

BIGHORN SHEEP MANAGEMENT PLAN

DATA ANALYSIS UNIT RBS-20 Weminuche Herd

GAME MANAGEMENT UNITS

S15 (Sheep Mountain)

S16 (Cimarrona Peak)

S28 (Vallecito)

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RBS-20 Weminuche Bighorn Sheep Herd
EXECUTIVE SUMMARY
February 2012

Current Status

- *Composed of GMUs S-15 (Sheep Mountain), S-16 (Cimarrona Peak), and S-28 (Vallecito)*
- *Post-2010 population estimate ~460*
- *Tier 1 State Standing ≥ 100 animals for $\geq 90\%$ of the years since 1986; native population comprised of one or more interconnected herds that have received few (< 50 animals total) if any supplemental releases of Rocky Mountain bighorn sheep in the past (George et al 2009)*
- *Population is currently hunted*

2011 License Allocation By GMU

GMU	Ram		Ewe	
	Resident	Non-resident	Resident	Non-resident
S-15	4	1	1	1
S-16	3	0	2	0
S-28	3	0	1	0
DAU Total	10	1	4	1

Background Information

The Weminuche Herd is a **Tier 1, primary population**, receiving the highest standard for bighorn populations within the state, based on the Colorado Bighorn Sheep Management Plan (George et al 2009). This is based on population size, population performance, and the lack of transplanted bighorns into the population. The Weminuche bighorn sheep population is one of only three native bighorn populations in the state that have not received substantial numbers of translocated bighorns. This is a rare occurrence in Colorado and across the western United States where bighorn have been judiciously moved about.

RBS-20 is located in the San Juan Mountains in the southwest portion of Colorado. The United States Forest Service (USFS) administers 95% of the land located within the Data Analysis Unit (DAU). The remaining 5% is private with a token amount of Colorado Parks and Wildlife (CPW) lands. Elevations within the DAU range from 7,500 feet to over 13,000 feet. There are three Game Management Units (GMUs): S-15 Sheep Mountain, S-16 Cimarrona Peak, and S-28 Vallecito. The DAU contains portions of Hinsdale, La Plata, Mineral and Rio Grande counties.

Most of the habitat within the DAU appears to be in good or excellent condition. Summer range is extensive and provides room for population growth. Winter range and lambing areas are more limited. Currently winter range and bighorn distribution on winter range is not limiting. However, if the population remains healthy and is allowed to grow these two factors are expected to limit the overall growth. Identified lambing areas in the DAU are limited. More effort is needed to locate lambing areas so that population dynamics can be monitored more effectively. Also, these areas should be offered a higher degree of protection from disturbance during critical times and from habitat degradation.

RMBS-20 is located in isolated portions of the Weminuche Wilderness Area in the San Juan Mountains making access and inventory of bighorn sheep, from the ground or by helicopter, difficult. Hence there is not reliable data to produce a population model with acceptable confidence. The current population estimate is 460 which was based on

helicopter and ground count inventory data. The population has steadily increased over the past 26 years. Bighorn sheep are being observed in new places as they re-occupy historic ranges and fill in gaps between core use areas.

Lamb production is good with typical observed postseason lamb:ewe ratios within 40-50:100. Age ratios obtained during the summer are similar to those from winter which indicates excellent lamb survival and the absence of a significant disease type that is limiting population growth.

Ram hunting was allowed in the DAU beginning in 1953 and ewe hunting began in 2010. The three year average success rate is 83% and the average age of harvested rams is 8.3 years. In 2010, the first year of ewe hunting, four hunters harvested three ewes.

A primary concern for the Weminuche herd is the prevention of disease outbreaks specifically resulting from interaction with domestic livestock. Strains of *Pasteurellaceae* can be transmitted from domestic sheep and goats to bighorn sheep causing pneumonia and death (Rudolf et al 2003, Lawrence et al 2010). This can lead to large scale bighorn mortality affecting all age and sex classes, followed by a long period of depressed lamb recruitment (George et al 2008). Temporal and spatial separation between wild sheep and domestic sheep is the best management practice to prevent disease transmission (WAFWA 2007, MOU appendix C). Within RBS-20 there is an active domestic sheep allotment at South River Peak in the Rio Grande National Forest. Bighorn sheep are found in the same vicinity creating a high risk of interaction between the two species and a venue for disease introduction into the bighorn population although not all domestic sheep are carriers of *Pasteurella*.

Population inventory has been better in this DAU than some others throughout the state, but is still lacking for population modeling. Complete inventory of the DAU should be done at minimum every other year to gather population statistics, identify occupied habitat and distribution, and monitor general health of the herd. Resources for monitoring should be high priority for this Tier 1 population.

There are a disperse group of constituents interested in the management of bighorn sheep in RBS-20. These include but are not limited to the USFS, CPW, Colorado Wool Growers Association, Rocky Mountain Bighorn Sheep Society, the Southern Ute Indian Tribe, hunters, recreationists, local livestock producers, and local governments. When considering management alternatives for RBS-20 care needs to be given to include and respect all those involved. Communication between all the constituents is necessary to be successful in managing the Weminuche Bighorn Herd.

Management Alternatives

Numerical population based objectives are difficult to identify and manage towards for RBS-20 because of the limited amount of quality data available to produce a population estimate. Population estimates can vary greatly based on flight conditions and the number of bighorn sheep detected on a single flight and herds are not flown annually. The Weminuche Bighorn Herd cannot be managed to the same level of precision as other ungulate herds with a decade or more of quality data without considerable more investment in inventory. Therefore, we are recommending alternative population performance metrics that complement existing resources; such as winter density on core winter range, age of harvested rams, and hunter success rates. Additionally, we are presenting what the population is expected to do under different management scenarios. This is an expected population response and reported population estimate rather than a population objective that is managed for. Even though bighorn sheep are poor colonizers of new habitats, some range expansion can be expected as a result of population growth.

Expected Population Performance

2010 population estimate – 460

2010 population density on mapped winter range – 2.2 bighorns/km²

Management Alternatives:

1) Maintain current population and distribution across the DAU

- Use ewe harvest to prevent population and densities from increasing, maintaining a density of 1.9-3.3 bighorn/km² (anticipated 400-700 bighorn)
- Assume opportunities for wildlife viewing remain at current levels,

- Assumes the risk of contact between domestic sheep and bighorn on USFS lands remain at current levels (separation of bighorn and domestic sheep will still be imperative).
- 2) **Allow the population to increase concurrent with expanding distribution across the DAU**
- The population would be allowed to continue increasing so long as winter densities would not exceed 4.4 bighorn/km², mid-range of Ram Mountain densities (this would produce a maximum population of 920)
 - Assumes an increase in wildlife viewing opportunities although minimal due to the remoteness of the area,
 - Bighorn expansion into occupied domestic sheep allotments would be discouraged so that spatial separation between bighorn sheep and domestic sheep is maintained. This will be done through harvest and/or other harassment techniques.
 - This essentially maintains status quo

Ram Hunting

Success Rates

3yr average – 83%

Management Alternatives:

- 1) **Three year average success rate of 50% to 70%** - this would provide the highest hunting opportunity, but the lowest quality hunt in terms of the ability to find mature rams and hunter densities. Remains above the statewide average of 45%
- 2) **Three year average success rate of 70% -90%** - offers the highest quality hunting in regards to finding mature rams and low hunter densities with the cost of less opportunity to hunt. Essentially maintains status quo.

Average Age of Ram Harvested

3yr average – 8.3 years

Management Alternatives:

- 1) **Three year average age of rams harvested of 5 to 7.5 years** – more licenses with a higher harvest rate of the ram segment of population, less mature rams in the population.
- 2) **Three year average age of rams harvested of 7.5 to 9.5 years** – less hunting licenses with a lower harvest rate of ram segment, more mature rams in the population. Essentially maintains status quo.

Management Objectives:

Based on the biological analysis and public involvement that has occurred during this DAU planning process, Colorado Park and Wildlife Commission adopted the following alternatives for future RBS-20 bighorn management.

Expected Population Performance:

Manage for an increasing population and expansion of distribution within DAU

Ram Hunting Success Rate:

Maintain a three year average hunter success rate of 70%-90%

Ram Hunting Success Rate:

Manage for a three year average age of 7.5 to 9.5 for rams harvested within the DAU

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Introduction and Purpose

The Colorado Division of 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 the 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. Colorado's wildlife resources require careful and increasingly intensive management to accommodate the many and varied public demands and growing impacts from land use and recreation. To manage the state's big game populations, the 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.

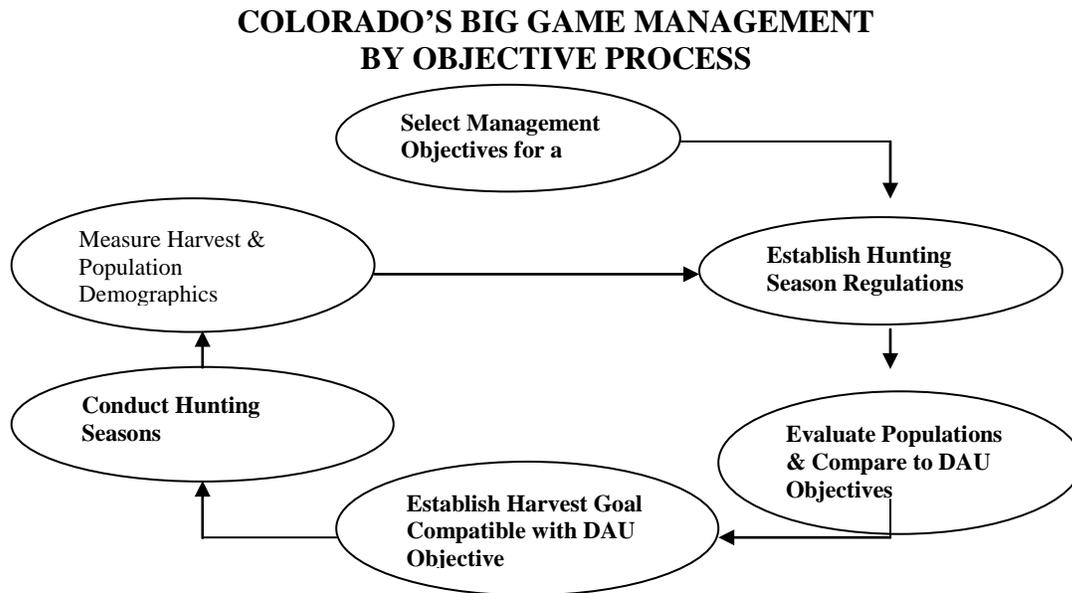


Figure 1. Management by objectives process used by Colorado Parks and Wildlife to manage big game populations on a DAU basis.

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 CPW Commission. Limited license numbers and season recommendations result from this process.

Bighorn sheep management in Colorado contrasts markedly with other big game management. Sheep populations are typically much smaller and often more geographically isolated than deer, elk, or pronghorn herds. Very 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 biologists. Furthermore, annual monitoring of bighorn sheep in Colorado has been variable and depends exclusively on budgetary constraints. 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.

Description of Data Analysis Unit

Location

Rocky Mountain bighorn sheep (*Ovis canadensis*) DAU RBS-20 is located in the southwest portion of Colorado and consists of GMUs S-15 Sheep Mountain, S-16 Cimarrona Peak, and S-28 Vallecito. The DAU is 2,600 square kilometers (1,004 miles²) and includes portions of Hinsdale, La Plata, Mineral, and Rio Grande counties. RBS-20 is bounded on the north by the Continental Divide and the Rio Grande River, on the east by Colorado Hwy 149, US Hwy 160, and the Continental Divide, on the south by USFS 667, Mineral-Archuleta and Hinsdale-Archuleta county lines, and on the west by the east shoreline of Vallecito Reservoir and Vallecito Creek (Figure 2).

Physiography

The climate is a highland or mountain climate, characterized by cool springs and falls, warm summers and moderately cold winters. Average precipitation and snowfall for Wolf Creek Pass located on the east side of the DAU are 45.4 and 435.6 inches per year respectively.. Vegetative types include: alpine over 12,000 feet elevation, spruce/fir stands down to 10,000 feet, and oakbrush, serviceberry, and ponderosa pine above 7,000 feet. The elevation in the DAU ranges from 7,500 feet to over 13,000 feet

Land Management

The majority of RBS-20 is Federal Land administered by the United States Forest Service (USFS). This consists of 2,450 km² (946 miles²) or 95% of the total DAU. Management is from the Divide Ranger District on the Rio Grande National Forest and the Pagosa and Columbine Ranger Districts on the San Juan National Forest. A significant portion of the USFS lands fall within the Weminuche Wilderness Area. Private land makes up 120 km² (5%, 46 miles²), and CPW owns a mere 3 km² (1 mile²) within the DAU (Figure 3).

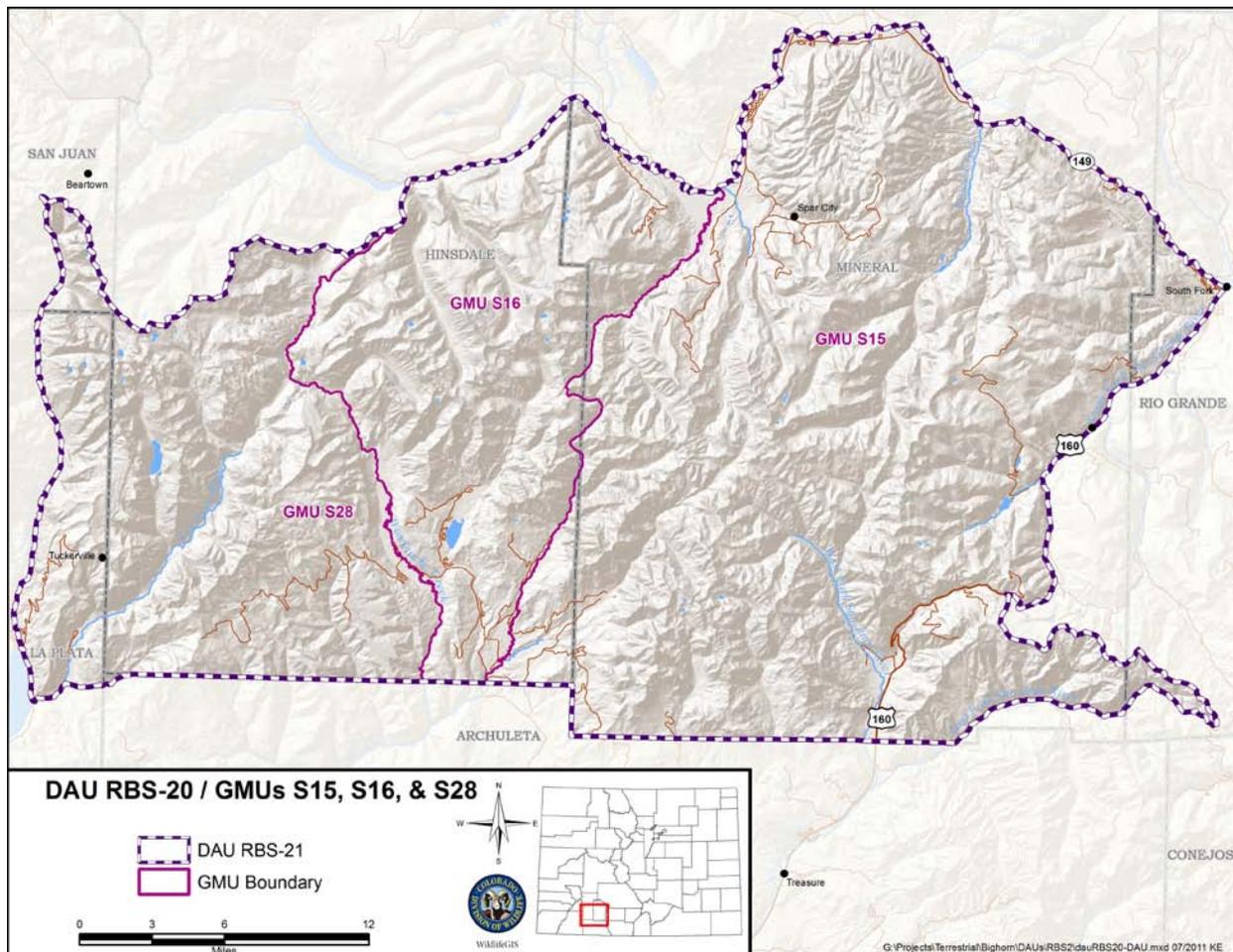


Figure 2. Geographic location of bighorn sheep Data Analysis Unit RBS-20 which includes Game Management Units S-15, S-16, and S-28.

Development and Fragmentation of Habitat

The threat of development or other anthropomorphic fragmentation, which includes residential development and mineral extraction, is relatively low. Most of the bighorn sheep range is under USFS management and much is designated Wilderness which offers a level of protection from human activities. Demand for mineral mining is low.

There is some residential development on the Granite Peak Ranch in S-28. The Ranch is in a conservation easement that will limit future development, but several houses have been built and are used as second homes or “cabins.” Bighorn sheep commonly use the slopes adjacent to the ranch. A continued relationship between the ranch and CPW is desirable. Current ranch management and activities do not appear to be causing problems with bighorn sheep.

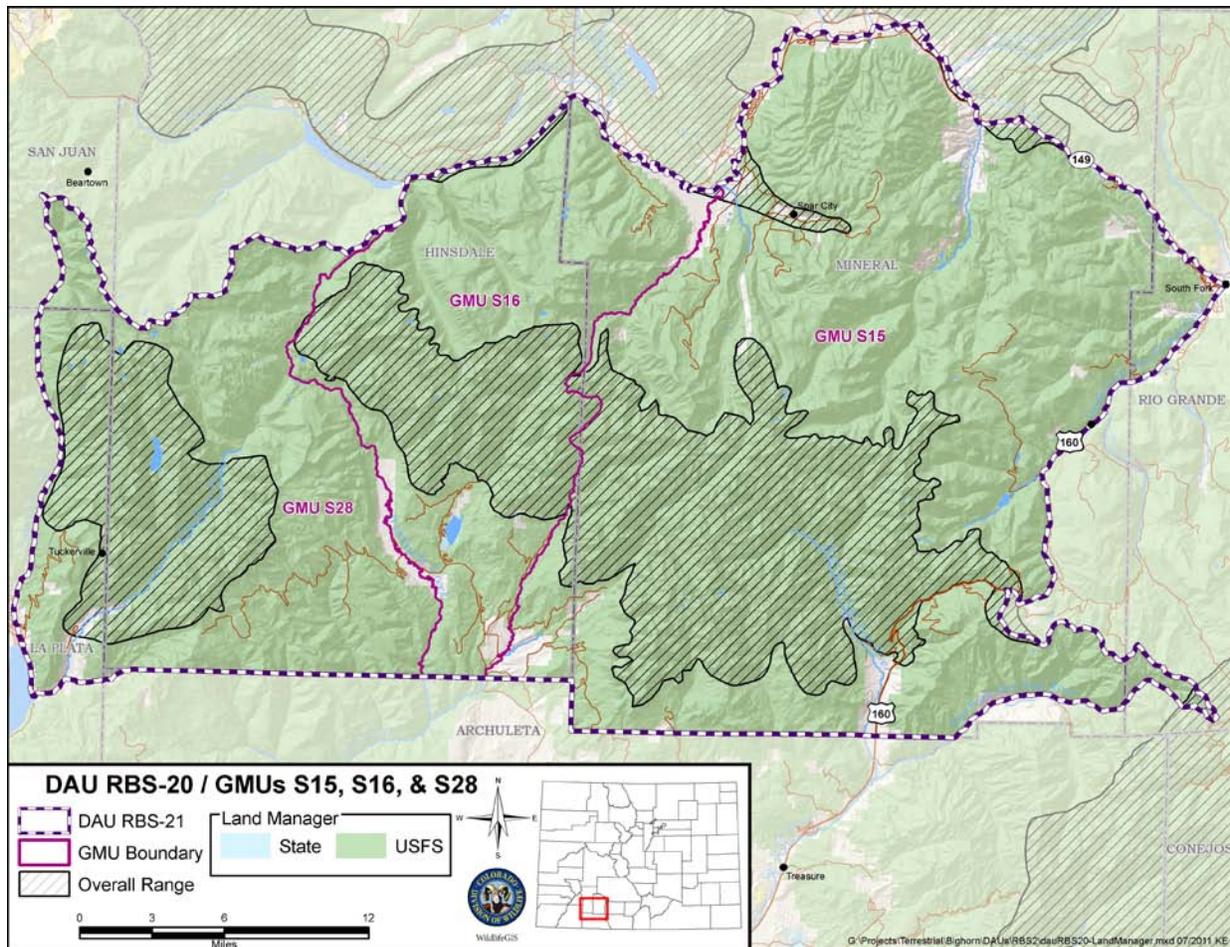


Figure 3. Land ownership in RBS-20.

Distribution and Habitat Resources

Historic Occurrence and Distribution

Rocky Mountain bighorn sheep are native to the San Juan Mountains including the area within RBS-20. The San Juan Mountains are suitable habitat for bighorn sheep. In all probability bighorn sheep historically occupied all of the higher and rougher portions of RBS-20. Bighorn sheep were extirpated throughout much of the San Juan Mountains from the late 1800's through the 1960's. It is surmised that this was influenced by overharvest of bighorn sheep by unregulated hunting, competition for forage with domestic livestock, and disease introduced by livestock.

One of the earliest documentations of bighorn sheep in the DAU was in 1911 when Cary recorded that "Forest Ranger E. E. Chapson, of Pagosa Springs, says that a good many sheep are killed by snowslides in the San Juan Mountains north of that point" (Cary 1911).

In 1962 Moser documented locations occupied by bighorn sheep representing a large geographical area within the San Juan Mountains. This included Cimarron Peak, South River Peak, Weminuche Creek, Grenadier Range, Sunshine Peak, and Engineer Mountain.

By 1973 the range of bighorn sheep had decreased significantly from historic occurrence. Summer range consisted of three main areas. The first was the country north of Wolf Creek Pass to Table Mountain and west to Beaver Creek. The second area included the headwaters of Weminuche, Cimarrona, Hossick, and Williams Creeks. And the third was the region between the Los Pinos River and Vallecito Creek north to Rock Creek (Bear and Jones 1973). The western areas, past Vallecito Creek, were no longer presented as occupied habitat.

During this same time period the winter range according to Bear and Jones (1973) overlapped the summer range but was limited by snow. Specific areas included the windswept ridges and southern exposures from Mount Hope to Sheep Mountain as well as the windswept ridges east of Emerald Lake. They also stated “reports from residents indicate that a portion of the herd, years ago, wintered in the downstream cliffs of the Los Pinos River.” Occasional use of the east side of the Los Pinos River was also recorded.

Current Occurrence and Distribution

Current distribution of bighorn sheep resembles Bear and Jones 1973 observations. In the eastern portion of the DAU, S-15, Sheep Mountain and its ridgeline to the north to Mount Hope continues to be an important year-round area for bighorn sheep where lambing occurs and bighorn sheep winter. The vicinity of the headwaters of Beaver Creek and the West Fork of the San Juan River is also favored by bighorn sheep. Rams, ewes, and lambs on the South River Peak ridgeline show up in reports from 1991 and again in 2010. These animals in 2010 were seen in both summer and winter months indicating year round residence at the location.

In unit S-16, bighorn sheep have been documented throughout the Williams Creek drainage and to the east. The Hossick Lake and Hossick Ridge areas are extensively used by ewe-lamb subherds, and most of the mature rams use the western end of Hossick Ridge. Limited bighorn sheep activity has been observed to the west toward Divide and Granite Lakes and to the north along the Continental Divide.

Finally in S-28 the overall range remains the area bounded by the Los Pinos/Piedra River divide, Vallecito Creek, and Flint Creek. More extensive use of the east side of the Los Pinos River has been documented. The ridge east of Emerald Lake is an important year round area.

Habitat Capability

Most of the habitat within the DAU appears to be in good or excellent condition based on anecdotal observation. Alpine areas are used throughout the year by bighorn sheep. Summer range is extensive and does not appear to be a limiting factor for the population. Modeled suitable habitat is 1,000 km² (386 miles²) or 42% of the DAU. Model parameters for suitable habitat are land areas with slopes equal or greater than 60%, plus the contiguous land within 300 m, as well as land within 1000 m if escape terrain is on at least two sides. Areas of dense vegetation, human developments, or blocked by man-made or natural barriers were removed from the model (George et al 2008).

Winter range is somewhat restricted, particularly following big snowfalls. Bighorn sheep winter at higher elevations (greater than 9,000 feet) where windswept ridges near escape terrain and

cliff bands that shed snow are key habitat features. Following big snowfall events, the sheep are extremely limited in habitat. Weminuche bighorn sheep often winter and summer on the same terrain. There are also areas that are used principally as winter range which are at lower elevations characterized by scattered Douglas fir within large rocky outcrops and cliff bands. In these locales canopy cover and sight distance may be a constraint on bighorn sheep population and distribution, as well as an enhancement for predators. Known winter range includes the Los Pinos River near Runlett Peak and Middle Mountain, the ridge east of Emerald Lake, the lower portions of the East Fork of the Piedra River, the West Fork of the San Juan River, Highway 160 near Treasure Creek and the switchbacks, Sheep Mountain, South River Peak, and the cliffs above Williams Creek and Weminuche Creek (Figure 4).

Modeled winter range (land areas defined as suitable habitat with southern aspects, George et al 2008) composes only 20% (500 km²) of the DAU (Figure 4). Snow cover is an important component missing in the winter range model and was not available for use in this document. None-the-less the model still conveys the degree in which winter habitat is limiting when compared to the overall range.

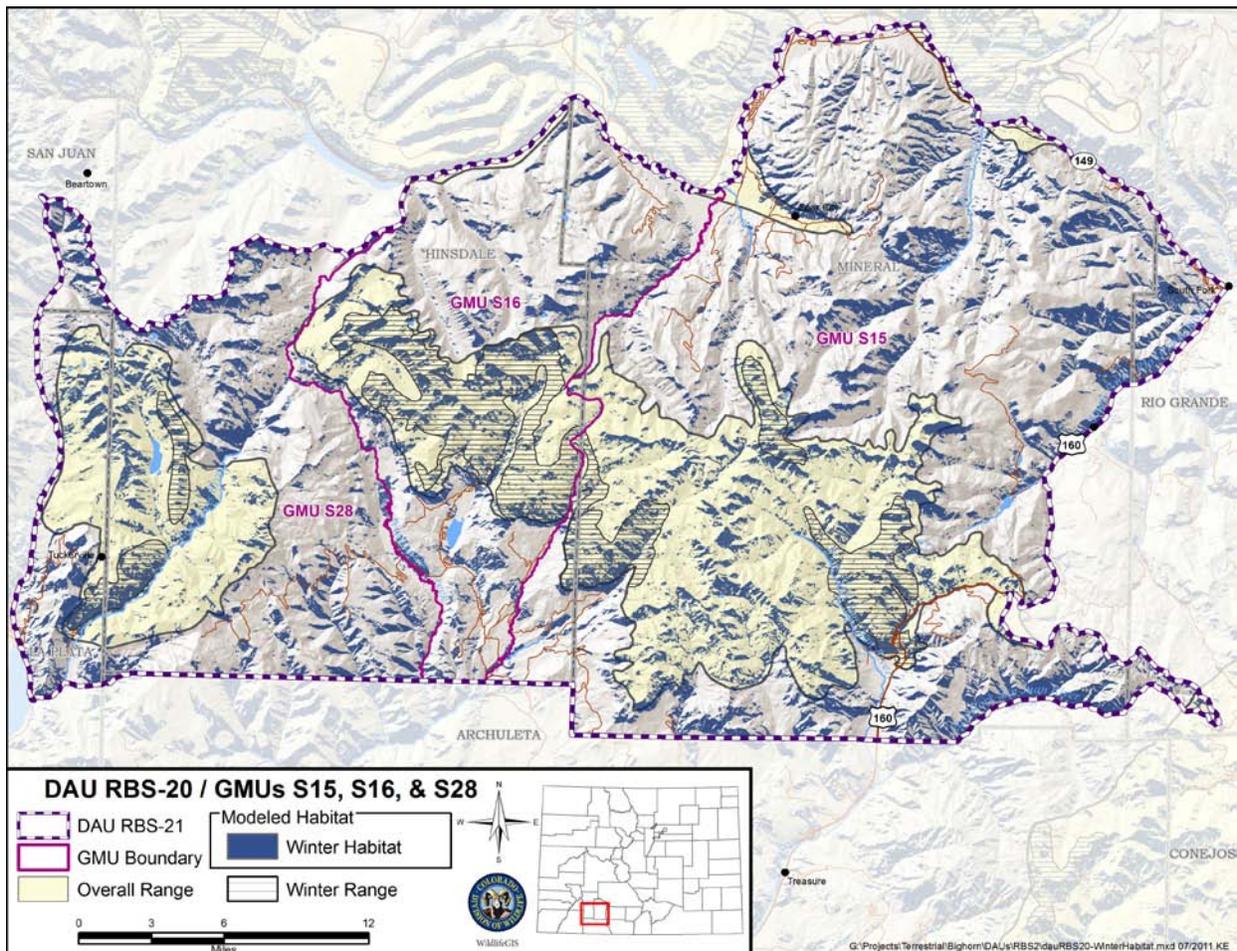


Figure 4. RBS-20 bighorn sheep overall range, winter range and modeled winter habitat.

Modeled lambing areas were also limited, encompassing only 10% (265 km²) of the overall suitable habitat (Figure 5). The modeled parameters of lambing habitat were; all suitable habitat

in greater than 2 ha patches, with slopes greater or equal to 60%, and with southern, eastern, or western aspects (George et al 2008). In the field lambing areas are difficult to identify and map because of poor access into occupied habitats in May and June. It is believed that there are some significant lambing areas that have not been located and mapped. Known lambing areas are on the southwest side of Sheep Mountain, the south faces of Hossick Ridge and Cimarrona Peak above Williams Creek Reservoir, and the ridges on either side of the Los Pinos River downstream from Lake Creek. Recent observations suggest that lambs are being born on the ridgeline containing South River Peak. In 2008 and 2009 USFS personnel out of the Pagosa Ranger District identified additional lambing activity on the ridge south of Puerto Blanco and southeast side of Sheep Mountain, both in S-15. A project in which ewes were captured and marked with radio collars would provide locations of these individuals during the lambing season by use of a receiver in a fixed wing aircraft. This would allow wildlife biologists to identify lambing areas with minimal disturbance to the ewes and lambs and gather data on time of use in these areas. Once identified it would be imperative for the well being of the population to protect these critical habitat areas from loss and various forms of disturbance. The use of a helicopter to capture the ewes would be necessary because of the remoteness of wintering bighorn. This adds a considerable expense.

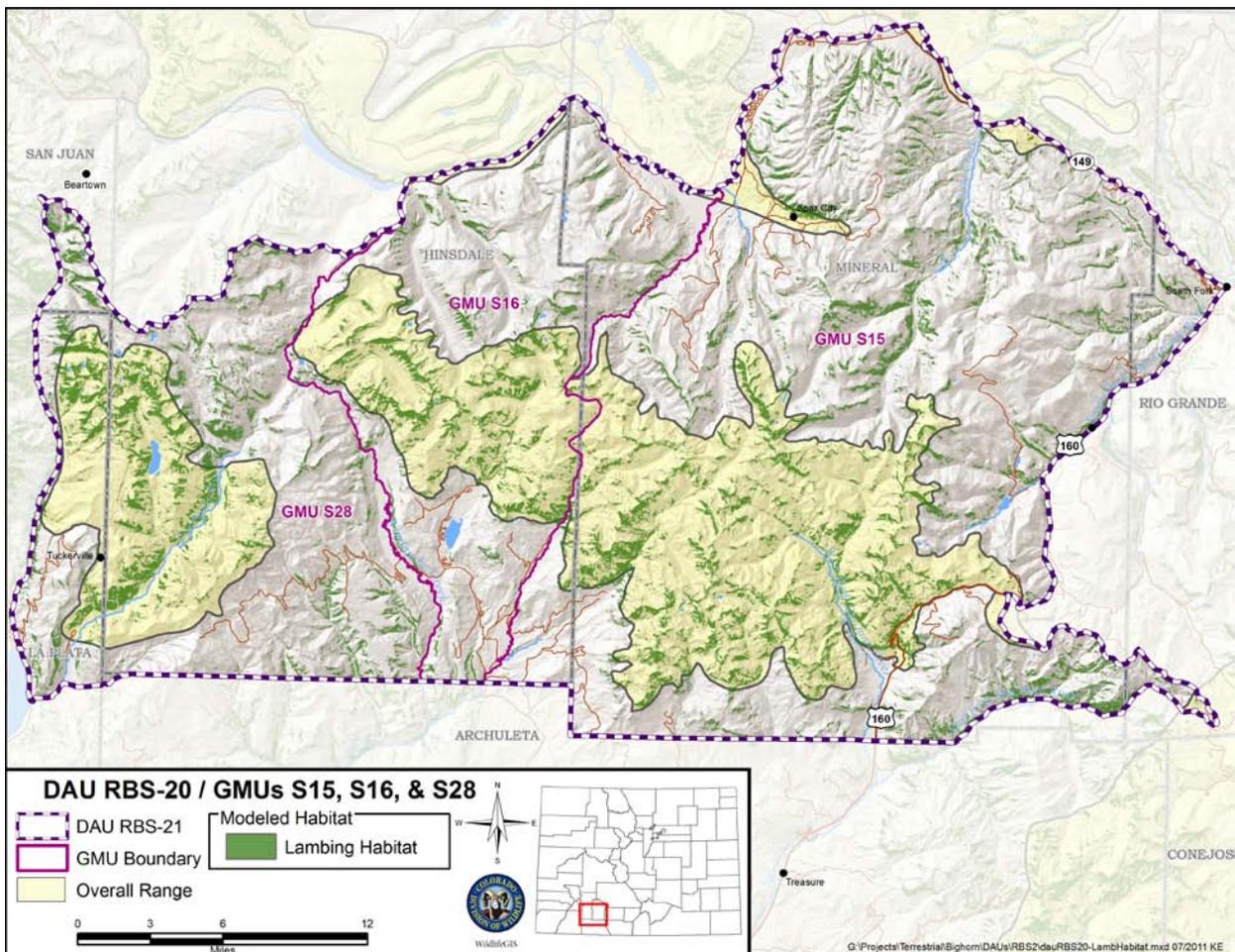


Figure 5. RBS-20 bighorn sheep overall range and modeled lambing habitat.

A management goal in the Colorado Bighorn Sheep Management Plan (George et al 2009) is that CPW will work to protect all bighorn habitat that is in good condition, and to take advantage of opportunities to improve situations where habitats are in fair or poor condition or where other factors limit potential for bighorn populations to thrive. CPW's role will be to provide technical expertise and funding when available to the USFS, landowners, and counties to protect and improve important existing and potential bighorn habitat. This will be done through partnerships and collaborative approaches with other agencies, industries, and non-governmental organizations to identify opportunities and funding. In RBS-20, beyond that which has already been mentioned, wildlife biologists need to identify possible movement corridors between bighorn groups and corridors that link various habitats such as winter range, lambing areas, and summer range. Afterward, habitat programs that open forest canopy in these areas would be beneficial for bighorn sheep. Use of natural fire would be the primary tool to accomplish this.

Improvement or creation of habitat might be accomplished in part through fire, whether natural or prescribed. This would also be the best way to address limiting winter habitat and lambing areas. CPW will work with the USFS by being involved in the implementation of fire plans to improve habitats and movement corridors with use of fire.

Herd Management

Population Status

The Colorado Wildlife Commission adopted the Colorado Bighorn Sheep Management Plan for 2009-2019 (George et al 2009). Within the document guidelines were given to evaluate bighorn populations on a statewide basis. Emphasis was placed on bighorn populations that were native, had greater than 100 animals and had received few if any supplemental releases.

RBS-20 is one of only a few indigenous, native bighorn populations, which have not been substantially supplemented with transplants in the State. There are only an estimated 6,900 bighorn sheep in State of Colorado and the current population estimate for the Weminuche bighorn sheep population is 460 (200 in S-15, 135 in S-16, and 125 in S28). RBS-20 is identified as a **Tier 1, primary population**, the highest ranking for a Colorado bighorn population. Tier 1 (primary core) Rocky Mountain bighorn populations (to be designated as DAUs) are regarded as those large (i.e., ≥ 100 animals for $\geq 90\%$ of the years since 1986), native populations comprised of one or more interconnected herds (in, or to be designated into, GMUs) that have received few (i.e., ≤ 50 animals total) if any supplemental releases of Rocky Mountain bighorn sheep in the past. Tier 1 populations should be given the highest priority for inventory, habitat protection and improvement, disease prevention, and research.

Bighorn sheep are also given high importance by the USFS in Region 2, in which RBS-20 is located, where the species is designated as a sensitive species. A sensitive species is defined as (www.fs.fed.us/biology/resources/pubs/tes/ss_sum_by_region_31Oct2005_fs.pdf) :

Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by:

- *Significant current or predicted downward trends in population numbers or density.*

- *Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.*
- *Objectives for sensitive species include:*
 - *Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.*
 - *Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.*

Translocations

RBS-20 is one of only three indigenous, native bighorn populations that have not been substantially supplemented with transplants in Colorado. The other two herds are S-2 (Gore Range) and S-9 (Sangre de Cristos). These three populations contain indigenous genetics that are unaltered by the cycle of die-offs and translocations. Genetically unaltered herds are extremely rare in other states as well. Biologists have just started seeing the benefits of this and will most likely not know the full importance until future decades. A more robust population which is adapted to local pathogens, habitat, extreme weather events (such as heavy snowfalls), and migration between habitats is expected when bighorns are not introduced from other areas. Because of this transplants into the DAU should be avoided.

Only one record of a translocation occurred in RBS-20 when bighorns were released into S-28 along the Los Pinos River on the Granite Peak Ranch. This event had a unique and interesting history. In January of 1988, 20 bighorns (12 ewes, 5 lambs, and 3 rams) were captured on Avalanche Creek south of Carbondale and released on the Los Pinos River near Runlett Peak. At that time, the S-28 herd was considered to be isolated from other herds in the San Juan Mountains and was experiencing continued low recruitment. The translocation was an attempt to increase genetic diversity, vigor of the herd, and distribution by pioneering. Domestic sheep happened to be grazed on an allotment within the area the same year, after the allotment had not been used for over a decade. In August physical contact was observed between the transplanted wild sheep and domestic sheep when individuals were seen grazing together. By September all but one of the transplanted wild sheep were dead. *Pasteurella* was suspected as the agent causing the die-off, as this is typical pattern for the disease. The released bighorn were monitored intermittently by ground observation and no direct interaction between the transplanted bighorn and the native bighorn were seen. If *Pasteurella* was the cause of mortality the disease was not spread into the native bighorn based on steady lamb recruitment in the population following the death of the transplanted sheep. It is common that lamb recruitment is depressed for years after a *Pasteurella* endemic (George et al 2008). It is also possible that the deaths of the transplanted sheep could have been caused by some other factor although the swiftness of the deaths is not familiar in other documented causes of mortality. The transplant was considered a failure, based on the known mortalities and the lack of performance of the herd following the transplant (Carron, personal communication 2011).

Although there hasn't been any other transplants into the DAU eartagged sheep have been observed in S16. These animals were likely from a release that occurred to the north near Wagon Wheel Gap, east of Creede, in 1985 and 1988. Wildlife released in an area unfamiliar to them often wander away from the release site more so than animals that may already inhabit the area. Because of this, the presumed interaction between the bighorn in Wagon Wheel Gap and S-16 was most likely a result of these wandering transplanted bighorn and are not representative of the interaction between the two populations.

Bighorn sheep have not been trapped and removed from RBS-20. Difficulty in accessing bighorn for capture has been a key component of not using RBS-20 bighorn as a source population and will be a factor in future considerations.

Future management of this herd should be based on promoting the current population through reproduction and recruitment of the existing bighorn. Releasing bighorn from other populations within the DAU or in areas adjacent to the DAU where there is a reasonable expectation that the release bighorn would interact with native bighorn should be avoided.

Inventory

Herds within RBS-20 were first inventoried in 1944 (Appendix A and B). Inventories have been conducted from hiking or horseback (ground counts) and various models of helicopters. Typically these have occurred in one of the three GMUs within the DAU and independent of one another. It is also common for bighorn sheep to be recorded or inventoried by helicopter as a secondary species during deer and elk classifications.

Early surveys were less standardized than more recent surveys. Often in earlier surveys only a total number of bighorn sheep observed, or the numbers of rams compared to the number ewes and lambs, was recorded. Dates and methods were frequently missing from records. These were still valuable in assessing bighorn densities and distribution. In the past fifteen years records have become more standardized with observed bighorn ages, sexes, rams' horn size (indication of ram age), and inventory method among other details used. Within the past ten years waypoints of bighorn locations have been marked with a Global Positioning System (GPS) unit which has assisted in mapping and understanding bighorn distribution.

On several occasions during the 1990's the USFS and CPW hired a seasonal technician to conduct bighorn surveys in the Weminuche Wilderness. These technicians would pack into an area and spend several days searching for and recording bighorn sheep. The efforts of these surveys provided bighorn occupancy and classification data. In 1990 and 1994 time was spent in the East Fork of Weminuche Creek and Hossick Lake region. The 1990 effort reported distribution, but did not provide specific numbers of bighorn sheep observed. The focus in 1991 was Sheep Mountain along the Continental Divide to South River Peak. There were 199 bighorn documented during this summer survey. However, it is unknown if there were any duplicate counts since surveyed areas were in close proximity and surveyed during separate time periods. The 1995 area was similar to that surveyed in 1991 with the addition of Window Lake and Fourmile Creek.

Results of inventory efforts provide critical population count data, distribution, and reproduction statistics. Inventory will continue to be a key component of gathering data to effectively manage this population. Although past inventory has been greater in RBS-20 than many other herds around the state, there is a need to increase intensity in order to more effectively manage this population. More on this is presented in the *Herd Issues and Strategies* section.

Post-hunt Population Size and Performance

Population estimates for bighorn sheep herds are commonly based on the number of individuals observed through various inventory methods as well as observations by other agency personnel, the public, and hunters. There is often a lack of unbiased estimates of sex and age structure and survival rates which are needed to create a reliable population model. This holds true for RBS-20. Hence a population model for this herd has not been developed. Sufficient data probably exist to build a rudimentary model but the accuracy would be questionable.

Prior to 1986 observed numbers of bighorn sheep were documented at irregular intervals within the DAU. Bighorn sheep population estimates began in 1986 and have occurred thereafter. Herd estimates vary greatly in reliability because they are based on highly variable amounts of field data and/or on impressions.

From 1944 to 1971 there are snapshots of the number of bighorn sheep located within the area now defined by RBS-20. In 1944 George Jones with the Colorado Division of Wildlife observed 68 bighorns within the DAU (Bear and Jones 1973). The next recording from 1956 estimates 96 bighorns with 82 individuals found (Moser and Pillmore 1956). Moser records this number again in 1962 (Moser 1962). Up to this point there was no mention of bighorns in the Vallecito/Los Pinos country. It is unknown if the locale was even surveyed for bighorn sheep. Finally in 1971 a total of 74 bighorn sheep were observed in the DAU; 33 at Sheep Mountain, 33 at Cimarrona Peak, and 8 at Vallecito (Bear and Jones 1973).

Population size and distribution observed in the early records are most likely relics of what the Weminuche herd once was. Increases in the population over the past 25 years likely represent recovery from the extirpation of bighorn in the late 1800's and early 1900's presumably caused by market hunting, competition with livestock, and disease related die-offs. The herd is once again beginning to expand to its potential.

Over the past 25 years, since population estimates began, the estimate has been steadily increasing (Figure 6). The estimate is at a 25 year high of 460 bighorn.

Although population estimates are not exact, the overall trend for RBS-20 is believed to be true based on inventory and observations. The population is increasing with bighorn sheep found in new locations and more bighorn sheep observed during a classification flight or ground count. A good example of this comes from 2008 when pre-season flights were conducted in the DAU and an all time high count for 2 of the 3 units was achieved. During 10 hours of helicopter time (8.2 hours searching) 323 bighorn sheep were observed: 151 in S-15, 103 in S-16, and 69 in S-28. There remains much habitat unoccupied allowing for additional population growth and expansion.

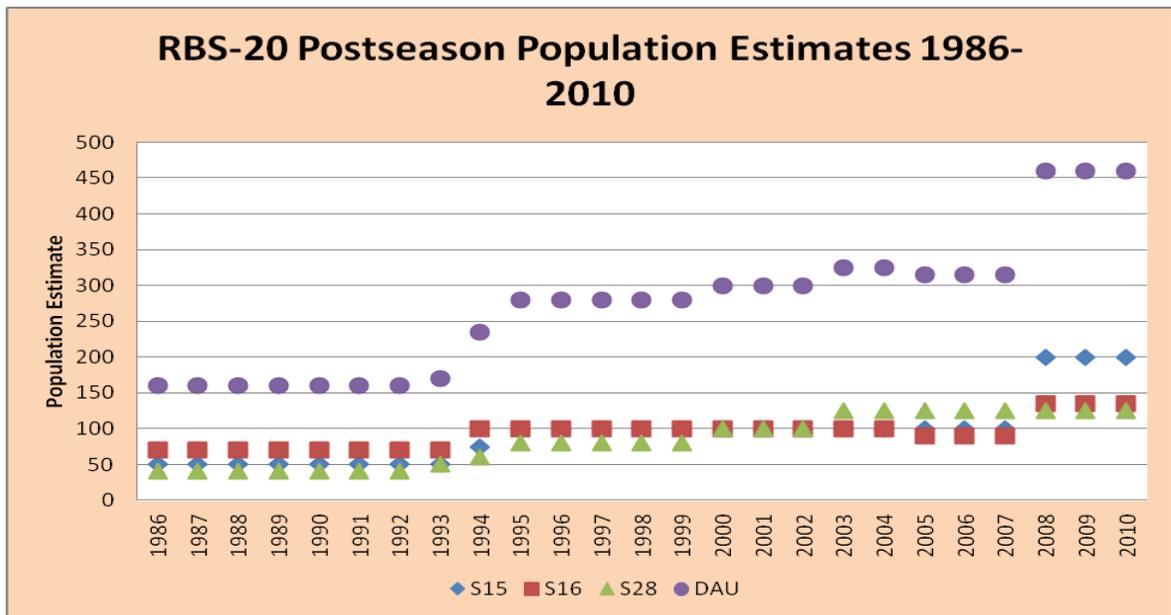


Figure 6. RBS-20 Annual Postseason Population Estimates 1986-2010.

From observations in S-28 it is speculated that this herd may not be performing as well as the rest of the population. Part of this apprehension is caused by bighorn sheep not being as readily found or not found in the same numbers in specific locations as in the recent past. The reality and cause of this has yet to be determined. Recruitment has remained good based on postseason lamb:ewe ratios. More intensive monitoring is needed to determine if the population is decreasing and to what degree or if the habits and occupied areas have changed making detection of animals more difficult. If it is determined that the population is decreasing then it is essential to identify the causes so that the appropriate management steps, if available and practical, can be taken to reverse this trend.

Measuring densities of bighorn sheep is an option for recording population performance when the lack of adequate data is available to create a population model. There wasn't any literature found that identified the optimal densities for bighorn sheep populations in an alpine environment. Extracting densities from the work done at Ram Mountain in Alberta provides some insight as to population densities and when acceptable densities have been exceeded (Jorgenson et al 1997, Festa-Bianchet 2003). This has not been rigorously tested and was not the original intent of the Ram Mountain studies. It does however provide us with a framework when evaluating bighorn populations. Ram Mountain is 38km² and has supported 94 to 232 bighorns at any one time or 2.5 to 6.2 bighorn/km². When the population reached the maximum recorded number it plummeted and has not recovered since. The cause of this was assumed to have happened due to unidentified density dependence factors. Based on this history, maximum densities of 6.2 bighorn/km² should be avoided in similar habitat until more is known in regards to optimal population densities.

When the 2.5 density (low end at Ram Mountain) was applied to the mapped overall range within RBS-20 and to the modeled suitable habitat it produced an unrealistically high population expectation for the DAU. Because winter habitat is a limiting habitat feature, the density was

applied to the mapped winter range and modeled winter range. This produced potential populations of 525 for the mapped winter range and 1250 for the modeled winter habitat. These were much more realistic. Calculating the uppermost density of 6.1 bighorns/km² produced a population of 1,280 and 3,060 for the respected winter range areas. The current density on mapped winter range is 2.2 bighorn/km². As previously stated, the modeled winter range did not account for snow cover so the area involved is high, and therefore the associated population numbers are higher than what can actually be supported. Although rudimentary, this does provide some expectation of an optimal population in the Weminuche Herd which may fall around 900 bighorn (the mean of the mapped winter range). This will be used later when exploring expected population performance management objectives.

Herd Compositions

Bighorn sheep classifications have occurred at varying times throughout the year. The most common classification times are late summer (preseason) or during the winter (postseason). Postseason data presents a better measure of population performance due to the high level of lamb mortality that can occur between the time of birth and October. Also bighorns are more concentrated on winter range which increases the probability of detection. Pre-season data provides better information about summer distribution as well as determine the potential lamb production. The difference between the number of lambs preseason and postseason can be an indicator of herd health and population performance.

Age Ratios

Age ratios are expressed as the number of lambs per 100 ewes. Earlier data from 1968 to 2000 has the highest postseason ewe:lamb ratio as 67:100 which occurred January 31, 1997 in S-16 (n=28). The lowest during the same time period was 7:100 in S-28, December 1995 (n=61). During this same year S-16 also recorded its lowest lamb:ewe ratio of 11:100 (n=53) while further to the east S-15 had a ratio closer to average. Interestingly the year with the lowest age ratio was a year after the high observed age ratio. Average postseason ratios from 1968 to 2000 for the three GMUs have been 40:100 in S-15, 38:100 in S-16, and 44:100 in S-28. The average for the DAU was 42:100. Average preseason age ratios were 35.7:100 in S-15, 36.8:100 in S-16, 43.7:100 in S-28 and 38.2:100 for the DAU (Table 1). There hasn't been a significant difference in postseason and preseason age ratios. The significance of this is discussed in detailed on the following page.

	S-15	S-16	S-28	DAU
Ave Preseason	35.7	36.8	43.7	38.2
Ave Postseason	40.0	38.4	43.8	41.5

Table 1: Preseason and postseason age ratios (lambs:100 ewes) for RBS-20, 1961-2000.

Overall postseason lamb:ewe ratios were higher over the past ten years than the earlier time period. Within the past ten years the average postseason age ratios have been 48:100 in S-15, 50:100 in S-16, and 45:100 in S-28. The average for the DAU from 2001 to 2011 was 48:100. The highest postseason age ratio was 73:100 in GMU S-16 (n=29) on December 21, 2006. The lowest for the same time period was 20:100 in S-28 (n=26) on December 21, 2006, the same day as the high was recorded in S-16 (Figure 7). Preseason age ratios during the same time period

were 41.0:100 in S-15, 41.0:100 in S-16, 39.5:100 in S-28, and 40.7:100 for the DAU (Table 2). There again a decrease was not recorded from preseason to postseason.

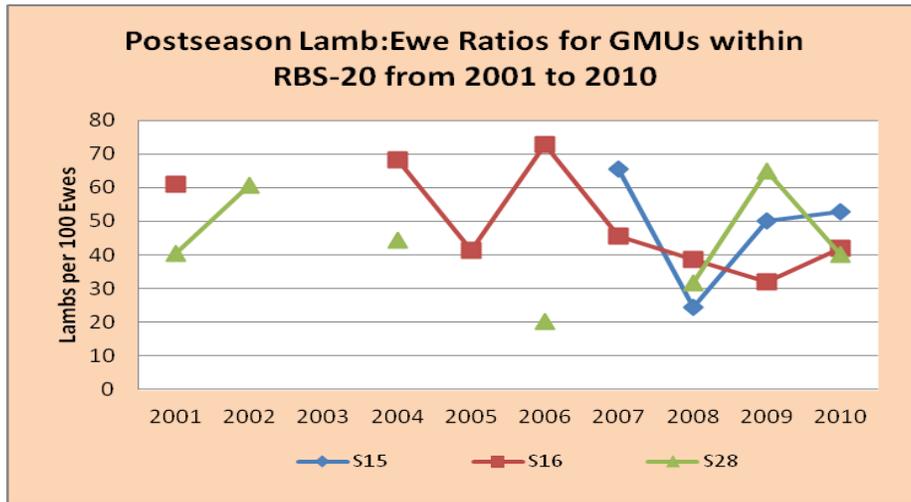


Figure 7. Post Season Age Ratios for Game Mamangement Units within RBS-20 from 2001-2010

Recruitment can be used as an indicator of herd performance. Within the Weminuche Herd a postseason lamb:ewe ratio 40-47:100 is considered normal for a healthy population. With this ratio the Weminuche bighorn population has been slowly increasing. A ratio above 50:100 is exceptional and would promote a rapid population growth. A ratio less then 30:100 is poor and would be unable to sustain the current population. An occasional drop to 30 or less is expected as part of the population dynamics. Several years of poor lamb:ewe ratios, which has not occurred, is a cause of concern.

	S-15	S-16	S-28	DAU
Ave Preseason	41.0	41.0	39.5	40.7
Ave Postseason	48.2	50.2	44.9	47.7

Table 2: Preseason and postseason age ratios (lambs:100 ewes) for RBS-20, 2001-2011.

Since populations are occasionally inventoried in summer and winter, preseason and postseason lamb:ewe ratios can be compared to determine lamb survival from late summer to early winter. A large decrease in age ratios from preseason to postseason indicates a health issue within the population. When disease is present lamb mortality can increase after the lambs are weaned from the ewe and become dependent on their own, undeveloped immune system. Previous to weaning the lambs received antibodies through the ewe’s milk to fight disease. Consistent ewe:lamb ratios from summer to winter are expected in vigorous populations. The preseason and postseason average lamb ratios in RBS-20 for the past 10 years have been 41 and 48:100 respectively which signifies that disease is not limiting recruitment in the DAU.

Sex Ratios

Sex ratios tend to fluctuate from count-to-count more so than age ratios due to the segregation of rams from ewe/lamb groups. For example the sex ratio within the DAU has ranged from 13:100 to 82:100. This is a huge variation caused by the observers’ ability to find animals during

classification and not an actual change in population sex ratios. The total number of bighorn sheep observed during classification flights or ground counts tend to be low which creates a large standard error. Because of this, management objectives based on sex ratios may not provide the best management guidelines. Traditionally ram hunting has been determined not through sex ratios but through providing a quality hunting experience. It is recommended to continue this management approach.

Harvest and Hunters

Bighorn sheep hunting was closed by the Legislature in the state of Colorado in 1887. The season was reinstated in 1953. Since its inception, the hunting season in RBS-20 has been a rifle season which allows archery hunting and all other legal methods of take for bighorn sheep. Hunters were required to harvest rams that were ½ curl or larger from 1953-1957 and 1960-1964. From 1958-1959 and 1965-1969 rams had to be ¾ curl or larger and in 1970 rams had to have a minimum of a full curl (Bear and Jones 1973). Currently rams have to have a minimum of a half curl and ewes must have a horn length of at least 5 inches.

Ewe hunting did not occur until 2010 when ewe licenses were introduced into the three GMUs. All ewe and ram licenses are limited in number and require hunters to apply in an attempt to attain one through a drawing system. Hunter harvest is at a minimal level and is not impacting the population.

Successful hunters are required to have their animal checked by CPW personnel within five days of harvest. At this time horn measurements, specifically length and basal circumference, are taken on each horn and annual growth rings are recorded. In addition hunters are asked to provide information about number, locations, age and sex of other bighorns observed during the hunt.

The 10 year average success rate for rams in the DAU is 72% and the average number of growth rings is 6.5. The average age of harvested rams was 8.0 years. The three year average success rate is 83% for rams and 6.5 annual growth rings. The three year average age of harvested rams was 8.3 years. Although there has been huge variation in success rates within the GMUs (0%-100%) over the past 4 years they have become more consistent. This is most likely due to the increased difficulty of drawing a license and hunters putting more effort into harvesting a ram. This trend is expected to continue into the future. Currently 2% of the population is taken annually in ram harvest which falls within the Colorado Bighorn Sheep Management Plan (George et al 2009) guidelines. Following is a breakdown of harvest by GMU.

GMU	Ram		Ewe	
	Resident	Non-resident	Resident	Non-resident
S-15	4	1	1	1
S-16	3	0	2	0
S-28	3	0	1	0
<i>DAU Total</i>	<i>10</i>	<i>1</i>	<i>4</i>	<i>1</i>

Table 3: 2011 hunting license allocation in RBS-20.

S15 – Sheep Mountain

The earliest recorded sheep hunt in this unit was in 1953 although no rams were harvested by 10 hunters. The season was closed in 1955-56, and hunted 1957-present. Since 1957, the herd has been hunted by 2-10 hunters every year. In 2011 there were 4 resident ram licenses, 1 resident ewe license, 1 non-resident ram license and 1 non-resident ewe license (Table 3).

In recent years (since 2000) the unit has hosted 5-6 ram hunters. Ewe hunting had not occurred until 2010 when two ewe licenses were introduced. Ram harvest has varied from 2 to 5, and the 3 year success rate is currently 72%. Ram hunter success rates have been fairly stable with a low of 50% and a high of 80% (Figure 8). Most rams harvested are of good size, in the 6-9 year old range. The average number of growth rings on harvested rams is 6.3. One ewe was harvested in 2010.

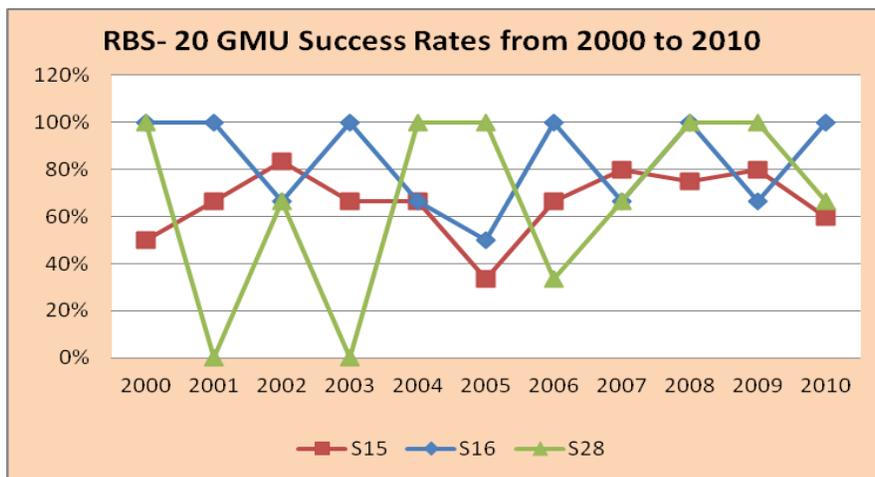


Figure 8. Hunter success rates from 2000 to 2010 in GMUs within RBS-20.

S16 - Cimarrona/Hossick

The earliest recorded sheep hunt in this unit was in 1954, when 2 rams were harvested by 10 hunters. The season was closed in 1955-56, and hunted 1957-present. Since 1957, the herd has been hunted by 2-10 hunters every year. There were 3 resident ram licenses and 2 resident ewe licenses available in 2011 (Table 3).

In recent years (since 2000) the unit has hosted 2-3 ram hunters. Ewe hunting had not occurred until 2010 when two ewe licenses were introduced. Ram harvest has varied from 1 to 3, and the 3 year success rate is currently 89%. S16 ram hunters have the highest success rates in the DAU. These have varied from 50% to 100% (Figure 8). Most rams harvested are of good size falling in the 5-8 year old range. The average number of growth rings on harvested rams is 6.5. One ewe was harvested in 2010.

S28 – Vallecito

The earliest recorded sheep hunt in this unit was in 1953, when 4 rams were harvested by 10 hunters. Seasonal hunting continued through 1956, was closed 1957-1962, hunted in 1963 (0 harvested by 6 hunters), and again closed in 1964. Since 1965, the herd has been hunted by 2-10

hunters every year. There were 3 resident ram licenses and 1 resident ewe license available in 2011 (Table 3).

In recent years (since 2000) the unit has hosted 2-3 ram hunters. Ewe hunting had not occurred until 2010 when one ewe license was introduced. Ram harvest has varied from 0 to 3, and the 3 year success rate is currently 89%. Ram hunters success has varied the most in this GMU with a low of 0% and a high of 100% (Figure 8). Most rams harvested are of good size, in the 6-9 year old range. The average number of growth rings on harvested rams is 7.0. One ewe was harvested in 2010.

Future Harvest

Emphasis should be placed on offering a quality experience to ram hunters measured by low hunter density and the opportunity to see and harvest mature rams. This is a management goal in the statewide management plan (George et al 2009). The demand to hunt bighorn, measured by the number of hunters applying for licenses continues to grow as opportunity (or licenses) remains mostly unchanged. Hunting bighorn rams has become an opportunity that is hard to come by. Therefore a high quality experience based on low hunter densities and the opportunity to see and harvest mature rams should be available to those who are lucky enough to obtain a license. This needs to be balanced with the opportunity to hunt. Some general guidelines are presented in the Colorado Bighorn Sheep Management Plan (George et al) for ram harvest in populations not modeled and should be followed for this population. This includes ram harvest falling within 2-5% of the post hunt population and/or 4-10% of the total post hunt ram numbers. In DAUs below objective, harvest rates may be reduced. The current allocation of rams licenses in RBS-20 fall within these guidelines.

Estimated Population in Relationship to Objective	Observed Winter Lamb:Ewe Ratio	Ewe Removal or Harvest Rate as a Percentage of Total Population	Comments
≥25% below	NA	No ewe removals	Exceptions allowed for disease management
<Objective, but within 25%	≥40:100	Up to 5% of total post hunt population ≥1 year old	Or up to 12% of pre hunt ewe population
At Objective	≥40:100 20-39:100 <20:100	5-10% of total post hunt population ≥1 year old <5% of total post hunt population ≥1 year old No ewe removals	Or 12-24% of pre hunt ewe population Or <12% of pre hunt ewe population Exceptions allowed for disease management
Over Objective		≥10% of total post hunt population >1 year old	≥24% of pre hunt ewe population

Table 4: Recommended ewe removal rates via hunting and translocations from the Colorado Bighorn Sheep Management Plan 2009-2019 (George et al 2009).

Ewe hunting in the population should be used to manage densities of specific herds. Higher population densities can have a negative impact to lamb mass and survival (Portier et al 1998) and yearling female survival (Jorgenson et al 1997). Guidelines for ewe harvest that are in the Colorado Bighorn Sheep Management Plan (George et al 2009) should be used for population

management (Table 4). In habitats where bighorn are at higher densities ewe harvest should be used to encourage dispersal and maintain herd health and vigor. In the same regard ewe harvest should be an option to discourage bighorn pioneering into occupied domestic sheep allotments. Care should be taken when using ewe licenses that herds, specifically those with the easiest hunter access, don't become overharvested. In addition ewe hunters should have minimal impacts to ram hunters. This in part can be done by designating the opening day of ewe hunting mid-way into the ram season, allowing ram hunters the opportunity to hunt without ewe hunters in the field.

Brunot Treaty

RBS-20 falls within the boundary of the Brunot Treaty Area (Brunot Area). The Brunot Area results from the 1874 Brunot Agreement between the United States government and bands of Ute Indians that were residing in Colorado at the time. Today descendants of these bands include the Southern Ute and the Ute Mountain Ute Tribes. The area that is involved in the treaty was removed from the tribes' reservation lands in 1874 after the discovery of gold in the San Juan Mountains to allow mining and settlement in the region by US Citizens. Although no longer reservation land, Article II of the agreement states that "The United States shall permit the Ute Indians to hunt upon said lands so long as the game lasts and the Indians are at peace with the white people". The Southern Ute Tribe (SUT) began to exercise their treaty rights in 2009. Any hunting and harvest of bighorn sheep by Tribal members falls outside the jurisdiction of CPW management and management plans. All but the eastern portion of RBS-20 falls within the boundary of the Brunot Treaty (Figure 9).

CPW and SUT have worked together to ensure that the bighorn populations are not overharvested. The SUT allocated one either sex license in 2009 and two licenses in 2010 and in 2011. A ¼ curl ram was harvested in 2009 and a full curl ram in 2010, both within GMU S-16. There was concern from local biologists regarding Brunot harvest coming from one area, more specifically on a group of sheep in S-16 near Williams Creek Reservoir where the two rams were harvested. To help address this issue and distribute harvest the SUT beginning in 2011 made one of the bighorn licenses valid in the north portion of the treaty area and the other one in the south portion. The north portion falls outside the DAU boundary so only one of the two licenses will be valid in occupied bighorn habitat in RBS-20.

Under the Brunot Agreement there remains the potential for additional annual harvest by Tribal members in RBS-20. Brunot license allocation has historically been calculated as a percentage of the total licenses issued within the treaty area. Thus, as licenses increase in the GMUs within the treaty area, Brunot licenses increase correspondingly. Also there is potential for increased Brunot harvest if the Ute Mountain Ute Tribe (UMUT) exercises Brunot rights on bighorn. UMUT currently exercise Brunot rights with deer, elk, and small game. Brunot bighorn harvest and the location the animals are taken will likely have some influence on general public license allocation and management over time.

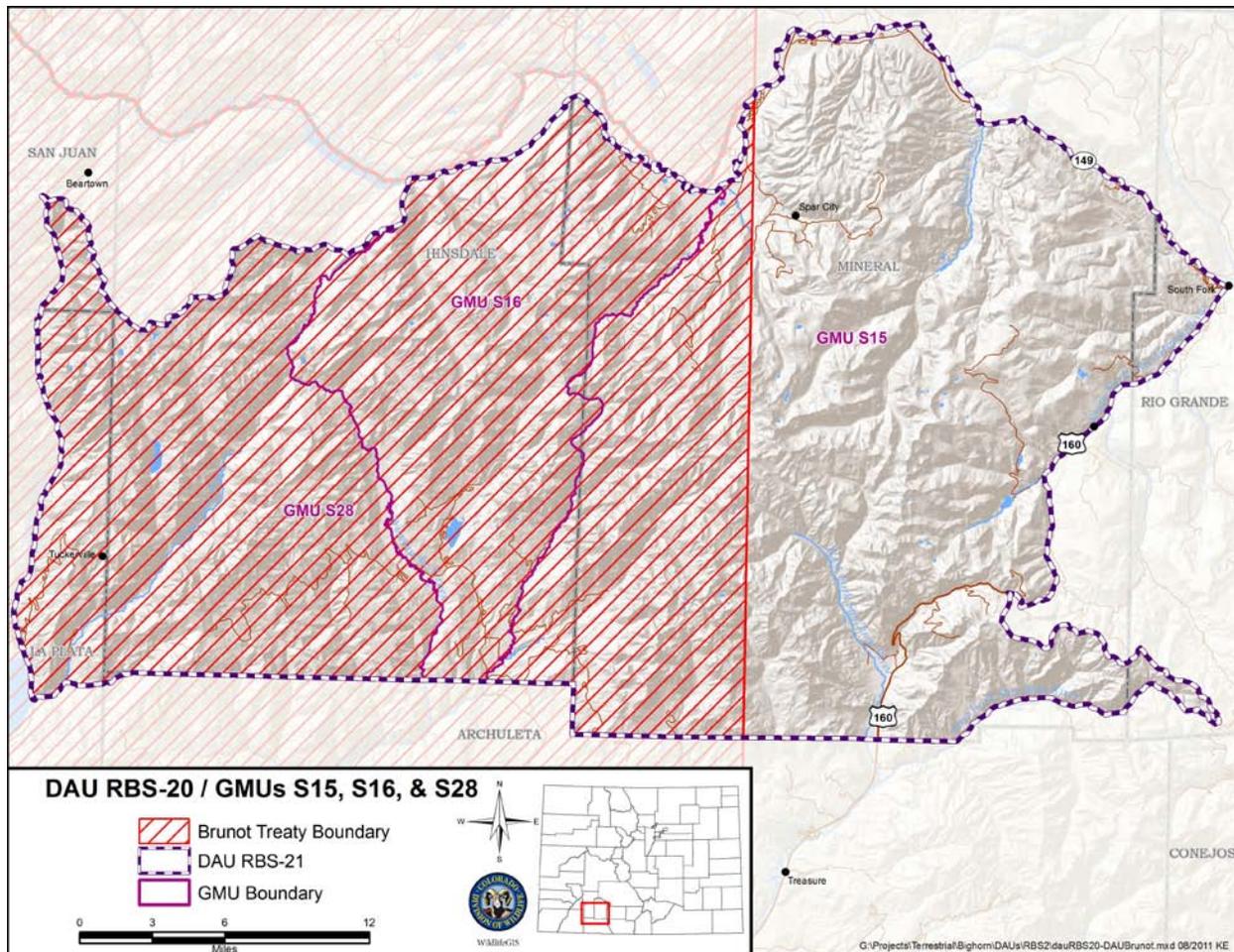


Figure 9. Illustrated area of the Brunot Treaty within RBS-20.

Herd Issues and Strategies

Disease and Parasites

Several diseases can occur in bighorn sheep and occasionally have consequences for population health or management. One of these is mange which at one time was found in Colorado and was detrimental to wild sheep. It has not been seen in wild sheep for several decades which may be accredited to the control of the disease in livestock. Bluetongue virus, epizootic hemorrhagic disease virus, contagious ecthyma, infectious keratoconjunctivitis and paratuberculosis also occasionally occur in bighorn populations. These diseases have not been seen in RBS-20.

Lungworms (*Dictyocaulus* spp) were once thought to be a limiting factor to bighorn populations. In 1953 and 1954 lung tissue was collected and lungworms were found in bighorns in S-15 and S-16. Today's belief is that lungworms are a natural parasite of bighorn sheep and do not appear to compromise the overall health of bighorn sheep at typical levels of infection (George et al. 2009). However other diseases such as *Pasteurella* can be aggravated by lungworms increasing the chance of pneumonia and death.

Pneumonia caused by *Pasteurellaceae* is the most devastating disease impacting bighorn sheep today. It can cause all age die-offs followed by suppressed lamb recruitment. Precautionary measures to prevent the spread of *Pasteurella* include spatial and temporal separation of domestic sheep from bighorn sheep and refraining from translocating bighorns from other areas into the population. Prevention is truly the best measure because there is no known way to purge *Pasteurella* once it becomes established in a bighorn population without depopulating all herd members. Survivors become carriers of the disease and serve as a source of infection for other animals in the same herd or other populations through natural movements or translocations. Thus far, the only indication of disease impact occurred with the transplanted bighorn in S-28 (see previous section on translocations). This type of population loss is typical of that caused by *Pasteurella*. There has not been any other record of bighorns being infected.

Disease testing of bighorn sheep should be done to provide a baseline of the herd's health. This is especially true for S-28 where apparently healthy transplanted bighorn sheep experienced rapid deaths after coming in contact with domestic sheep.

Respiratory Disease Introduced by Domestic Sheep and Goats

Mortality and depressed recruitment resulting from pathogens introduced by domestic livestock are regarded as the primary limiting factor for bighorn sheep in Colorado (George et al. 2009). There is a venue for this to occur in RBS-20 and it is the primary concern for the RBS-20 population. Therefore we are interested in preventing disease outbreaks specifically resulting from interaction with domestic sheep. Research has demonstrated that strains of *Pasteurellaceae* can be transmitted from domestic sheep to bighorn sheep, leading to pneumonia and death (Lawrence et al. 2010) and that in some cases exposure has led to large scale bighorn sheep mortality affecting all age and sex classes, followed by a long period of depressed lamb recruitment (George et al. 2008). The same appears to be true in regards to domestic goats (Rudolph et al 2003). This can be devastating to bighorn populations. Unfortunately it only takes one infected animal, domestic or wild, to introduce the disease into a population where it can spread. The USFS Rocky Mountain Region, BLM Colorado State Office, Colorado Department of Agriculture, Colorado Wool Growers Association, and CPW all agree that "Contact between domestic sheep and bighorn sheep increases the probability of respiratory disease outbreaks in bighorn sheep" (MOU Appendix C). Without having any other preventive measure, the consensus of wildlife managers and land managers is that total spatial and temporal separation of domestic and bighorn sheep is the best management practice to prevent bighorn sheep from acquiring this deadly disease, knowing that not all domestic sheep are infected with disease. This has already been accomplished in a large portion of the DAU.

Historically domestic sheep were commonly grazed and trailed throughout the DAU. Domestic sheep allotments on the USFS lands in the Pagosa Ranger District, which encompasses a significant portion of the DAU, became vacant from domestic sheep grazing as early as 1962 (Table 5). All but two allotments were vacant by 1973 and the last two allotments were last grazed by domestic sheep in 1990 and 1994. During the Pagosa Sheep Grazing Environmental Analysis (USDA Forest Service 2010) the USFS closed several vacant domestic sheep allotments because of the risk to wild sheep if these vacant allotments were stocked. This has effectively removed the risk involving domestic sheep and goat grazing in RBS-20 on the Pagosa Ranger District which encompasses a significant portion of RBS-20.

Allotment	Last Year Stocked	Average Stocking During Last 5 Years Stocked	Season of Use
Beaver-Rainbow	1967	1200	No data available
Deadman Turkey	1994	975	7-11 to 9-15
First Fork	1971	550	7-11 to 9-15
Hossick Canyon/ Middle Fork	1990	975	7-8 to 9-18
Peak	1967	960	7-11 to 9-15
Red Mountain	1971	815	7-11 to 9-15
Saddle Mountain	1972	960	7-11 to 9-15
Sheep Mountain	No data available	No data available	No data available
Treasure	1971	950	7-11 to 9-15
Weminuche Sheep	1962	900	7-1 to 9-15

Table 5: Historic Livestock Grazing Management in the Pagosa Sheep Grazing Analysis Area (USDA Forest Service 2010)

The USFS Columbine Ranger District, which overlays with the western portion of the DAU, contains several domestic sheep allotments that are currently vacant. These include the Falls Creek, Johnson Creek, Leviathan, Rock Creek, Cave Basin, and Flint Creek allotments. Five of the six allotments have not been grazed by domestic sheep since 1974. The Cave Basin Allotment was last grazed by domestic sheep in 1988 (USDA Forest Service 2009); the same year of the only transplant of bighorn sheep in the DAU which occurred on private land in close proximity to the allotment (see previous section *Herd Management – Translocations*). These allotments and/or the associated stock driveways are within or in close proximity to occupied bighorn sheep habitat in S-28 (Figure 10). Similarly is the Pine River Allotment which is vacant but was last grazed in 1980. Active use of this allotment would put domestic sheep in close proximity to bighorn sheep in S-16 and S-28 (USDA Forest Service 2009a). The demand to graze these allotments has been low due to the remoteness and the necessity to trail livestock over long distances. Domestic sheep grazing in any of these allotments would create a high potential for interaction between domestic and bighorn sheep. The USFS has recognized the risk of contact between domestic and wild sheep and recommend that these allotments not be considered for restocking with domestic sheep (USDA Forest Service 2009b).

On the east side of the Continental Divide domestic sheep are still grazed on the Rio Grande National Forest, through the Divide Ranger District, in the Fisher-Ivy/Goose allotment. This is within the northern portion of S-15 and overlaps an area where bighorn sheep are found on South River Peak (Figure 10). Potential of disease transmission, specifically *Pasteurella*, from domestic sheep to wild sheep remain extremely high and is a serious risk to the RBS-20 population.

To minimize potential for disease introductions in any location where overlap of domestic sheep and wild sheep occur or where potential for contact exists, CPW advocates following the Western Association of Fish and Wildlife Agencies *Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat* guidelines (WAFWA, 2007). This document provides management recommendations to state wildlife management agencies, land management agencies, conservation organizations, domestic sheep and goat permittees and management on

private lands taking into consideration the perpetuation of livestock grazing and the safeguarding of bighorn sheep.

There is also a memorandum of understanding between the Rocky Mountain Region of the USFS, the USDI Bureau of Land Management Colorado State Office, Colorado Department of Agriculture, Colorado Woolgrowers Association, and the Colorado Division of Wildlife concerning the management of domestic sheep and bighorn sheep (Appendix C). This MOU provides guidance for reducing the contact between domestic and bighorn sheep in order to minimize potential interspecies disease transmission and to ensure healthy bighorn sheep populations while sustaining an economically viable domestic sheep industry. The guidance within the MOU will be used in any management decision under this plan concerning the relation between bighorn and domestic sheep as long as the MOU is valid (expires March, 2014).

Individual or small groups of rams have a tendency to roam into different areas where bighorn sheep may not normally be found. The distances traveled can be large and the amount of time they use these areas is variable. These rams may also contact several different sub-herds of bighorn sheep as they move about. Wandering rams create the biggest uncertainty in regards to bighorn moving into an area occupied by domestic sheep and the greatest risk for bighorn sheep spreading disease into different groups of bighorns. CPW is using GPS collars to learn more about these movements in other areas of Colorado. Currently they appear random and unpredictable. The best management alternative is to follow WAFWA guidelines and the management of domestic sheep and bighorn sheep MOU. These documents outline that in the event that an individual bighorn sheep comes in contact with domestic sheep, despite if the domestic sheep appear healthy or not, the bighorn should be immediately destroyed by wildlife managers and prior to it coming in contact with any other bighorn sheep. Livestock producers and their herders are encouraged to report to USFS or CPW personnel any bighorn that come in contact with domestic sheep immediately so that CPW personnel can promptly address the situation.

The USFS has adaptive management guidelines within Environmental Analysis (EA) documents for active domestic sheep allotments. These management guidelines provide direction to the USFS for instances when bighorn areas of use may extend into an active allotment.

Specific management goals and strategies in the Colorado Bighorn Sheep Management plan (George et al 2009) are applicable to RBS-20 and include:

Management Goal: *Prevent introductions of infectious or parasitic diseases from domestic livestock that could adversely impact bighorn population performance and viability.*

Strategy: *Conduct research and surveillance to identify key pathogens of domestic sheep and other livestock species that can be managed to prevent epidemics.*

Strategy: *Develop, evaluate, and use appropriate tools, management practices, and policies (e.g. species and herd segregation, education, vaccines, therapeutics, habitat management, harvest and dispersal) to prevent pathogen introductions and/or protect bighorn populations from select pathogens that may be introduced via interactions with domestic ruminants.*

Furthermore in RBS-20 additional management actions would include:

- Work with the USFS and livestock permittee to create effective separation between domestic and bighorn sheep in the South River Peak/Goose Lake area of S-15,
- Identify along with USFS the level of risk of domestic and bighorn sheep interactions in the vacant and active domestic sheep allotments found within and adjacent to S-28 and encourage the level of response necessary to create or maintain effective separation,
- Support USFS management practices that create effective spatial and/or temporal separation of bighorn and domestic sheep and adaptive management practices that accomplish effective separation if bighorn sheep begin to occupy areas in or near active domestic sheep allotment,
- Discourage individual bighorn sheep from becoming established in active domestic sheep allotments through harvest, non-lethal harassment, or other means. Distribution of subherds of bighorn sheep will not be controlled in this manner,
- Refrain from transplanting bighorn sheep into or adjacent to any active domestic sheep allotment when it is reasonable to believe that bighorn would use the habitat within the allotment,
- Continue to use and support valid management practices outlined in the agency and wool growers MOU (Appendix C) and the WAFWA guidelines,
- Develop open communication between CPW, USFS, and wool growers by local personnel meeting annually, or as needed, to discuss plans, concerns and/or issues in RMBS-20,
- Encourage agency personnel, livestock producers and their herders, recreationalists and others to report bighorn sheep sightings, especially those outside of known areas of occurrence,
- Use the most up-to-date valid science to manage bighorn and domestic sheep interactions, and
- CPW personnel will be available to respond to reports of bighorn sheep that come in contact with domestic sheep and will encourage wool growers and their herders to report such incidences.

Communication and cooperative effort between wildlife managers, land management agencies, and livestock producers is necessary to successfully address the concern of contact between domestic sheep and wild sheep and minimize the risk of a large scale die-off due to *Pasteurella*.

Population Inventory and Modeling

Reliable data on bighorn sheep herd composition, recruitment and population numbers are needed to develop and evaluate population management goals and objectives and to make informed management decisions. Estimates of these population parameters should be based on rigorously collected data with known levels of precision whenever possible. It is recognized that this information is expensive and time consuming to collect due to bighorn sheep occupying remote, rugged areas with limited human access.

The Colorado Bighorn Sheep Management Plan (George et al 2009) cites a management goal of regularly surveying DAU populations at a minimum of every two years by either helicopter or by coordinated ground surveys to obtain herd composition, minimum population numbers, status of

individual herds, and population trends. Primary (Tier 1) populations such as RBS-20 should be surveyed or modeled annually. The surveys should occur in December to monitor recruitment rates which requires the use of a helicopter to get to occupied habitat. Focus in this population would be on surveys because of the lack of adequate data to produce a population model.

The Colorado Bighorn Sheep Management Plan (George et al 2009) also recommends a population estimate using mark-resight or other rigorous method should be done every 10-15 years. The commitment to obtain this information in RBS-20 is enormous because of the isolated and harsh country in which the bighorn are found. A mark-resight population estimate of the DAU done correctly would require the total commitment of several individuals making it a very costly undertaking when resources are already fully utilized and inadequate for such intensive work.

Besides herd composition and population data, inventory of this population is essential for other reasons. These include:

- Monitoring winter densities within existing herds so that maximum densities are not reached,
- Locate and document areas that bighorn are pioneering into, or where bighorn have not been previously documented,
- Identify bighorn near active domestic sheep allotments so that appropriate management actions provided in the previous section can be used to maintain separation between domestic and bighorn sheep,
- Locate mountain goats within the DAU (mountain goat and bighorn interactions and management guidelines are discussed in detail in a subsequent section),
- Determine the cause of decreased numbers of bighorn in historic areas of use in S-28 (see *Post Hunt Population Size and Performance*),
- Identify and remove any bighorn sheep that appear sick, and
- Identify lambing areas and other critical use areas.

Radio collars including Global Positioning System (GPS) collars would be useful to meet some of these requirements and would help in identifying individual's habits and movements. It is also important that aerial and/or ground surveys are done throughout the year.

Recreational Impacts

Hikers, horseback riders and other outdoor recreationalists can be found throughout the DAU creating overlap between bighorn sheep range and recreational areas. There are instances when human activity is somewhat predictable that bighorn sheep become habituated to it. Inversely, bighorn sheep may change their behavior and areas of use to avoid human activity which may have a population effect (Keller 2007). Additionally recreational activities could increase stress levels in individual bighorn sheep making them more vulnerable to disease infection, especially during winter months.

Winter is a period when bighorns are already stressed due to the limited amount of resources and are congregated in restricted areas. Backcountry skiing and snowboarding are becoming a more popular form of recreation. This includes everything from cross-country skiing to heli-skiing. Some of the terrain sought by these enthusiasts overlaps with that of wintering bighorn sheep.

Because of the vulnerability of bighorn sheep at this time additional human disturbance to bighorn sheep should be avoided.

Pack goats used by recreationalist also often go unnoticed. Domestic goats can transmit disease such as *Pasteurella* (as discussed previously in regards to domestic livestock), contagious ecthyma and infectious keratoconjunctivitis (*Mycoplasma conjunctivae*). Keratoconjunctivitis and contagious ecthyma infected a population of bighorn sheep in the Silver Bell Mountains in Arizona. The disease source was seemingly from domestic goats. The result of the disease on the bighorn population was a 23% abrupt decline. Half of the diseased animals that were marked died with predation being the proximate cause in 50% and starvation as secondary in 33% of the cases (Jansen et al 2007). Pack goats are occasionally used within RBS-20, but the San Juan National Forest does not have record on the extent of use. Avoiding contact between domestic goats and bighorn is necessary to prevent the possibility of disease transmission to wild sheep that could have population level impacts. A temporary area closure to domestic goat use on National Forest Service lands within the Shoshone National Forest was issued to “protect the health and viability of bighorn sheep, a Region 2 sensitive species, on their core habitat...” on November 14, 2011.

CPW will work closely with the USFS and other interested parties in the development of travel management, recreational, and other plans to ensure adequate human access is maintained while providing for secure undisturbed areas for all wildlife and resource protection. This may include prohibiting domestic dogs and pack goats on some trails in occupied bighorn sheep habitat (George et al 2009). It is also important for CPW to identify and document any conflicts that may already be occurring between bighorn and recreationists in RBS-20.

Habitat Issues

Noxious weed invasion is an issue that impacts numerous species of wildlife. When introduced intentionally or unintentionally non-native plant species out-compete native species replacing them on the landscape. Many invasive species provide little or no forage for wild and domestic animals. Once established the weeds are nearly impossible to eradicate, taking intensive amount of resources to do so. The best way to combat this is through prevention which can be done through education of agency personal, contractors, permittees, and the general public as well as monitoring for the appearance of these weeds on the landscape. If noxious weeds are found steps need to be taken to eradicate them before they spread. The USFS has already began identifying noxious weeds and exterminating them along the Pine River Trail in S-28 and S-16. CPW will report noxious weeds found on the forest and collaborate with the USFS, industries, and non-governmental organizations to identify opportunities and fund weed eradication as a part of protecting bighorn sheep habitat.

Spruce beetle (*Dendroctonus rufipennis*) is becoming more prevalent in the DAU, coming in from the northeast. It is currently abundant in S-15 and S-16 and only starting to be found in the northeast corner of S-28. Large stands of Englemann spruce are dying because of beetle infestation causing the overstory to open up. The resulting spruce die-offs are expected to increase forbs and grasses. This will have a direct positive impact on bighorn sheep providing a higher quality and more quantity of forage. Also, visual barriers caused by stands of living conifers will be reduced favoring bighorn sheep detection and avoidance of predators. Another

outcome might be the creation of connective corridors between groups of bighorn increasing pioneering and interaction between bighorn herds. At later stages when snags begin to rot and blow over, movement through these areas could become difficult and discourage bighorn use. Natural fires that occur in infected areas are probably the best source for removing dead trees and should be left to burn in bighorn sheep habitat. This will increase the amount of bighorn sheep habitat and will provide a higher quality habitat than areas with dead trees. CPW will work with the USFS to identify these areas and encourage the use of fire.

Bighorn/Mountain Goat Interactions

Mountain goats (*Oreamnos americanus*) were first introduced into Colorado in 1947. Subsequent translocations occurred in several areas around the state for the next 20 years. Mountain goats provide unique wildlife viewing and hunting opportunities. Populations are performing extremely well and often pioneer new areas. Many of Colorado's herds are so productive that harvest management is an important aspect of mountain goat population management to prevent impacts to alpine ecosystems and native bighorn sheep. As a result herd management has been aimed at preventing goat populations from increasing.

Bighorn sheep and mountain goat habitats often overlap which can lead to competition for resources. There is also the possibility of mountain goats carrying and spreading disease which could be detrimental to bighorn sheep. The closest mountain goat population to RBS-20 is located in unit G5 (the Needles Herd) located within 10 air miles from Emerald Lake and the closest bighorn herd. Expansion of the mountain goats so far has been more northern which does not overlap any area within RBS-20. Even so in 2010 a mountain goat was harvested east of Vallecito Creek in RBS-20. Current management plans for the mountain goats is to prevent population growth by using hunter harvest. Monitoring of the mountain goat population will be required and any mountain goats entering into the RBS-20 boundary and in the vicinity of bighorn sheep should be removed to circumvent any potential competition or disease transmission. To prevent species range expansion, Wildlife Commission Regulation #230 allows the director of CPW to issue special licenses to hunters so that they can harvest mountain goats found outside of a mountain goat unit.

Although overlap of mountain goats with RBS-20 bighorns is minimal, continued monitoring and removal of mountain goats within the DAU is needed by CPW. Also mountain goat expansion will be prevented through management of the G-5 herd as outlined in the Colorado Bighorn Sheep Management Plan (George et al 2009).

Predation

Predators of adult bighorn sheep in Colorado include mountain lions, coyotes, black bears, and domestic dogs. Additional predators of lambs include bobcats, golden eagles, and red foxes. Although predation removes individuals from the population it is usually considered much less of a limiting factor for bighorn sheep populations than disease and habitat (George et al 2009). Predators might be suppressing some groups of bighorn within the herd but there is little evidence that it is limiting the overall population. There is the possibility that mountain lions are impacting the bighorn herd that winters along the Los Pinos River in S-28. CPW will continue monitoring bighorn sheep in the area to assess if predation is limiting bighorn numbers. CPW will develop, evaluate, and use appropriate tools management practices, and policies where cost

effective and practical to temporarily or focally control predators in cases where bighorn herds or populations are threatened with extirpation because of excessive predation.

Snowslides

Bighorn sheep succumbing to snowslides was first recorded in 1911 (Cary). In the summer it is still not uncommon to find remains of several sheep where an avalanche occurred. It is important to recognize that individuals or small groups are occasionally removed by this natural event. The impact to the overall population is minimal.

Public Involvement

A copy of the draft DAU plan was posted on the Colorado Division of Wildlife website on September 9, 2011 through October 9, 2011 for public review. A link to an on-line survey (created using Survey Monkey) was provided with the plan as a means for individuals to provide comments. A press release was made at the same time informing the public of the plan and encouraging them to review it and participate in the survey. Additionally post cards with the same message were mailed to individuals who had hunted in one of the three GMUs within the past three years and to everyone who applied for a bighorn license in the three GMUs in 2011. Finally a written letter was sent to board of county commissioners for each county within the DAU area, the Rio Grande Forest Supervisor, the San Juan Forest Supervisor, the Colorado Wool Growers Association, the Colorado Outfitters Association, The Southern Ute Indian Tribe, and the Rocky Mountain Bighorn Society. The letters directed the involved entities to the plan's web address and requested that they provide written comments about the plan by November 1, 2011.

There were 44 individuals who responded to the survey via internet and two people who completed and returned hard copies. 95% (41 individuals) responded that bighorn sheep were very important to them and that bighorn sheep were in Colorado in the future. The other responses felt that the same issues were somewhat important. In regards to the following alternatives, there was more support for an expected increase in population of bighorn sheep (expected population alternative 2) than alternative 1 of an expected stable population with 57% and 38% support respectively. 69% of respondents supported maintaining the current hunting opportunity which corresponds to alternative 2 for success rates and alternative 2 for the average age of rams harvested. There were a significant number of written comments from survey participants in regard to the management of bighorn sheep in Colorado and CPW's big game policies. The survey and survey results are on file at the CPW Customer Service Center in Durango and are available on request.

Rocky Mountain Bighorn Society (RMBS) and Colorado Wool Growers Association (CWGA) were the only two special interest groups that provided written comments. Both of these letters are on file and available on request. RMBS supported the management decision to allow the population to grow to higher densities (Expected Population Performance alternative 2) and to provide a high quality hunt (Ram Hunting age of harvested rams and hunter success rates alternatives 2). RMBS also stated that CPW staff provides timely and accurate information to the USFS about bighorn sheep herd growth and expansion to reduce future conflicts and disease transmission to bighorn sheep. Furthermore according to RMBS it was "important that CPW

continues to work with the USFS to eliminate existing risks such as the active Fisher/Ivy/Goose domestic sheep allotment in S15.”

The CWGA were concerned about any bighorn sheep expansion negatively impacting domestic sheep grazing on public lands and were opposed to any bighorn sheep herd expansion. The organization also emphasized the importance of the 2009 MOU (Appendix C) and the hard work in creating it. Lastly pertaining to the RBS-20 plan, CWGA was “disturbed” by the recommendation that bighorn sheep receive special consideration during land use planning.

Valued comments were also received through letters from the Rio Grande National Forest, San Juan National Forest, La Plata County, Hinsdale County, and Southern Ute Indian Tribe. Comments from the Rio Grande National Forest and the San Juan National Forest were more editorial in nature and not on management direction. One common theme between the remaining agencies’ comments was the concern of interaction between domestic sheep and bighorn and the need to be proactive while respecting the needs of all parties involved. As outlined in the plan, this will require a collaborative effort with CPW, USFS, and local livestock producers. There was also encouragement for better inventory of the population and areas of use so that more informed decisions could be made. These letters are presented in Appendix D.

The DAU plan was posted on the Division of Wildlife’s website for public review a second time beginning December 19, 2011 and ending January 21, 2012. All agencies and organizations that provided initial comment were notified via e-mail of the opportunity to view and comment on the revised draft. Four written responses were received which included The Rio Grande National Forest, RMBS, and Hinsdale County. These comments were similar to comments provided by the same entities from the first posting. The fourth comment was an e-mail received from an individual expressing concern over the transmission of disease between domestic and wild sheep under range conditions. The e-mail also reiterated the importance of the MOU attached in appendix C. Copies of these comments are available upon request.

Comments that were received through the survey and from letters were extremely valuable and many of them were incorporated into the DAU plan as appropriate. These also represent the diverse interest in bighorn sheep. To be successful in bighorn management involvement and communication of all interested parties will be imperative.

Management Alternatives and Preferred Objectives

Expected Population Performance

Numerical population based objectives are difficult to identify and manage towards for RBS-20 because of the limited amount of quality data available to produce a population estimate. Population estimates can vary greatly based on flight conditions and the number of bighorn sheep detected on a single flight and herds are not flown annually. The Weminuche Bighorn Herd cannot be managed to the same level of precision as other ungulate herds with a decade or more of quality data without considerable more investment in inventory. Therefore, we are recommending alternative population performance metrics that complement existing resources; such as winter density on core winter range, age of harvested rams, and hunter success rates. Additionally, we are presenting what the population is expected to do under different

management scenarios. This is an expected population response and reported population estimate rather than a population objective that is managed for. Even though bighorn sheep are poor colonizers of new habitats, some range expansion can be expected as a result of population growth.

2010 population estimate - 460

2010 Population winter range density – 2.2 bighorn/km²

ALTERNATIVES

- 1) **Maintain the current population and distribution of bighorn sheep across the DAU.** This will be monitored by periodic estimates of density, calculated by dividing the annual population estimate by the current mapped extent of winter range. The current density is estimated to be 2.2 bighorns/km² (460 bighorn/210 km² mapped winter range). A winter density of 1.9-3.3 bighorns/km² which is well within the limits of the Ram Mountain minimum densities would produce a population of 400-700. There would not be any change to wildlife viewing or ram hunting opportunities. Ewe harvest would be used to the extent necessary to maintain these lower densities. There is still potential for domestic and wild sheep interaction as indicated earlier.

- 2) **Allow the population to increase concurrent with an increasing distribution and utilization of winter range across the DAU.** As noted previously, mapped winter range exceeds the current occupied winter distribution. The population would be allowed to increase, but the density would not be allowed to exceed 4.4 bighorns/km² (a midrange comparison of observed densities on Ram Mountain, Alberta). This would produce an expected maximum population of 920 bighorn sheep. Population estimates are currently produced annually, but in the case of this DAU are limited to personnel observations. Winter range occupancy is mapped at least every 4 years. Density estimates are derived by population estimate/occupied winter range. An increase in population size would increase wildlife viewing and ram hunting opportunities. There is a potential for increased conflict with other uses on the national forest. The increase, if any, would be expected to be minimal because of the remoteness of the area and the minimal amount of active domestic sheep allotments in the DAU. Ideal growth would be around and between existing herds of bighorn. Bighorn expansion would be discouraged into active domestic sheep allotments in order to promote spatial separation between domestic sheep and bighorn sheep. This would be done through focused hunter harvest and other harassment techniques.

Ram Hunting

Hunter harvest success rates are recorded annually and can be used as a measurement of hunting quality. Maintaining a high hunter success rate objective, which usually equates to a higher quality hunt, will be at the cost of placing higher restrictions on the number of licenses. A lower success rate objective will allow more licenses to become available at the cost of the quality of the hunt as well as the potential to successfully harvest a mature ram. Flexibility needs to be available in years when success rates fall below the minimum number so that the cause for this

occurrence can be evaluated. For example a hunter may not fill a tag because of illness or other commitments which prevent them from hunting, the hunter was unwilling to put the required effort into hunting, or the hunter had opportunities to harvest a ram but passed them up while looking for a larger animal. Only when hunters put a good faith effort into hunting and are unsuccessful should success rates be considered. Because the total number of hunters is so limited, these factors are often known by local wildlife managers.

3yr Average Success Rate 83%

ALTERNATIVES

- 1) 50% to 70% three year average success rate
This success rate is the lowest alternative but remains above the statewide objective of 45%.
- 2) 70% -90% three year average success rate
This alternative would allow current management to continue with some flexibility.

The average age of rams harvested is another measurement of hunting quality. The average age of rams harvested in the DAU is 8.3 years old. Adopting a high average age of harvested objective will decrease opportunity and increase quality of the hunt. A lower objective will allow more hunting opportunity with a decrease in the quality of the hunt.

3yr Average Age of Rams Harvested 8.3 years

ALTERNATIVES

- 1) 5 to 7.5 years three year average age of rams harvested
This objective would allow a higher level of harvest at the cost of a lower quality hunt in terms of hunter densities and size of rams.
- 2) 7.5 to 9.5 years three year average age of rams harvested
Current management could continue under this scenario allowing for a high quality hunt with minimum hunters in the field and mature rams available.

New Objectives

After reviewing all comments that were received regarding the DAU plan and meeting with local wildlife managers, the final approval was made by the Colorado Parks and Wildlife Commission, April 2012.

Expected Population

Allow the population to increase concurrent with an increasing distribution and utilization of winter range across the DAU

Ram Hunting – Success Rates

70% -90% three year average success rate

Ram Hunting - Rams Harvested

7.5 to 9.5 years three year average

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Appendix A: Pre and Postseason survey data for RBS-20, 1961-2000.

UNIT	DATE	Females		Lambs	Males		Total Sheep		lmb:100 ewes	survey method	count type	
		Yrl	Adlt		Yrl	Adlt	Unk	Clsfd				
S15	1961		4			8	58	70		U		
	1/15/1968	0	25	13	3	6	0	47	52.0	H	post	
	2/12/1969	0	18	10	3	6	0	37	55.6	H	post	
	Apr-70	0	9	2	1	2	0	14	22.2	H?	post	
	9/15/1970	0	22	8	0	0	0	30	36.4	H	pre	
	3/1/1971	0	15	9	0	9	0	33	60.0	H	post	
	3/15/1972	0	14	7	0	0	0	21	50.0	H	post	
	9/29/1973	0	6	0	0	9	0	9	0.0	H	pre	
	3/1/1975	0	4	0	0	6	0	10	0.0	H	post	
	8/12/1976	0	3	0	0	0	0	3	0.0	H	pre	
	8/10/1977	0	0	0	0	0	0	0		H	pre	
	4/9/1981	0	6	3	1	0	0	10	50.0	H	pre	
	8/19/1986	0	11	4	1	1	0	16	36.4	H	pre	
	1991		81	48	3	15	52	199**	59.3	G	pre	
	8/11/1992	0	0	0	0	0	0	0		H	pre	
	8/11/1994	0	31	23	1	12	0	67	74.0	H	pre	
	1995	1	3	0	0	3	0	7	33.3	G	pre	
	8/24/1995	0	37	12	2	8	0	59	32.4	H	pre	
	Ave Pre	0.1	22.2	10.9	0.9	5.3	5.8	25	35.7			
	Ave Post	0.0	14.2	6.8	1.2	4.8	0.0	27	40.0			
S16	Jan-68	0	26	11	0	5	0	42	42.3	H	post	
	Jan-69	0	21	8	0	5	0	34	38.1	H	post	
	Aug-69	0	17	7	0	1	3	28	41.2	G	pre	
	Apr-70	0	8	1	2	0	0	11	12.5	U	post	
	9/16/1970	0	14	8	0	3	0	25	57.1	H	pre	
	3/1/1971	0	24		0	4	0	28		H	post	
	1972							23		H	Unk	
	1973							14		H	Unk	
	1975							6		H	Unk	
	1976							27		H	Unk	
	1981	0	18	8	1	0	0	27	44.4	H	Unk	
	12/15/1985	0	28	13	2	10	0	53	46.4	H	post	
	8/18/1986	0	24	15	4	1	0	44	62.5	H	pre	
	1/9/1988	0	12	5	1	2	0	20	41.6	H	post	
	8/4/1988	0	13	4	1	3	0	21	30.8	U	pre	
	1/23/1989	0	14	3	2	3	0	22	21.4	U	post	

	6/22/1989	1	0	0	0	0	0	0	0.0	H	pre
	8/12/1992	0	34	17	6	18	12	87	50.0	H	pre
	8/10/1994	0	48	20	0	7	0	75	42.0	H	pre
	8/23/1995	0	36	4	5	8	0	53	11.1	H	pre
	1/31/1997	0	15	10	0	3	0	28	66.7	H	post
	Ave Pre	0.1	23.3	9.4	2.0	5.1	1.9	42	36.8		
	Ave Post	0.0	17.7	7.3	1.0	4.0	0.0	30	38.4		
S28	1/12/1968	0	7	3	3	3	0	16	42.9	H	post
	Nov-69	0	5	0	0	3	0	8		FW	post
	2/12/1969	0	5	1	1	4	0	11	20.0	H	post
	Apr-70	0	3	2	1	2	0	8	66.7	H	post
	9/17/1970	0	3	2	0	1	0	6	66.7	H	pre
	3/1/1971	0	4	2	0	3	0	9	50.0	H	post
	8/18/1971	0	4	1	0	3	0	8	25.0	H	pre
	3/15/1972	0	0	0	0	2	0	2		H	post
	2/27/1975	0	5	3	1	3	0	12	60.0	H	post
	8/11/1976	0	0	0	0	0	0	0		H	pre
	8/9/1977	0	0	0	0	0	0	0		H	pre
	4/7/1981	0	12	5	0	2	0	19	41.7	H	pre
	1/29/1983	0	22	9	0	8	0	39	40.9	H	post
	12/15/1985	0	12	3	3	3	0	21	25.0	H	post
	8/19/1986	0	2	1	0	0	0	3	50.0	H	pre
	8/4/1988	0	10	5	0	7	0	21	50.0	U	pre
	1/26/1989	0	14	8	2	0	0	24	57.1	U	post
	6/22/1989	0	0	0	0	2	0	2		H	pre
	8/11/1992	0	7	2	1	5	0	15	28.6	H	pre
	12/10/1992	0	17	10	2	11	0	40	58.8	H	post
	12/15/1994	0	25	16	3	8	0	52	64.0	H	post
12/19/1995	0	45	3	0	13	0	61	6.7	H	post	
1/29/1997	0	28	13	4	9	0	54	46.4	H	post	
2/23/2000	0	38	12	2	0	0	52	31.6	G	post	
Ave Pre	0.0	6.3	2.7	0.2	3.0	0.0	12	43.7			
Ave Post	0.0	16.1	6.1	1.6	4.9	0.0	29	43.8			
DAU	Ave Pre	0	18	8	1	5	3	28	38.2		
	Ave Post	0	17	7	1	5	0	30	41.5		

Survey Method: FW-fixed wing aircraft, G-ground, H-helicopter, and U-unknown

Count Type: pre-preseason, post-postseason

** possible duplication of bighorn groups

Appendix B: Pre and Postseason survey data for RBS-20, 2001-2011.

UNIT	DATE	Females		Lambs	Males		Total Sheep		Lmb:100 ewes	survey method	count type
		Yrl	Adlt		Yrl	Adlt	Unk	Clsfd			
S15	1/2/2007	0	32	21	0	9	1	63	65.6	H	post
	7/30/2008	0	73	39	0	32	7	151	53.4	H	pre
	8/15/2008	10	39	14	1	39	4	107	28.6	G	pre
	12/31/2008	0	37	9	2	6	0	54	24.3	H	post
	12/21/2009	0	40	20	1	11	0	72	50.0	H	post
	1/3/2011	0	36	19	1	9	0	65	52.8	H	post
	<i>ave pre</i>	5	56	26.5	0.5	36	5.5	129	41.0		
	<i>ave post</i>	0	36.3	17.3	1.0	8.8	0.3	63.5	48.2		
S16	12/9/2001	0	23	14	2	15	0	54	60.9	H	post
	1/21/2005	0	19	13	0	6	0	38	68.4	H	post
	12/27/2005	0	17	7	0	4	0	28	41.2	H	post
	12/21/2006	0	11	8	1	8	1	29	72.7	H	post
	1/3/2008	0	22	10	2	3	0	37	45.5	H	post
	7/31/2008	0	54	24	1	22	2	103	44.4	H	pre
	12/30/2008	0	31	12	2	2	0	47	38.7	H	post
	8/6/2009	8	48	21	2	11	7	97	37.5	G	pre
	12/18/2009	1	49	16	2	16	0	84	32.0	H	post
	1/4/2011	0	31	13	2	3	0	49	41.9	H	post
	<i>ave pre</i>	4.0	51.0	22.5	1.5	16.5	4.5	100.0	41.0		
	<i>ave post</i>	0.1	25.4	11.6	1.4	7.1	0.1	45.8	50.2		
S28	2/15/2001	0	21	12	0	2	6	41	57.1	G	post
	12/5/2001	0	47	19	3	20	0	89	40.4	H	post
	1/5/2003	0	51	31	3	13	0	98	60.8	H	post
	1/21/2005	0	18	8	4	7	0	37	44.4	H	post
	12/21/2006	0	15	3	0	8	0	26	20.0	H	post
	8/4/2008	0	38	15	0	15	1	69	39.5	H	pre
	12/30/2008	0	19	6	3	6	0	34	31.6	H	post
	12/17/2009	2	18	13	0	9	0	42	65.0	H	post
	1/2/2011	0	20	8	3	10	0	41	40.0	H	post
	<i>ave pre</i>	0.0	38.0	15.0	0.0	15.0	1.0	69.0	39.5		
<i>ave post</i>	0.3	26.1	12.5	2.0	9.4	0.8	51.0	44.9			
DAU	<i>ave pre</i>	3.6	50.4	22.6	0.8	23.8	4.2	105.4	40.7		
	<i>ave post</i>	0.2	27.9	13.1	1.6	8.4	0.4	51.4	47.7		

Survey Method: FW–fixed wing aircraft, G–ground, H–helicopter, and U–unknown
 Count Type: pre–preseason, post–postseason

Appendix C: Memorandum of Understanding for Management of Domestic Sheep and Bighorn Sheep

Forest Service Agreement No. 09-MU-11020000-006
Bureau of Land Management BLM-MOU-CO-482
Agreement No. _____

MEMORANDUM OF UNDERSTANDING FOR MANAGEMENT OF DOMESTIC SHEEP AND BIGHORN SHEEP

I. *TO MINIMIZE POTENTIAL INTERSPECIES DISEASE TRANSMISSION*

The purpose of this Memorandum of Understanding (MOU) is to provide general guidance for cooperation in reducing contact between domestic and bighorn sheep in order to minimize potential interspecies disease transmission and to ensure healthy bighorn sheep populations while sustaining an economically viable domestic sheep industry in Colorado.

II. STATEMENT OF MUTUAL BENEFITS AND INTEREST:

The interested parties of this MOU include the USDA Forest Service (USFS) Rocky Mountain Region, USDI Bureau of Land Management Colorado State Office (BLM), Colorado Department of Agriculture (CDOA), Colorado Woolgrowers Association (CWGA), and the Colorado Division of Wildlife (CDOW). The aforementioned parties have a mutual desire to prevent or minimize to the extent feasible direct contact between domestic sheep and bighorn sheep by developing and implementing mutually agreeable guidelines. By adhering to these guidelines, all parties should mutually benefit by maintaining healthy bighorn sheep populations while maintaining a viable domestic sheep industry as a result of reduced conflicts.

III. AUTHORITY

- a. The Act of October 21, 1976, Public Law 94-579, Federal Land Policy and Management Act (FLPMA); Section 302.

IV. ALL PARTIES AGREE THAT;

- a. Contact between bighorn sheep and domestic sheep sometimes occurs under rangeland conditions.
- b. Contact between domestic sheep and bighorn sheep increases the probability of respiratory disease outbreaks in bighorn sheep.
- c. Not all disease outbreaks and reduced recruitment in bighorn sheep can be attributed to contact with domestic sheep.
- d. Gregarious behavior of bighorn sheep and domestic sheep, as well as dispersal, migratory, and exploratory behaviors of bighorn sheep traveling between populations, increases the potential for contact.
- e. Several species of bacteria in the family *Pasteurellaceae*, other bacteria, virus and other agents can occur in apparently healthy free-ranging bighorn sheep and in apparently healthy domestic sheep.
- f. Bighorn sheep translocated to vacant or occupied bighorn ranges and domestic sheep moved onto grazing allotments should be in apparent good health, and where feasible herd health evaluations should be made for both species prior to release or turn-out to

- help reduce the potential for introducing new pathogens or pathogen strains into established bighorn sheep herds.
- g. All parties will act to familiarize the public with the potential risks regarding disease transmission between bighorn sheep and domestic sheep.
 - h. The goal is to minimize contact by decreasing the opportunities for domestic/bighorn sheep interaction; while still recognizing that some vacant sheep allotments are important to the domestic sheep industry as forage reserves or for other economic or management reasons.

V. CDOW AND CWGA AGREE TO THE FOLLOWING:

- a. CDOW and CWGA agree that closure of active domestic sheep allotments on public lands will not be recommended based solely on the potential for interaction between domestic and bighorn sheep. However, they recognize that the USFS and BLM will continue to follow existing regulation and direction regarding closure or modification of active domestic sheep allotments to resolve documented resource conflicts.
- b. The CDOW and CWGA may jointly or individually recommend vacant domestic sheep allotments for closure, modification, forage reserve status, activation, or management options at any time, including via standard USFS/BLM NEPA processes. The CDOW and CWGA understand that the USFS/BLM will follow current regulation and direction for closure, modification, activation, and management of vacant domestic sheep allotments to include consideration of recommendations from parties to this MOU.
- c. Individual bighorn sheep, or small groups of bighorn sheep (<5) that through dispersal or other movements come in contact with domestic sheep will be promptly removed by the CDOW using means determined appropriate by CDOW. Permittees and herders will be encouraged to operate in a manner that reduces opportunities for contact between bighorn sheep and their flocks and to notify CDOW as soon as possible if bighorn sheep appear with domestic sheep.
- d. Domestic sheep that stray into occupied bighorn sheep habitat or are not gathered and removed as specified by the allotment management plan pose a risk of interaction and will be removed by the owner as soon as possible or as otherwise specified by the land management agency. If stray domestic sheep are not claimed and reasonable attempts to locate their owner fail, then CDOW may seek remedies under existing statutory authority in cases where contact with bighorn sheep may occur.
- e. CDOW will inform land management agencies and domestic sheep industry representatives of proposals for transplants of bighorn sheep and will afford an opportunity for comment on translocation proposals prior to animals being released. Bighorn translocation proposals will include disease transmission risk and habitat evaluations consistent with existing CDOW guidelines and directives. In general, transplants will not occur in proximity (e.g., probable travel distance of dispersing bighorn sheep) to occupied domestic sheep allotments unless physical barriers to movement or other mitigating circumstances exist. Furthermore, CDOW assumes the risk of potential respiratory disease transmission from domestic sheep operations that are within proximity (probable travel distance of dispersing bighorn sheep) of the transplant location.

- f. Domestic sheep, when moved to grazing allotments in areas of potential contact with bighorn sheep, will be in apparent good health as determined by accepted best management practices for range sheep production.
- g. Bighorn sheep, when moved for translocation, will be in apparent good health as determined by accepted best management practices for bighorn sheep management.

VI. IT IS MUTUALLY AGREED AND UNDERSTOOD BY ALL PARTIES:

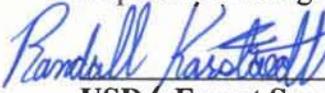
1. FREEDOM OF INFORMATION ACT (FOIA). Any information furnished to the Forest Service and Bureau of Land Management under this instrument is subject to the Freedom of Information Act (5 U.S.C. 552).
2. PARTICIPATION IN SIMILAR ACTIVITIES. This instrument in no way restricts the Forest Service, Bureau of Land Management or the Cooperator(s) from participating in similar activities with other public or private agencies, organizations, and individuals.
3. COMMENCEMENT/EXPIRATION/TERMINATION. This MOU takes effect upon the signature of all parties and shall remain in effect for five years from the date of execution. This MOU may be extended or amended upon written request of any of the parties and the subsequent written concurrence of the other(s). Any party may terminate this MOU with a 60-day written notice to the other(s).
4. RESPONSIBILITIES OF PARTIES. The Forest Service, Bureau of Land Management and all other parties and their respective agencies and office will handle their own activities and utilize their own resources, including the expenditure of their own funds, in pursuing these objectives. Each party will carry out its separate activities in a coordinated and mutually beneficial manner.
5. NON-FUND OBLIGATING DOCUMENT. Nothing in this MOU shall obligate the Forest Service, Bureau of Land Management, Colorado Division of Wildlife, Colorado Department of Agriculture, or Colorado Woolgrowers Association to obligate or transfer any funds. Specific work projects or activities that involve the transfer of funds, services, or property among the various agencies and offices of the Forest Service, Bureau of Land Management, Colorado Division of Wildlife, Colorado Department of Agriculture, and Colorado Woolgrowers Association will require execution of separate agreements and be contingent upon the availability of appropriated funds. Such activities must be independently authorized by appropriate statutory authority. This MOU does not provide such authority. Negotiation, execution, and administration of each such agreement must comply with all applicable statutes and regulations.
6. ESTABLISHMENT OF RESPONSIBILITY. This MOU is not intended to, and does not create, any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity, by a party against the United States, its agencies, its officers, or any person.

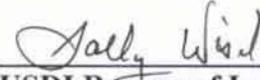
- Conflicts between the participants concerning procedures under this MOU which cannot be resolved at the operational level will be referred to successively higher levels, as necessary, for resolution.
- AUTHORIZED REPRESENTATIVES.** By signature below, the cooperator certifies that the individuals listed in this document as representatives of the cooperator are authorized to act in their respective areas for matters related to this agreement.

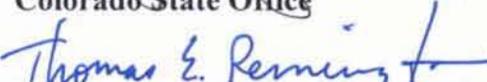
THE PARTIES HERETO have executed this instrument.

APPROVED:

This MOU is between the USDA Forest Service, Rocky Mountain Region, USDI Bureau of Land Management Colorado State Office, Colorado Division of Wildlife (DOW), Colorado Department of Agriculture, and the Colorado Woolgrowers Association.

 (FOR) ANTONIE L. DIXON March 2, 2009
USDA Forest Service (USFS) Date
Rocky Mountain Region

 3/13/09
USDI Bureau of Land Management (BLM) Date
Colorado State Office

 2/11/09
Colorado Division of Wildlife (CDOW) Date

 3-30-09
Colorado Department of Agriculture (CDOA) Date

 3/26/09
Colorado Woolgrowers Association (CWGA) Date

The authority and format of this instrument has been reviewed and approved for signature.

 3/2/09
Monica Cordova DATE
Forest Service G&A Specialist

Appendix D: Agency Comment Letters on RBS-20 Draft

Hinsdale County
311 North Henson Street
P.O. Box 277 • Lake City • CO 81235
Fax: (970) 944-2630
Email: lkvierheller@centurytel.net
www.hinsdalecountycolorado.us



October 26, 2011

Brad Weinmeister
Colorado Parks and Wildlife
151 East 16th St
Durango, CO 81301

Dear Sirs:

Per your request for comments regarding the Draft 2011 Bighorn Sheep Management Plan, Data Analysis Unit RBS-20, Weminuche Herd, Game Management Units S-15, S-16, and S-28 (referred to as "Plan"), the comments representing the Hinsdale County Board of Commissioners follow. While the concerns stated here are far from an exhaustive analysis of this plan, most of the major issues are addressed.

1. Inventory:
According to this Plan, inventory methods vary greatly in reliability. However, the herd is growing (see p-9, Figure 6). Growth would equate to herd health as the lamb:ewe ratios are part of what defines a healthy herd.
2. Science:
On p-14 of the Plan, it states, "Thus far the only known disease impact occurred with the transplanted bighorn is S-28. Although not confirmed, this type of population loss is typical of that caused by *Pasteurella*. There has not been any other record of bighorns being infected or signs of infection of *Pasteurella* within the DAU". Some of the language in the Plan, in fact, in this same paragraph, uses inflammatory language that is not supported by the data. The Plan infers that domestic livestock are a major concern, yet the data does not reflect a problem.

Also on p-14, pathogens from domestic livestock are cited as the limiting factor for bighorn sheep in Colorado. However, on p-3 a loss of bighorn due to avalanche is recorded. What about winter range limitations? Should there be a comparison of die-offs between herds with domestic livestock interactions and those that do not interact with domestic livestock?

There are many places in the Plan that discuss the difficulty in obtaining good data. Perhaps that information should temper the conclusions or be included in the conclusions.

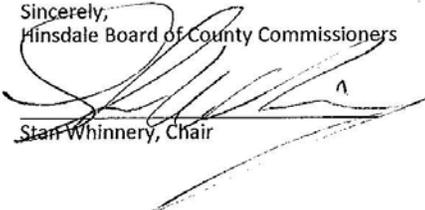
3. Hinsdale County is a Right to Farm and Ranch County, thereby giving preferences to these activities. It would be important that nothing in this Plan conflicts with the County policy.

Conclusion:

This Plan states repeatedly that the herd is increasing and doing well. Even with the difficulty in obtaining data, that seems to be the conclusion. If it is determined that the herd should be increased to its maximum 900, care should be taken to maintain the availability of sheep allotments in this area. It is

recommended that some of the language be reviewed and modified, and that the Plan be made available again for public comment and input.

Sincerely,
Hinsdale Board of County Commissioners

A handwritten signature in black ink, appearing to read "Stan Whinnery", is written over a horizontal line. The signature is fluid and cursive.

Stan Whinnery, Chair

CC: Pat Dorsey
Colorado Parks & Wildlife
151 East 16th Street
Durango CO 81301

Rick Cables, Director
Colorado Parks & Wildlife
6060 Broadway
Denver CO 80216



October 28, 2011

Colorado Parks and Wildlife
Brad Weinmeister
151 East 16th Street
Durango, CO 81301

Dear Mr. Weinmeister,

RE: RBS-20 Bighorn Sheep Draft Management Plan

Thank you for the opportunity to comment on the Draft 2011 RBS-20 Bighorn Sheep Management Plan. La Plata County offers the below comments for your consideration.

1) *Expected Population Alternatives*

County's Comments:

- a) Based on the Ram Mountain studies discussed in the management plan, we feel that the population density should not exceed 6.2 bighorns/km², which is in alignment with the proposed alternatives, since higher densities resulted in a population crash (in the Ram Mountain Studies) likely as the result of lack of adequate quantity and quality habitat components.
- b) Since both alternatives have densities not exceeding 6.2 bighorns/km², we find that both alternatives are acceptable. It appears from the population data in the management plan that the bighorn population in the Data Analysis Unit (DAU) is steadily increasing and that alternative #2 (i.e. the population is allowed to increase to a density of 4.4 bighorns/km²) would be feasible without limiting the number of licenses drawn each year.
- c) The DAU considered within this management plan is more remote compared to the DAU considered in the RBS-21 management plan, and it seems that a lesser amount of non-hunters would use the area to view bighorns (compared to the RBS-21 DAU). If CPW were to limit the population, this could have a negative effect on wildlife viewing of bighorn sheep by non-hunters in this area, because there would be less bighorns in the area to view. However the impact would probably be minimal due to the fact that the area is very remote and there is probably a limited amount of non-hunters that use this area to view bighorns as compared to the RBS-21 DAU.
- d) Winter habitat is considered a limiting factor in bighorn population growth. Therefore, if Alternative #2 is chosen, it may be helpful to begin regular vegetative sampling in occupied winter range areas in order to assess the quality of vegetation and detect any deterioration of winter habitat components. These vegetation samples could be a good

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indicator of the effects of an increased population density and could result in management changes that would avoid large die-off events that are density-dependent related (i.e. exceeding the carrying capacity of available winter habitat).

2) Ram Hunting: Success Rates Alternatives

County's Comments:

- a) It seems that the choice between these alternatives is driven more by hunter preference. Since both alternatives are above the statewide objective, we find that both success rates are acceptable.

3) Ram Hunting: Average Age of Ram Harvested Alternatives

County's Comments:

- a) Since rams have the ability to breed at 2 years of age and both age ranges listed in the *Average Age of Ram Harvest* alternatives (5 to 7.5 years or 7.5 to 9 years) would prevent the removal of individuals from the population before they reach breeding age. It seems that the choice between these alternatives is driven more by hunter preference. We find that both age ranges are acceptable.

4) Vacant Allotments

Management Plan Contents: Page 15 of the management plan references several domestic sheep allotments that are currently vacant within the Columbine District of the San Juan National Forest.

County's Comments:

- a) We would suggest that the Colorado Parks and Wildlife (CPW) and the United States Forest Service (USFS) work collaboratively to determine if these allotments should be closed or remain vacant. It appears that converting the domestic sheep allotments to cattle allotments will not be feasible, since these allotments are higher in elevation and could cause brisket disease (congestive heart failure) in cattle.
- b) We understand that USFS lands are managed for multi-use and that closing grazing allotments may not meet the management objectives of the USFS and, therefore, might not be practical. If these allotments remain in their current vacant status, we suggest CPW and USFS develop Annual Operating Instructions (AOI's) or other grazing management techniques for these allotments. If or when allotments are used, maximum spatial and temporal separation of domestic sheep and bighorn sheep occur to prevent the transmission of epizootic diseases - specifically *Pasteurella/Mannheimia haemolytica* species.
- c) There are several management guidelines outlined in the Western Association of Fish and Wildlife Agencies (WAFWA) Wild Sheep Working Group document that could be used to develop AIO's or grazing management techniques for the vacant allotments.

5) Additional Habitat Inventory

Management Plan Contents: On Page 17 of the plan it is discussed that further identification of critical habitats should be inventoried in order to prevent degradation and loss of these habitats.

County's Comments:

- a) Since the RBS-20 herds seems to be fairly isolated from disease factors (at least at this point in time), the other factor that could lead to substantial die-offs could be exceeding the carrying capacity of limiting habitats (i.e. winter habitats). We agree that it would be beneficial to inventory and evaluate the condition of limiting habitats in order to prevent herds from exceeding the habitat carrying capacity.
- b) Additionally, we feel it may be beneficial to eventually indentify and inventory high quality lambing habitats, since lack of quantity and quality forage during and after winter, and during parturition and lactation could result in extended periods of the ewes being in an energy deficit. These extended periods of energy deficit could lead to reduced body condition and would affect breed back capabilities of ewes.

If you have any questions on the above comments, please feel free to contact me.

Sincerely,



Courtney Krueger
Natural Resource Planner
La Plata County



United States
Department of
Agriculture

Forest
Service

Rio Grande National Forest

1803 West Highway 160
Monte Vista, CO 81144
(719) 852-5941
(719) 852-6271 TTY
<http://www.fs.fed.us/r2/riogrande>

File Code: 2610

Date: November 3, 2011

Scott Wait
Senior Terrestrial Biologist
Colorado Parks and Wildlife
Southwest Region
151 E 16th St.
Durango, CO 81301

Dear Scott:

First and foremost we want to thank Colorado Parks and Wildlife (CPW) for the opportunity to comment on the two draft DAU Plans currently being developed for Rocky Mountain Bighorn Sheep. We are sending our comments directly to you with a CC to the authors of both draft DAU Plans (Brad Weinmeister and Brandon Diamond) as we recommend that all attachments be read by all of you and a single email will help to simplify this process. Please ensure that Brad and Brandon receive these documents.

We have specific comments for both DAU Plans because, as proposed, both RBS-20 and RBS-21 involve bighorn sheep herds that utilize National Forest System land managed by the Rio Grande National Forest (RGNF). As you know, we have extended considerable effort in the past couple years to assess the status of BHS herds that occur or partially occur on the Forest and therefore have a high interest in the DAU Plans in regards to our mutual responsibility for ensuring the long-term viability and persistence of these herds. We also recognize that potential contact with and disease transmission from domestic sheep remains the primary limiting factor for most BHS herds in Colorado and that the Forest has a key responsibility in addressing this issue. To this end, we have developed and incorporated a quantitative risk assessment process into our planning and NEPA decision processes for domestic sheep (DS) allotments to ensure that potential contact is minimized while maintaining DS grazing where acceptable. We are currently addressing two known remaining problem areas through Annual Operating Instructions until an adequate risk assessment and NEPA decision can be completed utilizing the new national direction received from our Washington office in August and September 2011. Monitoring and adaptive management of our past allotment decisions remains on-going.

Both DAU Plans contain a substantial amount of information on the BHS herds being considered for inclusion within the proposed DAUs. We found this information very useful for our review and facilitating our response. After reviewing both documents, however, we felt that our comments are best provided in the following format:

1. General Comments Applicable to both DAU Plans. These comments are included as Attachment 1.



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2. Comments Specific to each DAU Plan. We found that these comments are best provided by using the Track Changes feature to capture comments and recommended edits. To accomplish this, we converted each DAU pdf document to a Word document so that comments can be included on the page/location where they apply. The integrity of the pdf's was retained through this conversion. These completed documents are also attached to this reply as Attachment 2 and Attachment 3.

Again, we sincerely appreciate the opportunity to be actively involved in these first draft DAU Plans for BHS. We look forward to continuing our work with CPW as we cooperatively manage for healthy BHS habitats and populations in the future. Please contact Randy Ghormley, our Forest Wildlife Program Manager, at 719-852-6243 if you should need further assistance or follow-up on our comments.

Sincerely,

/s/ Dan S. Dallas
DAN S. DALLAS
Forest Supervisor

cc: Randy Ghormley
Gary Snell
Thomas Malecek
Dale Gomez
Melanie Woolever
Brad Weinmeister
Brandon Diamond

General Comments Relative to DAU RBS-20 and RBS-21
Rio Grande National Forest
November 2, 2011

1. A more consistent, although not mirrored, approach to the DAU Plan format and information provided may be helpful to all readers. If so, we suggest using RBS-21 as a format as it contains more essential information including goals and objectives.
2. We suggest that both DAU Plans and RBS-20 in particular could strengthen and better highlight the opportunities for a more collaborative approach to BHS management between CPW and federal land management agencies relative to communication, M&E efforts, DS allotment planning, noxious weed efforts, etc. See comments in each individual DAU Plan.
3. We suggest that both DAU Plans could benefit from a brief section that recognizes and builds on the collaborative efforts contained within the 2009 MOU between the CDOW, USFS, BLM, Dept. of Ag, and Colorado Woolgrowers, particularly as related to understanding and reducing risk of contact between BHS and DS.
4. We recommend additional clarification and careful consideration of what CPW considers a Tier 1 population. We recognize that there are some general criteria in the 2009 Bighorn Sheep Management Plan and that some potential Tier 1 areas were identified at that time; however, we anticipate providing additional emphasis on Tier 1 populations and recommend that these be carefully identified where land ownership and potential disease transmission complexities are clearly manageable over time to achieve Tier 1 goals.
4. We would like the opportunity to briefly review the final BHS DAU Plans before they are approved by the Commission.

San Juan National Forest

10/28/11

Comment on the draft CPW bighorn sheep management plans for RBS 20 and 21.

The draft plans were reviewed by our specialists for Range and Wildlife management. The comments are captured below and reflect comment for the San Juan National Forest. We have also reviewed and support comment submitted by the GUMG National Forest for RPS 21 in their letter of October 12, 2011 to Brad Banulis and Brandon Diamond. General comment for each individual plan is applicable to both plans. We found the draft plans well thought out and written. We thank you again for allowing us to review the drafts and offer comment which reflect the perspective of another Agency involved in the management of these herds.

Comment on RBS 20:

Columbine Ranger District

Domestic Sheep Grazing:

- Reference the latest livestock analysis decision for each GMU?
- List/briefly discuss active/vacant allotments within each GMU (lists provided by FS)?
 - Is there overlap or close proximity between active/vacant allotments and BHS overall range, summer range, summer concentration areas, etc (allotments provided by FS)?
 - Wouldn't this information really set the stage for describing the level of concern (or risk) for the potential of physical contact in the DAU? How can there be meaningful discussions about the potential for physical contact without this information?
- Are there specific areas within the DAU where there is concern about the potential for physical contact (i.e. should the draft plan highlight areas of potential concern to CP&W, then later in an inventory or monitoring section encourage all parties to consider conducting monitoring activities in those areas)?
- Are livestock grazing design criteria in place to reduce the potential for physical contact?
 - If so, what are they?
- Is there a calling tree/response plan in place in case of reports of close physical proximity or actual physical contact between bighorn and domestic sheep?
 - If so, brief description of plans?
- It would seem that if post-hunt December helicopter flights are the only monitoring tool used in this DAU, it will be very difficult to assess/monitor the potential for physical contact between domestic sheep and bighorns. As a Tier 1 primary population with disease outbreak considered "the primary concern for the Weminche herd" (page iii), some discussion about the need to develop a

strategic monitoring plan geared specifically to monitoring areas and/or potential for physical contact appears both prudent and necessary. Clearly some discussion about how to address this risk factor is needed in the plan.

- In addition to discussions about management of domestic sheep, there should be at least some discussion about the issue of wandering rams.
 - Have recommendations been developed for how this important aspect of bighorn ecology might be monitored in the DAU.
 - Are there specific areas within the DAU where there is concern about the potential for wandering rams to contact domestic sheep, and if so, are response plans in place for protecting nearby bighorn herds from possible exposure to infected rams?

Recreation Impacts:

- The plan lists “disturbance caused by summer and winter recreationalists” as a threat second only to disease outbreak (page iii), yet the plan provides only broad generalizations about the potential impacts of recreation on animals in the DAU (pages 16-17).
 - Are there specific areas within the DAU where there is concern about the potential for recreation impacts to bighorns, such as on winter range?
 - Should the draft plan highlight specific areas or specific recreational activities that are of potential concern to CP&W, then later in an inventory or monitoring section encourage all parties to consider conducting monitoring activities targeting those areas or activities?
- Are there specific suggestions about methods to manage the potential for pack goats to come into contact with bighorns? Are there any areas in the DAU where CP&W is concerned about the potential for contact with pack goats?
- The plan states a need to provide information to the FS to better inform decision makers during policy and management decisions (page 17). Perhaps the plan could propose some form of more regular communication or meeting processes to provide more clearly defined information exchange and communication processes?

Herd Management:

- The Plan states simply that herds in this DAU cannot be modeled; therefore guidelines in the State’s management plan should be followed. Could there be a brief discussion about what this means? What methods will be used to monitor status and trends of this Tier 1 top primary population? On the basis of what type of information will herd management goals be evaluated and/or altered?
- The plan recommends conducting an intensive helicopter based survey of the DAU be conducted at least every 2 years, post hunt during the month of December. Will any other monitoring methods be recommended to monitor herd distribution, density, animal movements and/or occurrence in relation to mapped distribution (i.e. overall range, summer range, summer concentration areas, etc)?

- It seems that there are 2 primary mechanisms available for active herd management:
 1. Adjusting harvest levels (by CP&W).
 2. Managing risk factors (by FS and CP&W).
 - Improving amount/quality/access to important bighorn habitat areas (i.e., winter range habitat improvement projects). Could there be a discussion about opportunities for habitat improvement projects, including identifying areas for potential cooperative projects?
 - Reducing/eliminating potential for physical contact with domestic sheep. Could there be a discussion about opportunities to accomplish this? FS livestock management practices, and grazing decisions to reduce potential for contact could be discussed here.
 - Managing mortality factors (i.e., lion predation on winter range or lambing areas). Could there be a discussion about opportunities for reducing mortality factors such as lamb predation?

Habitat Management:

- Suggest some discussion in this section about the extent, quantity and quality of winter range in the DAU. The plan implies that winter range is the most limiting habitat feature, and is the basis for density calculations. If so, it would seem that some discussion is warranted about how to maintain and/or improve the quantity and quality of winter range.
- The plan recommends “identify critical habitats and protect it from degradation or loss” (page 18). Suggest providing a few more details on what this might mean, especially in terms of cooperative project opportunities with land management agencies. Providing some additional detail here might be helpful to land management agencies looking for habitat improvement project opportunities.
 - Is this recommendation primarily geared toward winter range habitats, or are summer concentration areas and production areas also included?
 - How does this recommendation compare to statements in several places in the plan that “most of the habitat within the DAU appears to be in good or excellent condition” (page ii)?
- In the predation section (page 19) the plan states that predation “is usually considered much less of a limiting factor for bighorn sheep populations than disease and habitat”. This statement again implies the CP&W has concerns about habitat quantity or quality, and suggests the plan should provide a bit more detail, if possible, about some concerns specific to the DAU. Additional detail here would be very helpful to land management agencies looking for habitat improvement project opportunities.
- The noxious weed discussion is important to include in this plan, and is a concern to land management agencies as well. The FS could provide a number of examples of how things discussed in the plan are ongoing. For example, the past several summers a contractor has been spraying weeds along the Pine River Trail as it passes through S-28 and into S-16.

Future Monitoring & Research Suggestions:

- Suggest adding additional discussion about monitoring/inventory efforts, with suggested areas to survey and periodicity of surveys. The plan recommends conducting a December helicopter survey at least every 2 years, but more discussion about this key aspect of managing this Tier 1 population would seem appropriate.
- As a Tier 1 primary population, the Plan recommends giving this DAU “priority for inventory, habitat protection and improvement, disease prevention, and research”, but provides little detail about what is desired in any of these categories. Clearly, periodic inventory/monitoring efforts are necessary to validate effectiveness of herd management actions and to assess sustainability of herd objectives.
 - If so, suggest a more detailed discussion of monitoring methods and periodicity to allow inter-agency planning processes for cooperative projects on this Tier 1 population.
 - The report states a concern by CP&W about poor population performance in S-28 (page 9). The plan states “This will need to be monitored” but provides little detail or recommendations on what is being considered or is feasible for this DAU. Certainly there is a need to develop a long term monitoring strategy that can effectively monitor population performance in S-28. For this reason, we suggest a more detailed discussion of monitoring plans/opportunities and potential inter-agency cooperative projects to address issues/concerns.
- The plan appears to rely heavily on density estimates (annual population estimate divided by amount of mapped winter range) as the basis for evaluating herd status and trends. This implies a need to validate modeled winter habitat areas, validate mapped winter ranges, and develop strategies for winter range monitoring. Will the plan discuss or recommend monitoring numbers of animals and distribution of animals on occupied winter range, or mapping the extent, condition, and capability of winter range?
- Will the Plan recommend surveys targeting areas of known bighorn occurrence to document occupied area/density, as well as areas found previously to be vacant to document bighorn herd expansion?
- Will the Plan recommend surveys targeting areas of the DAU where there is concern for the potential for physical contact to document if contact is occurring?
 - Are there any such areas in the DAU?
- Lion predation and affects on lamb/ewe survival in S-28. Is this a concern for CP&W, and if so, are there options/opportunities to address this concern?

Specific Editorial Suggestions:

- La Plata County should be added to the list of counties within the DAU (page 2).

Pagosa Ranger District

We understand this is a population management plan for managing Rocky Mountain bighorn sheep across Game Management Units (GMUs) S15, S16, and S28, encompassing Data Analysis Unit RBS-20. Our comments focus on the influences public land management practices may have on Colorado Parks and Wildlife (CPW) population management objectives described in the Draft Bighorn Sheep Management Plan.

Comment: Page iii, Significant Issues

“Several other issues occur but are relatively insignificant to the disease aspect. These include disturbance caused by summer and winter recreationists, human development and fragmentation of habitat, a means to gather better population data, habitat management, interaction and resource competition with mountain goats, and natural predation.”

Please describe specific areas across the GMUs on San Juan National Forest (SJNF) administered lands where summer and winter recreation activities are causing disturbance to bighorn sheep. Please also describe the type of disturbance (i.e., disturbance during key periods or key habitats such as winter range, lambing areas, etc.) and degree of disturbance. Are there disturbances occurring that have appreciably influenced bighorn populations or have potential to influence population management objectives for bighorns across the DAU? If so, we would like to review these activities to determine best management practices for addressing these concerns.

Similarly, are there locations on SJNF administered lands where habitat management and habitat fragmentation are a concern? Again, we would like to review these activities to determine best management practices for addressing these concerns.

Forest Service wildlife biologists and other resource specialists have assisted CPW in conducting coordinated ground counts to inventory and monitor bighorn sheep across the DAU. The data collected assisted with the completion of the Pagosa Sheep Grazing Environmental Analysis, and overall management of bighorn sheep, currently designated as a Forest Service sensitive species in Region 2. We would like to continue these coordinated inventory and monitoring efforts in the future so long as budgetary constraints allow.

Comment 2: Page 6, Habitat Capability

“Known lambing areas are on the southwest side of Sheep Mountain, the south faces of Hossick Ridge and Cimmarona Peak above Williams Creek Reservoir, and the ridges straddling the Los Pinos River downstream from Lake Creek.”

In 2008 and 2009 Forest Service wildlife biologists and other resource specialists on the Pagosa Ranger District conducted field reconnaissance for the Pagosa Sheep Grazing Environmental Analysis. The purpose of the reconnaissance was to evaluate rangeland health and condition, survey for bighorn sheep in vacant domestic sheep and goat allotments, and identify potential barriers that may provide separation should the allotments be stocked with domestic sheep. Field reconnaissance in 2008 and 2009 revealed additional lambing activity in the DAU beyond those mentioned above. In 2009, lambing activity was detected on the ridge south of Puerto Blanco in S15. Lambing activity was also observed in 2008 on the southeast side of Sheep Mountain. Given the presence of lambing activity in these areas, it was determined risk of contact between domestic sheep (if grazed in the areas) and bighorn sheep would be high, and therefore the allotments were recommended for closure.

Comment 3: Inventory

This section describes inventory and monitoring efforts with emphasis on past inventories. We suggest referencing more recent inventory efforts conducted in 2009 in S16 and 2008 in S15. The data collected showed bighorns are more widely distributed across suitable habitat when compared to prior survey years. The CPW and USFS conducted coordinated ground counts in these GMUs to assess the current status and distribution of bighorns. The data collected provided valuable information for the Pagosa Sheep Grazing Environmental Analysis, and showed bighorn populations increasing and expanding their distribution.

Comment 4: Risks Involving Domestic Sheep

“Domestic sheep allotments on the US Forest Service lands in the Pagosa Ranger District became vacant from domestic sheep grazing as early as 1962. This trend continued through the 1970’s and into the 80’s (USDA Forest Service 2010). In 1990 a conflict between domestic and wild sheep was recognized. This resulted in the USFS converting the domestic sheep allotments to cattle and horse grazing, and has since eliminated domestic sheep livestock grazing in the majority of the allotments west of the Continental Divide.”

The statement “This resulted in the USFS converting the domestic sheep allotments to cattle and horse grazing, and has since eliminated domestic sheep livestock grazing in the majority of the allotments west of the Continental Divide” is incorrect. All domestic sheep and goat grazing allotments administered by the Pagosa Ranger District in GMUs S15, S16, and S28 were closed to all livestock grazing (including cattle and horse) through the Pagosa Sheep Grazing Environmental Analysis. The closure of these allotments has effectively removed the risk involving domestic sheep and goat grazing on the Pagosa Ranger District. Risks to bighorn sheep and overall effect to population management objectives from domestic sheep grazing will be dependent on future grazing

analysis and decisions on the Columbine Ranger District (SJNF) and Divide Ranger District (Rio Grande National Forest).

Comment on RBS 20 and 21:

San Juan Public Lands Center Range Program

1. What is the relationship of these plans to the recently approved State-wide BH sheep plan?
2. Each plan needs to acknowledge the increasing expansions of noxious weed species into suitable habitat and further recommend federal, state and private partnerships to manage these populations including the use of local and state HPP and ORV funds.
3. Each plan should reference the existing MOU between the State, federal agencies and CO Woolgrowers, and it's guidelines followed as each plan is implemented.
4. Ongoing FS and BLM domestic sheep adaptive management should be identified and/or referenced i.e. 2009 Silverton Sheep management EA or the Pagosa High Sheep Management EA 2011, and furthermore there should be an acknowledgement that other adaptive management options may be developed and implemented through monitoring.
5. I agree with the GMUG that winter range, on both private and public lands, may be a crucial issue. What can be done to evaluate risk through different ongoing management activities?
6. The San Juan has closed vacant sheep allotments based on risk and no domestic sheep grazing demand. I do not believe that we should close vacant allotments to minimize perceived risk, but that we should do bonified risk assessments and use vacant allotments to both reduce risks to native populations as well as to increase management flexibility for domestic bands.



SOUTHERN UTE INDIAN TRIBE

Brad Weinmeister
Colorado Parks and Wildlife
151 E 16th St
Durango, Co 81301

October 28, 2011

Dear Mr. Weinmeister,

On behalf of the Southern Ute Division of Wildlife Resource Management I am writing to submit some brief comments on the *Draft Bighorn Sheep Management Plan: Data Analysis Unit RBS-20 Weminuche Herd*. Thank you for putting together the plan and sharing it with all interested stakeholders.

I hope I am not being too simplistic in breaking down the plan into the following relevant bullet points:

- Wild sheep population inventories are difficult; the CPW has surveyed as best it can and has shown a general increasing population trend for sheep in the DAU over the past 20 years, understandably there is not a high degree of confidence associated with estimates.
- Modeled habitat capability suggests there is room for the herd to grow, although again due to the ruggedness of the country, this idea is difficult to ground truth.
- Contact with domestic sheep is the largest threat to the wild sheep in the DAU
- Domestic sheep allotments:
 - have been eliminated on the Pagosa Ranger District (SJNF)
 - are a threat on the Columbine Ranger District (SJNF) where at least seven domestic sheep allotments are vacant, but nothing precludes them from being occupied at any time in the future
 - in portions of the Divide Ranger District (RGNF) pose a grave risk to wild sheep populations near occupied allotments

Domestic sheep and associated allotments clearly stand in the way of managing wild sheep populations to their potential in RBS-20. The Tribe believes that CPW's wild sheep management is severely compromised by domestic sheep grower interests on the National Forest, and would prefer to see a much stronger federal priority placed on wild sheep conservation. The fact that domestic sheep allotments can remain vacant but open for decades simply limits the ability of the CPW to effectively manage wild sheep populations in these areas.

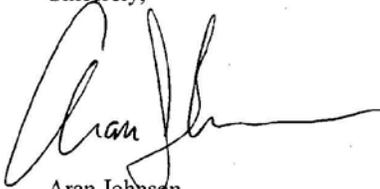
Understanding that State budgets and staff time are limited, the Tribe nevertheless makes the following "perfect world" recommendations regarding the RBS-20 plan:

P. O. B O X 7 3 7 ♦ I G N A C I O , C O . 8 1 1 3 7 ♦ P H O N E : 9 7 0 - 5 6 3 - 0 1 0 0

- 1) A more precise estimate of wild sheep numbers in the DAU is needed to make informed recommendations about population size. Any extra resources that the CPW could put toward this goal would be helpful.
- 2) The CPW should continue to work with the San Juan and Rio Grand National Forest and local sheep growers to eliminate domestic sheep allotments that have been vacant for decades.
- 3) Given the elimination of vacant allotments, wild sheep should be managed for population growth and eventually for more hunting opportunity.

I commend you for your past, present and future efforts. Please contact me directly with any questions or comments you have.

Sincerely,

A handwritten signature in black ink, appearing to read 'Aran Johnson', with a long horizontal flourish extending to the right.

Aran Johnson
Wildlife Biologist
Southern Ute Indian Tribe

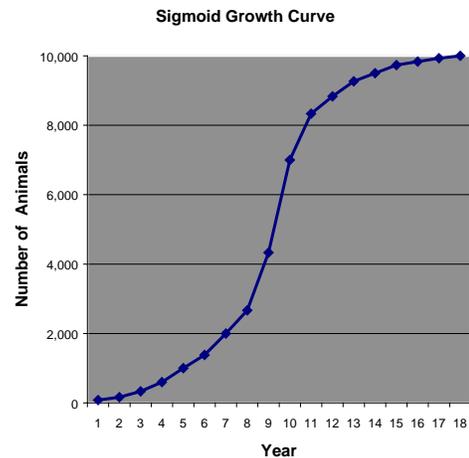
Appendix E: Population Dynamics, Maximum Sustained Yield, and Density Dependence

Numerous studies of animal populations, including such species as bacteria, mice, rabbits, and white-tailed deer have shown that the populations grow in a mathematical relationship referred to as the "sigmoid growth curve" (right). There are three distinct phases to this cycle. The first phase occurs while the population level is still very low and is characterized by a slow growth rate and a high mortality rate. This occurs because the populations may have too few animals and the loss of even a few of them to predation or accidents can significantly affect population growth.

The second phase occurs when the population number is at a moderate level. This phase is characterized by high reproductive and survival rates. During this phase, food, cover, water and space are not a limiting factor. During this phase, for example, animals such as white-tailed deer have been known to successfully breed at six months of age and produce a live fawn on their first birthday and older does have been known to produce 3-4 fawns that are very robust and healthy. Survival rates of all sex and age classes are also at maximum rates during this phase.

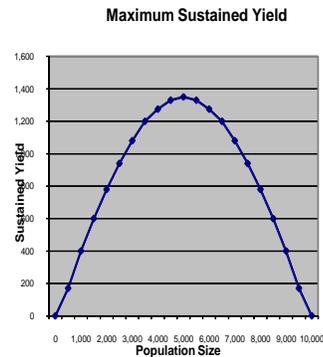
The final or third phase occurs when the habitat becomes too crowded or habitat conditions become less favorable. During this phase the quantity and quality of food, water, cover and space become scarce due to the competition with other members of the population. These types of factors that increasingly limit productivity and survival at higher population densities are known as density-dependent effects. During this phase, for example, white-tailed deer fawns can no longer find enough food to grow to achieve a critical minimum weight that allows them to reproduce; adult does will usually only produce 1-3 fawns; and survival of all deer (bucks, does and fawns) will decrease. During severe winters, large die-offs can occur due to the crowding and lack of food. The first to die during these situations are fawns, then bucks, followed by adult does. Severe winters affect the future buck to doe ratios by favoring more does and fewer bucks in the population. Also, because the quality of a buck's antlers is somewhat dependent upon the quantity and quality of his diet, antlers development is diminished. If the population continues to grow it will eventually reach a point called "K" or the maximum carrying capacity. At this point, the population reaches an "equilibrium" with the habitat. The number of births each year equal the number of deaths, therefore, to maintain the population at this level would not allow for any "hunnable surplus." The animals in the population would be in relatively poor body condition, habitat condition would be degraded from over-use, and when a severe winter or other catastrophic event occurs, a large die-off is inevitable.

What does all this mean to the management of Colorado's big game herds? It means that if we attempt to manage for healthy big game herds that are being limited by density-dependent effects, we should attempt to hold the populations more towards the middle of the "sigmoid



growth curve." Biologists call this point of inflection of the sigmoid growth curve the point of "MSY" or "maximum sustained yield." In the example below, MSY, which is approximately half the maximum population size or "K", would be 5,000 animals. At this level, the population should provide the maximum production, survival, and available surplus animals for hunter harvest. Also, at this level, range habitat condition should be good to excellent and range trend should be stable to improving. Game damage problems should be lower and economic return to the local and state economy should be higher. This population level should produce a "win - win" situation to balance sportsmen and private landowner concerns.

A graph of a hypothetical deer population showing sustained yield (harvest) potential vs. population size is shown (right). Notice that as the population increases from 0 to 5,000 deer, the harvest also increases. However, when the population reaches 5,000 or "MSY", food, water and cover becomes scarce and the harvest potential decreases. Finally, when the population reaches the maximum carrying capacity or "K" (10,000 deer in this example), the harvest potential will be reduced to zero.



Also, notice that it is possible to harvest exactly the same number of deer each year with 3,000 or 7,000 deer in the population. This phenomenon occurs because the population of 3,000 deer has a much higher survival and reproductive rate compared to the population of 7,000 deer. However, at the 3,000 deer level, there will be less game damage and resource degradation but lower watchable wildlife values.

Actually managing deer and elk populations for MSY on a DAU basis is difficult if not impossible due to the amount of detailed biological information about habitat and population size required. Additionally, carrying capacity is not static, the complex and dynamic nature of the environment cause carrying capacity to vary seasonally, annually, and trend over time. In most cases we would not desire true MSY management even if possible because of the potential for overharvest and the number of mature of bulls and bucks is minimized because harvest reduces recruitment to older age classes. However, the concept of MSY is useful for understanding how reducing densities and pushing asymptotic populations towards the inflection point can stimulate productivity and increase harvest yields. Knowing the exact point of MSY is not necessary if the goal is to conservatively reduce population size to increase yield. Long-term harvest data can be used to gauge the effectiveness of reduced population size on harvest yield.

Research in several studies in Colorado has shown that density-dependent winter fawn survival is the mechanism that limits mule deer population size because winter forage is limiting (Bartmann et al. 1992, Bishop et al. 2009). Adult doe survival and reproduction remain high but winter fawn survival is lower at higher population sizes relative to what the winter habitat can support. The intuition to restrict, or even eliminate, female harvest in populations where productivity is low and when populations are below DAU plan objectives is counterproductive and creates a management paradox. In that, for populations limited by density dependent processes, this "hands-off" type of management simply exacerbates and perpetuates the problem of the population being resource limited, and countermands the goals and objectives of the DAU plan. As Bartmann et al. (1992) suggest, because of density-dependent processes, it would be

counterproductive to reduce female harvest when juvenile survival is low and increase harvest when survival is high. Instead, a moderate level of female harvest helps to maintain the population below habitat carrying capacity and should result in improved survival and recruitment of fawns. Increased fawn recruitment allows for more buck hunting opportunity and a more resilient population.

Thus, the key for DAU planning and management by objective is to set population objectives in line with what the limiting habitat attributes can support. A population objective range aptly set must be below carrying capacity.

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