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GAME REPORT

Reintroduction of Rocky Mountain Bighorn Sheep in the Black Hills, South Dakota, 1986-1994

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Abstract

Reintroduction of Rocky Mountain Bighorn Sheep in the Black Hills South Dakota, 1986-1994

Numerous sites were evaluated within the entire Black Hills to determine potential release sites for bighorn sheep. Five sites were further evaluated for site specific advantages and disadvantages. Of these sites, Spring Creek Canyon was selected for the first transplant site. During 1991, 26 bighorns were released within the canyon. An additional 5 bighorns were released in the canyon during 1992. During 1991 and 1992, dispersal from the release site occurred and, by 1993, 3 sub-herds were established within the Black Hills. Population growth within all 3 sub-herds was documented with 29 in 1991, 42 in 1992, 51 in 1993, and 69 in 1994. Lamb production was documented at 6 in 1991, 11 in 1992, 12 in 1993, and 18 in 1994. Herd growth and lamb production and survival would indicate that the transplant was a success.

A survey of the bighorn sheep herd within the Badlands National Park was initiated to determine the feasibility of using a portion of the herd for transplant purposes within the Black Hills. Lamb/ewe ratios of 73/100 in 1988, and 79/100 in 1989 indicate good lamb production. Yearling/ewe ratios of 43/100 in 1988, and 41/100 in 1989 indicates good lamb survival. Survey results estimated population numbers at 133-200 bighorns within the park. Limited removal of bighorns from the Badlands National Park for transplant purposes was determined to be a viable option. Five bighorns were removed and transplanted within the Black Hills during 1992.

Preface

This report summarized data gathered by South Dakota Department of Game, Fish and Parks personnel during July, 1986 - December, 1994, on Reintroduction of Rocky Mountain Bighorn Sheep in the Black Hills, South Dakota, under Pittman-Robertson Project W-75-R, Study No. 7534.

This study was initiated to reestablish bighorn sheep in historical range in the Black Hills. Sheep were released in the winters of 1991 and 1992.

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Reintroduction of Rocky Mountain Bighorn Sheep
in the Black Hills, South Dakota, 1986-1994

INTRODUCTION

Audubon's bighorn sheep (Ovis canadensis auduboni) were native to the Black Hills and Badlands of South Dakota. Uncontrolled hunting had caused extinction of the subspecies by 1916 (Buechner 1960).

Several past attempts have been made in South Dakota to reestablish bighorn sheep within the Black Hills. In 1922, eight Rocky Mountain bighorn sheep (O. C. canadensis) were transplanted into what is now Custer State Park. The population grew to approximately 150 animals. However, the entire herd was eliminated by an unidentified disease by 1959. A second transplant was made in 1964, with 22 animals from Whiskey River, Wyoming, again in Custer State Park. This population increased to an estimate of between 100-150 animals by 1975 (Trefethen 1975). Although this reintroduction has established a resident herd of approximately 150 animals, recruitment appears to be only sufficient enough to maintain present numbers (McCabe et.al. 1984). McCabe et.al. (1984) investigated low recruitment as a result of heavy lungworm infestation. Spraker (1981) had found that lamb mortality due to pneumonia complex brought on by lungworm infestation could be an important limiting factor in bighorn herd population growth.

Another possible factor limiting Custer State Park herd growth could be due to the lack of exploratory or dispersal behavior common to bighorn sheep (Geist 1971). Winter range is also a potential limiting factor in population size and expansion (Coggins 1980, Rutherford 1972). Holl (1982) found that 245 hectares of winter range was required to support ten bighorn ewes. Overcrowding conditions resulting in poor quality and quantity of forage have been reported to affect reproductive success and lamb mortality (Fairaizil 1980, Long 1980).

Schmidt and Gilbert (1978) point out bighorn habitat still exists within their historic range. While considerable habitat change with pine encroachment has occurred in the last 100 years in the Black Hills, available habitat with the necessary rough terrain still exists, and could support additional small populations of bighorn sheep. Dispersal of transplanted bighorn sheep has been documented in several studies. Geist (1967) reported that reintroduced sheep behave like native, relict populations, remaining small in number and usually failing to spread far from the release site. However, Coggins (1980) believes that if

release of transplanted sheep occurred during the spring, immediate dispersal could be expected since bighorn sheep are normally moving to summer range at that time. Butts (1980) reported that in a Montana transplant the ewes lambed near the release site the first year; within 2 km the second year; and within 3 km following years. Another transplanted herd in Montana expanded 3 km west and 11 km east of the release site (Kapec 1982). Rutherford (1972) felt that dispersal of transplanted sheep would depend on the suitability of the release site.

Audubon's bighorn sheep (Ovis canadensis auduboni) were native to the Black Hills and Badlands of South Dakota. Uncontrolled hunting had caused extinction of the subspecies by 1916 (Buechner 1960). Past transplant efforts of Rocky Mountain bighorn sheep (Ovis canadensis canadensis) have resulted in two viable herds within South Dakota: Custer State Park and Badlands National Park. In addition, a small remnant band of 6-10 bighorns exist in Spring Creek Canyon.

In an attempt to reestablish several new viable herds of bighorn sheep within the Black Hills, the South Dakota Department of Game, Fish, and Parks began a cooperative venture with the Black Hills National Forest. Further bighorn sheep habitat was created in Spring Creek Canyon with vegetative manipulation consisting of clear-cutting and prescribed fire. In addition, a survey of the bighorn sheep herd within the Badlands National Park was initiated to determine the status of that herd and determine the feasibility of using a portion of the herd for transplant purposes.

In 1964, 22 bighorn sheep from Pikes Peak, Colorado were introduced into a 370 acre enclosure in the Badlands National Park by the South Dakota Department of Game, Fish, and Parks. The intent was to establish a captive population, with the progeny being used for further transplants within South Dakota and the park.

By August, 1967 the herd had only increased to 27 animals, at which time a die-off of 13 sheep reduced the group to: two adult rams, two adult ewes, four yearling ewes, and six lambs. Cause of the die-off was not known, however it was decided to release the remaining sheep into the Sage Creek Wilderness area within the park prior to any further deaths.

During 1980, a cursory survey by the National Park Service estimated the population at a minimum of 27 animals: eight rams, nine ewes, one yearling ewe, and eight lambs (McCutchen 1980). McCutchen felt that age structure of the herd indicated high lamb mortality causing a stable populations. Limited watering areas was felt to be the factor affecting lack of population

growth.

Since 1980, minimal survey work was conducted on the Badlands bighorn sheep herd. Population numbers, age structure, and lamb recruitment were virtually unknown. In order to assess the feasibility of using a portion of the herd for transplanting into the Black Hills, these factors needed to be determined.

OBJECTIVES

The objectives of this study were: 1) to reintroduce bighorn sheep within the Black Hills and evaluate success of such transplants; 2) to determine population status of released bighorn sheep; and 3) to determine population status of the Badlands National Park bighorn sheep herd.

Badlands National Park Study Area

The study area encompassed approximately 24,0000 acres of the Sage Creek Wilderness Area of the Badlands National Park (Figure 1). Habitat within the area is characterized by lowland basins mixed with vertical cliffs interspersed with grassy shelves and tables. Some dense stands of Rocky Mountain Juniper occur irregularly on steep slopes, with occasional Silver sage. Lowland basins, table tops, and shelves were usually dominated with western wheat grass, Japanese brome, sideoats grama, blue grama, buffalograss, green needlegrass, and little bluestem.

METHODS

In order to accomplish the objectives of the study, five different phases or jobs were outlined: Job 1) to determine bighorn sheep release sites; Job 2) to reintroduce bighorn sheep into determined release site; Job 3) to determine dispersal from release site; Job 4) to determine population status of released bighorn sheep; Job 5) to evaluate the Badlands National Park bighorn sheep herd as a possible source for transplant stock.

Job 1: Bighorn sheep release site

Determination of bighorn release sites were cooperatively made by the South Dakota Department of Game, Fish and Parks and the United States Forest Service. Site selection evaluated availability of

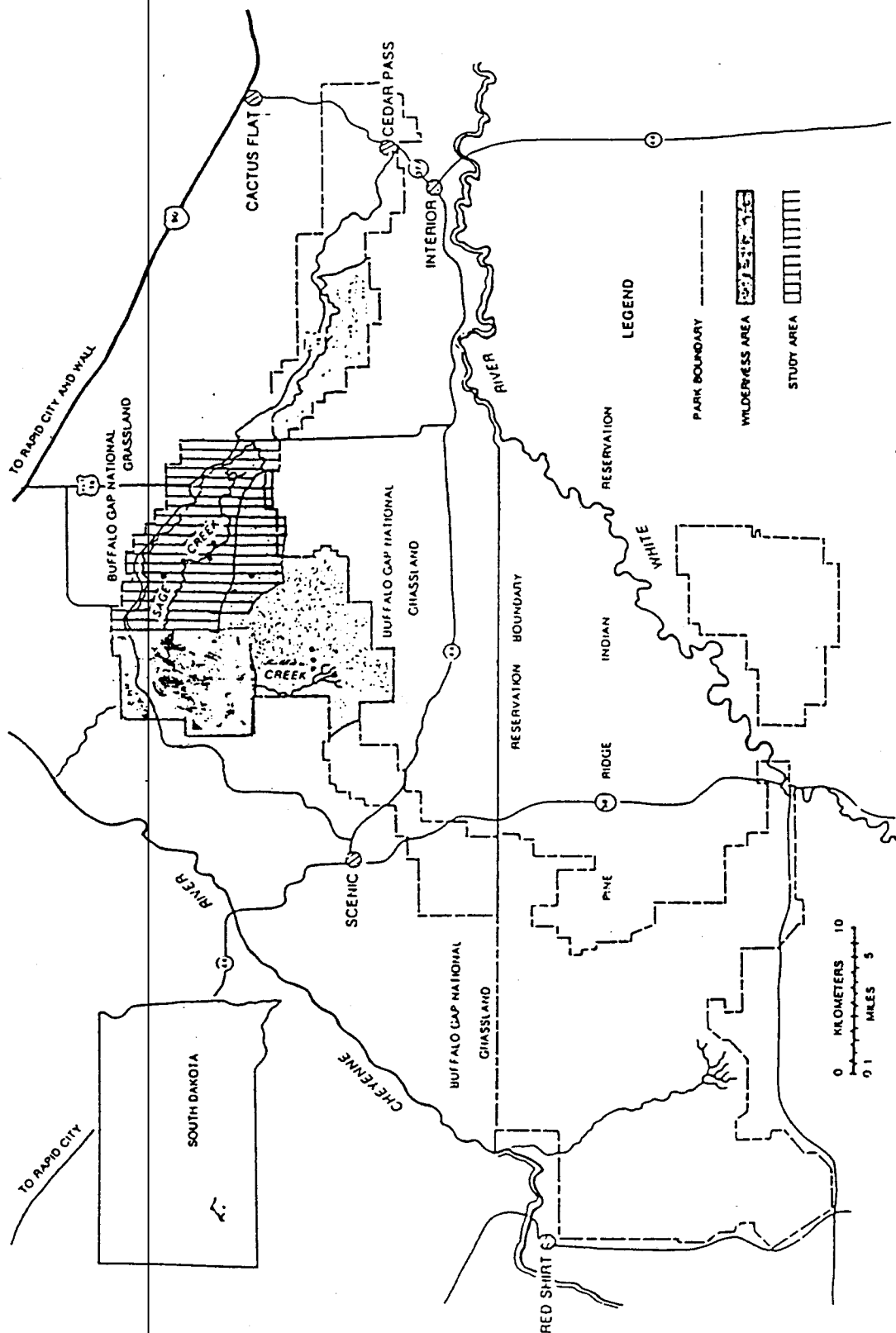


Figure 1. Badland National Park Bighorn Sheep Study Area

escape terrain, water sources, quality and quantity of forage by seasons, critical winter range, potential lambing areas, and other pertinent data. All sites were evaluated with on-the-ground inspections, aerial surveys, and aerial photographs.

Job 2: Bighorn sheep introduction

Bighorn sheep were acquired from sources with surplus animals. All released sheep were ear-tagged and a representative sample equipped with radio-collars. Prior to release all animals were treated with anti-helminthic drugs for lungworm infestation.

Job 3: Bighorn sheep dispersal from release site

On-the-ground observations were used to determine dispersal movements of marked and radio-collared animals. Daily and seasonal movements were used to determine if and when dispersal movements had stabilized.

Job 4: Black Hills bighorn sheep population status

After dispersal movements stabilized, daily and seasonal movements were used to determine migration paths, winter and summer ranges, and lambing areas. Reproductive success was determined with lamb counts during the summer and winter months.

Job 5: Badlands National Park bighorn sheep population status

Radio-collars were attached to selected adult bighorn sheep within the park boundaries. All radio locations and observations of marked and/or unmarked animals were plotted on topographic maps. Population composition: lamb/ewe ratio; yearling/ewe ratio; ram/ewe ratio; and number of bands within entire population was determined.

RESULTS AND DISCUSSION

JOB 1: Bighorn sheep release sites

Numerous areas within the Black Hills were evaluated for potential release sites for bighorn sheep. During November, 1986, Rich Sherman and Kevin Hurley from the Wyoming Game and Fish Department were invited by the South Dakota Department of Game, Fish and Parks to further evaluate selected sites. Of all areas evaluated, five sites were selected for potential release sites: Spring Creek Canyon, Dark Canyon, Pactola Reservoir area, Spearfish Canyon, and Hells Canyon (Figure 2). Further evaluation for site specific advantages and disadvantage were conducted and listed for each site (Tables 1-5). Spring Creek Canyon was selected as the first release site due to the existence of a remnant band of bighorn sheep in the area and the potential for habitat improvement.

During July of 1988, the U.S. Forest Service brought Steve Marquardt from the Grand Mesa, Uncompahgre and Gunnison National Forest and Rich Sherman, Colorado Division of Wildlife, to the Black Hills to evaluate the Spring Creek Canyon site and recommend habitat improvements within the site area. In order to help insure a success of the transplant, a habitat improvement plan was developed with U.S. Forest Service and Game, Fish and Parks recommendations. The plan, as described in an amended environmental assessment (1989), was implemented that will consist of total removal of all conifers in specific areas, thinning, controlled burning, seeding and fertilization, road closures and construction of fence lines to control livestock encroachment into the treated area. Approximately 600 acres will be treated within the canyon and surrounding area. In addition, 334 acres were redesignated by the United States Forest service to nonforested big game winter range thereby insuring perpetual nonforested open meadows.

Improvements began during the winter of 1988-1989, when 134 acres of pine was clear-cut. During April, 1990, a prescribed burn was conducted in the clear-cut area (Figure 3). Aerial seeding was conducted one week after the burn utilizing the following mixture: 30% Slender and 30% Thick Spike wheatgrass (Agropyron spp.); 10% Green needlegrass (Stipa viridula); 15% Indian ricegrass (Oryk;zopsis hymenoides); and 15% Yellow and Alsides Sweetclover (Melilotus spp.). Seed mix was applied at approximately 15 pounds per acre.

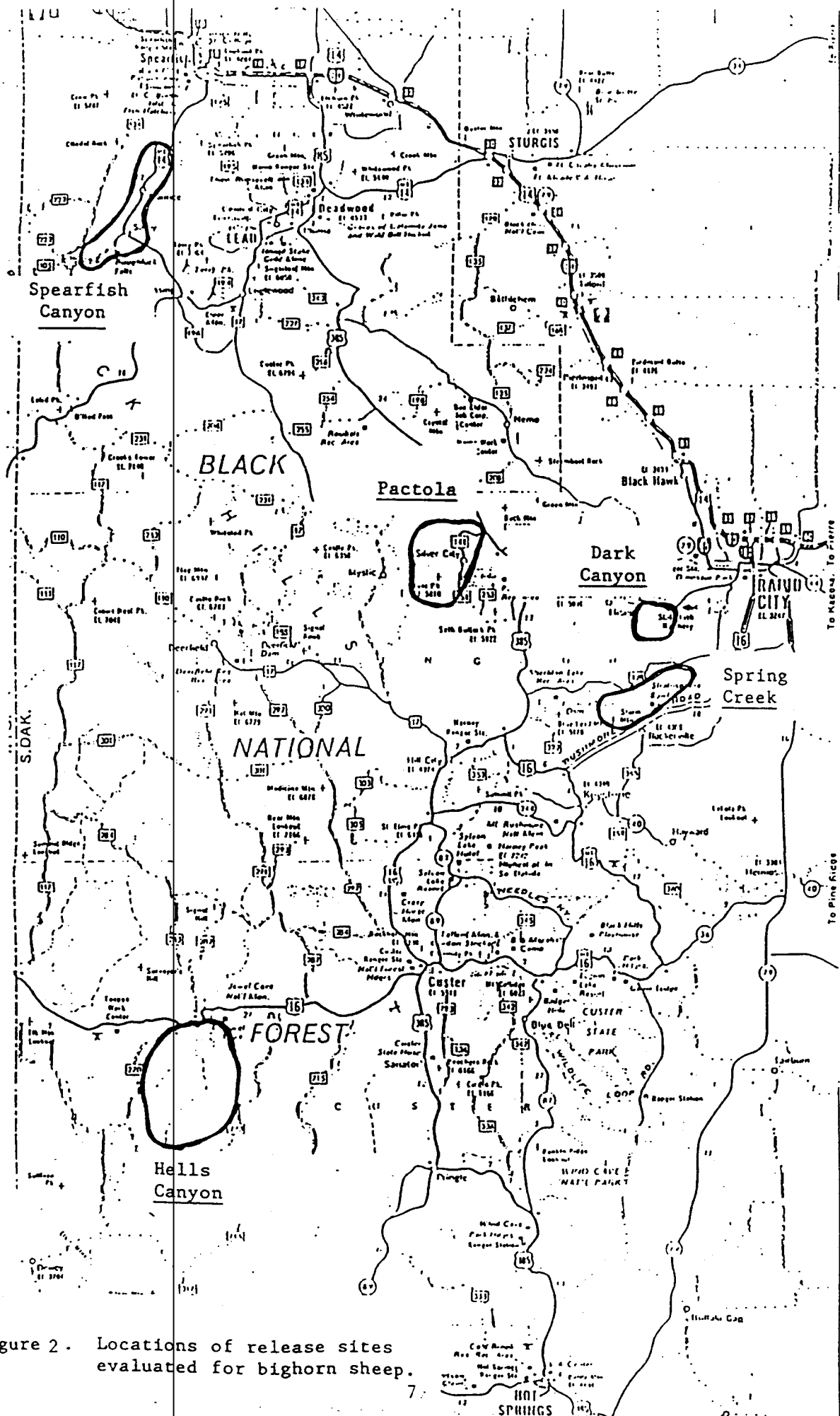


Figure 2. Locations of release sites evaluated for bighorn sheep.

Table 1. Spring Creek Canyon release site.

Site Advantages	Site Disadvantages
— Sheep present (8-10) Good water availability Good escape cover Low poaching potential Low livestock competition Low wildlife competition Good forage production Low snow depths USFS land jurisdiction	Medium canopy closure Subdivision development conflicts Lack of present population expansion Medium predation potential Medium treatment feasibility

Table 2. Spearfish Canyon release site.

Site Advantages	Site Disadvantages
Good water availability	High canopy closure
Good escape cover	Private land jurisdiction in bottom of canyon
Lack of livestock competition	Major highways in bottom of canyon
Low predation possibilities	High recreation conflicts
Low wildlife competition	Low forage production
	High snow depths
	Potential mining conflicts .
	Low treatment potential
	No sheep present

Table 3. Pactola release site.

Site Advantages	Site Disadvantages
Good water availability	Poor escape cover
Low predation potential	High canopy closure
Limited livestock competition	No sheep present
USFS land jurisdiction	High potential for subdivision development
	Critical deer winter habitat to south of site
	Low forage production
	Low treatment feasibility.
	Medium snow depths
	Medium poaching potential

Table 4. Dark Canyon release site.

Site Advantages	Site Disadvantages
Good escape cover	Small limited area
Good forage production	Private land jurisdiction
Good water availability	High dog-sheep conflict potential
Low predation potential	Highway on top of canyon-road in bottom of canyon
Low livestock competition	Low treatment feasibility
Low wildlife competition	No sheep present
Low canopy cover	
Low snow depths	
Low poaching potential	

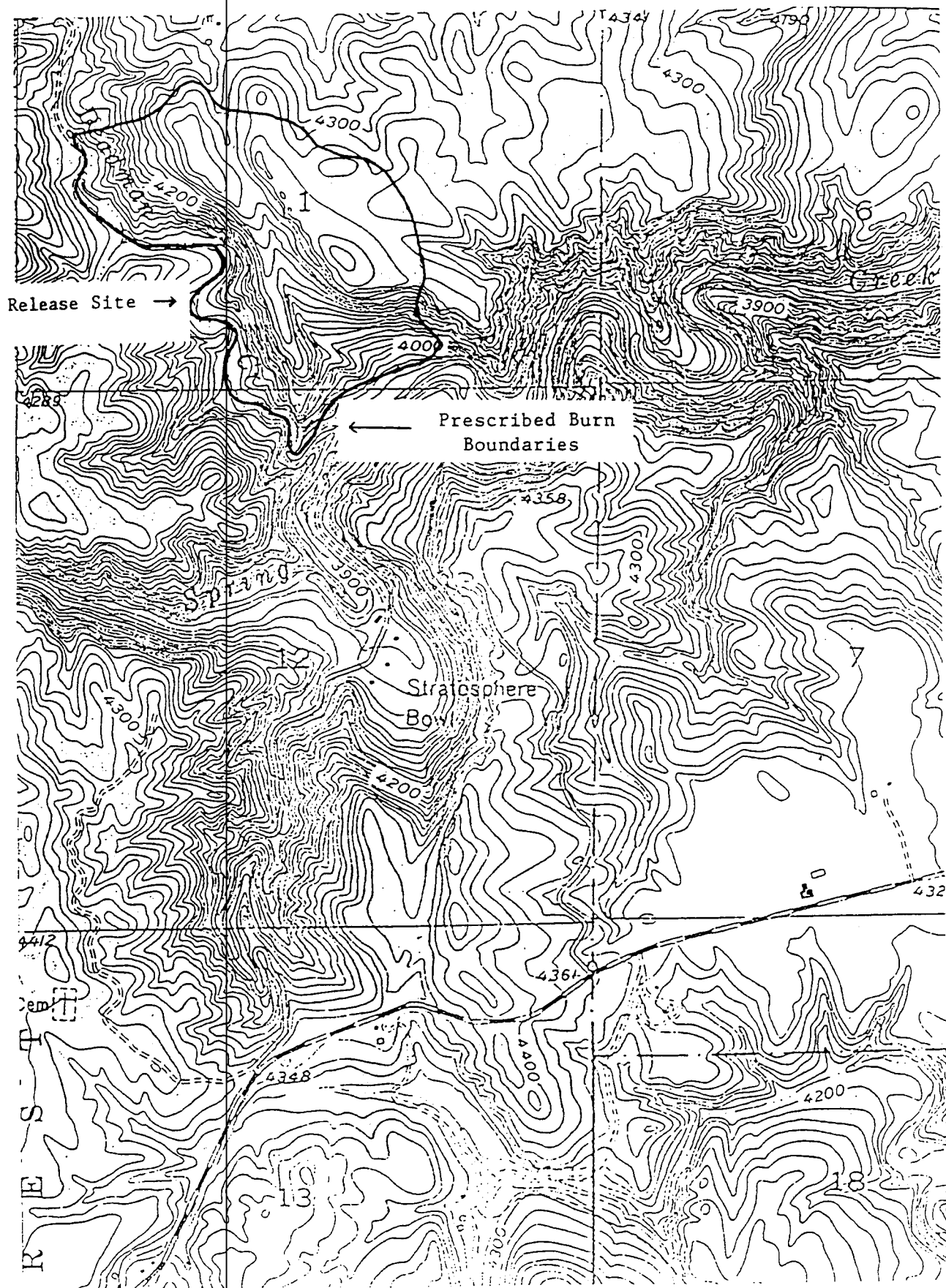


Figure 3 Spring Creek Canyon Prescribed Burn, April, 1990, Black Hills, South Dakota.

Table 5. Hells Canyon release site.

Site Advantages	Site Disadvantages
Low canopy closure	No sheep present
Low snow depths	Poor escape cover
Low human interference	Poor water availability
USFS land jurisdiction	Livestock competition
Good treatment feasibility	Road exists in middle of drainage
	High poaching possibilities
	Elk competition slight
	Medium forage production

Job 2: Bighorn sheep introduction

The first transplant of bighorn sheep into Spring Creek Canyon occurred on January 31, 1991. The animals were obtained from Georgetown, Colorado and consisted of seven rams (1- 3 year old, 1- 2 year old, 1- yearling, and 4 lambs) and 19 ewes (15 adults, and 4 lambs). All sheep were treated with anti-helminthic drugs for lungworm infection and anti-biotic drugs prior to release. All sheep were marked with red numbered ear tags for identification and seven ewes and two rams were fitted with Telonics (Telonics, Meza, AZ.) MOD 500 radio transmitters with whip antennas, attached to Butyl/Butyl collars. The ram transmitters were cast in polymer for shock resistance. All transmitters were equipped with motion-sensing mercury switches that accelerated pulse rates from 45 pulses per minute (ppm) to 90 ppm if sheep were inactive for more than 4 hours.

In February 1992, an additional five sheep (4 ewes and 1 ram lamb) from the Badlands National Park were released into Spring Creek Canyon. Again, these sheep were treated with anti-helminthic and anti-biotic drugs prior to release. The sheep were marked with white numbered ear tags for identification and the four ewes were fitted with Telonic's radio collars. These collars were similar

to previously described collars but lacked the motion-sensing capabilities.

JOB 3: Bighorn sheep dispersal from release site

Due to a lack of manpower, intense monitoring of the transplant was not possible. From the time of release until the winter of 1991-1992, minimal monitoring of the sheep was accomplished. Subsequent monitoring occurred sporadically for the remainder of the study.

Lamb/ewe group dispersal: By the winter of 1991-1992, of the seven radio-collared ewes obtained from Colorado, only one had not dispersed from the release area in Spring Creek Canyon. The six radio-collared sheep that dispersed were accompanied by an additional eight tagged sheep, leaving only 26% of the ewe and lambs at the release area.

Four radio-collared and four tagged ewes dispersed approximately 5 miles north to the Cleghorn\Dark Canyon area. Of these ewes, one was shot 10 months later during the rifle deer season. All of the remaining 3 collared ewes demonstrated a pattern of large movement during 1992, and subsequent years movements diminished to their present home range (Figures 4,5,6).

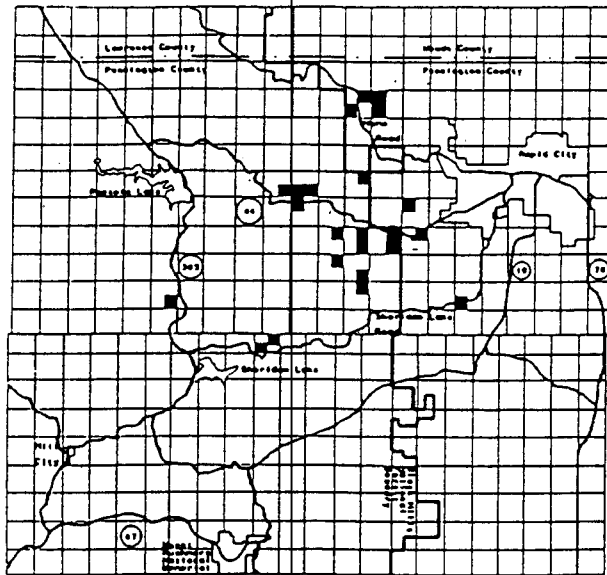
One radio-collared ewe and 4 tagged ewes dispersed approximately 8 miles west to the Sheridan Lake area. Again, during 1992, large movements were observed. However, as with the Cleghorn\Dark Canyon group, by 1994, movements were confined to a much smaller area (Figure 7).

A sixth ewe dispersed from the release area within the first year. However, she returned during 1993 and subsequently set up her home range there (Figure 8).

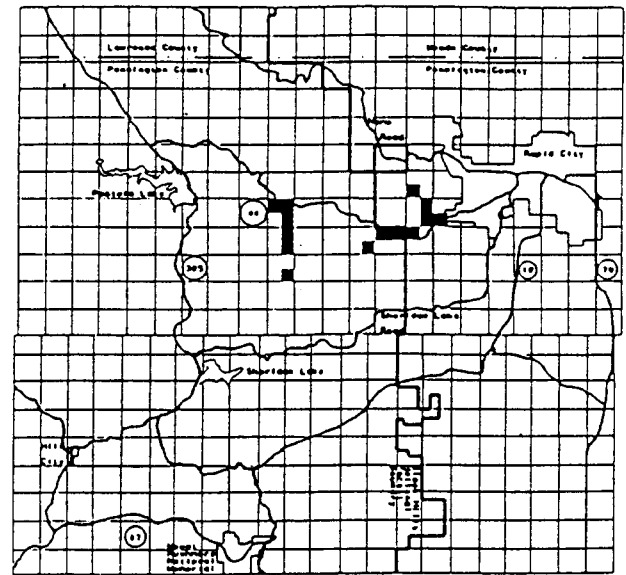
The remaining radio-collared ewe that did not disperse after release, stayed within the Spring Creek Canyon release area with five other ewes, lambs and numerous rams.

All five of the bighorn sheep trapped at the Badlands National Park and released into Spring Creek Canyon stayed within the area.

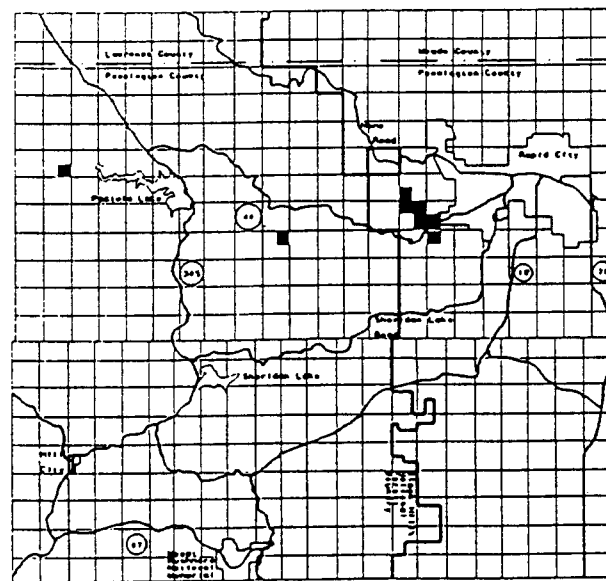
Ram Dispersal: There was no permanent dispersal by rams from the release site. Temporary movement by rams from Spring Creek canyon was noted for all of the transplanted rams, except the one ram transplanted from the Badlands National Park. Movement varied by time and duration. However, all rams returned and established within the Spring Creek canyon area, for at least a seasonal home range.



1992 Locations

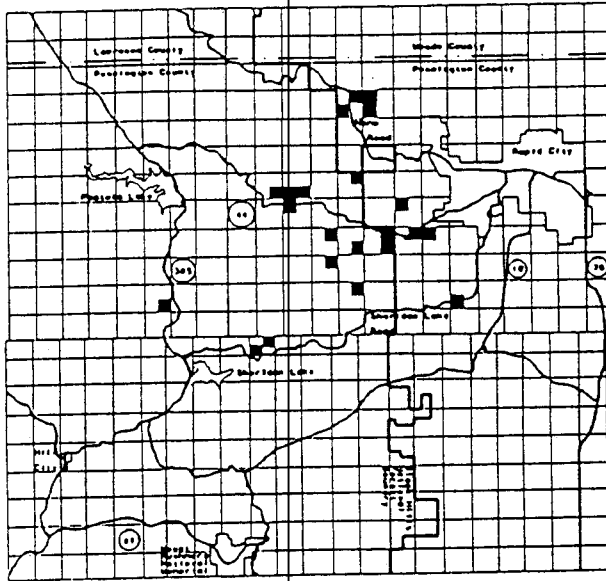


1993 Locations

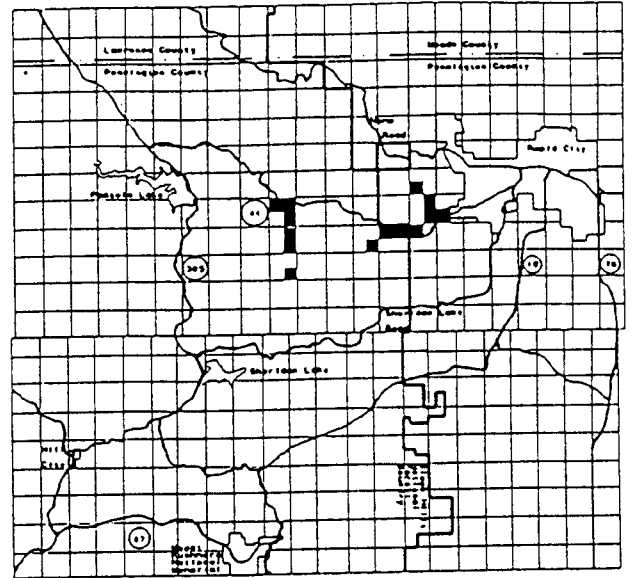


1994 Locations

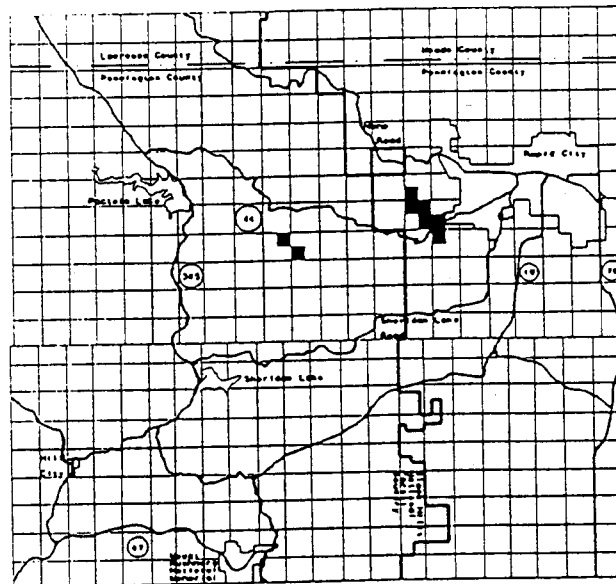
Figure 4. Radio telemetry location of ewe 151.010



1992 Locations

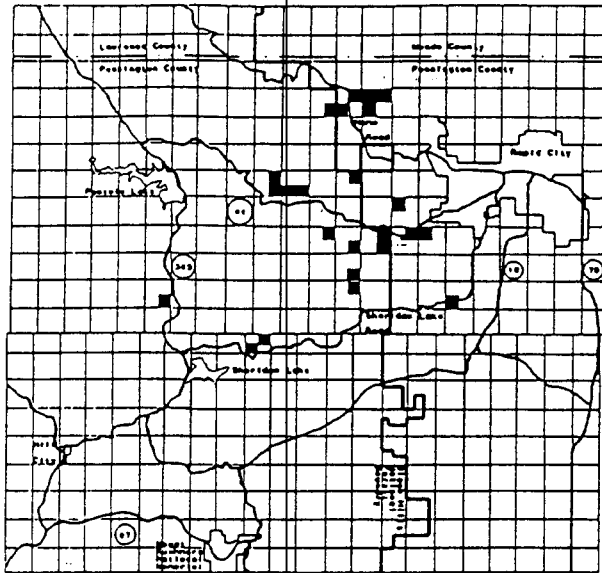


1993 LOCATIONS

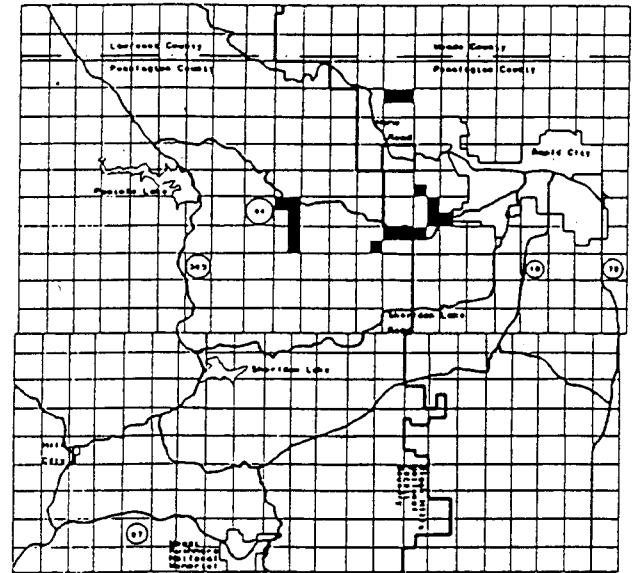


1994 Locations

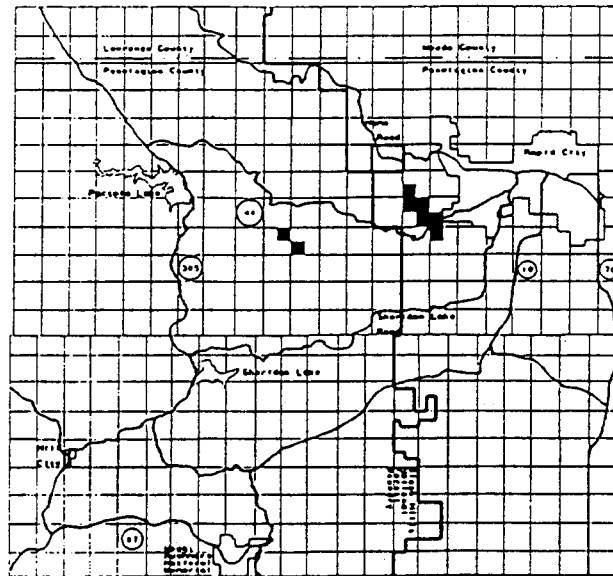
Figure 5. Radio telemetry locations of ewe 151.130



1992 Locations

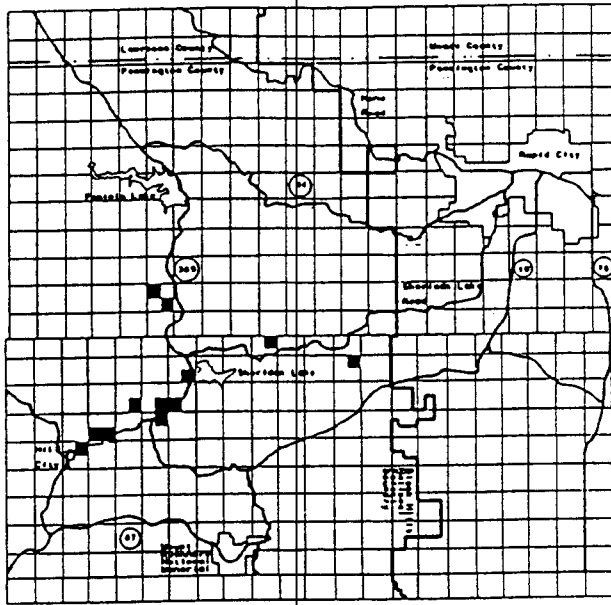


1993 Locations

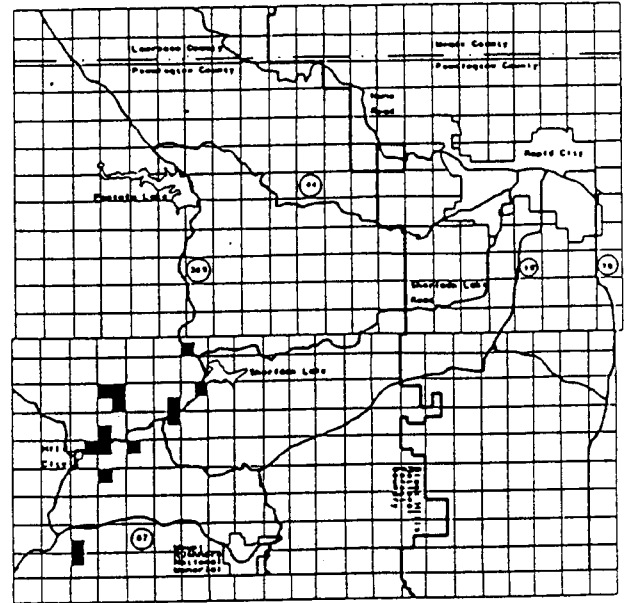


1994 Locations

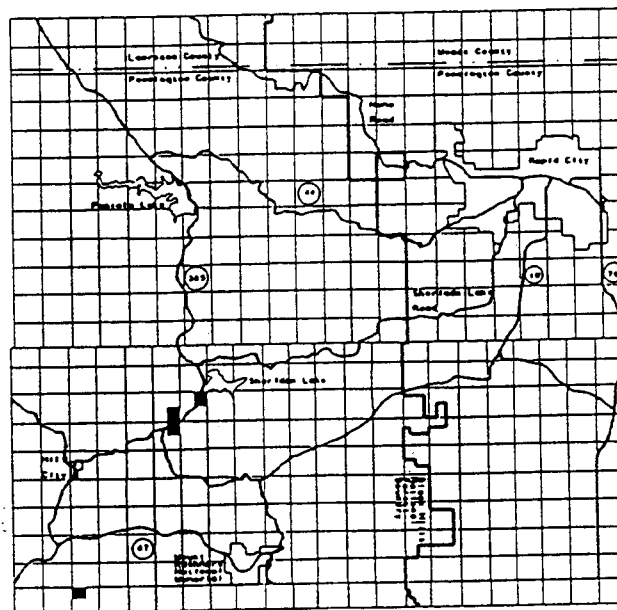
Figure 6. Radio telemetry locations of ewe 151.050



1992 Locations

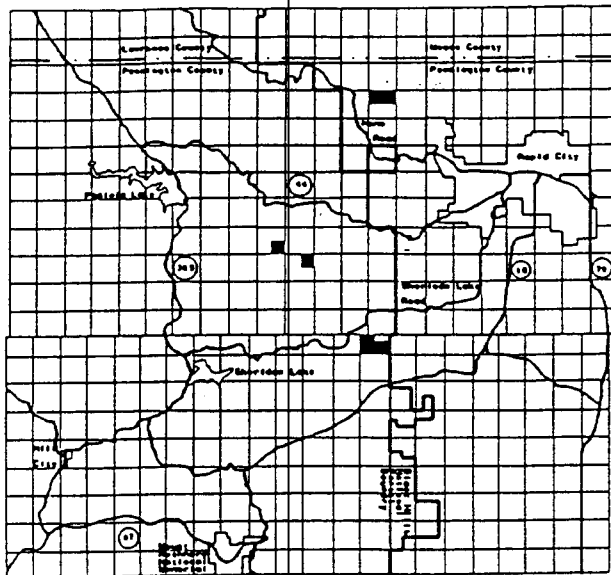


1993 Locations

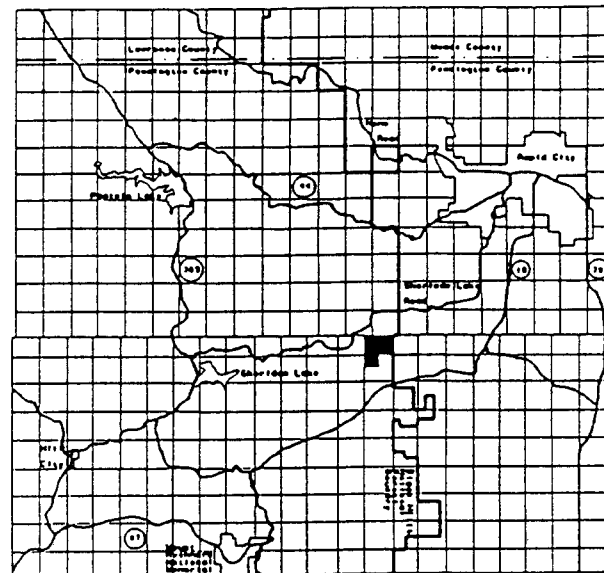


1994 Locations

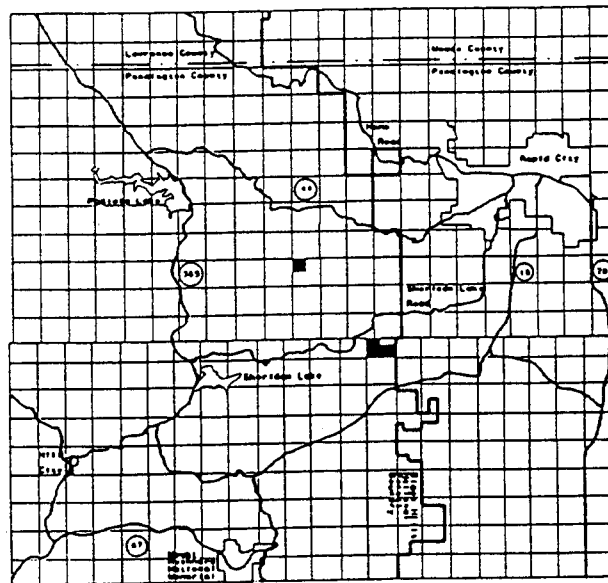
Figure 7. Radio telemetry locations of ewe 151.090



1992 Locations



1993 Locations



1994 Locations

Figure 8. Radio telemetry locations of ewe 151.150

During 1991, one radio-collared ram and two tagged rams moved approximately 35 miles north of the release site for a period of approximately 2 months. By July of 1992, this ram had established a pattern of seasonal movements utilizing an area 5 miles east of Spring Creek canyon (Hart Ranch) as summer range, and Spring Creek Canyon as winter range (Figure 9).

The second radio-collared ram moved between the transplant site, the Cleghorn\Dark Canyon ewe group, and the Hart Ranch area 5 miles east of Spring Creek Canyon for the first 2 years after the transplant. By the end of 1993, he had established 2 seasonal areas. Summer range is within Spring Creek Canyon, and during the rut and winter in the Cleghorn\Dark Canyon area (Figure 10).

Job 4: Black Hills bighorn sheep population Status

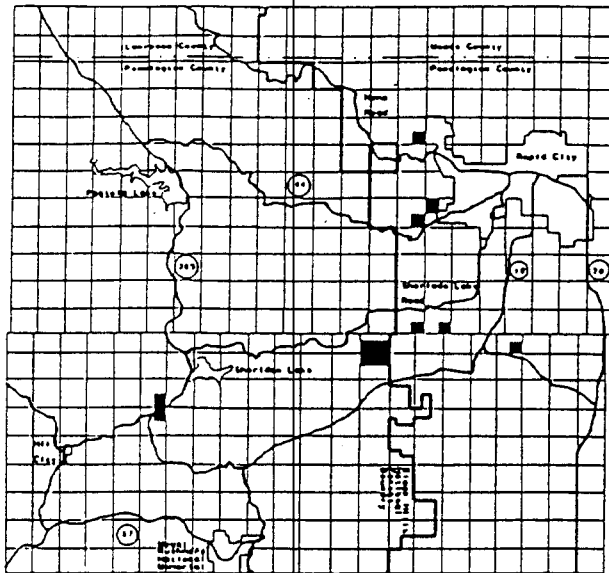
By 1994, dispersal from the original transplant site appeared to have ceased. Three distinct ewe/lamb groups (sub-herds) have been established: Spring Creek Canyon, Dark/Cleghorn Canyon area, and Sheridan Lake area. Ram movement between the 3 sub-herds has been documented.

Population growth within all 3 sub-herds was documented with the largest growth occurring in Spring Creek Canyon demonstrating excellent growth. Combined, the herds have grown from 29 in 1991, 42 in 1992, 51 in 1993, to 69 in 1994.

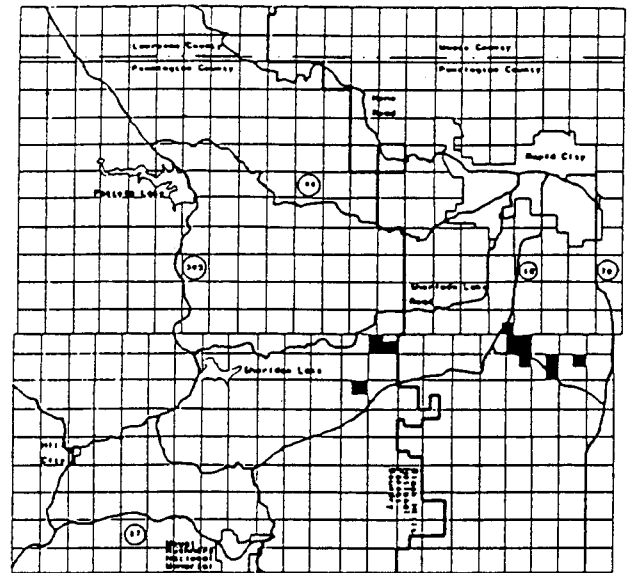
Lamb production and survival was documented on winter ranges for all 3 sub-herds (Table 6).

Table 6. Lamb production by sub-herd, 1991-1994

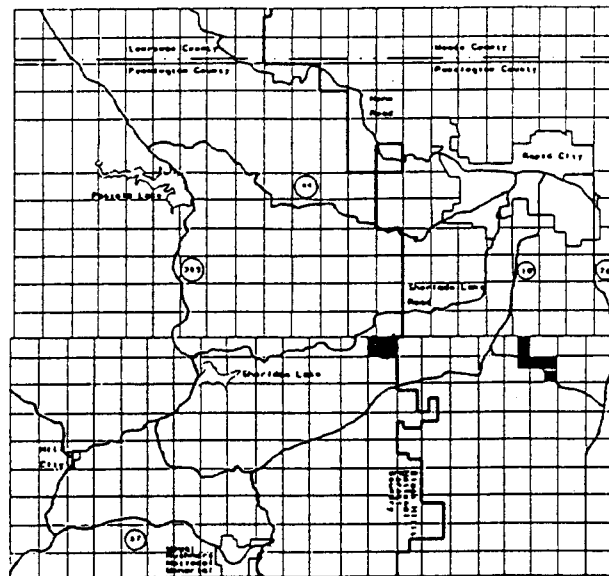
Sub-herd	Number of Lambs By Year			
	1991	1992	1993	1994
Spring Creek Canyon	6	9	7	10
Dark/Cleghorn Canyon	0	0	2	5
Sheridan Lake	0	2	3	3
Totals	6	11	12	18



1992 Locations

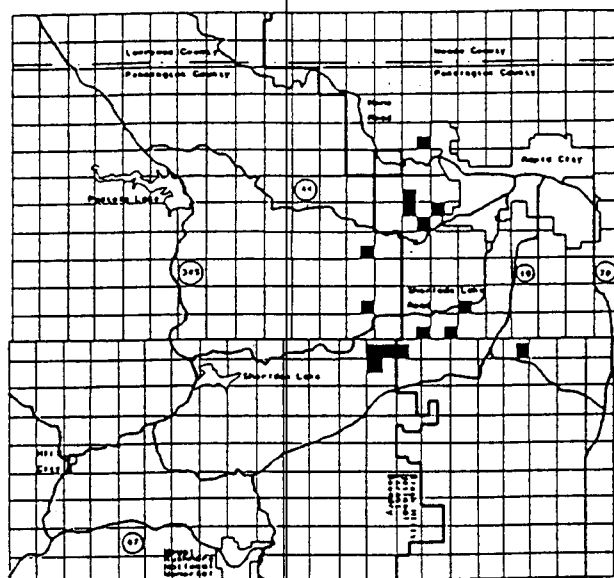


1993 Locations

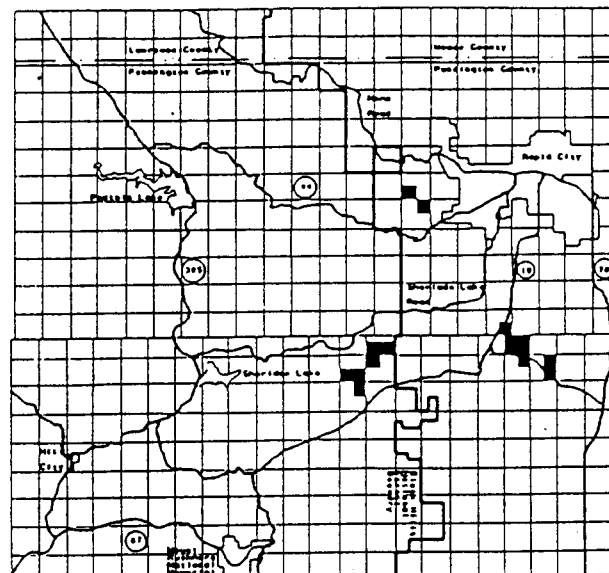


1994 Locations

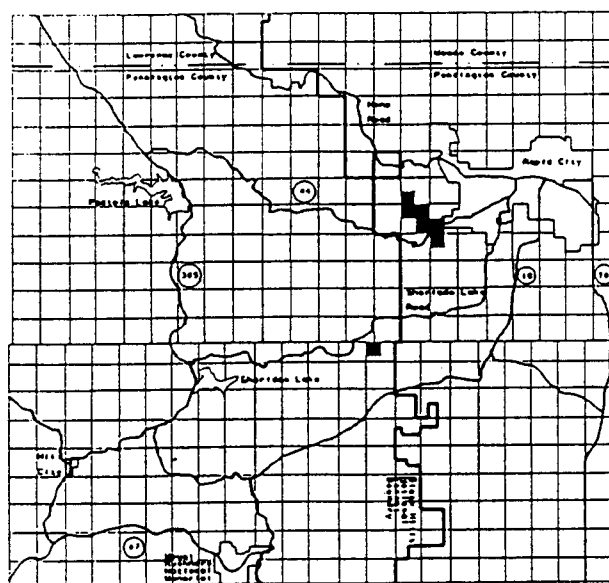
Figure 9 . Radio telemetry location of ram 151.290



1992 | Locations



1993 Locations



1994 Locations

Figure 10. Radio telemetry locations of ram 151.220

Job 5: Badlands National Park bighorn sheep population status

In 1987, two 2 1/2-year-old rams and three adult ewes were captured. An additional adult ewe was captured in 1988. Capture was accomplished with the use of a hand held net gun (Coda Enterprises, Meza, AZ.) from a helicopter. Captured sheep were fitted with Telonics (Telonics, Meza, AZ.) MOD-500 radio transmitters, with whip antennas, attached to Butyl/Butyl belting adjustable collars. In order to help insure radio collars were distributed within entire known sheep habitat, sheep were captured at five different locations (Figure 11) during two days of trapping operation.

Status of Badlands National Park bighorn herd was determined by utilizing radio collared animals in addition to observations of non-collared sheep. All radio locations and observations of collared and/or non-collared animals were plotted on topographic maps. Data collected included location, sex, age, and group composition.

Group composition was recorded as: lamb/ewe, yearling/ewe, ram/ewe, and percent of total number of rams observed as Class I (yearling), Class II (two year old), Class III (three year old), and Class IV (4+ year old).

Seasonal movement, home range, group composition, and estimated population numbers were determined using 452 radio locations and 764 observations of collared/non-collared animals. One ram captured in September, 1987, and fitted with a radio collar, died (causes unknown) in January, 1988. Due to lack of sufficient radio locations, data on this individual is not included.

Movement

There was no discernible seasonal movement that would indicate the Badlands sheep herd have established traditional winter/summer ranges. Radio collared sheep were observed to use their entire home ranges (Figures 12,13,14,15) throughout the year. However marked differences between seasonal use of lowlands and higher badlands tables and shelves were noted. During winter months, sheep were observed to use the higher tables and shelves more often than the basin lowlands for feeding. Conversely, extensive use during summer and early autumn of the lowlands for feeding was noted.

Bands of sheep in numbers of 5-60 individuals were observed throughout study duration. Radio collared sheep were observed to travel between these different bands demonstrating no distinct

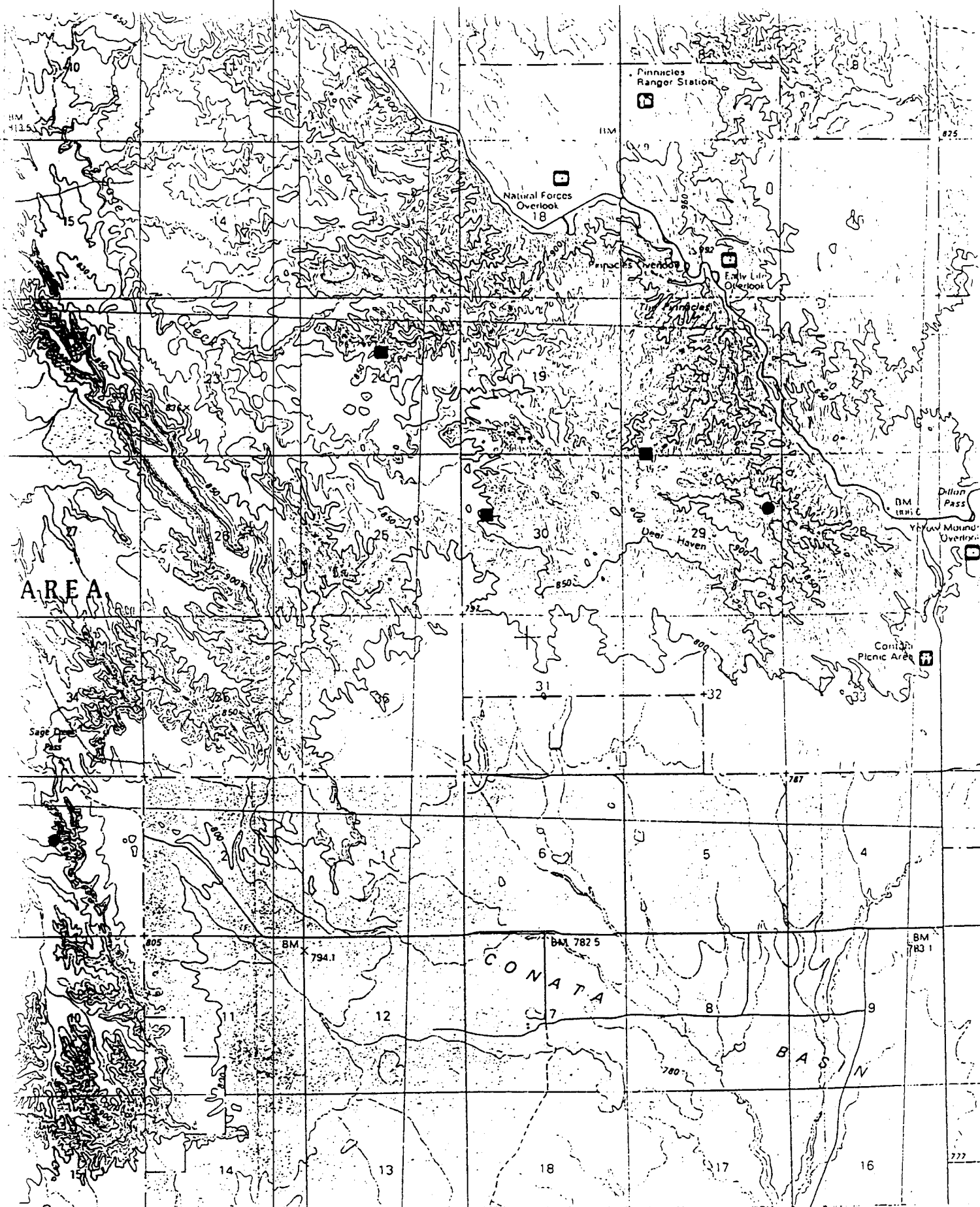


Figure 11. Badlands National Park capture sites.

- ewe capture sites
- ram capture sites

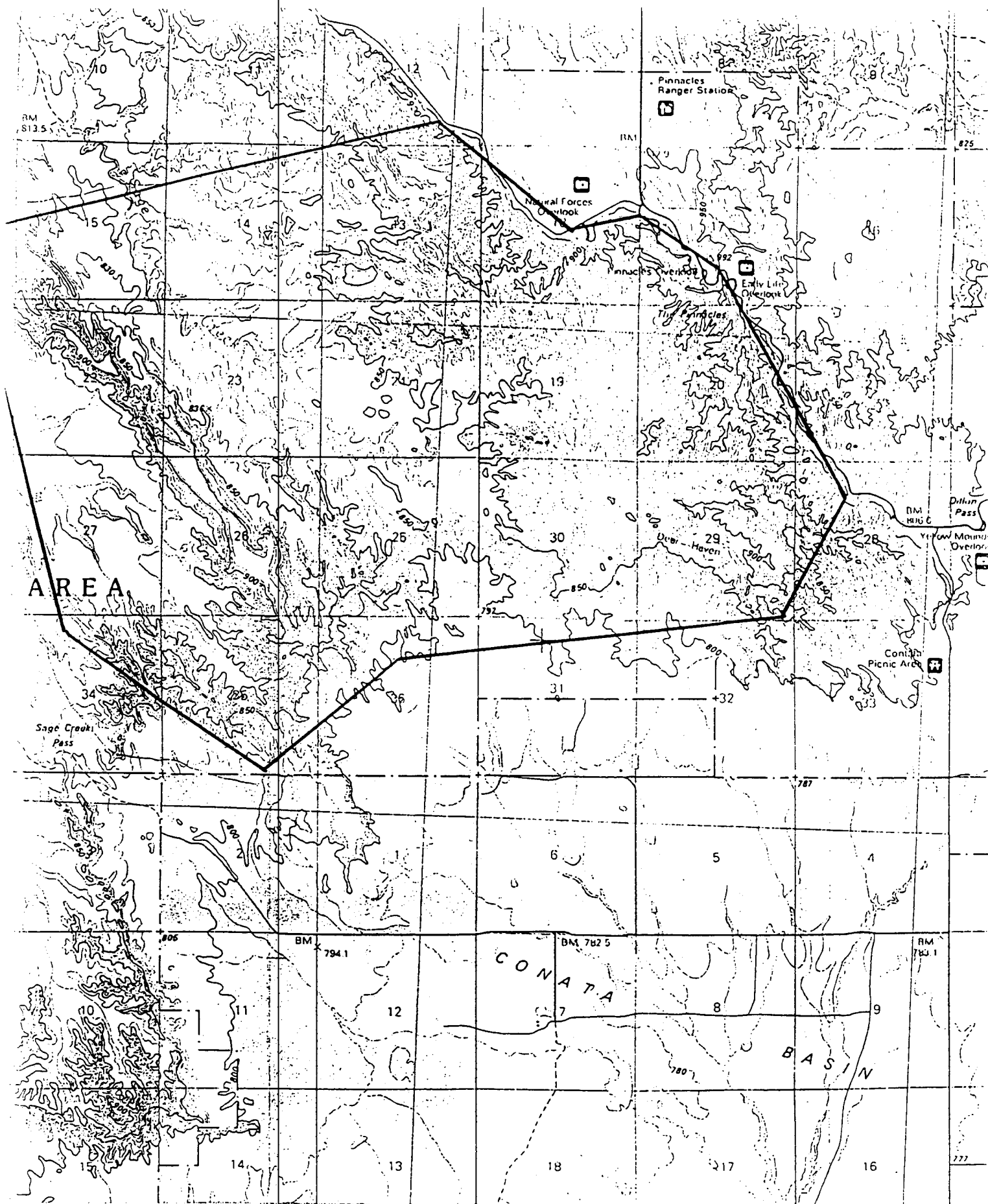


Figure 12. Home range of Blue ram, 1987-1990.

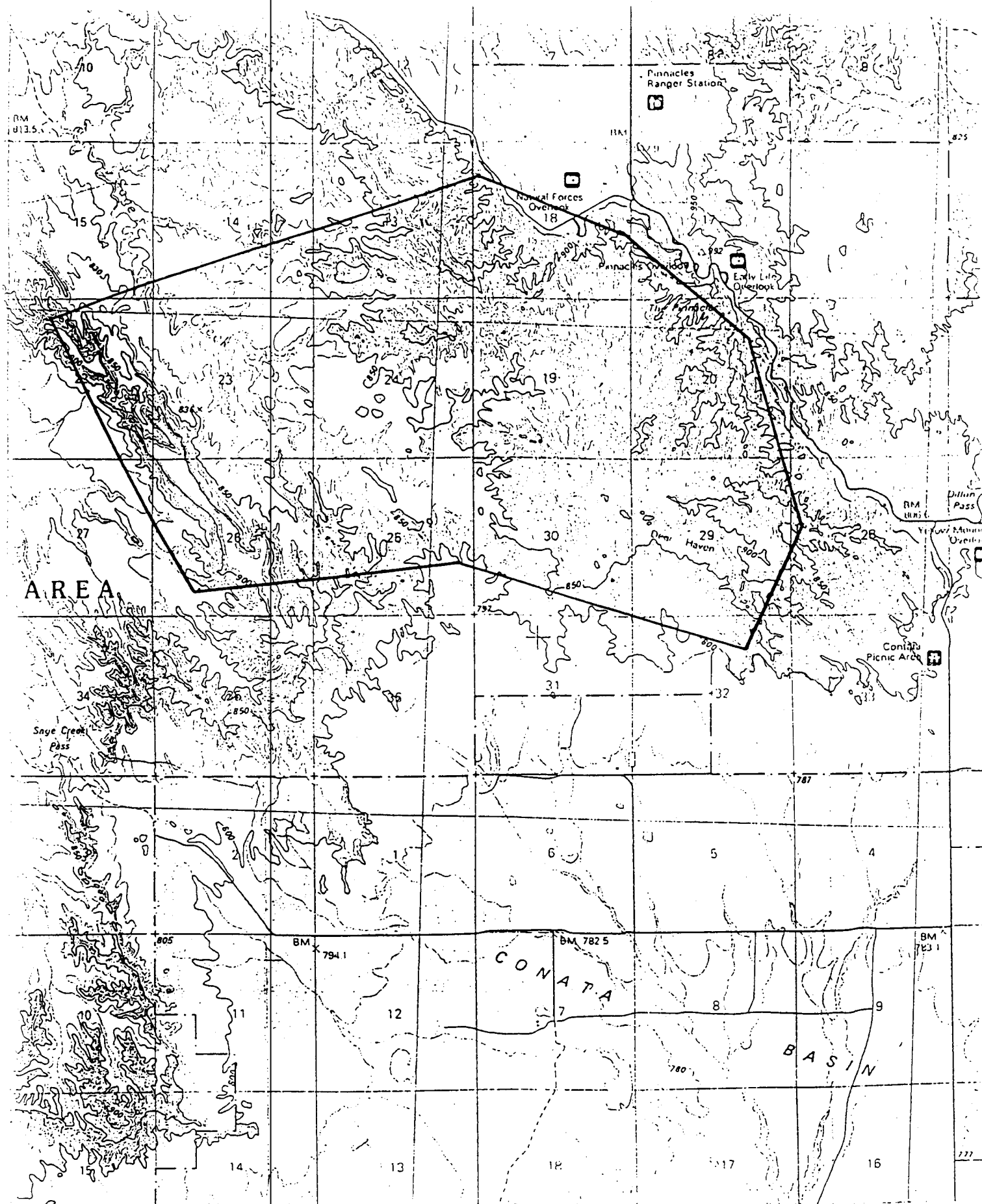


Figure 13. Home range of Red ewe, 1987-1990.

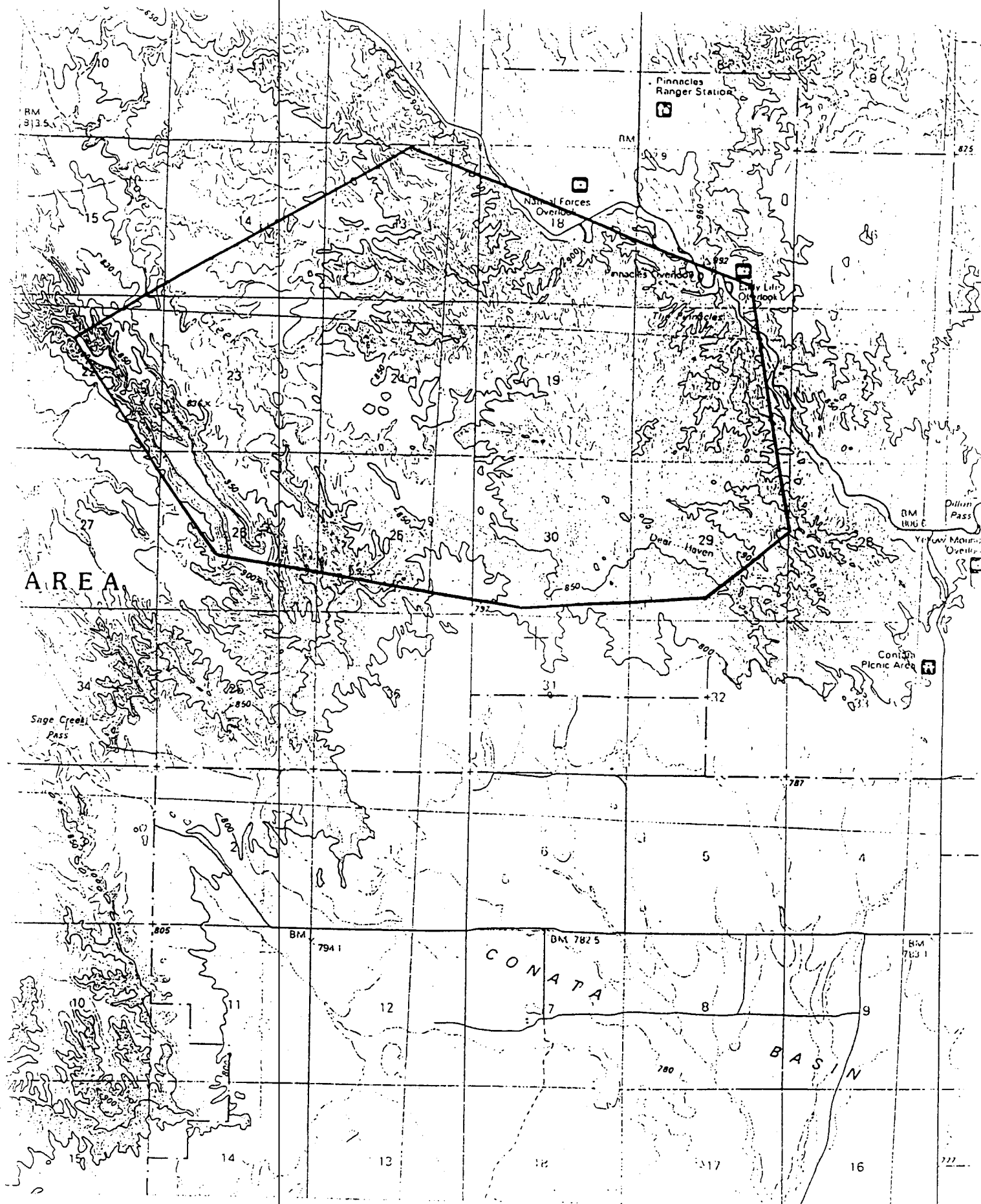


Figure 14. Home range of Silver ewe, 1988-1990.

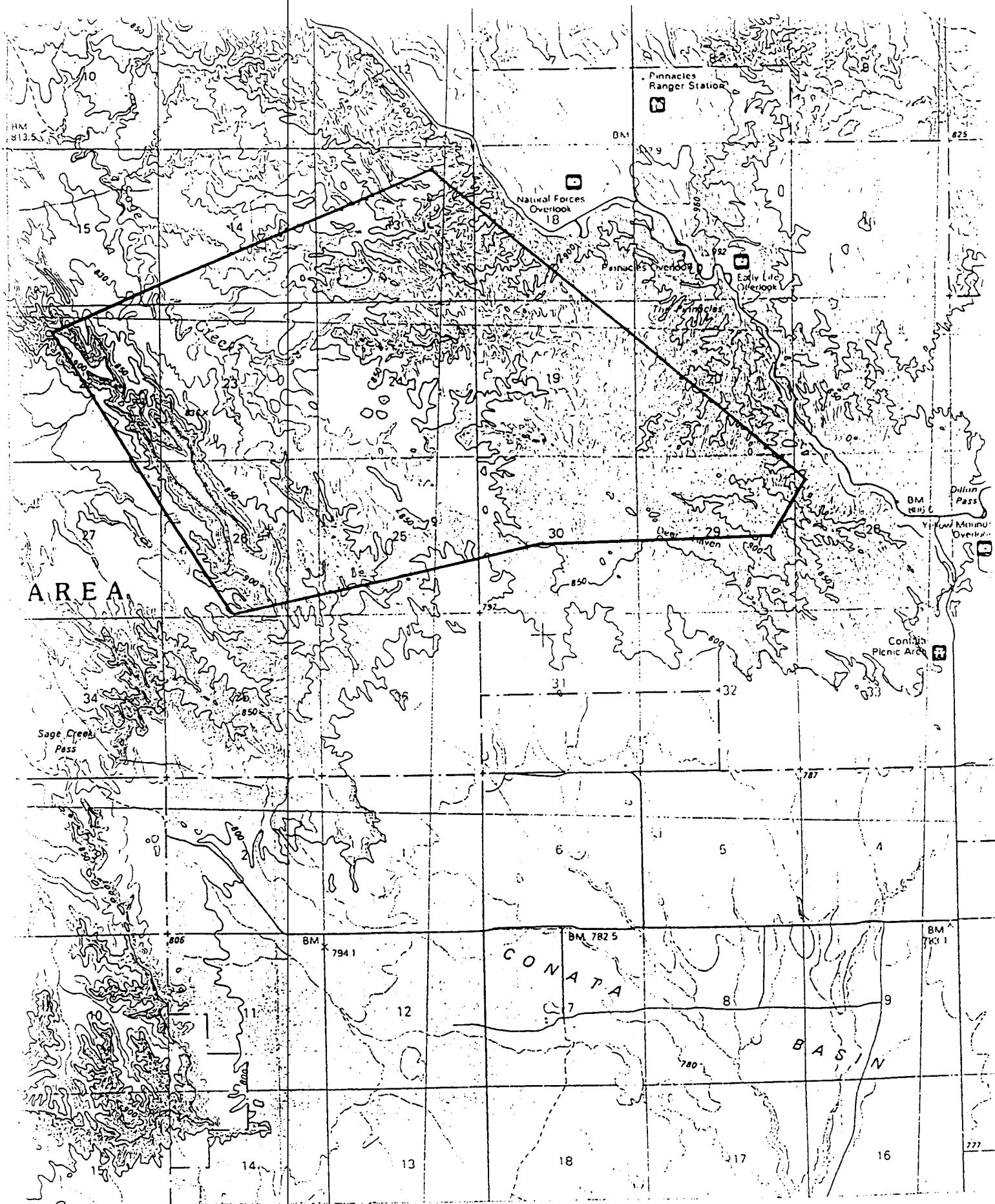


Figure 15. Home range of White ewe, 1987-1989.

fidelity to one particular area or band of individuals. Telemetry findings would then indicate that the Badlands sheep are one herd with no distinct or separate bands with the population. Observations of large groups of sheep (up to 60 individuals) occurred most often during winter months (mixed age and sex), and lambing season (lambs and ewes).

Population Status

Thirty two lambs were documented for each year during 1988, 1989, and 1990. Lambing grounds were located in three areas (Figure 16), with the largest concentration of lambs occurring in area A. Lamb/ewe ratios were calculated monthly from June through October during 1988 and 1989 and averaged 73/100 and 79/100 respectively (Figure 17). Yearling/ewe ratios were calculated monthly from June through October in 1988, and August through October in 1989 and averaged 43/100 and 41/100 respectively (Figure 18). High ratios for both lamb/ewe and yearling/ewe counts indicate good lamb recruitment and survival. Comparisons of lamb/ewe and yearling/ewe ratios between 1988 and 1989 counts (Figures 17 and 18), may suggest that the most accurate census can be taken in August and September.

Due to good horn growth within this population, rams obtained approximately 1/4 curl for the first three years of life. After age four, brooming held most rams to slightly less than full curl. A ram radio collared at two years of age was half curl (Class II) and attained Class IV status at age four. One dead ram found in the park was full curl at six years of age. Ram classification was conducted yearly to determine age composition within the ram population (Table 7).

Results indicate that approximately 41% of the ram population is three years old or younger, suggesting good recruitment of younger rams into the breeding population.

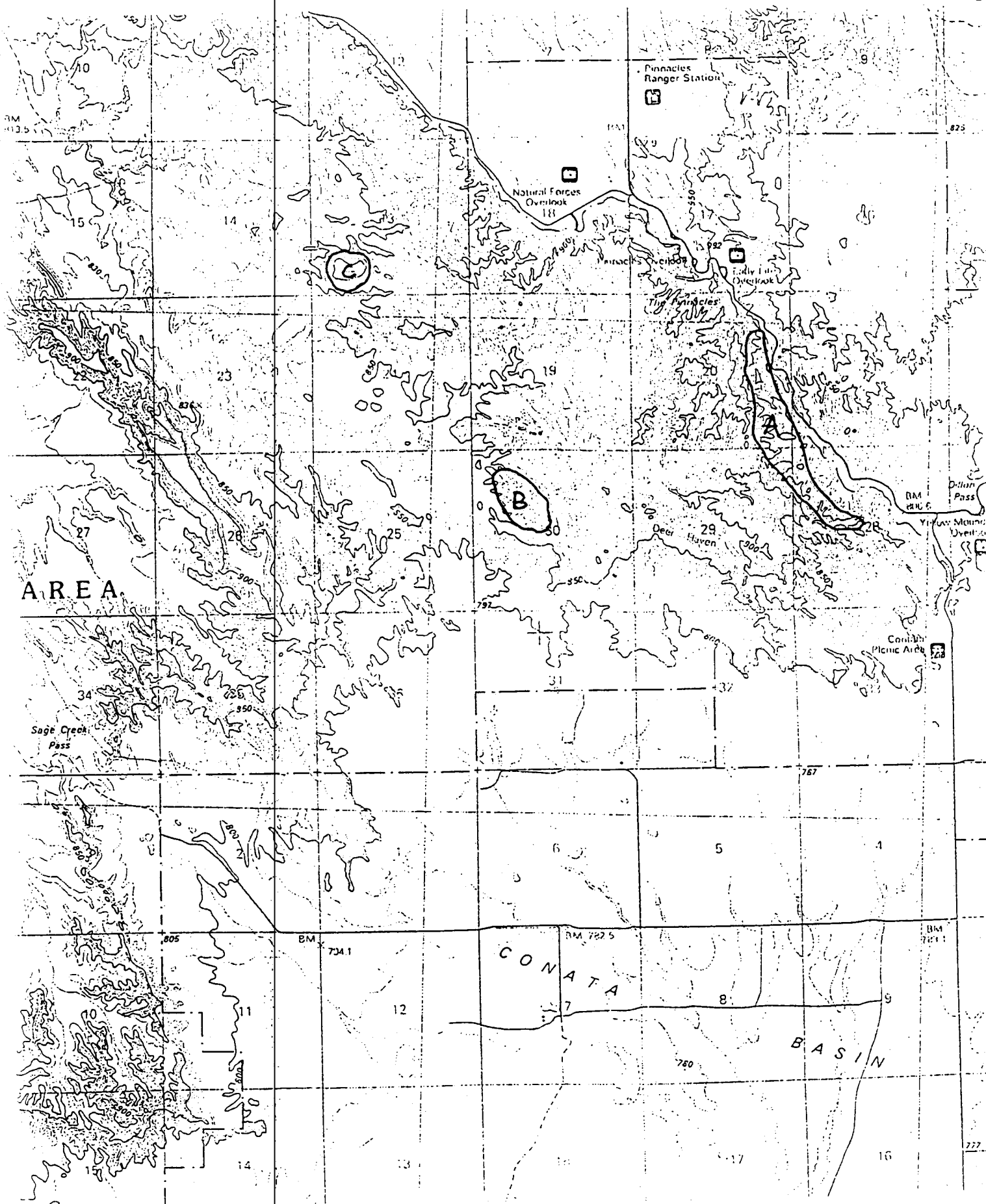


Figure 16. Documented lambing areas, Badlands National Park.

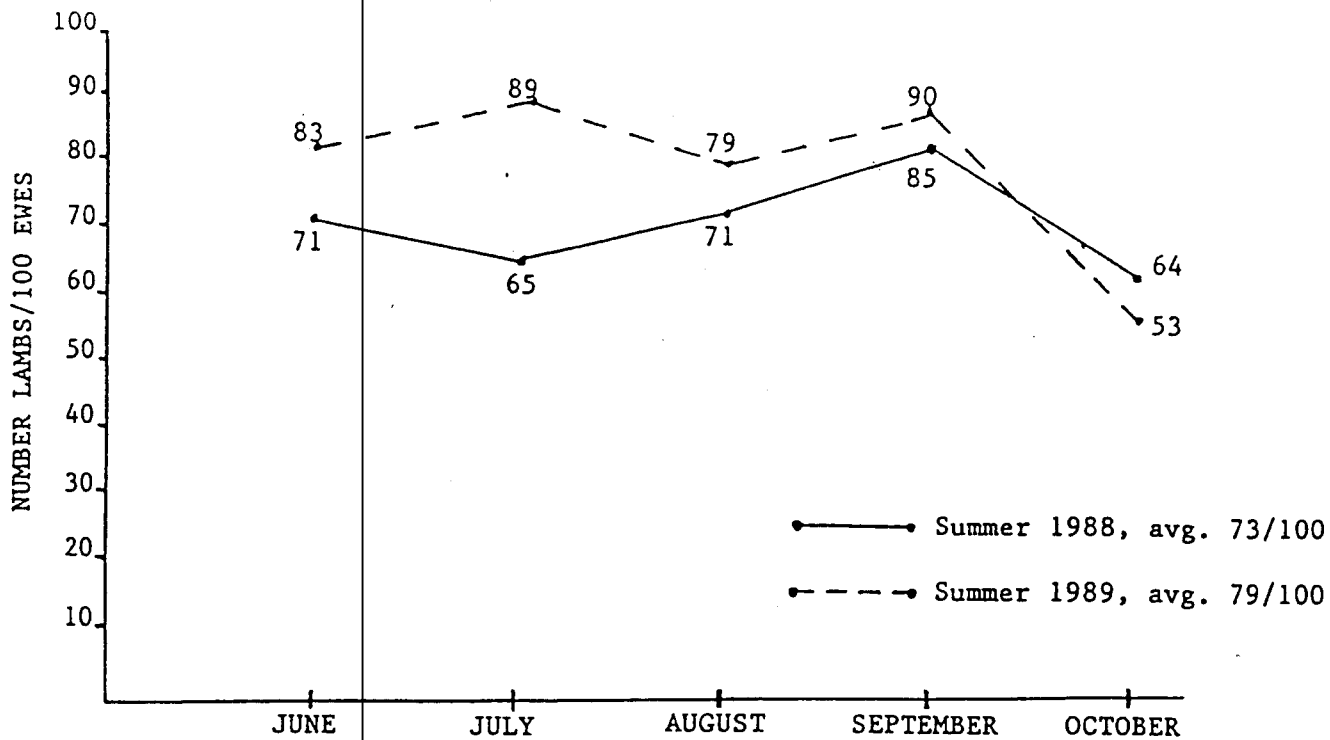


Fig. 17. Lamb/ewe ratios in Badlands National Park, South Dakota, 1988 and 1989.

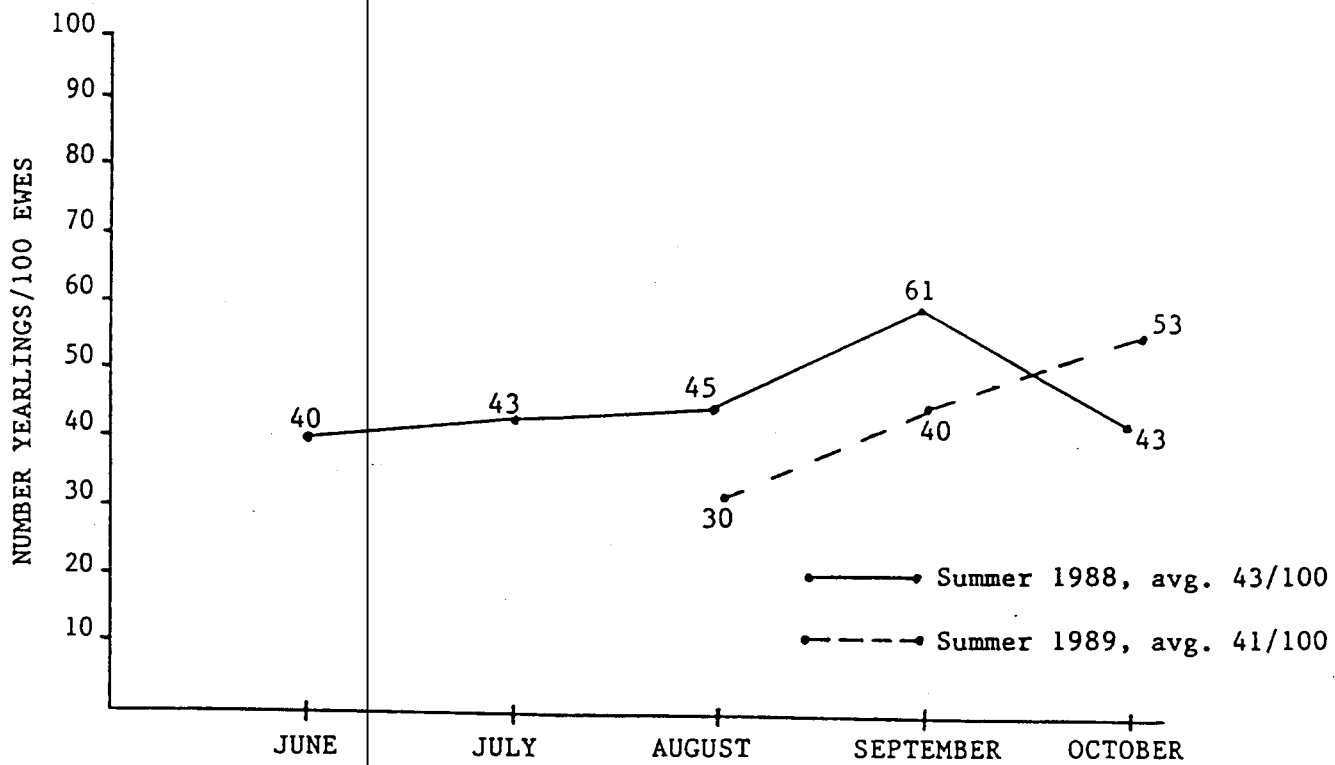


Fig. 18. Yearling/ewe ratios in Badlands National Park, South Dakota, 1988 and 1989.

Table 7. Ram classification, Badlands National Park, 1988-1990

Percent in total population				
Year	Class I (ylg.)	Class II (2 year old)	class III (3 year old)	Class IV (4+ year old)
1988	6%	18%	24%	52%
1989	7%	15%	19%	59%
1990	7%	10%	17%	66%
Avg.	7%	14%	20%	59%

During December and January of 1987-1988, 1988-1989, and 1989-1990, winter census counts were conducted from the ground at strategic points within the known bighorn range. In order to eliminate duplication, counts were limited to one hour periods unless sheep were separated by more than two miles. High winter counts of 78 sheep in 1987-1988, 82 sheep in 1988-1989, and 93 sheep in 1989-1990 would indicate a growth in population numbers. Due to the rough terrain, geomorphic features of the Badlands, and nonexistence of traditional winter ranges which allow for accurate census, it is estimated that these counts are indicative of approximately 40%-60% of the total population. This would suggest that the total population during the winter of 1989-1990 would be 133-200 animals.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Black Hills Reintroduction

One purpose of this study was to attempt to reestablish bighorn sheep in historic range within the Black Hills. Site evaluation and habitat improvements of the selected site significantly contributed to the success of the transplant. Dispersal of a large number of sheep did occur. However, the establishment of one sub-herd within the Dark/Cleghorn Canyon area further demonstrates the importance of site evaluation since this area was selected as a

possible site for future transplants if the Spring Creek Canyon transplant was successful. The growth of population numbers of the transplant indicates that, at present, the transplant can be considered a success.

The Spring Creek Canyon area was estimated to have a limited carrying capacity of 50 head during the first environmental assessment (Johnston 1987). Further evaluation and additional habitat improvements were implemented, increasing the capacity of the area by 50% to approximately 75 sheep. It is recommended that a management survey be developed and the herd be monitored. A limited hunting season should be implemented to maintain the herd size below or at carrying capacity. A limited removal of some sheep could be considered to supplement another transplant should that occur in the future.

Badlands National Park

The purpose of this job was to survey the Badlands National Park bighorn sheep herd, and evaluate the feasibility of using a portion of the herd for transplant purposes in the Black Hills, South Dakota.

Lamb/ewe ratios of 73/100 in 1988 and 79/100 in 1989 indicate good lamb recruitment. Yearling/ewe ratios of 43/100 in 1988 and 41/100 in 1989 would also indicate good lamb survival. Winter census counts of 78 in 1988, 82 in 1989, and 93 in 1990 would suggest increasing population numbers. Estimate of population numbers of 133-200 animals during the winter of 1989-1990 would further suggest a viable population (Burger 1990) at present time.

Due to the status of the Badlands bighorn herd at present time, limited removal for transplant purposes should not effect overall population viability. Until a more definitive population estimate is accomplished, removal of only 5-10 animals per year is recommended, not to exceed 20 animals within a three year period. Should a more accurate census determine that herd size is at the upper limits of the present estimate (200 sheep), further considerations for larger removals could be entertained. Sex ratio of animals removed should be consistent with ratio within the herd, i.e. 50% males, 50% females, help to insure the present balance.

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APPENDIX 1.

Bighorn sheep blood chemistry profiles, Badlands National Park, 1989.

Sex Age	Blue Ram (3 yr.)	#256 Ram (y1g.)	#254 Ewe (2 yr.)	#253 Ewe (3 yr.)	#255 Ewe (adult)	#252 Ewe (adult)
ALK Phos	600	520	245	48	200	151
BUN	14	21	13	33	17	13
SGOT	119	278	128	183	126	112
SGPT	25	29	19	22	25	24
Cholesterol	130	67	46	61	69	57
Glucose	106	198	150	93	143	132
Phosphorus	4.6	9.0	6.1	11.4	6.4	7.2
Albumin	5.1	7.5	6.5	5.7	6.5	7.1
Total Bili	0.7	0.5	0.8	0.3	0.4	0.4
Total Protein	6.8	7.9	6.1	7.3	7.4	7.5
Calcium	10.8	11.2	9.6	9.7	10.3	9.3
Creatinine	1.9	1.5	1.5	1.6	1.5	1.7
Pack cell vol.			46%	39%	42%	
White blood ct.			5600	6800	8400	
Hemoglobin			15g/dl	13g/dl	14.2g/dl	
Segmented			56	48	56	
Lymphocytes			28	22	32	
Eosinophils			16	10	12	

