

NRB:b

Draft Work Plan (3/11/92)

COMPARISON OF POPULATION CHARACTERISTICS, GENETICS, HABITAT  
USE, AND RESPONSE TO BURNING OF A ESTABLISHED AND A  
COLONIZING HERD OF BIGHORN SHEEP

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INTRODUCTION

Bighorn sheep (Ovis canadensis canadensis) currently exist in fragmented, remnant groups in the western U.S. Present populations in the west are estimated at only about 40,000, or about 2-4% of historic numbers (Seton 1927, Buechner 1960). Disease epidemics associated with contacts with domestic livestock, habitat losses, overgrazing of rangelands, and uncontrolled marked hunting are blamed for the declines (Buechner 1960, Wishart 1978, Risenhover et al. 1988, Bailey 1980). The National Park Service (NPS) units of the Rocky Mountain region currently support 26 recognizable herds of 3 subspecies; 55% of these herds contain isolated populations of 50 or less individuals.

Most existing populations of bighorns in the west stem from translocations. A major management problem with translocated groups is their tendency to remain sedentary near the point of release (Risenhover et al. 1988, Bailey 1986). Many translocations fail to survive more than a few years (Bailey 1990). Sedentariness of bighorns may result in increased transmission of lungworms, overutilization of localized ranges, increased cortisol and stress levels, loss of historic migration routes, and increased vulnerability to predators (Bailey 1980, Spraker and Hibler 1982, Risenhover et al. 1988). Gene flow between native established herds apparently occurs primarily when dominant rams move between groups during the rut season (Festa-Bianchet 1986, Cochran and Smith 1983). Rams in transplant groups, however, often do not move at all from the release site (Lennarz 1979, Hogg 1984). Limited dispersal of translocated groups contributes to insularity or fragmentation of bighorn herds. Insularity of bighorns may result in extreme inbreeding, lack of gene flow between herds, and a greater probability of extirpation during a catastrophic event. Extreme inbreeding, the mating of close relatives, results in smaller horn sizes (Fitzsimmons 1992) and lower lamb survival (Sausman 1982) in bighorns and smaller antler size and lower fecundity in other ungulates (Ralls et al. 1979, Cothran et al. 1983). Minimum viable populations of bighorns likely require 125-600 individuals (Berger 1990, Smith et al. in press, Craighead et al. 1991). However, no precise estimate of minimum viable population size is available for bighorns. Populations of < 50 individuals are too small; no population of this size survived for

60 years in the west (Berger 1990). Populations that are small (30-50) for 20 years likely will be subjected to a genetic bottleneck (S. Buskirk, pers. corres.).

The sheep presently occupying Badlands National Park result from a transplant from Pikes Peak, Colorado (the Rocky Mountain subspecies) in 1964. The original Badlands subspecies for the prairie area of the Dakotas and eastern Montana (O. c. audoboni) was extirpated by the early 1900s. The transplanted herd grew slowly and in 1980 was still estimated to be only 27 head (McCutcheon 1980). Starting about 1981, the herd grew rapidly and presently numbers in excess of 120. During the 1980's dispersing bighorns apparently from the north unit colonized the Stronghold or south unit of the park, a dispersal distance of 45 km. Unsuccessful ram dispersals have also been observed 30 km to the east of the park near Kodaka (L. Koertje, pers. corres.). The bighorns of Badlands Park are predicted to be inbred as a consequence of the 17-year bottleneck (Berger et al. 1990). The Badlands bighorn population has violated 3 rules of conventional wisdom:

- (1) The population currently exhibits very high recruitment in spite of a 17-year genetic bottleneck,
- (2) The herd has exhibited a high rate of dispersal, unlike most transplanted herds,
- (3) Not only rams, but also ewes, have been involved in the successful dispersal to the southern unit,

Almost nothing is known concerning the characteristics of a naturally colonizing population of bighorns. What sex and age classes were involved in the initial dispersal? Do the animals differ in genetics from the established or source group? To the best of our knowledge, no similar opportunity exists in the west to observe a naturally colonizing group of bighorns.

The existence of a naturally colonizing group also presents a unique opportunity to test the application of habitat models presently being developed and used in the Rocky Mountain region (Smith et al. 1992, Smith 1991). No such model exists for prairie habitat. The existing habitat models have been criticized for lack of testing; for example the models can not really be tested on a transplanted group since they tend to remain where they are placed. A naturally colonizing group, however, that is allowed to freely select the most preferred habitats is a valid test of the models.

The purpose of this investigation is to compare the genetics, home range size, movements, and habitat use patterns of bighorns in the established north unit and the colonizing population in the south unit. A badlands bighorn habitat model will be developed for the north unit. The pattern of occupation of the Stronghold and Palmer units will first be predicted with the model and then this prediction will later be tested against the observed occupation of

the south unit. Almost no other valid scientific test of HEP (habitat evaluation procedures) are available. Most tests of HEP involve circular reasoning; i.e. HEP are tested in the same area they are developed for. Tests of HEP on transplanted groups are invalid since transplanted bighorns tend to remain sedentary where they are transplanted and they therefore exhibit little real habitat preference.

Experimental prescribed burning will be conducted in the north unit to see if bighorns will expand their area of occupied range to exploit the burns. Prescribed burning will also be experimentally conducted to see if fecal lungworm rates can be lowered in bighorns. A special concern in Badlands will be to protect islands of pinyon-juniper which may be critical to bighorns as cover. Prescribed burning in the Rocky Mountains has been demonstrated to reduce tree and shrub cover, to increase the distance bighorns feed from escape terrain, to reduce lungworm rates, to increase foraging efficiency, to increase diet quality, and to increase horn growth rates in rams (Shannon et al. 1975, Stelfox 1971, Elliot 1978, Hobbs and Spowart 1984, Peek et al. 1985, Seip and Bunnell 1985, Johnson and Strang 1983, Hurley and Irwin 1986).

It is also the purpose of this investigation to address all of the additional management needs for bighorns expressed in the park's Resources Management Plan and Environmental Assessment (Badlands National Park 1984). These needs include:

- (1) Determine if bighorns are using any critical natural or rehabilitated water sources. Determine the extent of co-use of water sources by bighorns and bison.
- (2) Determine through radiotelemetry studies if bighorns are contacting any domestic livestock along the fence or with trespass livestock that penetrate the fence.
- (3) Monitor lungworm rates in bighorns in both units.
- (4) Apply the habitat model in both units to see if any high quality seasonal or lambing habitat exists that could be occupied after development of a water source. Apply the model to see if any apparently suitable habitat remains unoccupied. Apply the badlands habitat model in Theodore Roosevelt National Park and for the Slim Buttes area of South Dakota where bighorn restoration is being considered.

#### RELATIONSHIP TO OTHER STUDIES

A total of 29 bighorns were captured in the north and south units of Badlands National Park in late February with a net gun and helicopter. Twenty-one of these animals were radiocollared for a separate project to develop a census technique for bighorns (Singer and Garton 1992). Blood, tissue, and swab samples will be drawn

from the bighorns for studies of diseases (Williams et al. 1992) and genetics (Buskirk and Johnson 1991). The disease antibodies of bison will also be sampled during the next roundup. The disease and genetic information will aid Badlands park managers in evaluating the need for (and wisdom of) genetic augmentation of the herd. The information gathered on diets, habitat use and forage offtake by bighorns will greatly aid future carrying capacity estimates for large herbivores in Badlands. A carrying capacity model is currently in progress for Wind Cave National Park (Swift and McNulty Huffman 1991) with possible application to Theodore Roosevelt and Badlands National Parks.

This project is dependent upon GIS information becoming available by next winter in terms of a vegetation map and digitized elevation and slope (S. Wynn, NPS, pers. corres.). The habitat modeling portion will be benefitted by over 600 bighorn group locations gathered during a 3-year study of the bighorns (1987-89) by Ted Benzon of South Dakota Game, Fish and Parks. His group locations are accurate to + 200 m, but they will be useful in a landscape approach to occupied versus occupied habitat.

#### MANAGEMENT IMPLICATIONS

The disease and genetics surveys will enable the park staff to decide whether or not augmentations to either existing bighorn herds are advisable. There are considerable risks in mixing bighorns stocks with different disease antibodies. The genetic work will advise managers whether or not the animals in the south unit are unique in any way, or if, due to small founder size, they are inbred. The habitat model effort will provide three important pieces of information to park managers: (a) whether or not unoccupied habitat exists, (b) whether or not habitat exists that could be occupied with additional water sources, (c) a predictive estimate of the numerical carrying capacity of the Stronghold and Palmer units. The park could be approached for proposals to hunt in the south unit, if the herd continues to grow. Park staff would benefit from an estimate of the numbers of bighorns the south unit can support. Similarly, numerical estimates of a fully-occupied north unit would be useful during consideration of requests for transplants.

Prescribed burning or letting some wildfires burn is one of the few active management measures that park staff could take to benefit bighorn sheep. Fire suppression has likely resulted in unnatural conditions on bighorn ranges. Burning may reduce lungworm rates in bighorns and increase the area used by bighorns. Burning in bighorn range has been extensively studied in Rocky Mountain environments, but never to my knowledge in a prairie environment. Management of water sources is a second potential management practice for bighorns. This project will identify key water sources and areas of good bighorn habitat where water sources are lacking.

## FIELD METHODS

### Genetics, Diseases, Demography and Population Sizes of the 2 Units

1. Associated population, disease, and genetic information will become available through the other studies funded through the regional initiative. Disease information will include testing for Pasteurella, Brucella, Mycobacterium, Leptospirosis, Toxoplasma, lungworms, and stress evaluation through cortisol (Williams et al. 1992). Genetic analysis will include protein heterozygosity, DNA fingerprinting, DNA heterozygosity, and an index of relatedness (Buskirk and Johnson 1991). Population sizes, and sex and age characteristics will be sampled during two helicopter surveys each winter (Singer and Garton 1992). The goal is to maintain 20 radiocollared bighorns in the north unit and 12-14 in the south unit for the studies.

2. Census efforts will require 10-13 field ground crews in the north unit and 7-10 in the south unit the day of the aerial census. Sighting conditions and reactions of the bighorns will be recorded by the ground crews at the moment the helicopter passes. Sighting conditions for animals seen and not seen will form the basis of a sightability model for correction of future census flights (Singer and Garton 1992).

### Habitat Use

1. Habitat use of the radiocollared animals will be determined through a combination of ground triangulation, ground visual observations, and aerial locations. Visual observations will be emphasized. During each ground and aerial visual location the following habitat information will be collected: vegetation type, slope, aspect, elevation, topographic position, distance to known water sources, distance to escape terrain, distance to p-j cover, distance to high, precipitous terrain (clay walls), group size, sex and age composition of the group, and behavior of the group.

2. More detailed habitat information will be recorded for every 5th group location. The site will be inspected after the animals leave and the following additional information will be recorded: forages consumed, availability of forages (% cover), relative abundance of snails (ab, mod, ra), clay caves, other shade, presence of water, p-j cover, and other microsite conditions.

3. Seasonal and annual home ranges will be calculated for each radiocollared animal with adequate data. A minimum of 25 radiolocations will be required for each seasonal home range, or 100 per year per animal for an complete annual home range.

### Document and Map Water Sources

1. Extensive foot and horseback surveys will be conducted in both units to locate and map all year-round water sources. Local

ranchers, rangers, and others will be interviewed concerning the location of water sources. Each source will be visited four times/year and the presence of all ungulates (bighorn, bison, cattle, mule deer, pronghorn) will be recorded from visual, track and scat sign.

### Diets

1. Diets will be estimated from microhistological analysis of feces. A minimum of 15 aggregate samples will be collected during each season, or 60 total per year. Each aggregate sample will include 6-10 pellets from each of 6-10 fresh groups. Fresh samples will be gathered after bighorns vacate an area in order to avoid confusion with mule deer. These samples will be frozen right away. Additional samples will be collected for lungworm larval counts. The fecal samples will be air dried in paper bags.

### Prescribed Burning Experiments

1. Several (4 minimum) small prescribed burns will be conducted in and adjacent to the existing discrete, non-overlapping ranges of at least 4 radioed bighorns. Four replicates of the experimental treatment of burning will thus be available. The hypothesis will be investigated that bighorns will alter their habitat use and expand their home ranges to use the burns. Prescribed burning is a well established technique for Rocky Mountain bighorns but it is not studied for bighorns in prairie habitats. Home ranges will be determined for 1 - 1.5 years prior to and 1 - 1.5 years following the burning. The sites for burning will be selected following the first year of radiotelemetry studies. If feasible, the burns will be conducted in 1993.

2. Production and offtake will be compared between burned and unburned vegetation with the same site characteristics. Small grazing exclosures (n= 4) will be placed in each burned and adjacent unburned site. Similarity of sites and placement of exclosures will take place prior to the burning. Production will be measured 3 times each of the first 2 growing season following the burning.

3. Fecal lungworm rates in bighorns and snail abundance will be monitored before and after the burning along randomly-located line transects. Lamb ratios will be monitored before and after the burning.

### DATA ANALYSIS AND HABITAT MODELLING

1. Observations of habitat use of radiocollared bighorns in the north unit will be developed into a model following the procedures of Smith et al. (1992). Their habitat model found escape terrain (slopes > 40 %), distance from escape terrain (<200m), distance to

water sources (<3 km), steep lambing habitat, and open visibility were critical features of bighorn habitat. The model will be applied to and then tested against the observed habitat use patterns in the southern unit. The proportion of radiolocations outside of the predicted area of use will constitute a test of the applicability of the model. Essential elements of badlands bighorn habitat may include juxtaposition of high clay hills, a year-round water source, flat grassy "hay" buttes, and small clumps of p-j tree cover.

2. The final habitat model will be applied to Theodore Roosevelt National Park (both the north and south units) and the Slim Buttes area of northwestern South Dakota.

3. Bighorn habitat use will be compared between the 2 units using the G-test (Sokal and Rohlf 1969).

4. Any differences in sizes of home ranges before and after prescribed burning will be tested with the Mann-Whitney U test. Differences in habitat use will be tested with the G-test.

5. Any differences in diets between the north and south unit and before and after significant burning will be tested with analysis of variance.

6. Fecal lungworm rates, snail abundance, and lamb ratios will be tested before and after burning treatment using ANOVA.

#### ROLES AND RESPONSIBILITIES

F. Singer will provide technical and scientific supervision of the field crews at Badlands National Park and the GIS habitat modeling to be conducted at Colorado State University. Singer will also coordinate the activities of the consultants conducting the disease, genetics, and census analyses. Bruce Beskin will provide on-site logistic support and he will conduct the prescribed burns. Ted Benzon, SDG&F, has agreed to contribute his locations of bighorn sightings, 1987-89, to the habitat model. Tom Chapman, SDG&F, will conduct the occasional aerial radiolocation flights, when animals can not be located from the ground. Tom is co-investigator on the separate census project and he will coordinate the loan of 4-6 radio receivers and field employees for the annual census flight.

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## BUDGET

|                                                                                                             | BADLANDS<br>PARK<br>FY92 | REGIONAL<br>OFFICE<br>FY93    FY94 |            |
|-------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------|------------|
| NPS REGIONAL OFFICE ADMINISTERED                                                                            |                          |                                    |            |
| 1. Technician, GS-5                                                                                         | 7.3                      | 20                                 | 20         |
| 2. Student Conservation Association<br>volunteers: (1) Jun-Aug, (2) Nov-<br>Jan, (3) Febr-Apr @ 1.95k each. | 1.9                      | 5.9                                | 5.9        |
| 3. Vehicle                                                                                                  | 2.5                      | 4.8                                | 4.8        |
| 4. New equipment purchase (grazing<br>exclosures, field equipment)                                          |                          | 2.0                                |            |
| 5. Fecal analysis                                                                                           |                          | 7.5                                | 7.5        |
| 6. Nutritional analysis of burned<br>forages                                                                |                          | 6.0                                | 6.0        |
| 7. Travel (F. Singer)                                                                                       | .5                       | 1.0                                | 1.0        |
| 8. Trailer rental at Interior or<br>Wall for all field personnell<br>@ 250/mo. plus utilities               | 1.6                      | 3.8                                | 3.8        |
| 9. Upkeep of saddle horses for use<br>in South unit                                                         | <u>.5</u>                | <u>1.0</u>                         | <u>1.0</u> |
| SUBTOTAL                                                                                                    | 14.4                     | 52                                 | 50         |
| NREL ADMINISTERED                                                                                           |                          |                                    |            |
| 1. Data analysis (3 ms.) for habitat<br>models, programmer/biologist                                        |                          | 5.3                                | 5.3        |
| 2. Travel for programmer/biologist<br>during clipping periods                                               |                          | .4                                 | .4         |
| Indirect costs (.20)                                                                                        |                          | <u>1.1</u>                         | <u>1.1</u> |
| SUBTOTAL                                                                                                    |                          | 6.8                                | 6.8        |
| TOTAL NPS FUNDS:                                                                                            | 14.4                     | 58.8                               | 56.8       |

# SUMMARY OF CONTRIBUTED FUNDS

|                                                                   | <u>FY92</u>           | <u>FY93</u>           | <u>FY94</u>           |
|-------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|
| I. STATE OF SOUTH DAKOTA                                          |                       |                       |                       |
| A. Occasional aerial locations of<br>animals not found by ground. | 0                     | 2.0                   | 2.0                   |
| B. Transfer to NPS                                                | <del>2.0</del><br>2.0 | <del>6.0</del><br>8.0 | <del>6.0</del><br>8.0 |
| II. BADLANDS NATIONAL PARK                                        | 12.4                  | 2.0                   | 2.0                   |
| III. NPS, SCIENCE BASE FUNDS,<br>REGIONAL COMPETITIVE PROGRAM     | 0.0                   | 20.0                  | 20.0                  |
| IV. RMRO, BIGHORN INITIATIVE                                      |                       | 22.8                  | 20.8                  |
| V. FOUNDATION NORTH AMERICAN WILD SHEEP                           |                       | <u>10.0</u>           | <u>10.0</u>           |
| GRAND TOTAL                                                       | 14.4                  | 58.8                  | 56.0                  |