58	5	28	12	0.18	0.43
2009	combined S1, S40 & S58	27	40	13	0.68	0.33
2010	combined S1, S40 & S58	29	44	14	0.66	0.32
2011	combined S1, S40 & S58	29	49	24	0.59	0.49

Table 1: Results of the RBS-1 (S1, S40 & S58) bighorn sheep posthunt coordinated ground surveys from 1985 to 2011. Ratios from 1985 to 2004 were largely based on the results of a survey conducted on a single day. Ratios from 2005 to 2011 are based on the highest daily total count, by gender and age, across repeated surveys conducted between mid-November and mid-December (4 in 2005, 6 in 2006, 8 in 2007, 9 in 2008, 10 in 2009, 8 in 2010 and 7 in 2011).

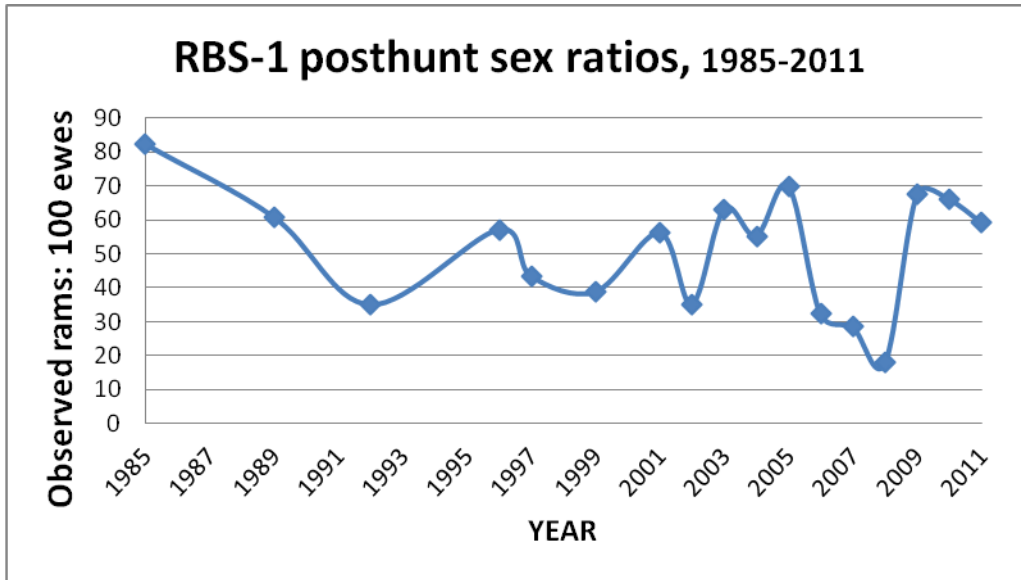


Figure 8: Observed range of posthunt rams per 100 ewes in DAU RBS-1 from 1985 to 2011. Data are from S1 and S58 (1985-2008) and S1, S40 and S58 (2009-2011).

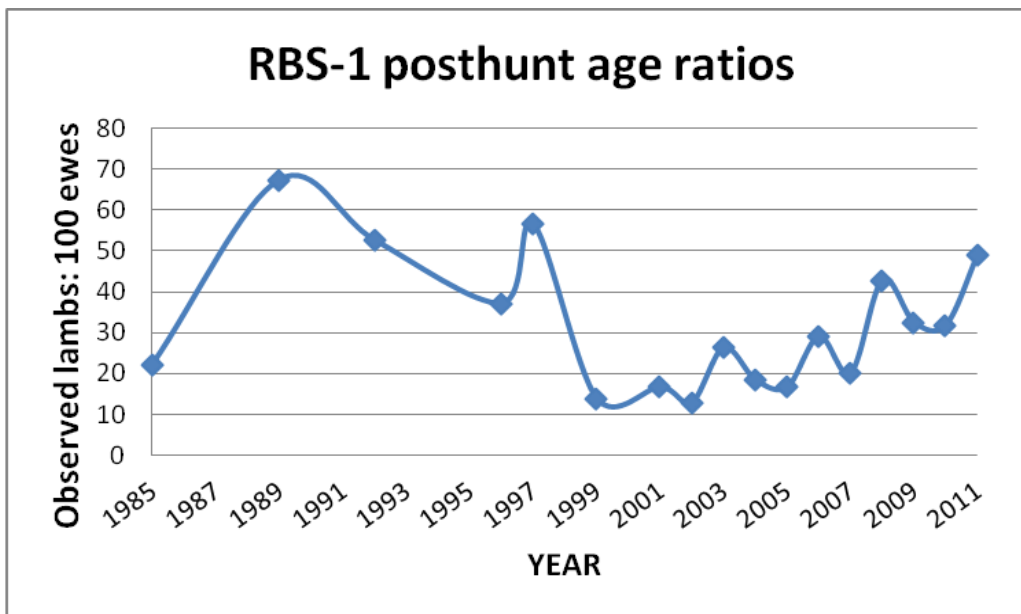


Figure 9: Observed posthunt lambs per 100 ewes during surveys in DAU RBS-1 from 1985 to 2011. Data are from S1 and S58 (1985-2008) and S1, S40 and S58 (2009-2011).

Population Estimation

Estimating population numbers of wild animals over large geographic areas is a difficult and approximate science. Colorado Parks and Wildlife recognizes the difficulties of estimating the size of bighorn populations as a challenge in managing populations and attempts to maximize the accuracy of these estimates by using the latest technology and inventory methodology available. As better information and techniques become available (e.g., new estimates of survival/mortality, wounding loss, sex ratios, density, or new modeling techniques and software) they are evaluated and used where

appropriate. The population estimate presented in this document should, therefore, not be considered a completely accurate enumeration of the animals in the DAU.

Historically the size of the RBS-1 (or at least the S1/S58 portion of the herd) was calculated based on a single survey day, and results were considered as a minimum estimate. These single-day trend counts were the main tool informing the herd size portion of management until 2003. During 2003 and 2004, surveys were conducted twice within a 1 week period, with earlier and later starting times in the morning. No difference was observed between sighting success on early morning versus midmorning surveys. Road surveys from 1985-2004 are considered at best minimum counts as there is no way to estimate sightability or standardize effort between routes, observers or weather conditions. The high count in each age and sex category was used to calculate a total sheep estimate.

Beginning in 2005, a series of mark-resight surveys have been employed in S1/S58 to generate rigorous population estimates. The use of this mark-resight estimator on a “marked” population of animals can be used to generate accurate and precise estimates of herd size. Neal et al. (1993) provide an evaluation of a series of estimators used to estimate the population size in a Colorado bighorn sheep herd. The estimator suggested by Neal et al. (1993) for sheep estimates is the joint hypergeometric maximum likelihood estimator (JHE), however Bowden’s estimator (Bowden and Kufeld 1995) would also be appropriate depending on which of each model’s assumptions are met. Either approach will provide a point population estimate and 95% confidence intervals to give an estimate of precision. Sheep were “marked” in 2005-2008 as part of the Poudre population estimation and lamb recruitment project. Radiocollars (VHF) with unique letter and number combinations were deployed on captured sheep. In this survey technique radioed sheep were located before and during the resighting surveys (by independent observers) to confirm that all ‘marks’ were available to be seen (alive and within the survey boundaries). The survey area, which was larger than the total area used by all radioed sheep, was broken into 6 separate driving and hiking routes. Each route was surveyed and all sheep, marked and unmarked, were recorded and classified to age (lamb, yearling, adult), sex and curl size for adult males.

The following graph shows the population results from the 2005-2011 surveys, as minimum counts (total # of sheep seen). Additionally, the graph shows the total population estimate and 95% confidence intervals using Bowden’s estimator. Bowden’s estimator is the more robust and sophisticated of these mark-resight estimators, as it can account for individual sighting differences between sheep as well as accounting for marked sheep that were seen but couldn’t be uniquely identified by ID number.

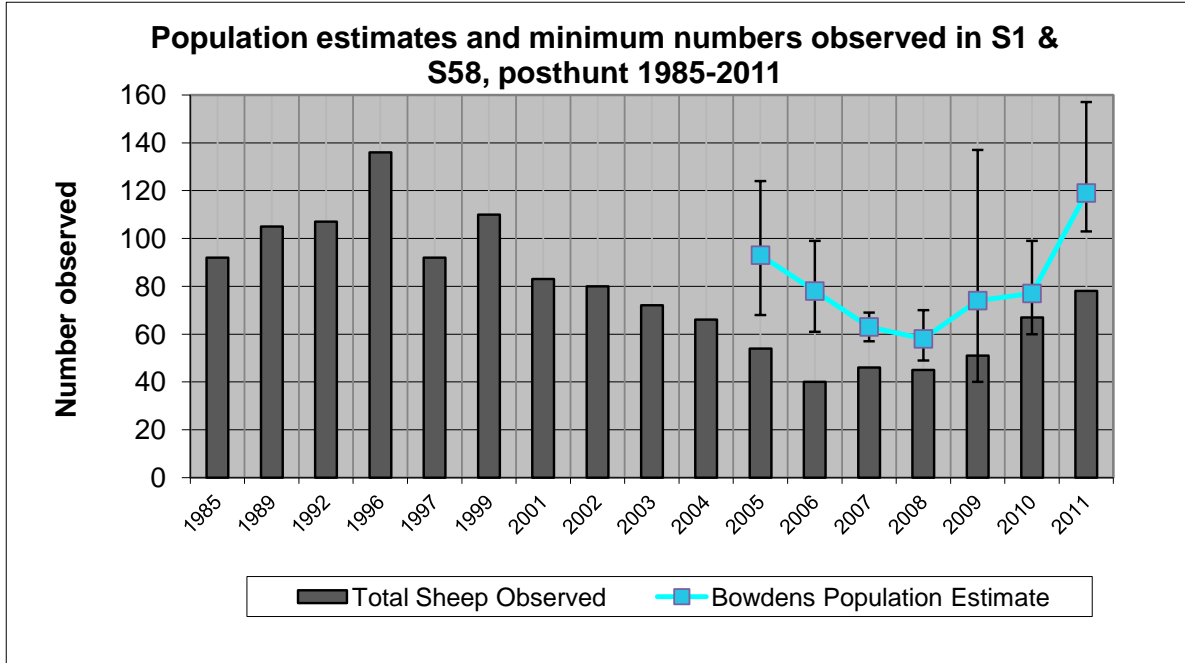


Figure 10: Minimum annual population counts and mark-resight population estimates for S1 and S58 portions of DAU RBS-1 from 1985 to 2011.

The S1/S58 portion of RBS-1 appears to have been at its largest at some point in the mid-90s. The sustained absence of any lamb recruitment in S58 and the low recruitment in S1 from 1999-mid 2000s contributed directly to the population declines evident in Figure 10. The population reached its lowest level in 2008 with a combined posthunt estimate of 58 sheep in the lower and upper Poudre Canyon. An increase in lamb recruitment coupled with the reintroduction of sheep into the Lower Canyon in 2010 has produced the significant increase in population size seen over the last 2 years. Given a minimum count of 24 bighorns observed in S40 during the 2011 posthunt classification surveys and a projection of approximately 15 bighorn wintering in the Rawahs (S18) the total 2011 posthunt population in RBS-1 is approximately 160 bighorns (Figure 11).

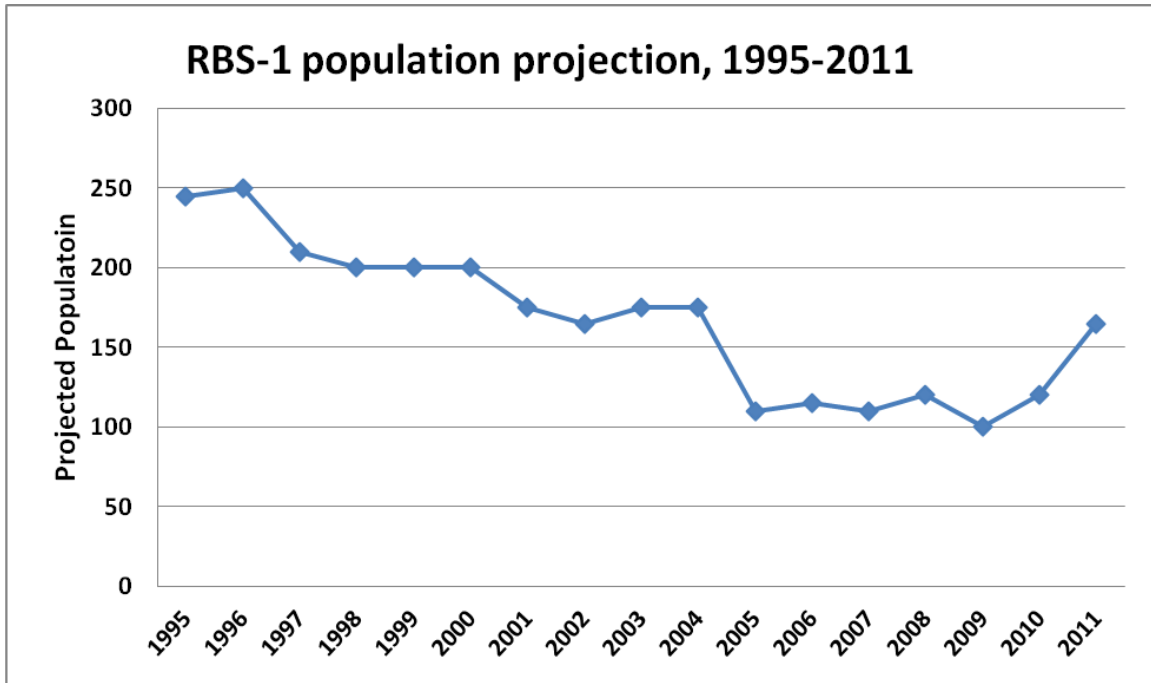


Figure 11. RBS-1 bighorn posthant population projection from 1995 to 2011.

Research Projects

The Upper and Lower Poudre canyon bighorn herds have traditionally been well studied sheep units. One of the more in-depth projects associated with these herds was the Poudre Population Estimation and Lamb Survival project conducted from January 2005 to 2010. This CDOW project was funded as an auction/raffle project with two main goals. The first was to use a mark-resight estimator on both the S1 and S58 herds to generate population estimates with measures of precision. The second goal was to use the radioed ewes as indicators of their new lamb’s location, so each lamb could be monitored daily from birth through late-summer, when most lamb mortalities would occur. As a secondary result of having these radiocollars deployed, biologists were able to gain significant information on adult ewe survival rates, mortality factors, movement patterns, lambing grounds and localized habitat selection.

Translocations

The modern history of the Poudre River bighorn sheep herd is traced back to a December 1946 transplant of 16 sheep (3 rams, 6 ewes, 4 lambs, and 3 yearlings) from the Tarryall Mountains (Bear and Jones, 1973). These animals were released approximately 5 miles upstream from Rustic, in the area that is now considered part of the Upper Poudre herd’s range (Bear 1979). Due to the presence of considerable sheep habitat and to initiate range expansion, 25 sheep were captured in January 1975 above Rustic, and moved 7 miles below the eastern extent of the herd’s overall range. In 1977, at least 15 sheep were believed to be using this second transplant area (Sheep Mountain, above Stove Prairie Landing) with significant movement back and forth between the upper range (Bear 1979)

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A single transplant of 19 sheep including 2 rams, 13 ewes and 4 lambs was made into S40 in 1977 (Bailey 1990). These sheep were released on the CPW Lone Pine SWA (originally known as the Lamb Property) and largely used the south-facing slopes near the release site (CDOW memo, 1984). The 1991 release of 18 sheep in S58 at Seaman Reservoir may have been hindered by a late afternoon release, but a bighorn herd failed to establish itself in the slopes along the North Fork and Seaman Reservoir. It may be that those released sheep wandered north and joined parts of the S40 herd, or moved west along the lower Poudre Canyon and were incorporated into the existing S58 bighorn bands 4-5 miles west of the release site.

The last release of sheep in RBS-1 was the transplant of 3 rams and 15 ewes into the unoccupied sheep range of S58. During the winter of 2009, the 7 ewes which constituted the only remaining portion of the S58 herd were culled by CPW due to disease concerns. The bighorn range in S58 was unoccupied during the summer and fall of 2009, and on January 8th, 2010 the 18 bighorn captured in lower Clear Creek Canyon (GMU S32) were released at Hewlett Gulch. These 18 sheep were all radiocollared and are part of a larger CPW project assessing the impacts of bighorn sheep density and habitat on lamb survival and recruitment.

From 1975 to 1982 the herd in the Upper Poudre exhibited good population performance and sheep were trapped on 5 separate occasions during those years for transplant to other areas in Colorado. A total of 110 sheep (15 rams, 62 ewes and 32 lambs) were removed from S1 during those 7 years (see Table 2).

YEAR	DATE	TRAP SITE	TRAP GMU	RELEASE SITE	RELEASE GMU	RAMS	EWES	YRLG	LAMBS	TOTAL
1946	12/6/46	TARRYALL RANGE	S27	UPPER POUUDRE	S1	3	6	3	4	16
1975	1/21/75	UPPER POUUDRE	S1	LOWER POUUDRE	S58	7	18			25
1977		TRICKLE MT. (SAGUACHE)	S10	LONE PINE (LAMB PROPERTY)	S40	2	13		4	19
1991	2/3/91	FALL RIVER (ESTES PARK)	RMNP	LOWER POUUDRE (SEAMAN RES.)	S58	2	9	2	5	18
2010	1/8/10	CLEAR CK - GEORGETOWN	S32	LOWER POUUDRE	S58	3	15			18
1977	2/9/77	UPPER POUUDRE	S1	APISHAPA SWA	S38	3	15		7	25
1978	2/9/78	UPPER POUUDRE	S1	ALAMOSA CANYON (CONEJOS R.)	S29		11		9	20
1980	3/7/80	UPPER POUUDRE	S1	BUTTON ROCK	S37	3	7		9	20
1982	3/26/82	UPPER POUUDRE	S1	NATURAL ARCH (EAGLE ROCK)	S44	2	11		7	20

Table 2: Number of bighorn sheep translocated from and to RBS-1 from 1946 to 2010.

Hunting Season Structure, License Numbers and Timing

Unregulated market hunting, along with habitat losses and introduced diseases, contributed to reductions in bighorn numbers in the 1860s and 1870s. In response to declining bighorn populations, the Colorado legislature placed a moratorium on bighorn

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sheep hunting in 1885 (George et al. 2009). By 1953, many of the herds in the state had recovered and several areas were reopened to hunting, including RBS-1. Hunting has occurred in various units within RBS-1 from 1953 to present (Table 3). Since 1953 the only year in RBS-1 with no bighorn sheep hunting was 1970 when the season was closed.

	S18- Rawah		S1- Upper Poudre		S40- Lone Pine		S58- Lower Poudre				S1/S18 Combined		S1/S18/S40 Combined	
	Ram	Ram	Ram	Ram	Ram	Ram	Ram	Ram	Ewe	Ewe	Ram	Ram	Ram	Ram
YEAR	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest
1953			5	2										
1954			5	0										
1955			5	2										
1956			5	2										
1957			10	1										
1958			6	5										
1959			4	3										
1960			4	1										
1961			10	6										
1962			10	5										
1963			12	1										
1964			12	4										
1965			12	2										
1966			24	2										
1967			24	0										
1968			6	3										
1969			6	4										
1970														
1971			4	3										
1972			6	1										
1973			6	2										
1974			6	0										
1975			6	0										
1976			12	7										
1977			12	7										
1978	4	0	12	7										
1979			12	4										
1980			16	4										
1981			12	5	4	1								

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	S18- Rawah		S1- Upper Poudre		S40- Lone Pine		S58- Lower Poudre				S1/S18 Combined		S1/S18/S40 Combined	
	Ram	Ram	Ram	Ram	Ram	Ram	Ram	Ram	Ewe	Ewe	Ram	Ram	Ram	Ram
	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest	Licenses	Harvest
1982	15	1	12	6	8	4								
1983			12	0	8	4								
1984			12	5	8	2								
1985			6	1										
1986			6	4										
1987			6	2										
1988			6	2			3	3						
1989			6	3			4	4						
1990			6	2			5	5						
1991			6	5			5	4						
1992			4	4			2	2						
1993			4	1			2	2						
1994			4	2			4	3	2	1				
1995			6	3			6	6	5	5				
1996			6	0			6	6	6	4				
1997			6	0			6	4	6	3				
1998			6	1			4	2						
1999											3	3		
2000											4	2		
2001											4	3		
2002											4	4		
2003											2	2		
2004											2	1		
2005											2	2		
2006											2	1		
2007											2	2		
2008											1	1		
2009											1	1		
2010													1	1
2011													2	2

Table 3. Number of licenses issued and harvest by huntcode unit and method in RBS-1, 1953- 2011.

Curl restrictions

Minimum curl restrictions have been used in Colorado to direct ram harvest towards the desired age classes. Restrictions in DAU RBS-1 have followed statewide restrictions in most years and have included ½ curl, ¾ curl, and full curl (Table 4).

Year	Minimum Curl
1953-1957	1/2
1958-1959	3/4
1960-1964	1/2
1965-1969	3/4
1970	No season
1971-1973	3/4
1974-1981	3/4
1982-present	1/2

Table 4. Minimum curl restrictions on ram harvest in RBS-1, 1953- present.

Nonresident licenses

Prior to 1985, only residents of Colorado were eligible to draw bighorn sheep licenses. From 1985 to 1988, 20% of the licenses were made available to non-resident hunters. Since 1989, 10% of statewide licenses have been offered to non-resident hunters annually.

Season timing/Method of take/Ewe hunting

Hunting seasons have occurred in August, September and October. Currently, the single RBS-1 hunting season occurs between the Tuesday after Labor Day in early September and runs for 30 days until early October. The only archery season offered in RBS-1 was in 1982 in S18. During the limited timeframe when there were female hunting seasons in RBS-1, ewes were hunted in S40 from 1994 to 1997.

Hunt unit boundaries

Sheep hunting unit S1 was opened in 1953 to hunting and has continued as an open unit to present. Sheep unit S18 was opened in 1999, and included with S1 on the same huntcode (hunnable units on the same license). S40 was opened as its own hunting unit in 1981 and was closed in 1984. It was reopened in 2010, but was added into the hunnable units on the same huntcode as S1 and S18. The Lower Poudre (S58) was opened in 1988 for hunting as its own unit and was closed in 1998 (see Table 3). The boundaries of RBS-1 were re-evaluated in 2010, and a few increases in surface area were made in S58 and S40 to include areas with documented bighorn use. Most notably was the extension of S40 to include increased bighorn habitat east of Highway 287 and north of Livermore. This evaluation and subsequent expansion was done to capture new known areas of bighorn use within the revised boundary.

Harvest

Hunters have harvested 0 - 10 bighorn rams annually in RBS-1 since 1953 (Table 3, Figure 12, Figure 13). During the 4 year that females were hunted in S40 (1994-1997), harvest ranged from 1-4 bighorn ewes. From 1953 to 1998 ram hunter success rates

ranged from 0 to 100%, although only twice in that time did success rates go over 80% (Figure 14). The average success rate during that time period was 41%. After S18 was opened to hunting in combination with S1 (1999- present), ram hunter success rates ranged from 50% to 100%, with the average success rate during that time being 87%.

The largest impact to the horn length measurements of harvested rams in RBS-1 was the opening of S18 in 1999 (Figure 15). In general, the horn size of harvested rams decreased from 1987 into the late 1990s. However, when S-18 was opened to hunting on the S1 huntcode in 2009 there was a significant increase in horn size of harvested rams. There was likely a surplus of older, previously unavailable rams in the Rawahs that became available to hunters with the opening of the unit; DAU harvest locations show this as from 1999 to 2009 every harvested sheep was taken in S18 in one of two specific drainages. With the addition of S40 to the S1/S18 huntcode in 2010 harvest pressure again moved to the newly opened units. In 2010 and 2011 two of the 3 RBS-1 rams harvested came from S40, and both had relatively large horn measurements. In summary, the average horn length of harvested rams increased when a new, unharvested unit was added into the huntcode unit boundaries (1999 addition of S18, 2010 addition of S40) (Figure 15).

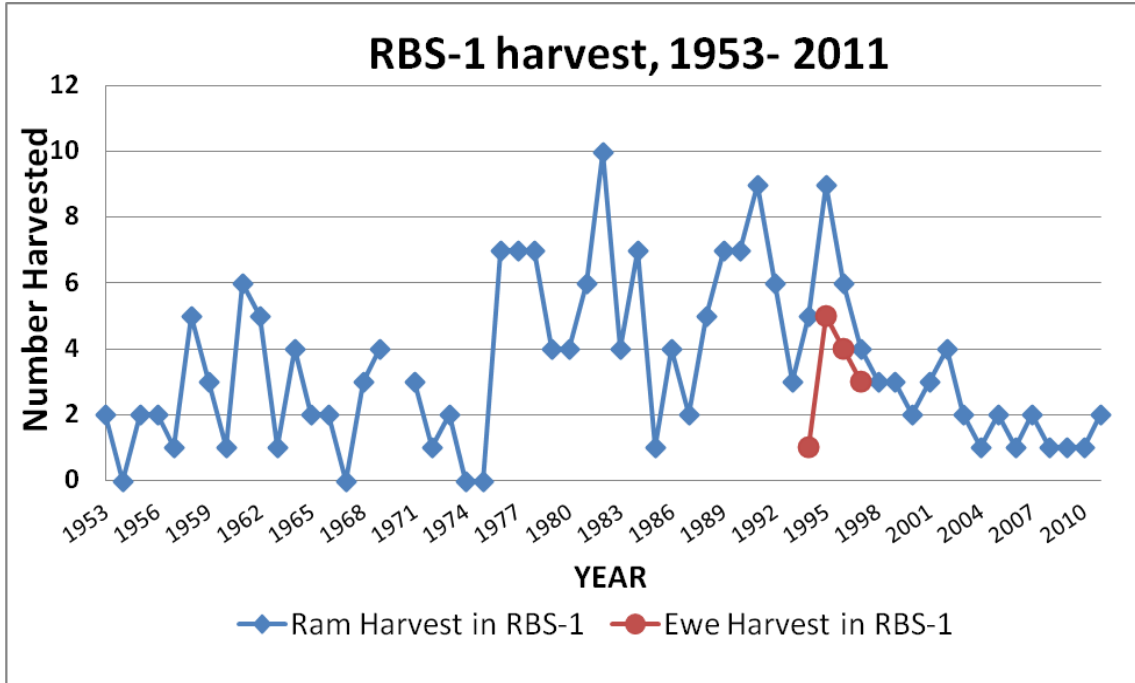


Figure 12: Bighorn sheep harvest in RBS-1 from 1953 to 2011.

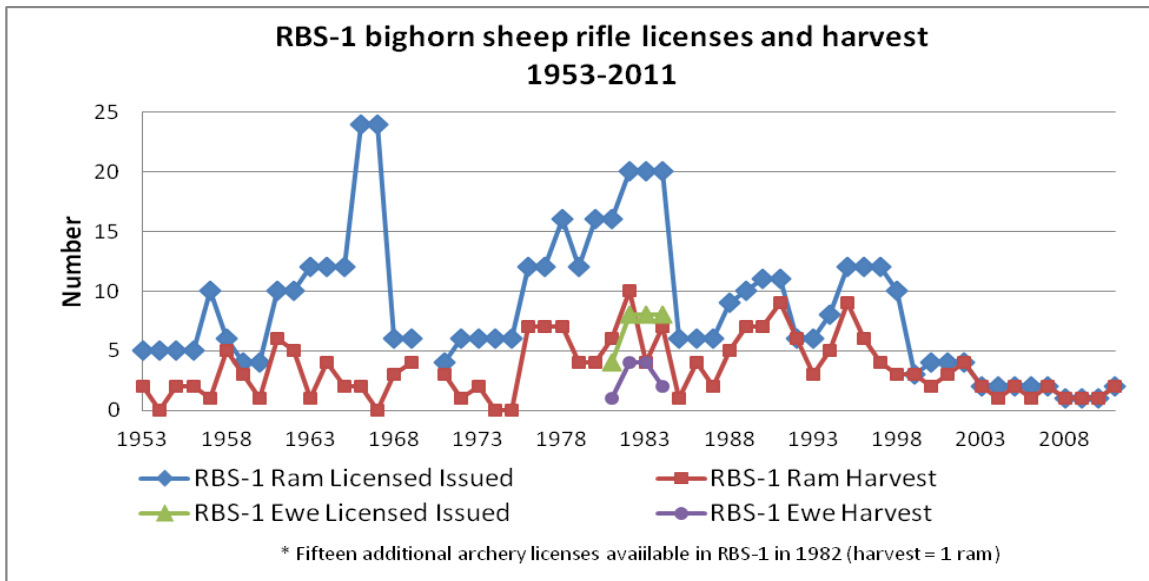


Figure 13: Licenses numbers and harvest in RBS-1 from 1953 to 2011.

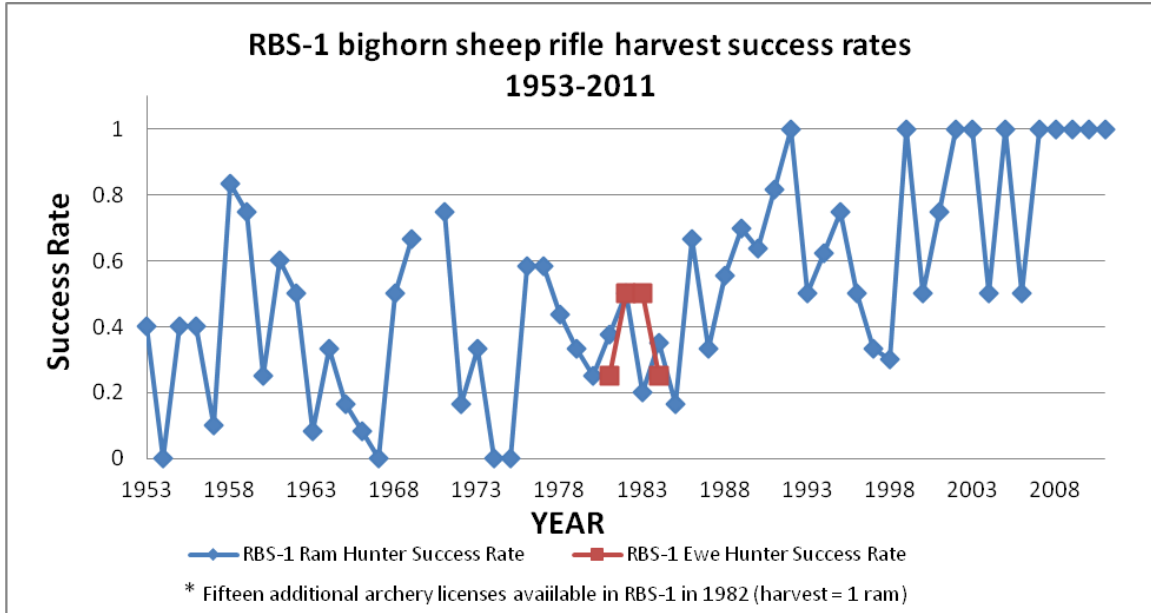


Figure 14: Hunter success rates in DAU RBS-1 from 1953 to 2011, calculated as the number of sheep harvested divided by the number of licenses issued, by gender.

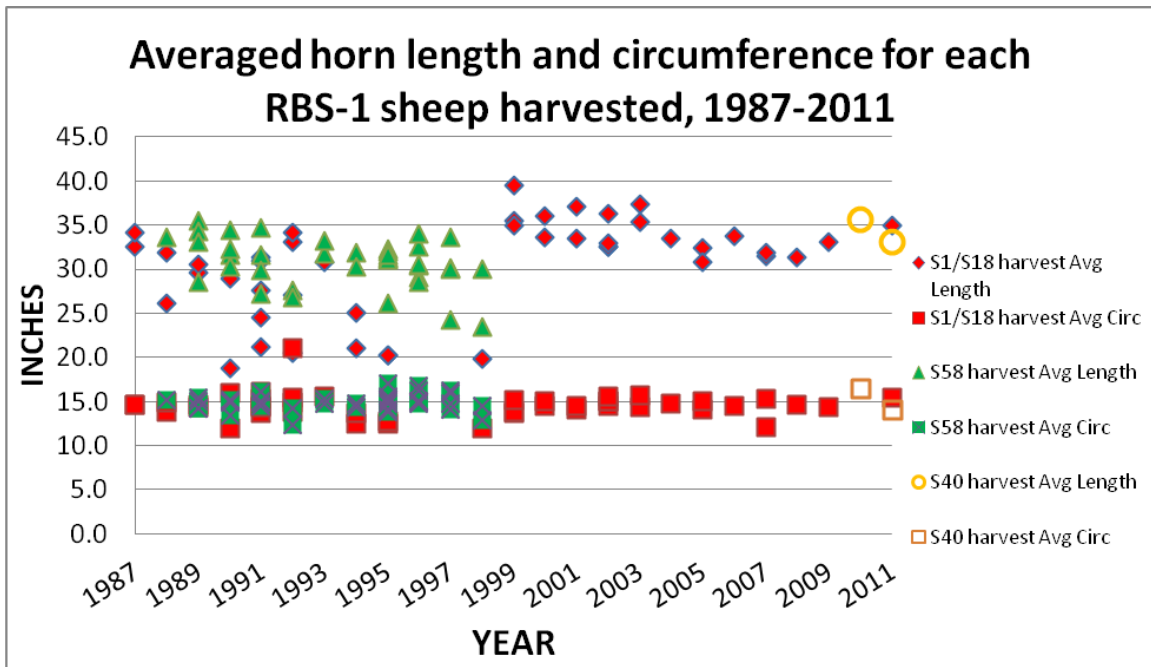


Figure 15: Averaged horn length and circumference (left and right) for each harvested RBS-1 sheep, grouped by GMU, 1987 to 2011

MANAGEMENT ISSUES

Habitat Quality

Fire suppression over the last 100 years has resulted in the encroachment of shrubs and trees into bighorn sheep habitat. Tree and shrub encroachment (mostly juniper) has resulted in habitat loss and fragmentation by deterring bighorn sheep from using otherwise suitable habitat and by decreasing the amount of forage available in the areas they do use. Habitat quality and quantity could be increased by reducing juniper encroachment in parts of RBS-1.

Much of the lodgepole pine stands in the western half of the DAU have been infested with the mountain pine beetle (*Dendroctonus ponderosae*). This infestation began on the western slope in 1996 and spread eastward into the DAU in the early 2000s. This infestation is expected to continue its eastward expansion, resulting in the death of the majority of the mature lodgepole pines in the area by 2013 (Colorado State Forest Service 2008). Dead trees are expected to remain standing for a number of years before they begin to fall.

The large-scale mortality of lodgepole pine trees will result in changes to bighorn sheep habitat quality and quantity in the DAU over the next 20 years. Initially, lodgepole mortality may increase the openness of the terrain and allow bighorn to use areas from which they are currently excluded due to visual obstruction. This could decrease habitat fragmentation and increase habitat quality and quantity. The long-term overall effect this will have on bighorn sheep is unknown. The effects of fallen dead trees and vegetation succession following lodgepole mortality on bighorn habitat will vary within the DAU depending on the physiography of specific sites.

Impacts of Human Development

Both US 287 and CO 14 highways abut the RBS-1 sheep range and as such contribute to easy human development of land, particularly private property adjacent to the roadways. From a standpoint of human development, fortunately the majority of sheep in RBS-1 currently occupy public lands (see Land Management section) as 72% of the current occupied range is managed by USFS or CPW. While there may be other uses of these public lands that have impacts to wild sheep, the direct threat of development is not significant on those properties.

Human Recreation Impacts

Increasing vehicle traffic in Poudre Canyon, much of it associated with recreational use of the landscape is a concern. Impacts on sheep seem to be mainly due to increased roadkill risk, and to a lesser degree harassment by people who observe them along the road. The direct impacts of this disturbance are unknown, but there is no question that the amount of traffic passing through the core of this sheep range has increased exponentially since the 1940s.

Vehicle Caused Mortality

As with many Colorado sheep herds that are easily viewable, portions of RBS-1 range fall directly along both a state and federal highway (Colorado Hwy 14 and US 287). Bighorn are occasionally hit along both these sections of road, with Colorado

Department of Transportation (CDOT) and CPW anecdotal records showing the highest risk area of vehicle-bighorn collisions to be between Rustic and Poudre Falls along Highway 14. This would represent the southern edge of the S1 herd's range. The primary time for vehicle caused mortality is in the winter when sheep are already lower down on south-facing slopes and closer to the canyon bottom where the road is located. An additional attractant comes in the form of de-icing compounds used by CDOT along Highway 14 during snow and ice events. Bighorn seem invariably attracted to the magnesium chloride applied to the roads, which increases their vulnerability to being hit by vehicles particularly under poor driving conditions.

For the purposes of cause-specific mortality analyses from January 2005 into 2010, thirty one radiocollared sheep were monitored in RBS-1. Of those 31 sheep, 22 animals died during that 6 year period. Of the 22 mortalities, 3 were positively identified as being "roadkills" or vehicle-caused mortalities. After predation, vehicle collisions were the second leading cause of radiocollared sheep mortality in S1 and S58 during 2005-2010.

Diseases and Parasites

Bighorn sheep are unique among Colorado's big game species with respect to the influence that infectious diseases have on population performance and species abundance. Bighorn sheep managers generally agree that bacterial pneumonia is the main reason for Rocky Mountain bighorn sheep population declines across much of the west in recent decades. There are a number of strains of pneumonia-causing bacteria commonly carried by domestic livestock that are highly pathogenic to bighorns, and introduction of a pathogenic strain or another novel pathogen into bighorn populations can cause all-age die-offs and lead to low lamb recruitment. In some instances, low lamb recruitment can last for a decade or more. Once introduced, these pathogenic bacterial strains can persist in survivors of the initial epidemic. These infected survivors may serve as a source of infection for other animals in the same herd and for other herds and populations through natural movements and translocations. The susceptibility of bighorn sheep to pathogens originally introduced by domestic livestock is regarded as the primary factor limiting Rocky Mountain bighorn sheep populations in Colorado. Moreover, the continued presence of introduced pathogens appears to have played an important role in preventing statewide bighorn numbers from rebounding to some approximation of historical levels. Based on a substantial volume of literature, one of the most important aspects of bighorn sheep management is to keep them separated from domestic livestock (George et al. 2009).

The complete lack of lamb recruitment in S58 for the 13 years beginning in 1998 can, with some certainty, be attributed to a pneumonia epidemic. While the all-age die-off that is often characteristic of the beginning of an episode was not clearly documented, the persistent lack of any lamb recruitment for 13 years on its own is quite definitive. Lambs were documented as being born alive in May and June in relative abundance, but by late-August all were dead. From 1998 to 2010, no surviving lambs were ever documented during posthunt classification surveys in S58. During January-March 2008 a combined treatment of 11 weeks of nutritional supplement, 10 weeks of trace element supplement and 4+ weeks of increasing dose tetracycline were applied to the approximately 5-8 remaining ewes in S58. These treatments were all applied

simultaneously, *ad libitum*, in oral bait stations. This group of ewes included 2 radiocollared ewes that were part of the larger Poudre Population Estimation and Lamb Survival project. This treatment attempted to address any nutritional and mineral deficiencies in this subherd's diet that might make ewes and their lambs more susceptible to respiratory illness. Additionally, the long-term dose of tetracycline was delivered in an attempt to treat any current, ongoing respiratory illness of bacterial origin. This sustained treatment during 2008 failed to successfully increase lamb recruitment; all lambs born in S58 died by late August 2008.

One main purpose of the Poudre Population Estimation and Lamb Survival project was to document causes of lamb mortality in S1 and S58. Radiocollared ewes were monitored daily from the beginning of lambing into October. Each lamb born from a radiocollared ewe was also monitored for fate on a daily basis. When lambs were no longer present with the radioed ewe, particularly early in the summer, efforts were made to locate the carcass or confirm cause of lamb mortality. In many cases carcasses weren't located, but date of lamb death was recorded. In 2006 one lamb carcass was retrieved, one carcass in 2007 and three carcasses in 2008. All 5 recovered summer lamb carcasses were immediately submitted to the CPW Wildlife Health Lab for necropsy and in all 5 cases pneumonia was found to be the cause of death.

Disease surveillance was conducted in S1 and S58 during 2005 and 2006 in order to characterize the potential pathogens present in the herd. There was serologic evidence of exposure and active infection to both Bovine Respiratory Syncytial Virus (BRSV) and Parainfluenza-3-virus (PI3) (Table 5). In addition, bacterial cultures isolated potentially pathogenic (beta hemolytic) *Pasteurellaceae*, including strains of *Mannheimia* (*Pasteurella*) *haemolytica* and to a lesser extent *Bibersteinia* (*Pasteurella*) *trehalosi*.

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Sex	PI-3 titer	BRSV titer	Isolate	Biovar.	Hemolysis	Iso.	Biovar.	Hemo.	Iso.	Biovar.	Hemo.
F	1:128	< 1:2	<i>P. haemolytica</i>	16 ^{aEG}	nh	<i>P. h.</i>	U ^b	beta	<i>P. t.</i>	4 ^{CDS}	nh
F	1:16	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:16	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:2	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:16	< 1:2	<i>P. haemolytica</i>	U ^b	beta	<i>P. t.</i>	4 ^{CDS}	nh			
F	<1:2	< 1:2	<i>P. trehalosi</i>	2	nh	<i>P. t.</i>	2 ^S	nh			
F	1:256	< 1:2	<i>P. trehalosi</i>	2	nh	<i>P. t.</i>	2 ^C	beta			
F	1:128	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:64	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:4	< 1:2	<i>P. trehalosi</i>	2	nh	<i>P. t.</i>	2 ^{CES}	beta	<i>P. t.</i>	2 ^{CG}	nh
F	1:2	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:16	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh	<i>P. h.</i>	U ^{abBX}	nh			
F	1:64	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:128	< 1:2	<i>P. haemolytica</i>	U ^a	beta	<i>P. t.</i>	2	nh			
F	1:128	< 1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh	<i>P. h.</i>	1 ^E	beta	<i>P. h.</i>	10 ^{ARX}	nh
F	1:8	< 1:2	No <i>Pasteurella</i> isolated								
F	1:256	1:128	<i>P. haemolytica</i>	U ^b	beta	<i>P. t.</i>	4 ^{CDS}	nh			
F	1:64	1:64	No <i>Pasteurella</i> isolated								
M	< 1:2	< 1:2	<i>P. haemolytica</i>	U ^{abE}	beta	<i>P. t.</i>	4 ^{CDS}	nh			
M	< 1:2	< 1:2	<i>P. haemolytica</i>	U ^{aER}	nh						
F	1:16	<1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:16	<1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:64	<1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:16	<1:2	<i>P. trehalosi</i>	2	nh						
F	1:8	<1:2	<i>P. trehalosi</i>	2	nh						
F	1:32	<1:2	<i>P. trehalosi</i>	4 ^{CDS}	nh						
F	1:1024	<1:2	Non-pasteurellaceae								
M	<1:2	<1:2	<i>P. haemolytica</i>	3 ^{DEG}	beta	<i>P. h.</i>	6 ^a	beta	<i>P. t.</i>	4 ^{CDS}	nh

Table 5. Disease profile results from 26 bighorn sheep (S1 and S58) handled during 2005 and 2006 as part of the Poudre Population Estimation and Lamb Survival Project.

Interspecific Competition

There are no active domestic sheep allotments within the DAU. There are a significant number of cattle allotments in the DAU, but only a few are within occupied bighorn range. Interspecific competition between bighorn sheep and cattle on these few allotments or leases is negligible due to limited spatial overlap across available habitat types within the overall allotment boundary. There is not believed to be any direct competition issues for bighorn sheep with elk, moose or mule deer in RBS-1. Deer and elk likely interact with bighorns on alpine and open/shrub habitats, but there are no concerns over competition.

At present there are no known populations of mountain goats in RBS-1. Neither CPW nor Rocky Mountain National Park (to the south) manage the area in and around RBS-1 for mountain goats. Very infrequently however, CPW will receive what appear to

be legitimate reports of a single mountain goat or group of goats, mostly along the S-19 and S-18 boundary (Cameron Pass area).

Predation

The effect of predation on the DAU RBS-1 bighorn sheep population has not been clearly demonstrated over the history of the DAU. Mountain lions, coyotes, golden eagles and bobcats all inhabit RBS-1 bighorn sheep range and it is likely that each accounts for some bighorn mortality. The most applicable information on predation impacts was collected from 2005-2010 during the Poudre Population Estimation and Lamb Survival study. What emerged was a conclusion that mountain lions are occasional predators of bighorn sheep in RBS-1, specifically documented in S1 and S58. However, punctuated episodes of heavy temporally and spatially specific lion predation can have significant impacts on RBS-1 herds as was the case in S1 in 2006.

For the purposes of cause-specific mortality analyses, thirty one radiocollared sheep were monitored in RBS-1 from January 2005 into 2010. Of those 31 bighorns, 22 animals died during that 6 year period. Of the 22 mortalities, 10 mortalities were definitively attributed to mountain lion predation and one more was listed as probable mountain lion. Based on these results, nearly 50% of the radiocollared sheep mortality during that project time period can be attributed to predation. More specifically, 5 of the 10 confirmed lion mortalities occurred in a two-month period between January and March 2006 in a relatively specific area of the S1 herd range. Based on a suite of *a priori* models evaluating ewe survival rates across the 2005-2010 time period, there appears to have been a significant impact to survival rates from lion predation during 2006, but not during any other years.

Illegal Kill

There is little direct evidence that illegal take of bighorns in RBS-1 is a problem. However, bighorns are highly visible in almost all areas of the herd range, particularly in winter and this can provide an opportunity for poaching to occur. The only recently documented occurrence of illegal take was in November 2011, when one of the three radiocollared rams that was transplanted into the lower Poudre Canyon (S-58) was poached. The radiocollar was found thrown into a tree along with evidence of the ram carcass being gutted and loaded into a vehicle.

Watchable Wildlife

Given the relative ease of spotting bighorn sheep along Highways 14 and 287, bighorn in RBS-1 provide a great deal of watchable wildlife opportunity. The results of local and national surveys completed in 2006, suggest that the total economic impact of wildlife viewing in Colorado is estimated to be \$1.22 billion, close to the total economic impact of both hunting and fishing combined (\$1.8 billion) (BBC 2008). Wildlife viewing recreation continues to attract a growing number of participants nationwide (US Fish and Wildlife Service 2006). With input from CPW, the USFS has restored a series of signs at the USFS Big Bend Campgroup sheep watching station. These signs provide background information on bighorn herds in the area, bighorn sheep management and suggest where viewers can most likely see sheep.

Domestic Livestock Disease Issues

In the past, city, county and NGO land managers in RBS-1 have used both domestic goats and domestic sheep as management tools, largely for weed control. Currently however, these land managers do not use goats or domestic sheep for any control activities within RBS-1. Larimer County and City of Fort Collins Natural Resources Departments are aware of the potential hazards of domestic sheep and goats to bighorn and have worked with CPW to avoid interactions and maintain an acceptable buffer distance. It is however, exceedingly difficult to detect and mitigate the presence of a small number of domestic livestock on private property. The biggest threat to the overall health of this herd is the possibility of the introduction of a disease to the herd from contact with domestic/hobby sheep or goats on private property.

PUBLIC INPUT IN DAU PLANNING PROCESS

From early February 2012 through mid-March 2012 a stakeholder and land management agency outreach effort took place to gather input on management alternatives in RBS-1. An online survey (see Appendix A) was developed that could be taken by any person interested in bighorn sheep management in RBS-1, as well as those respondents that had read the draft DAU plan. The survey and draft DAU plan were posted jointly on the CPW webpage for 30 days. Postcards were sent to the last 2 years of license applicants in RBS-1 advising them of the planning process and providing information on how to comment or take the survey. Local homeowners associations in the greater Poudre Canyon area placed the outreach information in their newsletters. A press release with information on how to participate in the comment/survey process was sent out to local media outlets and ran on the CPW webpage. The hardcopy of the draft DAU plan and related weblinks were sent to impacted city, county, state, federal and non-governmental organization (NGO) land management agencies for a 30 day comment period. The draft plan was also sent to two bighorn sheep conservation groups. Two comment letters on the draft plan received from the land management agency and NGO outreach are included in Appendix B.

The preferred sex ratio and population alternatives recommended in this document are supported by the majority of survey respondents and by both comment letters.

MANAGEMENT RECOMMENDATIONS AND FUTURE NEEDS

Prevention of contact between bighorn sheep and domestic livestock

Colorado Parks and Wildlife should continue to work with the USFS, city and county governments to prevent the introduction of domestic sheep and goats near bighorn sheep range. Colorado Parks and Wildlife should also remain vigilant in identifying and mitigating the impacts of domestic livestock on private property. When domestic livestock are found within bighorn range, information will be provided to the landowner on the threats of domestic livestock to bighorn sheep and possible ways to reduce the potential for negative impacts to bighorn sheep.

Population management throughout herd

Several studies on other herds have shown decreased lamb recruitment at high sheep densities (Jorgenson and Wishart 1993; Portier et al. 1998). Additionally, sheep herds that utilize a very limited range, particularly in winter, may begin to experience density-dependent impacts particularly via parasite and disease transmission. Colorado Parks and Wildlife strives to maintain bighorn sheep herds at population objective levels, while also maximizing recruitment and overall herd health. In the case of RBS-1, it may be that ewe hunting can be used as a tool to encourage bighorns movement within their range and help maintain sheep density at a level that is compatible with the long-term objective and minimizes disease and low recruitment factors.

Habitat improvement recommendations

Fire suppression over the last 100 years has lead to tree and shrub encroachment into bighorn sheep range causing some habitat loss and fragmentation. The CPW should work with land managers to use prescribed burns or forest thinning in order to reduce the visual obstruction in bighorn sheep range and improve forage quality. These efforts should concentrate on summer and winter ranges largely within USFS administrative lands. The CPW should also work with the USFS and other emergency response agencies to allow naturally occurring fires to continue where possible.

Critical habitat protection

The CPW should pursue acquisition of or conservation easements on properties within these movement corridors to ensure genetic diversity throughout the herd and to protect traditional bighorn sheep movement patterns, particularly in S40.

Research needs

Data on the lower Poudre herd transplant should continue to be collected in 2012. This project extends beyond RBS-1 and involves comparisons between S58 lamb recruitment and recruitment in the source herd (S32) near Georgetown. This study will help inform managers about the importance of bighorn density, and by extension habitat/forage conditions, on herd health and performance. A replicate of this initial project, using other source herds and transplant habitats will help with expanding the scope of inference.

MANAGEMENT OBJECTIVES

Posthunt Population Objective

The posthunt population objective should be established at a level that allows for a healthy, self-sustaining herd while providing quality hunting and wildlife viewing opportunities. It is difficult to estimate this ideal population level for this herd; however, we can base a population objective on basic wildlife population management theory and the population performance of this herd at various population levels in the past.

Many studies on various species have shown that animal populations are most productive and individual animals are healthiest at approximately half the maximum number of animals that the habitat can sustain. At high population densities, the health of

individual animals, the body and horn size of individual animals and recruitment of young animals into the population decrease due to competition among individuals for resources. Several studies in bighorn sheep specifically have suggested that disease caused mortality is higher in densely populated herds than in less densely populated herds and have shown decreased lamb recruitment at high sheep densities (Jorgenson and Wishart 1993; Portier et al. 1998).

There currently is no population objective in RBS-1.

Alternative 1: 125- 175 Bighorn Sheep, posthunt

This would require a slight reduction from the 2011 posthunt population to reach the range midpoint. Given the recent increases seen in recruitment in the last 2 years it is likely that some additional male and female harvest would be needed to reach this objective. This would represent a population level lower than has historically existed in RBS-1.

Alternative 2: 175- 225 Bighorn Sheep, posthunt

This intermediate population level would represent an approximate 25% increase from the 2011 posthunt population. If current recruitment and harvest levels are maintained the midpoint of this range should be achievable in 2-3 years. Once reached, this increased population level should provide for an increase in ram harvest and a level of ewe harvest adequate to keep the herd within objective range. This alternative strikes a balance between the negative aspects of having a high population density, while still providing for an increase over current hunting and watchable wildlife opportunities.

Alternative 3: 225- 275 Bighorn Sheep, posthunt

The midpoint of this alternative represents over a 50% increase in population size from the 2011 posthunt population. This alternative would provide the greatest number of bighorn in the population, but might bring about detrimental aspects of high animal density such as decreasing lamb survival/recruitment and increased disease risks.

Posthunt Sex Ratio Objective

The posthunt sex ratio objective should be set at a level that provides for the long-term health of the herd while providing the public with the desired level and quality of recreational opportunities. The higher the sex ratio of a herd is, the higher the number, age, and horn size of the rams in the herd. These rams are highly valued by wildlife viewers, photographers and hunters. However, fewer rams can be harvested if high ram to ewe ratios are to be maintained, so hunting opportunity is lower at higher sex ratios. Also, the higher the ram to ewe ratio is, the lower the reproductive potential of the herd. That is because the higher the number of rams at a given population size, the lower the number of ewes and, therefore, the lower the number of potential lambs. Finally, high sex ratios may lead to increased extra range movements by rams thereby increasing the probability of contact between bighorn and domestic sheep or bighorn from other herds and the related risks of disease transmission. It is difficult to estimate the “natural” range of sex ratios of bighorn sheep herds. However, given the slightly higher mortality rates of adult rams than ewes, it is thought to be below parity (less than 100 Rams:100 Ewes).

There currently is no sex ratio objective for RBS-1.

Alternative 1: 30 – 50 Rams per 100 Ewes, posthunt

This alternative would represent the lowest ratio among the three options. This would represent the greatest amount of hunting opportunity, as more rams could be harvested each year. Rams could be expected to be younger and have the smallest horn size under this alternative. While ratios in RBS-1 have, at times, dropped down to levels within this range, this alternative would represent a decrease of approximately 20% from the 2011 posthunt observed ratio.

Alternative 2: 50 – 70 Rams per 100 Ewes, posthunt

This intermediate alternative would bracket the current 2011 posthunt observed sex ratio in RBS-1. Assuming current population levels, this ratio would provide at least the current level of ram hunting and watching opportunity. Age and body/horn size of rams would be at an intermediate level given this alternative. Extra-range movements would not be encouraged under this ratio, while opportunities for hunters and viewers to see mature male sheep would be maintained.

Alternative 3: 70 – 90 Rams per 100 Ewes, posthunt

This alternative has the highest sex ratio among the 3 options and as such would provide for the oldest, largest-horned rams in the population, but would also have the lowest levels of ram licenses. Extra-range movements would occur more often at this level and could increase the risk for disease transmission to, and within, each herd. This ratio midpoint would require over a 35% increase from the current 2011 posthunt observed ratio.

PREFERRED ALTERNATIVES

Preferred Population Objective Alternative

Alternative 2: 175- 225 Bighorn Sheep, posthunt

Preferred sex ratio objective alternative

Alternative 2: 50 – 70 rams per 100 ewes, posthunt

The preferred alternatives both provide a reasonable balance between increasing bighorn numbers to utilize available habitat while also guarding against increased extra-range movements and potential for disease events at higher densities. Population Alternative 2, (175-225 bighorns) represents a moderate increase in population from current levels and is the preferred alternative by CPW as well as the majority of surveyed public respondents. The preferred sex ratio alternative is Alternative 2, where RBS-1 would be managed for a ratio of 50-70 rams:100 ewes. This range overlaps the currently observed ratio and with a larger population should allow for a modest increase in ram and ewe hunting opportunity. This alternative was also preferred by the majority of public survey respondents. Both these alternatives were supported in the land management agency comments received as well.

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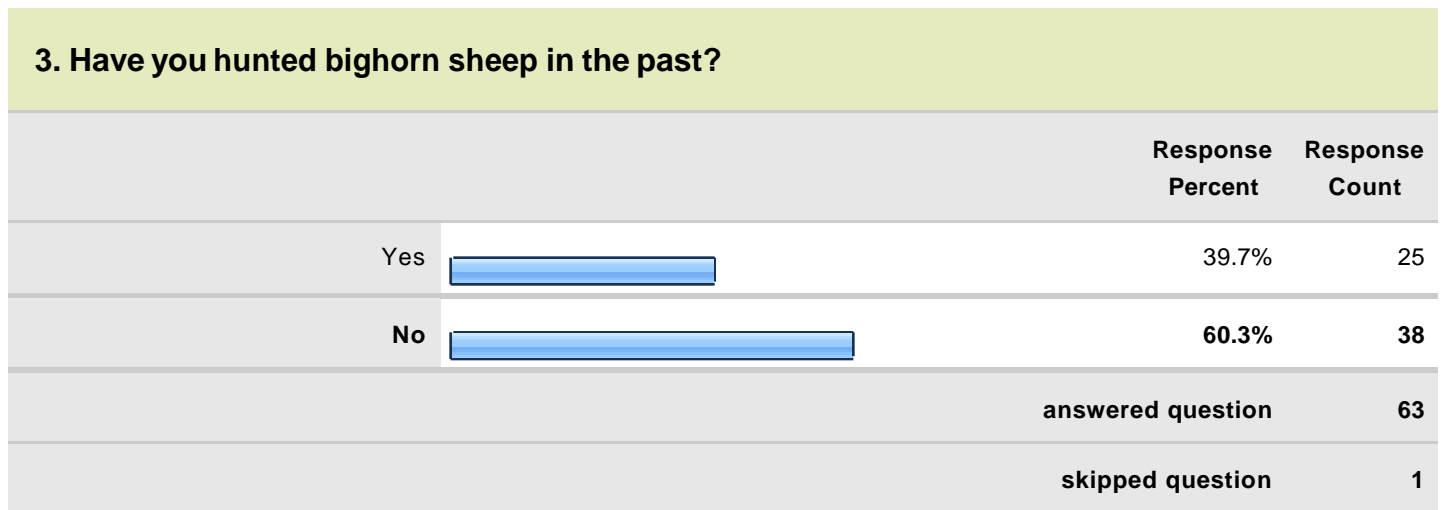
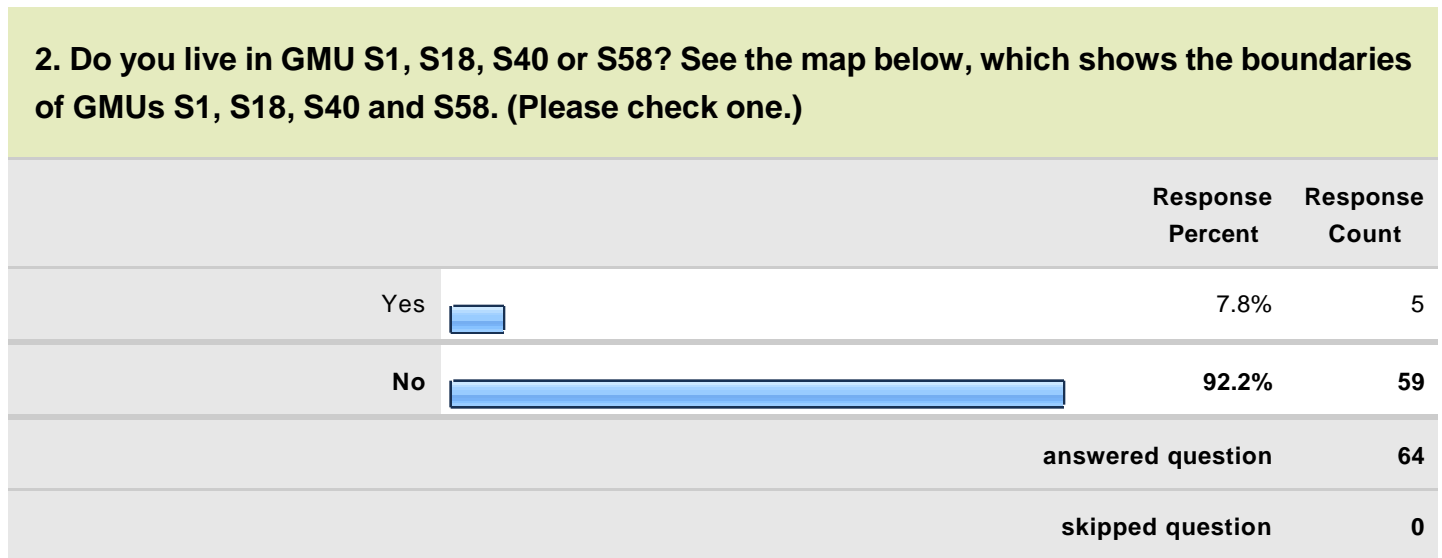
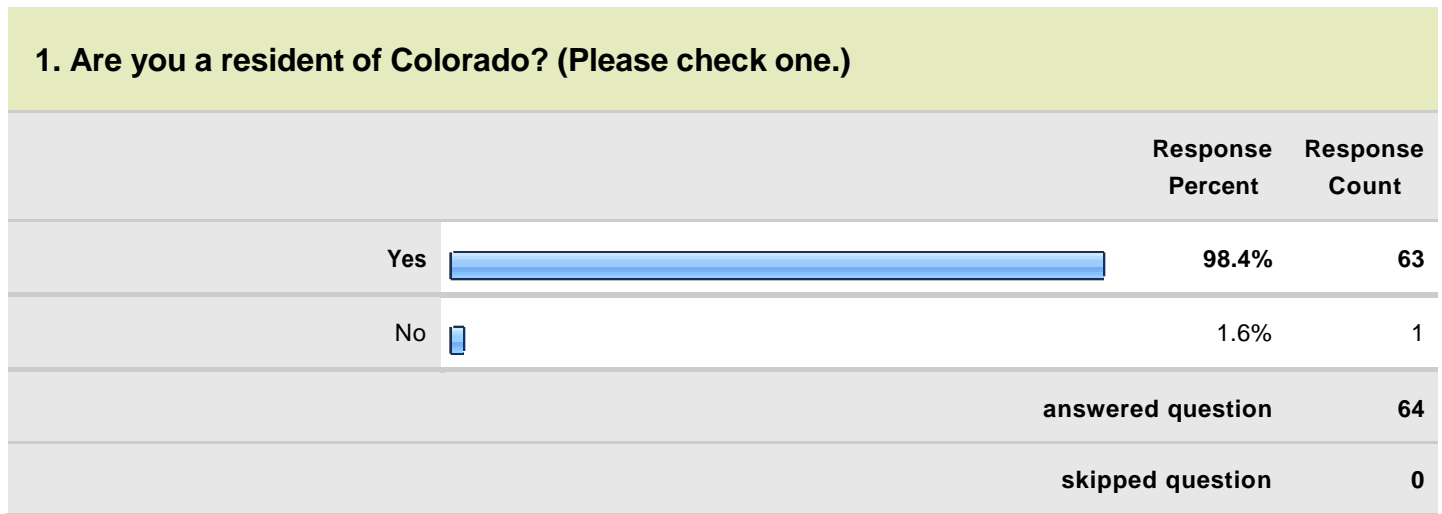
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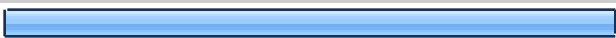
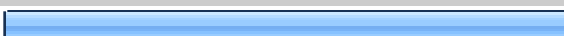




Appendix A. Survey used in public outreach. Respondent results included.





4. Have you applied for a bighorn sheep hunting license in GMUs S1, S18, S40 or S58 in the past?

		Response Percent	Response Count
Yes		60.3%	38
No		39.7%	25
answered question			63
skipped question			1

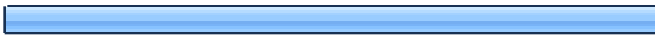

5. Which of the activities listed below do you participate in that may affect your interest in bighorn sheep in northern Larimer County? (Check all that apply.)

		Response Percent	Response Count
Hunting		92.1%	58
Wildlife Watching		84.1%	53
Own land in or near bighorn sheep range		9.5%	6
Livestock production or grazing		4.8%	3
Hiking, skiing and other outdoor recreation		66.7%	42
Other (please specify)		9.5%	6
answered question			63
skipped question			1






6. How important are wild bighorn sheep to you?

		Response Percent	Response Count
Very Important		87.3%	55
Somewhat Important		12.7%	8
Neither Important, nor Unimportant		0.0%	0
Somewhat Unimportant		0.0%	0
Very Unimportant		0.0%	0
I am not sure.		0.0%	0
answered question			63
skipped question			1

7. How important is it to you that there are bighorn sheep in Colorado in the future?

		Response Percent	Response Count
Very Important		98.4%	62
Somewhat Important		0.0%	0
Neither Important, nor Unimportant		0.0%	0
Somewhat Unimportant		1.6%	1
Very Unimportant		0.0%	0
I am not sure.		0.0%	0
answered question			63
skipped question			1



8. To what extent do you agree with the statement below? (Please check one.) I believe that CPW is currently doing an adequate job of managing bighorn sheep in GMUs S1, S18, S40 and S58.

		Response Percent	Response Count
Strongly agree		29.0%	18
Somewhat agree		43.5%	27
Neither agree, nor disagree		9.7%	6
Somewhat disagree		4.8%	3
Strongly disagree		0.0%	0
I am not sure.		12.9%	8
		answered question	62
		skipped question	2


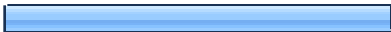


9. The following are all considerations of city, county, state and federal agencies when deciding how to use and manage land in this area. Please tell us which of these you feel should be most important in future land use decisions in northern Larimer County. (Please type a number from 1 to 7 which indicates how important you feel each item should be, where 1 is the most important item and 7 is the least important.)

	Response Average	Response Total	Response Count
Bighorn sheep populations	1.87	118	63
Deer and elk populations	1.94	122	63
Non-motorized recreation (hiking, backpacking, skiing, etc.)	3.56	224	63
Motorized recreation (ATV riding, Off-road driving, etc.)	4.75	299	63
Livestock grazing	4.32	272	63
Mineral extraction and mining	5.54	349	63
Residential and commercial development	5.94	374	63
	answered question		63
	skipped question		1

10. Have you reviewed the draft bighorn sheep management plan for GMUs S1, S18, S40 and S58? (Please check one.)

		Response Percent	Response Count
Yes		53.2%	33
No		46.8%	29
		answered question	62
		skipped question	2

11. Which of the following alternatives would you prefer to guide CPW's decisions about ram harvest and sex ratio in the next 10 years in GMUs S1, S18, S40 and S58? (Please check one.)

		Response Percent	Response Count
Increase ram hunting opportunity, which would decrease the number of rams relative to the number of ewes in the herd. This may increase hunter crowding and reduce the age of rams harvested, but would allow more hunters to draw a permit each year.		21.0%	13
Maintain current ram hunting opportunity and sex ratio, which would limit crowding and encourage harvest of rams of different ages, but require longer to draw a permit.		58.1%	36
Decrease ram hunting opportunity, which would increase the number of rams relative to ewes in the herd. This would lead to the least crowding and greatest harvest of older rams, but require the largest number of preference points to draw a permit.		17.7%	11
I am not sure.		3.2%	2
		answered question	62
		skipped question	2

12. Which of the following alternatives would you prefer to guide CPW's decisions about the number of bighorn sheep in GMUs S1, S18, S40 and S58 in the next 10 years? (Please check one.)

	Response Percent	Response Count
Decreasing population: Reduce number of sheep through increased hunter harvest, which would temporarily increase the number of hunting licenses available and may maintain or reduce the current risk of diseases among wild sheep, but would reduce the opportunity to view wild sheep.	8.2%	5
Small increase in population: Small increase in the number of bighorn sheep, which will allow for small increases in the number of hunting licenses available each year, stable opportunity to view wild sheep but may increase the risk of disease among wild sheep.	55.7%	34
Large increase in population: Increase wild sheep numbers by up to 50%, which will allow for long term increases in the number of hunting licenses available each year for rams and ewes, increased opportunities to view wild sheep, but may also increase the risk of disease among wild sheep.	36.1%	22
I am not sure.	0.0%	0
	answered question	61
	skipped question	3

Appendix B.

United States Forest Service, Canyon Lakes Ranger District, draft DAU plan comments

File Code: 2610

Mark Vieira
Colorado Parks and Wildlife
317 W. Prospect
Fort Collins, CO 80526

Dear Mark:

This letter is to submit comments on CPW's Draft Bighorn Sheep Management Plan for DAU RBS-1 (Poudre, Rawahs, Lone Pine herds). My wildlife staff person has reviewed and discussed the plan with me. The plan is very informative and well done, and greatly helped to inform my comments below.

Bighorn sheep is a Region 2 Forest Service sensitive species, and Forest Service direction for sensitive species generally is to restore, protect, and enhance habitats, and to increase or stabilize populations. With that in mind, I do not support the Alternative 1 population objective because it would reduce the population somewhat from current numbers, and bring the numbers to well below population levels of recent past. I do support both Alternative 2 and 3 population objectives, with a caveat of emphasizing sex ratio management to inhibit disease transmission risk as a result of sheep movement. Regarding the sex ratio objective alternatives, I endorse Alternative 2, specifically because this alternative would not encourage extra-range movements that could increase the risk of disease transmission into sheep herds. Likewise, I do not support the Alternative 3 sex ratio objective because it would be expected to increase the risk of disease transmission from more frequent extra-range sheep movements.

I would like to be notified or receive the draft plan again once a preferred alternative is identified, and then to receive the final plan. Thank you for the opportunity to comment on your Draft RBS-1 Bighorn Sheep Management Plan. Should you have questions or wish to discuss this further, please contact myself or Dale Oberlag.

Sincerely,
/s/ Kevin W. Atchley
KEVIN W. ATCHLEY
District Ranger
cc: Mark Leslie

Rocky Mountain Bighorn Society draft DAU plan comments



Rocky Mountain Bighorn Society
P. O. Box 8320
Denver, Colorado 80201
720-201-3791

March 4, 2012

Mark Vieira
Terrestrial Biologist - CPW
Fort Collins Service Center
317 West Prospect Avenue
Fort Collins, CO 80526

Dear Mr. Vieira:

The Rocky Mountain Bighorn Society (RMBS) welcomes the opportunity to comment on the draft management plan for Rocky Mountain bighorn sheep DAU RBS-1 prepared by Colorado Parks and Wildlife (CPW) biologists. Our organization represents approximately 800 members, with a mission to promote science-based management of Colorado's state animal, the Rocky Mountain bighorn sheep, and to assure the sportsman's privilege to pursue bighorn sheep.

We are pleased to see issues we believe to be a priority for this DAU are included in the draft management plan. We agree that CPW should work closely with local governments and 4H groups to identify and mitigate potential impacts of domestic livestock on private property. Disease transmission from domestic sheep is arguably the greatest threat facing bighorn sheep herds today.

Fire suppression in RBS-1 has allowed shrub and juniper encroachment across much of the bighorn sheep habitat in the unit. In addition, the mountain pine beetle infestation of lodgepole pine forest in the western half of the DAU. While this large-scale mortality of trees will likely improve habitat for bighorns by reducing ambush cover and increasing forage quality, the long term effects are not known. There is a concern that as dead trees begin to fall they may impede movements of bighorns between historical summer range in the Rawah Wilderness and winter range along the upper Poudre River.

The RMBS recommends a tiered approach to identifying and treating decadent bighorn sheep habitat within the DAU. We suggest CPW biologists first use existing radiocollar data to identify summer and winter ranges along the Poudre River for treatment of encroaching junipers and shrubs. We recommend biologists then identify treatment areas in migration corridors potentially affected by lodgepole pine die-off. Finally, we suggest CPW identify and treat areas of potentially suitable bighorn sheep habitat adjacent to occupied habitat in an effort to reduce bighorn sheep density and allow for a potential

increase in the post-hunt population management objective. We encourage CPW to engage conservation partners such as RMBS, Wild Sheep Foundation and Northern Larimer County Habitat Partnership Program to develop treatment plans and funding sources for habitat improvement in RBS-1.

The RMBS recommends that CPW use targeted control of mountain lions preying on radiocollared sheep in the DAU when possible. We realize that this may not always be possible due to the fact that VHF collars are being used rather than GPS collars. However, targeted control of mountain lions preying on sheep in New Mexico and California has proven to be very effective at reducing predation rates in those areas of study. We would like for CPW to have a plan in place to implement such control if a freshly killed sheep is discovered.

The RMBS prefers **Alternative 2: 175-225 Bighorn Sheep, posthunt** under *Posthunt Population Objective* in the draft management plan. We recognize that current habitat conditions in the DAU may preclude a larger population without risking detrimental aspects of high density such as reduced recruitment and increased disease risks. However, we hope that habitat treatment within the DAU will increase the quantity and quality of bighorn sheep habitat, and that CPW will revisit the posthunt objective as range conditions improve.

The RMBS prefers **Alternative 2: 50-70 Rams per 100 Ewes, posthunt** under *Posthunt Sex Ratio Objective* in the draft management plan. We believe that this alternative allows for both adequate hunter opportunity and optimum reproductive potential for the herd. This metric is preferred over average hunter success rate or average age of harvested rams, which both may often be affected by the effort or ability of the individual hunters who draw tags.

Thank you for giving RMBS the opportunity to comment on this draft management plan. Please do not hesitate to contact me if you have any questions or concerns about our comments. Also, please apprise us of future opportunities to comment on this plan or other bighorn sheep management issues.

Sincerely,

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