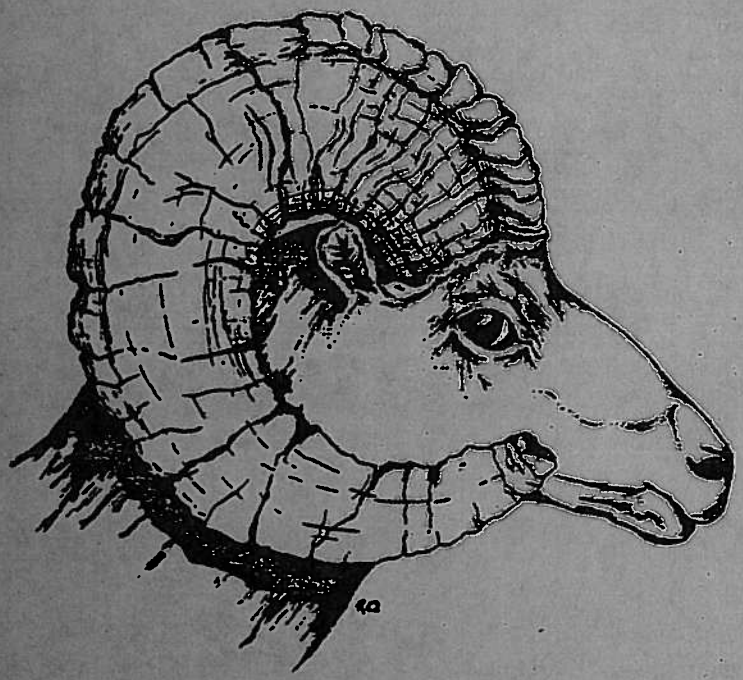
Sierra Nevada

Bighorn Sheep

Recovery and Conservation Plan



SIERRA NEVADA BIGHORN SHEEP
RECOVERY AND CONSERVATION PLAN

Sierra Bighorn Interagency Advisory Group*
September, 1984

*A formal interagency group established at the request of the director, California Department of Fish and Game, and composed of wildlife biologists from the California Department of Fish and Game, Inyo National Forest, Sequoia and Kings Canyon National Parks, Yosemite National Park, Bakersfield District of the Bureau of Land Management, and John Wehausen, a private consultant.

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I. MANAGEMENT PROBLEM

Before the arrival of European man to the Sierra Nevada, bighorn sheep (Ovis canadensis californiana) were distributed from Jawbone Canyon (15 miles north of Mojave) to Sonora Pass (Wehausen 1979). Sheep apparently occurred wherever appropriate rocky terrain and winter range existed. With some exception, most of these populations wintered on the east side of the Sierra Nevada and spent summers near the crest.

Most of these herds disappeared by 1900, probably due to disease transmission from domestic livestock, compounded by competition with livestock for forage and by overhunting (Buechner 1960, Wehausen 1980). Only the Mt. Baxter and Mt. Williamson populations are known to have survived to present in the Sierra Nevada. In 1971, sanctuaries were established for these two herds, and about the same time bighorn in the Sierra Nevada were classified as rare by the state of California.

In 1979, 1980, and 1982, a total of 60 bighorn were removed from the Mt. Baxter herd for reintroductions. Two sites within the Sierra Nevada - Wheeler Crest and Mt. Langley - have been restocked. As of 1984, Sierra Nevada bighorn number less than 300, occurring in four herds: Mt. Baxter, Mt. Williamson, Wheeler Crest, and Mt. Langley.

II. MANAGEMENT OBJECTIVES

The goal of this recovery program is to improve the status of Sierra Nevada bighorn sheep. Since this recovery plan focuses on the Sierra Nevada and does not discuss managment of herds in northeast California, criteria for removing this subspecies from rare status will not be addressed. However, eventual declassification is the desired outcome. Consequently, the following objectives are identified for Sierra Nevada bighorn sheep:

- Insure the future of bighorn sheep in the Sierra Nevada by maintaining the health and viability of all existing populations, and by promoting the establishment of at least three populations that are both large (exceeding 100 animals) and geographically distant from one another.

- Restore bighorn sheep to all former ranges within the Sierra Nevada where it is ecologically, economically and politically feasible, and where conditions could be made favorable to their success.

- Ensure genetic integrity of the Sierra Nevada subspecies by using only bighorn from existing Sierra Nevada populations to restock historic ranges.

To achieve these management objectives, a program consisting of four elements will be implemented. These are: 1) Population Management, 2) Reintroductions, 3) Habitat Management, and 4) Monitoring and Research. This plan will be reviewed annually and revised as new information from research and monitoring become available.

The specific provisions of each program element are:

A. POPULATION MANAGEMENT

1. Mt. Baxter Herd

The Mt. Baxter herd is a native population of approximately 220 sheep. It has been increasing in size at least since 1978 and has been used successfully as transplant stock in 1979, 1980 and 1982. It is the only large population of bighorn in the Sierra, is geographically isolated from other populations, and is extremely important to the stability of bighorn sheep in the Sierra Nevada mountains.

a. The Mt. Baxter herd will be managed to provide transplant stock for reintroductions (see Appendix).

b. Sheep removal from the Mt. Baxter herd will attempt to approximate a maximum sustainable harvest, as discussed in the appendix. Calculations indicate this herd will provide adequate numbers of sheep for reintroduction no more often than every other year.

c. Bighorn should never be removed from the Mt. Baxter herd so as to decrease the number of ewes below 70, with a minimum of 18 on the north side of Sawmill Creek and 52 on the south side.

2. Other Populations

At present, other bighorn populations include the Mt. Williamson herd, a native population of approximately 30 to 40 sheep; the Wheeler Crest herd, a reintroduced population of at least 30 sheep; and the Mt. Langley herd, a reintroduced population with status unknown but comprising at least 14 animals.

The Mt. Williamson population appears to have reached carrying capacity and has been stable since 1978. The Wheeler Crest population has experienced a slow initial population growth rate. The range appears capable of supporting over 100 sheep and is geographically isolated from other populations, and thus may be an important buffer against catastrophic loss. The Mt. Langley herd has not received sufficient monitoring to clearly indicate population status. It is unlikely this population will exceed 100 sheep due to the lack of extensive winter range.

a. The goal for managing herds other than the Mt. Baxter herd will be to maintain healthy viable populations.

b. Removal of individuals may be desirable in selected situations where high density appears to threaten a population with an epizootic disease.

c. Herd augmentation may be necessary to compensate for excessive losses, to add genetic variability, to increase population growth rate, or to add telemetry collars.

d. Plans for any bighorn augmentation, removal, or other population manipulation should be reviewed by the Sierra Bighorn Interagency Advisory Group.

B. REINTRODUCTIONS

1. Site Criteria

a. Evidence of Historic Use - Documentation of historic use of an area by bighorn is a good measure of habitat suitability and will be considered in selecting and prioritizing reintroduction sites.

b. Quality of Winter Range - Good winter range should contain precipitous rocky escape terrain on south-facing slopes where snow melts quickly enough to prevent excessive accumulation. It also provides adequate forage with mixtures of shrub and grass species for use under different phenological and snow conditions.

c. Accessibility to Summer Range - Unobstructed migratory corridors between suitable winter and summer ranges are essential to any successful reintroduction. Where escape terrain is adequate along potential migration corridors but forest canopy is dense, timber removal could be used to create a usable migratory corridor. Once migratory routes are present, adequate summer range is not expected to be a limiting factor.

d. Geographic Separation from Existing Herds - With two reintroductions already having taken place in the Owens Valley, priority will be given to sites further removed from the Mt. Baxter herd so that they may act as buffers against potential catastrophic loss.

e. Carrying Capacity - Sites are preferred that appear capable of supporting relatively large populations (e.g. over 100 animals). Such populations are expected to have greater intrinsic stability. They also would provide greater protection of bighorn in the Sierra through the potential to serve as reintroduction stock in the event of catastrophic loss of the Mt. Baxter herd.

2. Potential Sites

Based on the site criteria listed above, the following areas appear to have the greatest potential for bighorn reintroduction sites:

a. Lee Vining and Lundy Canyons - Lee Vining Canyon has steep cliffy habitat with abundant forage and direct access to alpine summer range. It is spatially separated from existing populations and is part of the known historic range of bighorn sheep. It is also the only site that would permit the reestablishment of bighorn to Yosemite National Park--a goal that has been identified as high priority in the Yosemite Natural Resources Management Plan. The only drawback to Lee Vining Canyon as a reintroduction site is a portion of a domestic sheep grazing allotment (approximately 670 AUMs), which is adjacent to the anticipated winter range.

The only quantitative snow data available for Lee Vining Canyon are from winter 1983-84. That year was one of average precipitation, but with a little less than average snowpack at lower elevations. The winter range was essentially snow free under those conditions. In most years snowpack will not be a significant factor on the winter range. During those occasional years of extreme snowpack, winter lamb survival and possibly spring lamb production may be reduced, but significant adult mortality is not likely. The winter range has an abundance of palatable browse which will be available under conditions of deep snow. The steep southfacing slopes will promote rapid melting of snow.

Lundy Canyon, which lies immediately north of Lee Vining Canyon, also has potential as a winter range, but its higher elevation contributes to greater snow depths. Monitoring of snow conditions for several years is essential prior to a decision to release bighorn there. Lundy and Lee Vining Canyons together would represent one population due to the opportunity

for interchange on the summer range, and may reach 100 animals. Consequently, these ranges are considered important in providing a buffer against catastrophic loss, and maintaining genetic viability.

b. Middle Fork of the San Joaquin River - A long, continuous band of cliffs exists along the north side of the river, within an elevational range of 5,000 to 8,000 feet above sea level. Since these cliffs face south and east, rapid snow melt is expected, creating a potential for substantial bighorn winter range. Historical bighorn use of this drainage is unknown, although two rams were reported in 1947 on Pincushion Peak (Jones 1950), which is approximately three miles to the south. Investigations are needed to determine actual snow depths, forage availability, and adequacy of mirgation routes to the anticipated summer range in the Minarets. This reintroduction site is geographically separated from the Mt. Baxter herd, but it is close enough to the Lee Vining-Yosemite summer range to allow for occasional contact between herds if bighorn were to be reintroduced to both sites.

c. Mt. Tom - Bighorn wintered on Mt. Tom into the 1930's, presumably in the Elderberry Canyon area. The limited amount of suitable potential winter range indicates fewer than 100 sheep can be supported by this range. The population numbered 40-50 in the early part of this century (Ober 1914). No conflicts with livestock grazing are known to exist. Adequacy of winter forage and snow conditions need investigation prior to release of bighorn there. There could be an interchange of bighorn between Mt. Tom and the existing herd on Wheeler Crest; thus Mt. Tom would provide little additional benefit as a buffer to disease epizootics.

d. Shannon Canyon - This area contains excellent winter range. The Coyote Flat area is a substantial barrier to migration to summer range along the Sierra Crest. It is unlikely that a

reintroduced population would initially develop a migration route across Coyote Flat or along the south fork of Bishop Creek to the crest. Consequently, total range of an introduced population would be limited to the slopes east of Coyote Flat. Such a population is unlikely to exceed 100 animals. Insect-vectored diseases might be introduced to bighorn from the cattle grazed on Coyote Flat in summer. The existence of specific insect species in question needs investigation prior to any reintroduction.

e. Taboose Creek - Wintering bighorn were documented in Taboose Creek in the early part of this century (Ober 1911). The area provides adequate habitat and no conflict with livestock grazing. Drawbacks to reintroduction are: (1) its close proximity to the Mt. Baxter herd, which may allow sheep to return there, and (2) its considerable distance from a roadhead, which would require that bighorn be helicoptered into the release site. A recent colonization by the Mt. Baxter herd of Goodale Creek (one canyon south of Taboose Creek), suggests a high probability of an eventual natural colonization of Taboose Creek. Bighorn wintering in Taboose Creek would probably contact members of the Mt. Baxter herd in the high country. Consequently, from a disease epizootic standpoint, a reintroduction to this canyon would not necessarily provide a buffer against total loss of Sierra Nevada bighorn.

f. Great Western Divide - This area apparently contained a large number of bighorn prior to disease epizootics in the 1870's (Jones 1950). Currently there are no conflicts with livestock. Much remains to be learned about suitability of potential wintering sites in terms of snow depths, forage availability, and migratory corridors. Bighorn would have to be helicoptered into any release site.

g. Olancha Canyon - Olancha Canyon and the canyons on either side of it represent a substantial block of potential bighorn habi-

tat. However, this habitat resembles the Shannon Canyon area in that: (1) the Kern Plateau is topographically inadequate as summer range, except Olancha Peak and possibly some rocky ridges extending onto the Plateau, and (2) extensive cattle grazing on the Kern Plateau offers the possibility of disease transmission to bighorn, especially those vectored by insects. With a very limited amount of alpine summer range, a population established here is unlikely to reach 100 in number. Investigations of insects that might vector cattle diseases are necessary prior to any reintroduction there.

3. Transplant Operation Guidelines

   a. An environmental assessment must be prepared and approved by the appropriate management agencies prior to any transplant operation. A cooperative agreement outlining agency responsibility and an action plan will be prepared for each new site.

   b. Bighorn will be captured by whatever methods are deemed most efficient and safest by Department of Fish and Game personnel and are in accordance with the policies of the land management agency responsible for the area involved. Currently successful techniques include drop netting, drive netting with a helicopter and free range capture using immobilizing drugs and projectile syringes.

   c. Capture teams will attempt to transplant at least 20 animals with about 2/3 of them female. If fewer sheep are released, the herd will be augmented at the first opportunity. Initial release at any site will not involve fewer than 10 sheep.

   d. Reintroduced populations may be augmented at later dates to compensate for excessive losses, to add genetic variability, to increase population growth rate or to add telemetry collars.

e. Any plans for the transplant of bighorn sheep in the Sierra Nevada, or predator control in conjunction with a bighorn transplant should be developed in conjunction with the Sierra Bighorn Interagency Advisory Group.

C. HABITAT MANAGEMENT

1. Habitat manipulation may be used on some ranges to increase otherwise low carrying capacity or to provide migration corridors.

2. To protect bighorn sheep from the serious effects of disease transmission, domestic sheep grazing should not be permitted within two miles of bighorn range (Jessup, Calif. Dept. of Fish and Game). Cattle could be permitted in areas adjacent to bighorn range in the absence of vectors for diseases that could impact bighorn. Where vectors are present, cattle use should not be permitted within two miles of bighorn range. Special topographic or wind conditions may alter the size of the buffer needed between bighorn range and areas of sheep or cattle grazing.

3. Resource developments such as mining and recreation that are proposed in or adjacent to bighorn range should be designed so as to minimize impacts on bighorn and their habitat.

4. Management plans and environmental assessments will be prepared on an individual range basis if habitat management is deemed necessary.

5. Habitat management plans and the associated environmental assessment should be reviewed by the Sierra Bighorn Interagency Advisory Group.

D. MONITORING AND RESEARCH

1. Monitoring

The purpose of monitoring is to provide information on bighorn distribution, habitat use, population status, reproduction and mortality. This information is necessary to make recommendations

for habitat improvement, herd augmentation or herd reduction, and to compare results with predicted effects. For reintroduced herds, monitoring is essential for determining the outcome of the release.

a. The Mt. Baxter herd will be continually monitored in order to use it as reintroduction stock. Minimum monitoring will be yearly winter censuses.

b. The Mt. Williamson herd will be monitored when conditions are optimal for an accurate census. Good census data should be obtained approximately every three years.

c. Reintroduced Herds

1) At least 40 percent of the sheep released at a site should be fitted with telemetry collars.

2) Sheep will be monitored daily for at least two weeks immediately following reintroduction.

3) Sheep should be monitored winter and summer for the first two years following reintroduction.

4) Reintroduced herds should be monitored annually until their populations exceeds 50 or have stabilized at some lower number.

5) Once reintroduced herds are well-established, optimal conditions should be taken advantage of so as to obtain good census data approximately every three years.

6) The monitoring program, funding, and other responsibilities will be determined prior to any reintroduction.

d. A status report will be written yearly so long as annual monitoring continues, and following each census thereafter.

2. Research

Continued research will enable more accurate evaluation of habitat on potential reintroduction sites. Of particular interest is habitat from the standpoint of both nutrition and predation and the tradeoffs bighorn make between these factors. Both these factors will strongly influence population growth rate.

III. MANAGEMENT RECOMMENDATIONS

Consonant with the policies and directives of the individual management agencies, and in keeping with the provisions of this plan, the following management actions are recommended. The agencies responsible for each action are listed in parentheses. Identification of responsibilities and approval of this plan indicate agency support of the needed work and priorities, but are not a promise or commitment of funds. Work will be completed as funding becomes available. These recommendations will be updated regularly.

A. Population Management

1. Continue to protect the integrity of the Mt. Baxter herd and manage it as transplant stock through periodic removals. (California Department of Fish and Game)

2. Seek consultation on maintenance of genetic diversity and recommend action based on best scientific advice available. (Sierra Bighorn Interagency Advisory Group)

B. Reintroductions

1. Initiate the environmental assessment process to evaluate the feasibility of reintroducing bighorn sheep to each proposed site where adequate weather, habitat and disease potential data are available. (Inyo National Forest, Yosemite National Park, Sequoia and Kings Canyon National Parks)

2. Study habitat on potential bighorn range for reintroduction feasibility where all habitat parameters are not known. This includes an assessment of snow depth, forage availability and migration corridors to seasonal ranges. (Sequoia and Kings Canyon National Parks, Inyo National Forest, Yosemite National Park)

3. Determine the presence or absence of insects that vector diseases in potential sites where domestic grazing is present. (California Department of Fish and Game, Inyo National Forest)

C. Habitat Management

1. Monitor the effects of current equine grazing on bighorn habitat use patterns, food habits and movements in the Mt. Baxter herd winter range. (Inyo National Forest)

2. Initiate the environmental assessment process to evaluate the feasibility of timber removal in Diaz Creek to improve winter habitat of the Mt. Langley Herd. (Inyo National Forest)

3. Monitor any habitat modification to determine effect on bighorn herd.

D. Monitoring and Research

1. Continue annual monitoring of the Mt. Baxter herd. (California Department of Fish and Game, Inyo National Forest, Sequoia and Kings Canyon National Parks)

2. Conduct monitoring of other herds at the following levels of intensity (Calif. Dept. of Fish and Game, Inyo National Forest, Sequoia and Kings Canyon National Parks):

   a. Mt. Langley: intensive seasonal monitoring

   b. Wheeler Crest: seasonal monitoring

c. Mt. Williamson: monitor seasonally when weather conditions provide optimal census opportunities

3. When reintroductions are approved, research should be conducted to address the following:

   a. Evaluation of transplant outcome.

   b. Seasonal distribution and food habits of transplanted sheep.

   c. Importance of forage quality and habitat conditions relative to individual and population growth rates for Sierra bighorn. (Yosemite Natitonal Park, Calif. Dept. of Fish and Game, Sequoia and Kings Canyon National Parks, Inyo National Forest).

4. Investigate the potential for disease transmission from cattle, horses and llamas to bighorn sheep.

APPENDIX

Management of the Mt. Baxter Herd for Reintroduction Stock

Wehausen (1979, 1980) concluded that the Mt. Baxter herd had undergone a large population increase during the 1970's that presumably began in the previous decade. Additionally, he demonstrated that the rate of increase for any year during this period, as measured by winter recruitment ratios, was primarily under the control of winter precipitation two years prior, through its influence on nutrition and subsequent ovulation rates.

As of 1979, population density exhibited no statistically evident effect on recruitment ratio for the Mt. Baxter herd. However, in both 1980 and 1981, this ratio was 11 lambs per 100 ewes below the value expected on the basis of precipitation, while in 1982 it returned to the predicted value. (During all previous years of data it deviated no more than 6 lambs per 100 ewes from expected). The most likely explanation for these data is that density effects began appearing due to the population increases that resulted from high recruitment in 1976 and 1977. Thus, the influence of the 1978 population density on individual nutrition acted in addition to precipitation in determining body condition of ewes and resultant ovulation rates that fall. Since the population changed insignificantly between 1978 and 1979, this density effect should have persisted relatively unchanged; whereas the removal of 31 bighorn from the population in 1980 for reintroductions should have relieved it, causing the return to the predicted recruitment ratio in 1982. The absence of discernible density effects until fairly high population density is in accord with the expected pattern for an animal with the life history characteristics of bighorn sheep (Fowler 1981a, 1981b).

Maximum sustained yield for such a demographic pattern will occur at the population size where density effects first enter. Since the Mt. Baxter herd numbered 220 in 1978, this point can be estimated to occur at a population of about 200. Consequently, an approximate harvest expectation can be calculated for different population sizes up to this density. These calculations are based on the following assumptions: (1) a ram: 100 ewe ratio of 70 recorded in this population prior to sheep removals (Wehausen 1980), (2) a recruitment ratio of 32 lambs per 100 ewes calculated to be necessary for population maintenance (Wehausen 1983);

and (3) an average (expected) recruitment ratio of 43 lambs per 100 ewes based on long-term precipitation means. This has also been the average ratio for 11 years of recruitment data up to 1982 (excluding the two years with apparent density effects). The following table lists the results:

Total* Population	Number of Ewes	Average No. of Lambs	Average Annual Removable Surplus to Maintain Population
200	94	40	10.0
190	89	38	9.5
180	85	36	9.0
170	80	34	8.5
160	75	32	8.0
150	70	30	7.5

*excluding Goodale Creek

This table is not intended to serve as the basis of a schedule of animal removal, but as a general indicator of what can be expected. What it suggests is that a reintroduction of twenty bighorn will be possible every other year on average if the Mt. Baxter herd is maintained at an average of about 94 ewes. If the Mt. Baxter herd is harvested down to 70 ewes, about three years will be necessary between reintroductions. These correspond to total populations of 200 and 150, respectively, if the adult sex ratio is maintained at about 70 rams per 100 ewes. A higher sex ratio will have adverse influences in lamb production if it results in a population in excess of 200. This approximate harvest schedule assumes that the sex ratio of sheep removed will parallel that in the population. For a reintroduction of 20 sheep, this means 11 or 12 females, including lambs. The desirability of about 15 females in a reintroduction means that removals for reintroduction will not usually be possible every other year, even at maximum sustained yield. What the actual harvestable yield will be depends on precipitation patterns and any other factors that might influence lamb recruitment. Continual monitoring of the Mt. Baxter herd will consequently be a prerequisite to using it as a source of reintroduction stock. Weather conditions do not allow a complete census of the Mt. Baxter herd every year. However, good population estimates can be made based on years of good census data and winter lamb: ewe ratios in subsequent years using the population maintenance ratio of 32 lambs per 100 ewes calculated by Wehausen (1983). It is undesirable to make

such estimates for more than 4 consecutive years, since any errors would be compounded. There is considerable evidence that Sawmill Creek separates two distinct wintering populations of bighorn. Consequently, removals for reintroduction should strive to harvest both populations in proportion to their occurrence in 1978 of 26 percent of the ewes north of the creek. It is also desirable to maintain the natural sex ratio.

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APPENDIX I

ADDENDUM TO THE SIERRA NEVADA BIGHORN SHEEP RECOVERY AND CONSERVATION PLAN

In 1986, 27 Sierra Nevada bighorn sheep were transplanted into Lee Vining Canyon. There are 18 sheep remaining in Lee Vining Canyon, and 5 have emigrated to Bloody Canyon. Consequently, only 5 reproductive ewes remain in Lee Vining Canyon. Intensive study indicates that habitats will support a successful herd; however, predation and emigration have threatened the reproductive population.

The Sierra Nevada Bighorn Sheep Recovery and Conservation Plan (SNBSRCP) specifies that a minimum of 18 and 52 ewes remain north and south of Sawmill Canyon, respectively, following removal. Currently, there are 18 and 56 ewes, respectively, in these populations.

On 10 December 1987, the Sierra Nevada Bighorn Sheep Interagency Advisory Group concluded that the risk of losing the Lee Vining herd was significantly greater than impacts on the Baxter herd if sheep were removed to augment the Lee Vining Canyon herd. This addendum permits an exception to the the SNBSRCP by allowing the removal of 10 ewes from that portion of the Baxter Herd south of Sawmill Creek (Sand Mountain population) during the winter of 1988. This could potentially reduce the Sand Mountain population to 46 reproductive ewes, 6 below the recommended level.

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