



HISTORY AND DISTRIBUTION OF BIGHORN SHEEP IN COLORADO

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FOREWORD

This publication attempts to summarize the recorded history of bighorn sheep in Colorado by providing, in varying detail, available information on population fluctuations, range conditions, harvest and current status of the nearly 40 still recognizable herds. As such, the report is intended primarily for Colorado wildlife administrators and managers, but it is hoped that given findings will be applicable to bighorn management over the species' Rocky Mountain range.

Field work supporting this report was performed by many individuals, and began before initiation of the first Federal Aid research projects in 1938. In these earlier days, record keeping and reporting were not as formalized as now, and the various herds were not studied or censused, or even observed, on a planned and systematic basis. As a result, prominent herds like the Tarryall, Pikes Peak and the Kenosha received disproportionate time and attention. It is primarily for these reasons, plus the inaccessibility of some herd ranges, that the accounts given vary rather widely in degree of coverage and information.

The Wildlife Research Section of the Division of Wildlife takes this occasion to recognize the contributions of all who have assisted with surveys and special studies over the years, thus making this background report possible.

Jack R. Grieb
Wildlife Research Chief

January, 1973

JOB FINAL REPORT

State of COLORADO

Project No. W-41-R-22 : Bighorn Sheep and Mountain Goat Investigations

Work Plan No. 1 : Job No. 12

Job Title: Distribution of Bighorn Sheep Herds

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Personnel: L. Hibbs, T. Woodard, W. Rutherford, and G. Bear

ABSTRACT

Information available on the history, distribution, population trends, mortality, harvest, range and other bio-ecological relationships for each of the bighorn sheep herds in Colorado are summarized in this final job report.

ACKNOWLEDGMENTS

This publication is an effort to summarize the efforts of many persons that have worked with bighorn sheep in Colorado. We extend our grateful appreciation to numerous field personnel, Colorado Division of Wildlife, for providing current data on bighorn sheep herds, as cited in text; and to William H. Rutherford for the bighorn harvest records. Wayne Russell, Pilot, deserves special thanks for flying project personnel on aerial surveys.

We are indebted to Doris Rust, Draftsman, Colorado State University, for her dedication and excellence in drafting the distribution maps. These maps are drawn to scale and denote land ownership, except in the San Juan Mountains where there are numerous small mining claims.

For editorial assistance, we are grateful to Dr. Lee E. Yeager.

George D. Bear
George W. Jones

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Frontispiece--Success, now the work begins.

HISTORY AND DISTRIBUTION OF BIGHORN SHEEP IN COLORADO

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GENERAL

Population Trends and Distribution

Journals of early explorers and travelers indicate great numbers of bighorn sheep (Ovis canadensis canadensis) in the 1800's in the mountainous areas of the then Colorado Territory. This was the time when white men first began to settle in the West. Moser (1962) and Beuchner (1969) have presented accounts of these records, partially serving such need for this report.

Although bighorn populations have undergone periodic fluctuations, the general trend is downward in Colorado as well as throughout the western states. There were an estimated 7,230 bighorns in Colorado in 1915; 3,200 in 1958; and 2,200 in 1970 (Seton 1929, Moser 1962). Considering the last 10 or 15 years, approximately half the herds in Colorado were classified as static or increasing, while the remainder were decreasing. Currently, the most productive herds are on Pikes Peak, Trickle Mountain, Mount Evans, San Luis Peak, Dinosaur National Monument, Collegiate Range, Tarryall-Kenosha Mountains, and Poudre Canyon (Table 1).

Herds classified as static are Rocky Mountain National Park, Ouray-Cow Creek, Lake City, Taylor River, Sheep Mountain (Wolf Creek Pass), Cimarrona Peak, Battlement Mesa, Gore Range, and Clinetop Mesa. All other herds are now considered to be in decreasing status (Table 1).

Nearly all herds are currently smaller in number than during historical times. The status classification assigned to herds in Table 1 are indicative of a short period of time. For example, the Tarryall herd experienced a die-off in 1885, increased again, died off in 1923-24, increased to nearly 1,000 head about 1952, died-off to approximately 30 head in 1953, and increased as of 1970, to an estimated 100 sheep. The population is far below the 1952 high, yet it is classified as an increasing herd.

Distribution of bighorn sheep in Colorado is also decreasing. Historically, bighorns were widespread. Herds, as we view them today, are remnants that persisted in most productive or isolated portions of the range. Historically, the bighorn herd in Rocky Mountain National Park was very large, utilizing areas eastward to the edge of the plains.

Table 1. Status of bighorn sheep herds in Colorado with 1970 population estimates.^a

Herd Status		
Decreasing	Static	Increasing
Georgetown-Empire (75)	Rocky Mountain Natl. Park (190)	Pikes Peak (300)
Sangre de Cristo Range (70)	Ouray-Cow Creek (90)	Trickle Mountain (175)
Buffalo Peaks (50)	Lake City (70)	San Luis Peak (150)
West Elk Mountains (45)	Cimarrona Peak (40)	Mount Evans (160)
Mesa Verde National Park (30)	Sheep Mountain (40)	Dinosaur Natl. Mon. (139)
Rampart Range (20)	Taylor River (40)	Collegiate Range (100)
Arkansas River Canyon (20)	Battlement Mesa (35)	Tarryall-Kenosha Mtns. (100)
Beaver Creek (20)	Gore Range (30)	Poudre Canyon (75)
Snowmass (25)	Clinetop Mesa (15)	
Redstone (25)		
South Platte River Canyon (18)		
Vallecito (12)		
Glenwood Canyon (12)		
Pole Mountain (14)		
Mt. Silverheels (15)		
Black Canyon (10)		
St. Vrain (6)		
Brush Creek (0)		
Roan Creek (0)		
Mt. Zirkel (0)		
Wilson Peak (?)		
Blanco Basin (?)		

^a Numbers in parentheses are population estimates for 1970.

Shortly after the turn of the century, distribution was reduced to ranges within the Park and adjacent areas. In more recent times, the southern portion of the Park has become nearly void of sheep. There is reasons to suspect that the Mount Evans herd also extended eastward to the edge of the plains. It has been reduced to herds around Mount Evans and a remnant flock in the South Platte River Canyon.

Occupied range of the Sangre de Cristo herd is now limited to an area in the most rugged and isolated portion of the mountain range. Bighorns became extinct in the extreme southwestern portion of the state (Mesa Verde National Park area and Dolores River), in the Book Cliffs in west-central Colorado, in the northwestern corner of the state (Dinosaur National Monument), and in the Park Range in north-central Colorado. Herds were re-established in Mesa Verde National Park and Dinosaur National Monument--all representing changes in bighorn distribution in the state (Fig. 1).

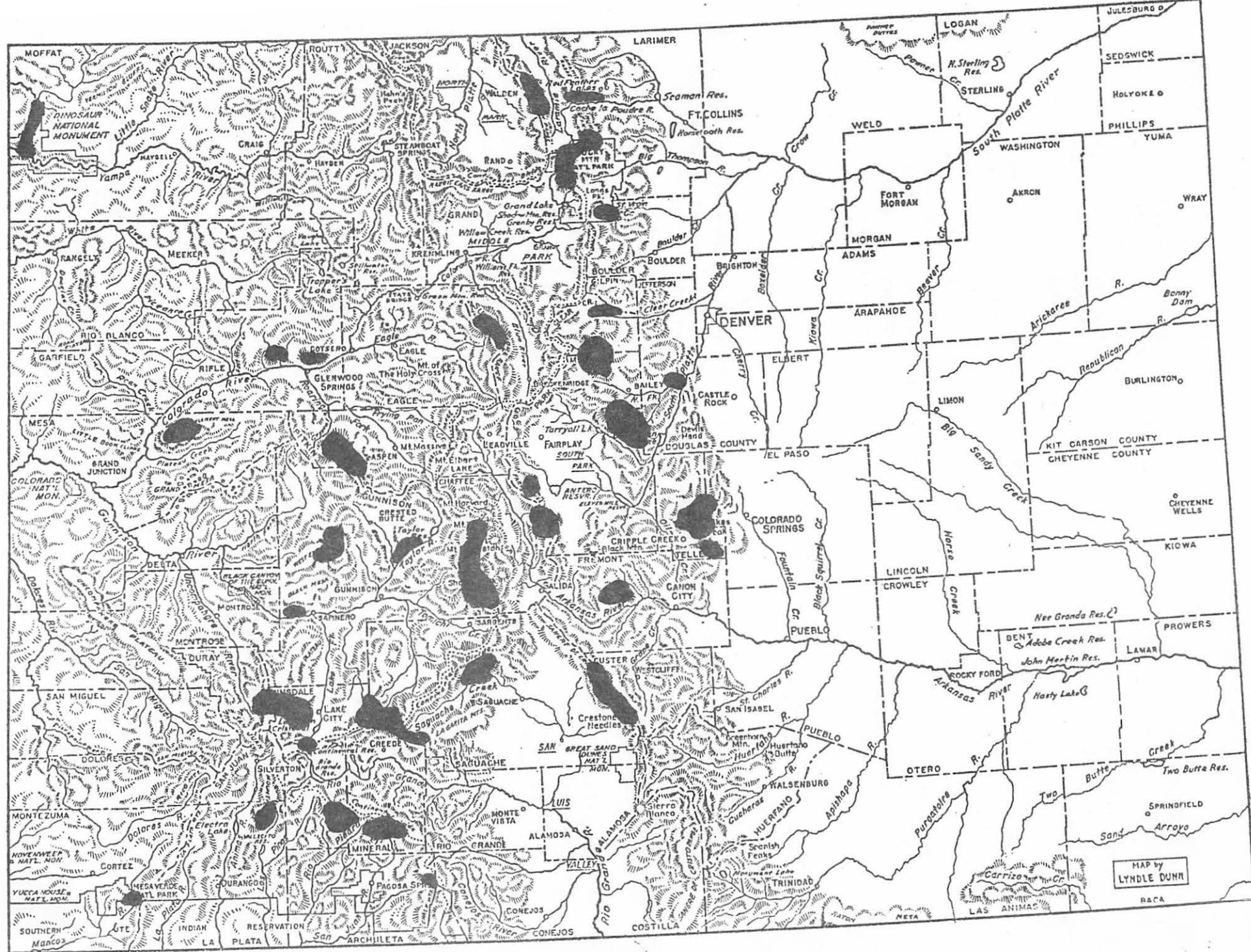
Limiting Factors

Reasons for the declining status of many bighorn herds in Colorado are complex and preclude many specific and vital answers. Mortality factors affecting herds are limited to scattered necropsy reports and information concerning the more spectacular die-offs. Some of the reasons offered are parasites, diseases, mineral deficiencies, competition with other ungulates for forage, and advancement of civilization.

Advancing civilization has undoubtedly had, and is still having, a tremendous impact on Colorado's sheep herds. Many authors point to the bighorn sheep as a true wilderness species; thus, civilization has rendered much of their original range as intolerable. A few small bands of sheep seemed to have adjusted to human activities. Agricultural and recreational developments also have done much to encroach onto bighorn ranges, attracting people to mountain valleys formerly used by the sheep. This is now most pronounced in the vicinity of Aspen, Vail Pass, South Platte River Canyon near Denver, Mount Evans, and Rocky Mountain National Park.

Much of the detrimental effects of human and land use appear to be irreversible. To make the problem worse, many people have become back-pack enthusiasts, invading roadless areas into which the bighorns have been crowded. The Forest Service is restricting motorized travel in many areas, and the National Park Service has considered limiting the number of people allowed in an area at any one time. These remedies seem certain to benefit the bighorns in some instances. Prohibition of large-scaled developments on critical sheep range in the future would be another step in the right direction.

Competition with other ungulates for forage has been given as a major cause for bighorn declines. Little detailed research on the nutritional and special requirements of various ungulates is available for given



Map from COLORADO OUTDOORS magazine

Fig. 1. Distribution of bighorn sheep in Colorado. (Map by Lyndle Dunn)

land units. Interactions of these animals, however, indicate that severe competition and poor range conditions have been detrimental. At the present time, deer and elk competition appears to be a potential problem only in Dinosaur National Monument and Rocky Mountain National Park. Livestock competition with bighorns is a more widely spread problem, of most concern where domestic sheep are grazed on alpine ranges occupied by bighorns. The alpine, highly fragile, is easily abused by overgrazing and is very slow to recover. Many alpine ranges in Colorado are being retired from livestock grazing, almost certainly benefiting bighorns.

A program concerned with restriction of livestock grazing on bighorn wintering areas, whether alpine or not, should be currently considered. There has been a substantial increase in the Wind River bighorn herd in Wyoming since the state provided critical winter range via land acquisition, and trade or other agreements on land use to minimize livestock grazing (Crump 1971). In considering competition, or range abuse, over-concentration and competition within the bighorn herds must be evaluated. In Colorado, concentrations of bighorns seem to be of prime concern only on Pikes Peak and Trickle Mountain.

Parasites and diseases have played an important role in bighorn sheep mortality. A die-off in 1933 apparently extirpated the Dinosaur National Monument herd. This die-off was attributed to the sheep nose-bot fly (larvae) (Oestrus ovis) and severely overgrazed ranges (Barmore 1962). The scabies mite was an important factor in the early decline of the Rocky Mountain Park herd. Hemorrhagic septicemia and the parasite Eimeria were found in later years. Extensive mortality in the Tarryall herd in 1885 was attributed to the psoroptic mite; and the decline in 1923-24 was blamed on hemorrhagic septicemia.

Carhart (1943) was concerned by the high level of parasite infection (primarily Eimeria spp.) in the Pole Mountain and Tarryall herds. He recommended a trapping and transplanting program and/or hunting seasons to disperse the bighorn concentrations in the Tarryall to prevent die-offs. Extensive die-offs occurred in the Tarryall Mountains, Kenosha Mountains, Pikes Peak, Beaver Creek, Rampart Range, Arkansas Canyon, Buffalo Peaks, and the Collegiate Range throughout the 1950's. Much of this mortality was attributed to lungworm, or the verminous pneumonia complex. Early investigations and more recent work show that all bighorn herds in Colorado are infested with lungworms.

Several authors point out that successful parasites do not destroy the host. When destruction does occur, the host's resistance is first lowered by some other interacting factor, such as malnutrition, which may result from overgrazed ranges, overcrowding, weather conditions, etc. However, there may be exceptions. When the scabies mite was introduced into Colorado, apparently via domestic sheep, bighorn sheep (the new host) had very little resistance to the parasite and suffered heavy losses. Range conditions in the Tarryall Mountains were not exceptionally poor either before or after the massive die-off in 1953. Beachner (1960) postulated that lungworm infestations could act as a population decimation factor without being preceded by malnutrition.

He suggested that population densities in the Tarryalls had reached such a high level that individuals were subjected to continued reinfection with lungworms until the sheep were unable to adjust to the enormous parasite load.

A very important consideration is poor lamb survival. Obviously, a herd with extremely low lamb survival is going to decline. This is apparently happening in many Colorado herds. It is vital, therefore, that the cause of such mortality be studied and isolated.

Use of natural licks by bighorns has prompted many investigators to postulate mineral deficiencies in the diet of bighorns. Salt and mineral supplements have been provided in Colorado since the 1940's. Limited research on the chemical analysis of plants on the alpine ranges of Pole Mountain and Buffalo Peaks indicate that the vegetation would be deficient in some minerals for domestic sheep. It is common practice for ranchers to supplement the feed of livestock. Mineral deficiencies can affect the health, reproduction rate, and survival of domestic sheep. However, there is no information on the nutritional requirements of bighorns, or how these requirements are fulfilled by the forage available. It is, therefore, premature to say that a mineral or supplementation program is needed, and, if so, how much.

Past studies in the Cache la Poudre Canyon, Georgetown-Empire, Pikes Peak, Tarryall Mountains, Glenwood Canyon, and Collegiate Range definitely indicate that bighorns utilize supplements, and will go out of their way to do so. On occasion, the bighorns ceased using natural licks when salt blocks were provided. Colley (1970) has provided the Pikes Peak herd with supplements since 1962, and believes that lamb-survival has increased because of the program. Packard (1946) noted bighorns using natural licks in Rocky Mountain National Park and recommended the placement of mineral and salt blocks. He advanced the theory that bighorns historically obtained needed minerals on the winter ranges in sedimentary formations in the foothills whereas, in recent times, they are restricted to ranges in granitic rock formations lacking the necessary minerals. Much research is needed in this field before the formulation of definite conclusions.

Predation appears to have minor effect on bighorn herds in Colorado. The only significant case reported was in the Tarryall Mountains during the early 1950's before the die-off, when coyote and sheep populations were high. A coyote-control program was set up to reduce coyote numbers. There have been a few scattered reports on mountain lion predation on bighorns.

Management

Good population data are both scarce and spotty for many bighorn herds in the state. It is difficult and time consuming to obtain good census data for most herds. Habitat occupied by bighorns is extremely variable,

requiring that the time and method of survey be adjusted to fit conditions. Sheep occupying alpine or open ranges may be readily surveyed using airplane or helicopters. Some sheep herds in Colorado are concentrated in localities readily accessible by ground travel, where aerial surveys may be dangerous or impractical. The time of year to conduct the survey also varies and needs to be adjusted to suit conditions in the area concerned. Winter surveys are often preferred because sheep are concentrated and rams and ewes are grouped together.

Herd structure is as important when viewing population trends as total numbers. Census data should be classified by sex, age, (lambs, yearling, and adults), and location of animals observed. Since ram-curl regulations are used to control harvest by age, rams should be classified as to curl size (quarter, half, three-quarter, and full).

In the late 1800's bighorn sheep reached extremely low numbers and it was feared they might become extinct. Colorado legislators officially closed the bighorn season in 1887. It was not reopened until 1953, when it was realized that hunting pressure was needed to disperse high concentrations of sheep and hopefully prevent the "boom and bust" situations that occurred in the Tarryall and Kenosha Mountains. Sheep seasons have been allowed in Colorado each year since 1953, and a total of 817 bighorns have been harvested (1953-1970), with a hunter success of 23.8 percent (Table 2). Hunters have been restricted to ram harvests, with the exception of three either-sex hunts in the Buffalo Peaks area. Most of the earlier seasons were restricted to rams having horns a half-curl or larger in size, and the trend has been toward more restrictive regulations. The full-curl ram regulation was tried in 1970; however, many field personnel believed it was too restrictive. Most older rams broom their horns off to such a degree they would never qualify as legal full-curl rams even though they are trophy animals. The three-quarter-curl and up horn requirement seems to be most acceptable, since they limit harvest to trophy-class sheep and permit older animals to be taken. Several authors believe rams should be represented in most age classes to maintain a healthy herd. Therefore, hunting permits should be regulated to permit older rams to be retained in the herd.

Harvest of a few trophy rams from excessively dense sheep populations has little effect on controlling populations. The trapping and transplanting program carried on in the Tarryall Mountains prior to the last die-off (1953) proved to be beneficial in restoring many small herds. A very intensive trapping and transplanting program should again be initiated in Colorado, since there are many small herds that are not large enough to be productive and are gradually heading for extinction.

There are other areas where bighorns have already disappeared. Also, there are large herds in the state, particularly on Pikes Peak and Trickle Mountain, now following the same trend that resulted in extensive die-offs in the past. An effort should be made to stabilize these herds at an optimum level, using any feasible means to accomplish

Table 2. Summary of bighorn sheep harvest 1953-1970^a.

Year	Licenses Issued (Number Hunters)	Success Ratio	Ram Harvest	Total Harvest
1953	169	.34	58	58
1954 ^b	239	.33	58	79
1955	179	.25	45	45
1956	177	.19	34	34
1957 ^b	218	.28	39	60
1958 ^{b, c}	212	.24	32	51
1959 ^c	148	.17	25	25
1960	176	.23	40	40
1961	210	.21	45	45
1962	229	.27	61	61
1963	228	.29	66	66
1964	207	.29	59	59
1965	205	.20	40	40
1966	285	.12	33	33
1967 ^c	204	.18	36	36
1968 ^d	131	.24	32	32
1969 ^e	145	.26	37	37
1970 ^f	98	.15	15	15

^aFrom: Colorado Big Game Harvest, 1970. Colo. Dept. of Natural Resources, Div. of Game, Fish and Parks.

^bEither sex allowed in certain areas.

^cHorn of 3/4 curl or better required. During all other years horn requirements were variable with both 1/2 and 3/4 curl allowed, depending on area.

^dHorn of 3/4 curl or better (east slope); 1/2 curl or better (west slope).

^eHorn of 3/4 curl or better in all areas except Sheep Creek-Trickle Mountain, where a horn of 1/2 curl or better was allowed.

^fHorn of 3/4 curl or better on Pikes Peak, Trickle Mountain and Taylor River. Full curl in all other areas.

this end. If these herds continue to increase under an intensive trapping-transplanting program, either-sex hunting seasons should be initiated to stabilize them. Unfortunately, either-sex hunting in Buffalo Peaks was not continued long enough to supply information on how such a program should be administered. Beuchner (1960) defined the role of hunting in bighorn sheep management in the following:

"The conclusion that the harvest is rather limited is inescapable, provided (a) quality hunting and (b) control of numbers only where needed are accepted as the basic objectives of management. It is also inescapable that preservation of the herds subject to excessive mortalities requires regulation of numbers through shooting. In general, natality and survival are likely to increase in any herd that is harvested. Therefore, hunting should be an important feature of the program for conservation of the bighorn sheep. Within national parks, populations should be allowed to seek their own levels without hunting to provide a guide to the dynamics of nonhunted populations.

"Since there is no likelihood that there will ever be many bighorn sheep to harvest, there may be an inclination to ignore the animal. It is expensive to administer harvests of sheep and the hunting public must subsidize the costs. Special fees are charged, but this amount does not cover the expenses of counts, research, administration of permits, and supervision of hunting. Some administrators consider mass production of deer the only economical way to supply hunters with big game. There are many hunters and they demand returns for their license fees. So few hunters benefit from expenditures on sheep that it is difficult to justify management and research on an economic basis. Furthermore, a sentimental public violently opposes hunting for fear of extirpation, making bighorn sheep harvests all the more difficult for departments of game. An adjustment of values is needed by all parties. Bighorn sheep populations are benefited, not injured, by controlled harvests. If hunting is permitted, funds should be made available to improve habitats and keep records of the welfares of populations. The hunter needs to take a broader, less-selfish view and give the department of game a freer hand with license funds. If these points are accepted by the parties concerned, administrators can investigate and manage bighorn sheep properly."

ROCKY MOUNTAIN NATIONAL PARK-NEVER SUMMER RANGE

Distribution

Distribution of the Rocky Mountain National Park herd has been greatly reduced in modern times. Historically, bighorns were dispersed throughout the alpine ranges within and adjacent to the Park and in some areas of the Big Thompson Canyon to the east. Thus, Packard (1946) reported:

"How many bighorns inhabited the present park region when the first white settlers came here in the middle of the nineteenth century is unknown--the older residents believe there were about 4,000. Their especial habitat, then as now, was the alpine tundra of mountain tops. Most of the bands are believed to have summered there, and, although winter conditions reduced the carrying capacity of those ranges, large areas were blown clear of snow most of the winter so that part of the summering population may have remained on the tundra the year round. A large number of sheep, however, descended in fall to the lower hills, some of them almost to the edge of plains, few of the migrants remaining above 7,800 feet. The deep snows of the higher forest precluded their return until rather late in spring so that many bighorns actually spent much of the year on forested terrain."

Eastward migration was eliminated by settlement on the plains, beginning by about 1850. Contor (1958) found the bighorn's eastern distribution was even less than given by Packard in 1939, for he did not find them in the Needles area northwest of Estes Park, or in the Mary's Lake area south of Estes Park. These areas are void of bighorns today.

At the present (1972), bighorns occupy the alpine ranges north of Mount Ida, Specimen Mountain, the Never Summer Range, and the Mummy Range, (Figs. 2, 3 & 4). Bighorns in the southern part of the Mummy Range frequent country immediately south of Crystal and Lawn lakes, Mount Tileston, and Bighorn Mountain. Sheep on Bighorn Mountain make daily treks down to the Sheep Lakes during the summer months, apparently for mineral supplements (Capp 1967).

There appears to be very few bighorns left in the southern portion of the Park, and all appear to winter on the alpine areas of windswept ridges on Specimen Mountain, the Never Summer Range and the Mummy Range. Some sheep may winter in alpine areas in the northern section of the Mummy Range; however, such areas are not known if they exist.

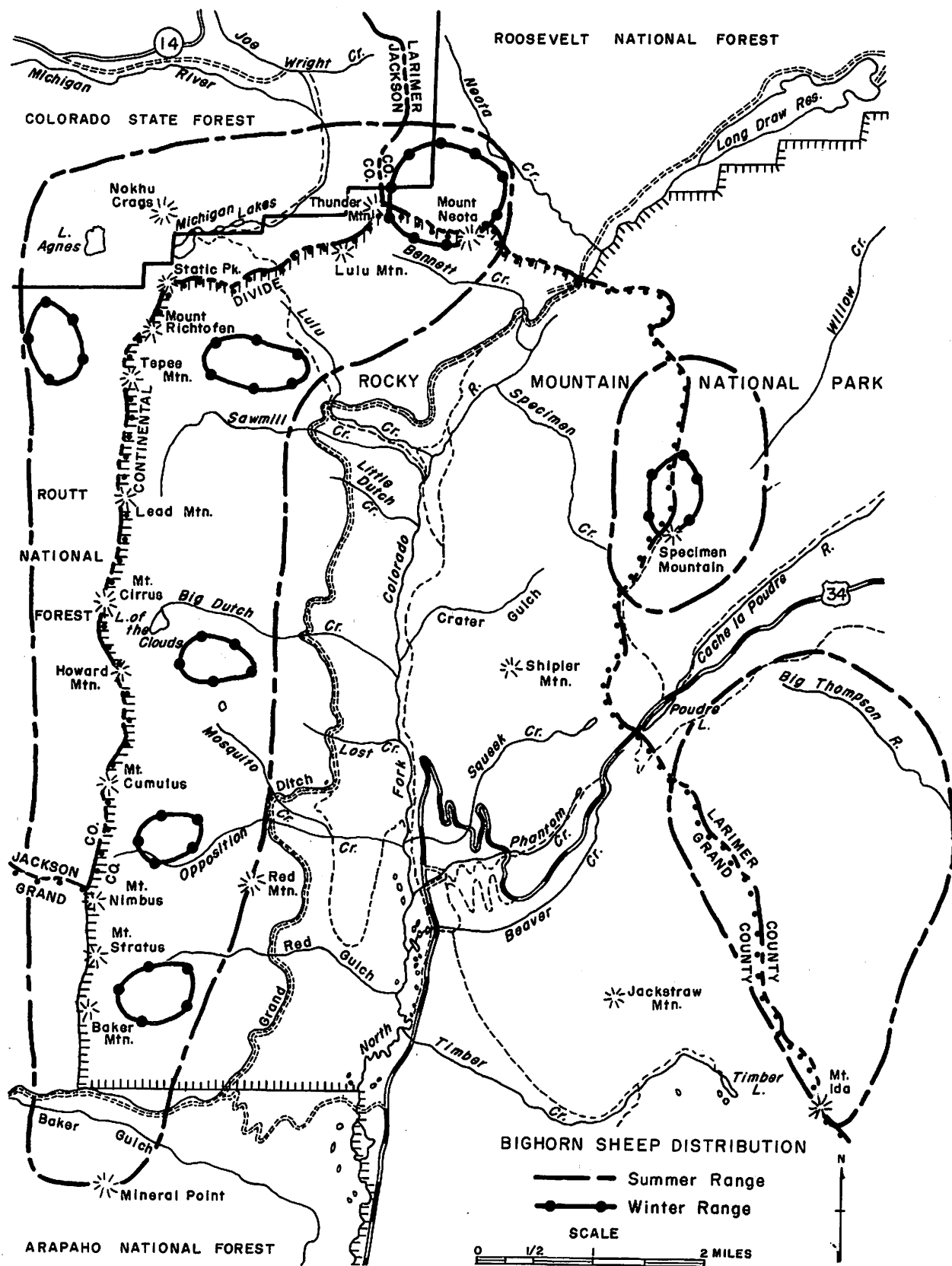


Fig. 2. Bighorn sheep distribution, Never Summer Range and northwestern Rocky Mountain National Park.



Fig. 3. Never Summer Range looking south from Thunder Pass.
(Photo by George D. Bear)

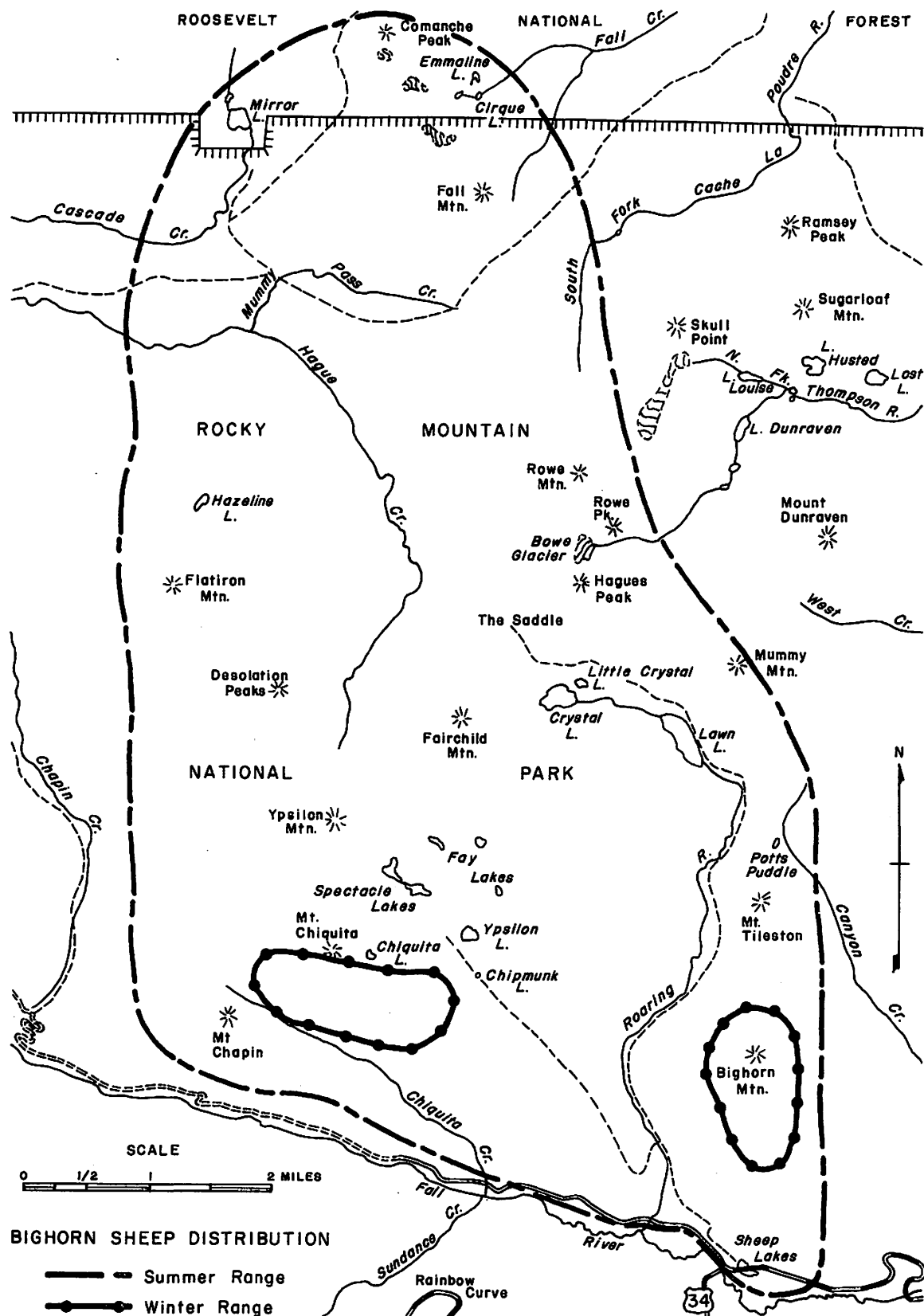


Fig. 4. Bighorn sheep distribution, northeastern Rocky Mountain National Park.

Population Trend

The population and distribution of this herd has greatly decreased in modern times. As stated, Packard wrote that older residents believed that about 4,000 bighorns originally occurred in the Park. Though only a crude estimate, bighorns were plentiful when the first white settlers came to the area. Packard attributes the early decline of bighorns to market hunting, scabies, and restriction of winter range.

There was apparently an increase in the herd for a short period after the turn of the century, described by Packard (1946):

"Between 1909 and 1921 the bands increased in number and in health until bighorns were plentiful in places from which they had been nearly extirpated. Unfortunately, the period of recrudescence did not last many years. By 1920, elk were again competing with bighorns for the range. In 1912 and 1913 two small herds of elk were planted in the park, of which the second succeeded in establishing itself. During the next few years their number was too small to be of much consequence to the bighorns. By 1926 or 1927 it became evident that there was danger of the elk crowding the sheep off certain parts of their range. By about 1933 it was realized that this condition had actually arisen and that the elk were again active competitors of the bighorns. There has been considerable conjecture whether they may not have been a major factor in causing the second drop in the bighorn population which began about 1921 and became alarming in 1930. Actually, however, this competition appears to have been less influential than certain other factors."

Population estimates by Neal Guse, Rocky Mountain National Park, indicated approximately 400 bighorns in the Park in the late 1920's. Packard believed there were approximately 300 head in 1939-40. Contor (1958) observed 109 bighorns in the Never Summer Range, 66 in the Continental Divide Range, and 36 in the Eastern Slope for a total of 211, Table 3.

Table 3. Bighorn sheep counts in Rocky Mountain National Park, November-December, 1957 (Contor 1958).

Area	Rams	Ewes and Yearlings	Lambs	Unknown	Total
Never Summer Range	22	46	31	10	109
Continental Divide	2	33	16	15	66
Eastern Slope	5	16	7	8	36
Total	29	95	54	33	211

Contor's 1957-58 bighorn observations, compared to Packard's in 1939, showed an increase of 31 percent in the Never Summer Range, 19 percent decrease along the Continental Divide, and 78 percent decrease on the Eastern Slope of the Park.

Capp (1967) studied sheep in the southern portion of the Mummy Range during the summers of 1965 and 1966, and reported a maximum of 38 sheep (18 ewes, 16 lambs, and 4 yearlings) in 1965, and 50 sheep (23 ewes, 20 lambs, and 7 yearlings) in 1966. The lamb:ewe:yearling ratio was 88:100:22 and 87:100:30, respectively.

The Rocky Mountain National Park herd has remained relatively stable during the last 15 years, based on Park personnel estimates. Contor counted 211 bighorns and Neal Guse's annual estimates, 1958 to 1961, were 225 annually. Dave Stearns, Rocky Mountain National Park research biologist, estimated the present population at 180-200 bighorns.

Recent aerial surveys, mostly by helicopter, indicate that the Never Summer Range population is considerably lower than counts by Packard and Contor indicated. However, their surveys were over a period of several months, and the number of duplicate observations was never determined. Dale Hibbs, a former Division of Wildlife biologist, counted 37 sheep (3 rams, 22 ewes, and 12 lambs) on July 8, 1966; only one ram was on Specimen Mountain, the others were in the Never Summer Range. Sixty-eight bighorns were counted later in the fall of 1966. A total of 77 (38 ewes, 15 lambs, and 24 rams) were counted via helicopter in 1968; 53 in the Never Summer Range, 9 on Specimen Mountain, and 15 in the Mummy Range. In the winter of 1969, 79 sheep (36 ewes, 10 lambs, and 33 rams) were counted on similar survey; 51 in the Never Summer Range, 4 on Specimen Mountain, and 24 in the Mummy Range. In 1970, Specimen Mountain was not surveyed, only one ram was seen in the Mummy Range, and 47 (34 ewes and lambs, 12 rams, and 1 unclassified) were in the Never Summer Range.

This herd may be static or even declining at the present (1970). Ground surveys have indicated a larger number of bighorns than recorded in aerial surveys during recent years. More data for the same dates are needed in order to compare the two surveys.

Aerial surveys, however, have indicated low lamb crops. Dave Stearns observed a large number of lambs early in summer, but they decreased in number before winter. Capp's (1967) observations also indicated good lamb crops, but lower recruitment into the yearling age class. The ram:ewe ratios are quite high, as might be expected in view of the non-hunting policy under which the national parks are administered.

Hunter Harvest

The portion of the Never Summer Range lying outside Rocky Mountain National Park and the Rawah area (Clark's Peak) has been open to sheep hunting since 1953. The season was closed in 1956 and 1957. During

the 16 hunting seasons 145 licenses were issued for the area, resulting in a harvest of 27 rams for a hunter success of 19 percent, Table 4. Hunting was under the half-curl or larger horn regulation in 1953-1955 and 1961-1965, the three-quarter-curl or larger in 1958-59 and 1966-1969, and full-curl rams or larger in 1970. Harvest and hunter success were, respectively, 13 and 19 percent; 14 and 20 percent; and no harvest for full-curl rams in 1970. It is interesting to note that hunters were equally successful under the more restrictive three-quarter-curl regulation.

Other Mortality

Parasites and diseases may have been important factors contributing to bighorn decline in Rocky Mountain National Park and the Never Summer Range. Packard (1946) listed scabies as one of the descimating factors, commenting:

"Market hunting and the restriction of the winter habitat has begun the decrease of these mountain sheep when another serious factor appeared. Whether domestic sheep were responsible for the introduction of scabies is uncertain. Students elsewhere have stated this epidemic began in 1902, but several of the older residents in the vicinity of the National Park believe it started much earlier, Mr. Abner Sprague dating it from 1878. At the time sheep were being grazed near Pikes Peak, in the Sapinero region, along the foothills, and possibly in the Poudre country to the north. One of these flocks may have introduced mites, but no definite evidence has been found to prove it. Mr. Sprague states that during the last decade of the century it was difficult to find a bighorn fit to eat, for almost every sheep was covered with scabs. The epidemic raged with varying intensity until about 1903 and then began to subside rather rapidly. There appears to have been a climax about 1902, corresponding with similar epidemics elsewhere in Colorado and Wyoming. There is no valid records of scabies among the Park bighorns since 1906."

Packard (1946) collected fecal samples from several band of bighorns in the Park and had them analyzed for parasites at Colorado State University. His report follows:

"The most important of these parasites are those of the genus Eimeria, the principal causal agents of coccidiosis. Four species of Eimeria have been identified from the Park bighorns. Of these E. arloingi is the most dangerous, for its effects can be virulent and fatal to lambs. The less abundant E. ninakohl has similar effects. E. faurei and E. parva are not considered significant. Coccidial parasites are present in moderate numbers in most individuals of the many host species, and if the hosts are strong and

Table 4. Bighorn hunting seasons and harvest, Never Summer Range and Rawah Wild Area, 1953-1970.

	Year															
	1953	1954	1955	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Seasons ^a																
Opening Date	9/3	9/11	9/3	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (Days)	11	9	9	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl Regulation	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	Full
Applications Received	-	-	-	-	10	10	16	20	33	25	39	51	35	34	54	29
Licenses Issued	5	5	5	6	6	6	6	6	12	12	12	24	12	8	12	8
Animals Harvested	3	0	0	0	3	1	1	1	4	1	2	6	2	1	2	0
Percent Success	60	0	0	0	50	17	17	17	33	8	17	25	17	12	17	0

^a Hunting season closed in 1956 and 1957.

healthy this chronic condition is harmless. The danger period is early in life, a natural immunity being developed with age. This immunity may be reached after about a year in domestic sheep, but the length of the danger period varies with the host species. Lambs may be chronically affected, showing symptoms at about two months, but eventually die of cachexia (debility). Younger lambs may die of acute infection and show marked symptoms: extreme constipation, mucous-coated, sometimes bloody, feces and debility. Such cases are probably due to infestation while grazing at first with the mother who has harbored the parasite over the winter. The important lethal factors in the Park bighorns has not been determined. Apparently many of the adults are chronic carriers and it is possible some of the lambs are being infected with acute and fatal cases."

Packard (1946) reported sighting several bighorns suffering from pneumonia (coughing and nasal discharges) in 1939 and 1940, and commented:

"Apparently debility caused by parasites increasingly activated by dietary deficiencies, and particularly the irritation and congestion caused by lungworms, permit the deadly pneumonic bacteria to enter the bloodstream. In cases of hemorrhagic septicemia the bacillus is Pasteurella ovisseptica, which is present in abundance in the environment, but which requires either decreased stamina or irritation of the flesh, or both, to become effective as the agency of death. In some cases other bacilli, such as Corynebacterium pyogenes, may become established and produce a different kind of pneumonic condition that is equally fatal. Whatever the actual cause of death, the usual sequence of events seems to be: first, a decreased bodily stamina due to dietary deficiency and internal parasites; second, the activation of lungworms, if present, causing increased weakness and irritation of the respiratory tract; and third, the admission of a lethal bacillus with resultant death."

Potts (1936) isolated hemorrhagic septicemia organisms in two bighorns in 1935 and 1936. He found Pasteurella ovissepticus in the lungs of a ram found near Glendevy campground on April 8, 1935. On April 10, 1936, he found a dead ram near Mary's Lake. The ram was emaciated and had unmistakable signs of a pneumonic condition. Potts isolated P. ovissepticus and Corynebacterium pyogenes from the lungs.

Fred Harrington delivered the body of a three-year-old ram to Dr. Gordon (1968), Colorado State University, on June 20 of that year for necropsy, who reported:

"The significant gross findings were: a relatively emaciated animal, marked hydropericardium; generalized myocardial hemorrhage, foci of congestion in the lungs, edema in the pulmonary lymph nodes, hemorrhage in the cortex of the adrenal gland, and a caseated nodule present in the abdominal cavity.

"It would seem that the parasite load, although not causing an acute process, could be responsible for the general condition of the ram. Any abnormal stress could cause some pulmonary embarrassment. The nasal discharge which was noted in the field is due to the presence of the parasites. Identification of the parasites is being attempted. They appear to belong to the Meullerius or Protostrongylus genera."

In a letter to Dave Butts, Rocky Mountain National Park, Fred Harrington wrote:

"On 21 June 1969, a yearling bighorn ram was found beneath a cliff in the 'Crater' of Specimen Mountain. The animal had fallen from a small cliff. Initial inspection suggested that the fall was probably not the cause of mortality.

"A subsequent necropsy confirmed my initial impression. No extensive physical damage had incurred, but the necropsy revealed: (1) an extremely emaciated animal, (2) extensive lesions on the lungs with adhesions to the pleura, (3) enlarged pulmonary lymph nodes, (4) left ventricle congested with pus of a cheese texture, constricting blood flow, and (5) an apparent generalized hemorrhage in subcutaneous blood vessels.

"Bacterial analysis of material collected by Dr. George Post, Department of Fishery and Wildlife Biology, CSU, revealed the presence of a Pasteurella-like organism. Pasteurellosis (hemorrhagic septicemia) reported initially by Potts in Rocky Mountain National Park is, therefore, implicated as a continuing source of mortality in this herd.

"Other analyses revealed: (1) 82 lungworms (probably Protostrongylus silesi) in 4-gram fecal sample; and (2) rumen contents--approximately 500 grams of Kobresia mysuroides and traces of volcanic mud.

"A bighorn ewe was also observed in the vicinity, emaciated and sometimes barely able to maintain equilibrium, although the rugged terrain precluded capturing her. The ewe disappeared before permission could be

obtained to immobilize her with suscostrin. Although the animal most probably died, attempts to locate her failed.

"No other sick animals have been found to date, although 5 of a total of 11 sheep, including the above yearling, present in the 'Crater' area in February, died by the end of June. Parts of the animals have been recovered, but the causes of mortality in 4 animals are unknown. Age classes of the 5 animals are: two yearlings, one 2-year-old ewe, one 3-year-old ewe, and one 7+ ewe. A 5-year-old ram, 3-year-old ram, yearling, and two ewes remained in apparent healthy condition. Of the two, however, only one produced a lamb. The ewe mentioned previously may have succumbed also, bringing the total to 6. No similar mortality rates were documented in other bands of sheep, although several dead animals were found, and lamb production was negligible on the west side of the park. In addition, yearling survival was low on the east side."

Parasites and diseases have played an important role in population trends of the Park herd. Scabies, hemorrhagic septicemia, and lungworms were important factors in early die-offs. Material collected by Fred Harrington indicated heavy mortality in this herd, and Dave Stearns believes that heavy lamb mortality is continuing, substantiated by low lamb counts and a relatively static population trend. There is much need for isolating mortality factors.

Packard (1946) noted that bighorns around the area frequented natural licks and ate considerable amounts of soil at these sites. After analyses of these soils he concluded the granitic nature of the area precluded it from supplying the sheep with needed minerals or salts, and that they ate soil at the licks to supply a deficiency. Packard advanced the theory that the sheep historically obtained mineral on the lower winter range, which were sedimentary rock formations. He also found that the bighorns readily used blocks of mineralized salt containing less than 4.5 percent crude protein, 15 percent calcium, 4.5 percent phosphorus, 30 percent sodium chloride, and 0.04 percent iodine. A block of plain salt was placed with each mineralized block at the recommendation of a representative of Gudahy Packing Company. Since these blocks would readily be used by the sheep, Packard recommended placement at strategic locations on the bighorn range. Packard also commented:

"A deficiency of minerals may be of vital importance to the health and virility of the bands, yet not be the entire factor; the metabolic mechanism can be thrown out of balance simultaneously or independently by a diet lacking sufficient variety. Only recently has it been realized that protein and vitamin deficiencies have a very great influence on the success of range and game management policies and that they, too, must be carefully investigated."

Predation is not likely to be an important factor in bighorn mortality. Packard (1946) and Contor (1958) believed that coyotes, cougars, eagles, and bobcats frequent the Park and probably take an occasional bighorn. They believed that such losses were negligible and probably good for the herds.

Range Competition and Human Influences

Increased volume of grazing and human activity on the bighorn ranges during modern times has apparently contributed to the decline of the Rocky Mountain National Park bighorn herd. Packard (1946) reported that grazing of domestic livestock, hunting, accelerated settlement of the foothills, and road building in the canyons forced the bighorns to abandon the winter ranges in the low country east of the Park. As cited earlier, elk had increased in number by 1927 and were important competitors on bighorn ranges. There has been a general increase in elk herds during the last 45 years.

Ratcliff (1941) was concerned about overgrazing on deer and elk winter ranges, and pointed out that the Federal agency bought considerable private acreage within the Park in 1932, eliminating competitive grazing by livestock. This should have given the range a chance to recover and improve; however, increasing numbers of elk and deer reduced it to a more depleted condition. Contor (1958) reported:

"Civilization has forced the abandonment of ancient migrational habits which formerly brought the wild sheep to lower elevations near the edge of the plain during the winter months. Now they must live the year-round in the higher mountains along the Continental Divide, adjusting themselves to more severe, less productive habitat.

"Competition with other herbivores is of prime importance. The increase of the Never Summer bighorns is probably due to lack of elk and deer competition and the eventual recovery of the range from overgrazing by domestic sheep which occurred prior to 1930, when the Never Summer Range was added to the Park. This population increase was predicted by Packard in 1941.

"It may be stated that the number of elk wintering on the alpine range appears to be increasing. In the winters of 1939-40 and 1940-41, this has been especially noted and forage has been consumed to a marked degree. To summarize, it would appear that elk, through the past ten years or more, may have been consuming so much of the winter range forage that they were, by weight of competition, confining the bighorns largely to the high-country range in the winter. Now, they threaten inroads of serious proportion even in the high country during the winter months.

"The records show that the eastern ranges were heavily overpopulated with elk for several years before effective control was established. Present conditions reveal that this winter range competition between elk and bighorns is now seriously detrimental, but evidence indicates that the 78 percent loss in the eastern bighorn population within the past 19 years probably resulted from excessive range depletion by elk. The lack of wintering herds of elk and deer in the Never Summer's, correlated with an increase in bighorns substantiates this evidence."

Capp (1967) did not believe there was much competition between elk, deer and bighorns in the southern portion of the Mummy Range. However, his observations were confined to the summer months. He said the study should be expanded to include winter ranges and weather to evaluate other relationships of the three species. Bighorns occupy specific habitats and elk, in increasing numbers, could crowd sheep out of these areas.

Domestic sheep are still grazed in the Never Summer Range, outside the Park boundary, during the summer months. During these periods, bighorns are concentrated on the Park side of the boundary. Bill Brandes (W.C.O.) reported non-use on this grazing permit for two years (1968-69), and that these animals were outside the Park during the summer and fall months. Permanent removal of livestock grazing from the alpine area in the Never Summer Range would benefit the bighorns.

Rocky Mountain National Park personnel have been concerned about the impact of people on Specimen Mountain bighorns. Increasing numbers of people venture onto the mountain to look at and photograph the sheep, tending to crowd them out of the area. The National Park Service plans to close the trail up Specimen Mountain to eliminate part of this harassment of the animals.

POUDRE CANYON-RAWAH WILD AREA

Distribution

This herd primarily occupies the north slope of the canyon along the Cache la Poudre River near Rustic, Colorado (Fig. 5). Here, the canyon is very deep, with steep, shrub-covered slopes interspersed with numerous rocky outcrops and cliffs. Bitterbrush (Purshia tridentata), big sagebrush (Artemisia tridentata), and ponderosa pine (Pinus ponderosa) are common along the lower slopes; aspen (Populus tremuloides), Douglas fir (Pseudotsuga sp.), and Engelmann spruce (Picea engelmanni) are more typical of the higher areas. The elevation is approximately 7,500 to 8,500 feet. A small group of sheep occupy the alpine area about 7 miles northwest of the canyon range. Richard Norman, Division of Wildlife, believes there is movement between these areas and that only one herd may be involved. Also, Anderson (1953) reported that local residents suspect bighorn movement between the two areas.

Bighorn sheep seen in the Rawah Wild Area apparently summer throughout the alpine range (Fig. 6). Rams were sighted in the McIntyre Burn at the northern end of the Rawah area in the summer of 1969. Sheep are occasionally reported by hikers and fishermen in the Rawah lakes and Clark's Peak areas during the summer months. Courtney Crawford (W.C.O.) reported that some sheep winter in alpine country around Clark's Peak and Rawah lakes. It is quite possible that other sheep descend to the Poudre Canyon to winter. Much more information on the organization and movements of this herd is needed.

Segments of the herd in Poudre Canyon are commonly seen during the summer on the north side of the Poudre River from the Big South Picnic Ground downstream to Washout Gulch. During winter they are most commonly seen lower in the canyon between Kinnikinick and Rustic. During winters of deep snow, the sheep are sometimes seen on the north side of the river, 3 to 5 miles eastwardly of Rustic. It appears that wintering grounds may be directly related to snow accumulation. Anderson (1953) found that bighorns in the Poudre Canyon ordinarily avoided areas of crusted snow. Some bighorns (usually rams) have been seen in adjacent areas, and a group of rams were observed northeast of Red Feather Lakes in the summer of 1971. In 1960, a ram was killed by a deer hunter near Livermore, and a ram was seen at the mouth of the Poudre Canyon about 1955. It is not uncommon for male bighorns to explore new areas. Bighorn sheep in the Poudre Canyon range primarily on public lands.

Population Trends

This area was probably historical bighorn range, but there were no known sheep in Poudre Canyon when introductions were made on December 6, 1946. Sixteen head (3 rams, 6 ewes, 4 lambs, and 3 yearlings) were released at that time 3 miles above the Zimmerman Ranch. George Jones and Claude White reported, April, 1950:

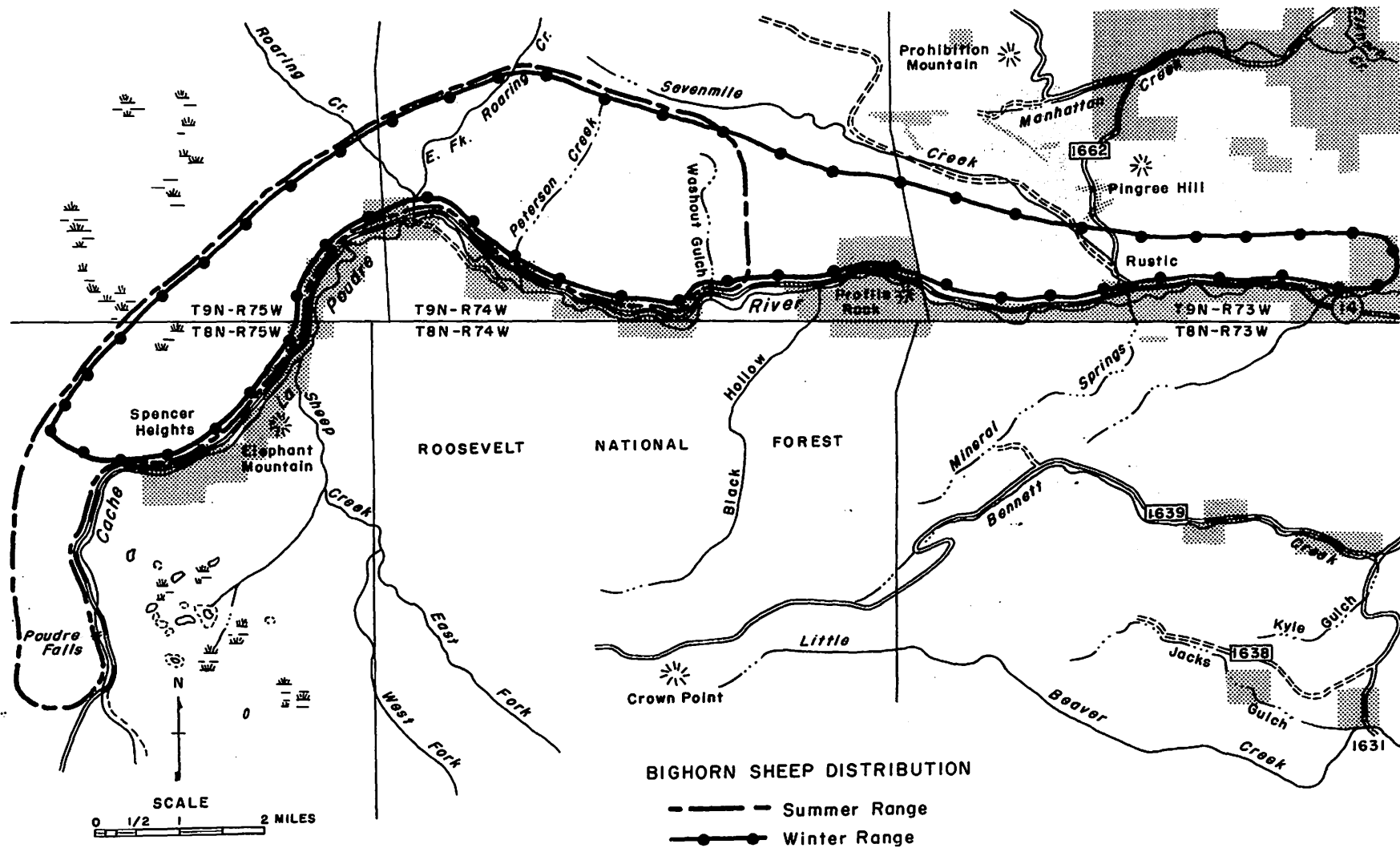


Fig. 5. Bighorn sheep distribution, Cache la Poudre River.

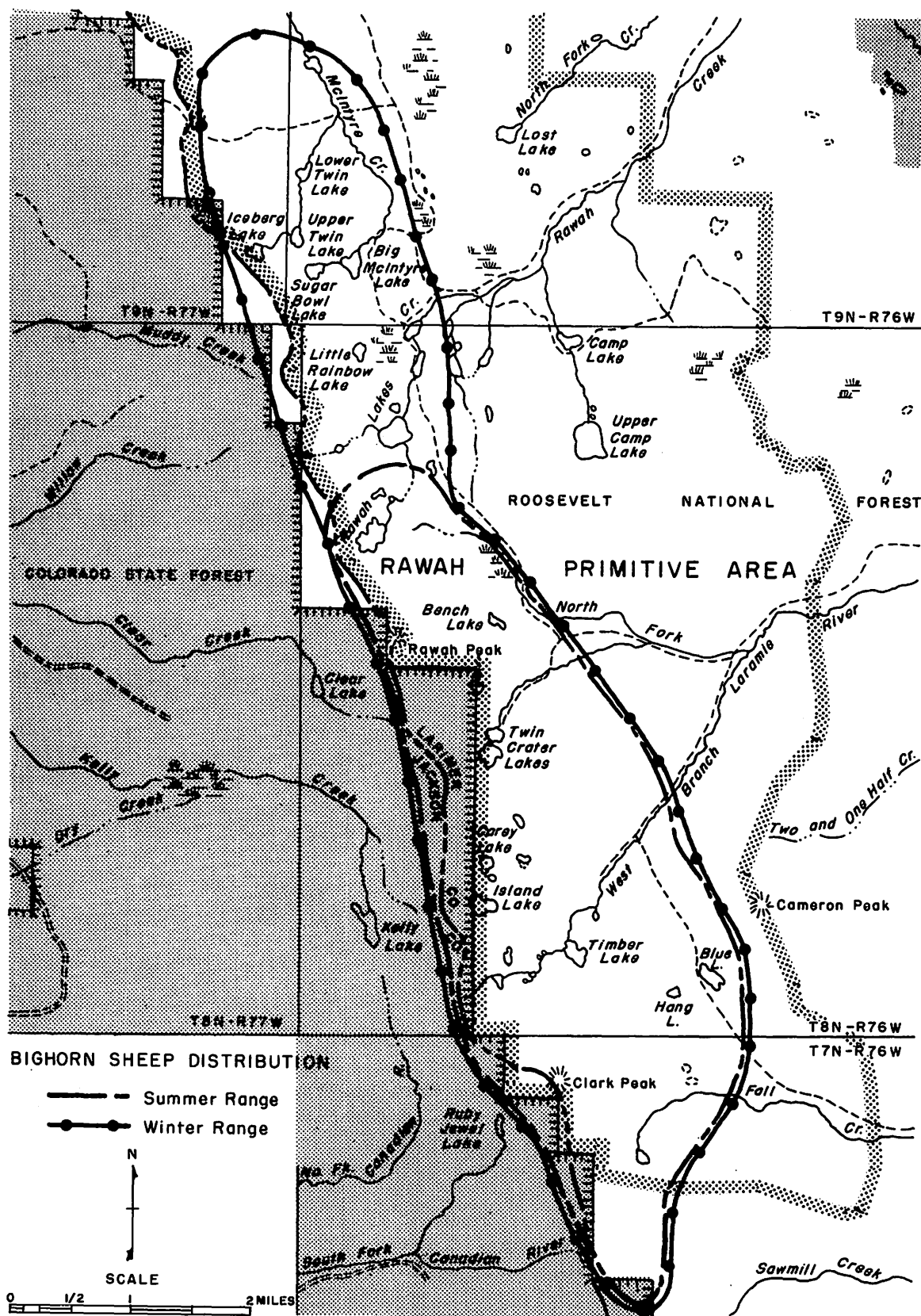


Fig. 6. Bighorn sheep distribution, Rawah Primitive Area.

"The Poudre herd has now expanded its range to include all of that area between Sportsman Lodge and Rustic. This still represents the range of two separate groups, one from Sportsman Lodge to the State Rearing Ponds and one from Washout Gulch to Rustic. The 1949 total census was 29, including 9 rams, 9 ewes, 8 lambs, and 3 yearlings. This represents an increase of 6 over 1948 and a total increase of 13, or a 45 percent increase since their release in 1946. It is noted that the sex ratio over a three-year period has become even."

Jack Remington and C. E. Till counted 21 bighorns (8 rams, 9 ewes, 4 lambs) on December 17, 1953, at Roaring Fork, Foote's Cabin, and Ault's Cabin.

Anderson (1953) observed 16 sheep in the Ault Ranch area, 10 near Kinnikinnick, and 21 at Washout Gulch, a total of 47 (12 rams, 14 ewes, 13 yearlings, and 8 lambs). He commented:

"Analysis of this inventory reveals that the sex ratio is nearly equal and that the lamb crop is decreasing. Thus, the rate of increase of the Poudre bighorn herd may be approaching a static state, or is on the verge of decreasing."

Moser (1962) estimated 60 bighorns in the Poudre herd. Glen Ekberg (Superintendent, Poudre Fish Rearing Unit) observed 86 bighorns during 12 sightings around the unit in April, 1970, (48 ewes, 21 lambs, and 17 rams). Many sightings were duplications since the maximum number of sheep seen at any one time was 17. Sig Palm (W.C.O.) classified 37 head (19 ewes, 14 lambs, and 4 rams) on March 3, 1970. Thirty-three sheep (21 ewes, 4 lambs, 3 yearlings, and 5 rams) were classified on a ground survey between Kinnikinnick and Rustic on December 30, 1970.

Helicopter bighorn censuses in the Poudre Canyon gave the following: April 29, 1969--41 total (16 ewes, 9 lambs, 5 yearlings, and 11 rams); February 28, 1970--12 total (8 ewes, and 4 rams, census conditions poor due to extremely high winds); and August 26, 1970--41 total (15 ewes, 12 lambs, 10 rams, and 4 unclassified).

Richard Takes, former Management Biologist, observed 29 bighorns on Clark's Peak in the summer of 1969. A fire occurred on Green Ridge in Poudre Canyon a few weeks before this observation, and Takes believed the fire caused the sheep to move to the Clark's Peak area for green food. Five ewes and 1 ram were seen on Clark's Peak, and one ewe was seen on Rawah Peak during an aerial survey, February 28, 1970.

Field personnel estimate the present (1970) Poudre Canyon bighorn population at 65-75 bighorns. Courtney Crawford believes there may be 15 head in the Rawahs, and Sig Palm estimates the Poudre Canyon group at 50 head; a total of 65. Norman estimated the entire herd at 75. This is only a very slight increase over Moser's (1962) estimate

of 60. From these data, it appears that the herd increased rather rapidly after the release in 1946, and leveled out in the mid-1950's. Lamb:ewe ratios are relatively high, suggesting rather high mortality in older animals. Again, more data are needed to insure a reliable statement concerning population status and trends.

Aerial survey census is extremely difficult in the Poudre Canyon, although quite feasible in the Rawah Wild Area. Poudre Canyon is very narrow and subject to down-draft wind conditions; thus, fixed-wing aircraft flights are dangerous at best. Helicopter flights are feasible on calmer days, and annual counts can be used to supplement ground observations. In winter, the sheep are readily seen from the highway; therefore, intensive and systematic ground surveys would probably yield valuable information on herd status in the canyon.

Hunter Harvest

Hunting seasons for the Poudre Canyon herd were allowed 1953 through 1969. The season was closed in 1970. Clark's Peak, or the Rawah Wild Area, was included in the Bowen Pass Hunting Unit. The half-curl ram regulation was in effect from 1953 through 1957, and from 1960 through 1965; the three-quarter-curl ram regulation was in effect during 1958, 1959, and 1966 through 1969 (Table 5). Forty-three rams were harvested during the 17 hunting seasons, for hunter success of 27 percent. Twenty-six of the rams were taken during seasons regulated by the half-curl limitation, for which hunter success was 29 percent. The other 17 rams were taken during three-quarter-curl regulation seasons for hunter success of 24 percent. It is interesting to note that in 1966 and 1967, a large number of permits (24 each year) were issued and success was extremely low; in 1968 and 1969 a small number of permits (6 each year) were issued and success was very high. Insufficient population data precludes speculation as to factors influencing the harvest. Hunter harvest in general was slightly higher in years of more liberal curl regulation, as would be expected.

Range Competition, Mortality, and Human Influences

Any competition for range in the Poudre Canyon would be with deer, since both species use the same type of winter range. Deer and bighorns have been observed grazing in close proximity on the same slopes. Simmons (1961) found that bighorns and deer on this area often fed and bedded in the same locality, and generally seemed to ignore each other. Elk use the same winter areas on occasions.

Domestic livestock grazing is limited to the bottom lands next to the river.

Table 5. Bighorn sheep hunting seasons and harvest, Poudre Canyon, 1953-1969.

	Year																
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Seasons ^a																	
Opening Date	9/3	9/11	9/3	9/1	8/31	11/15	11/14	11/5	11/18	11/17	11/16	11/21	11/20	11/19	11/18	11/30	11/26
Duration	11	9	9	9	16	9	9	9	9	9	9	16	11	12	13	16	12
Curl Regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4
Applications Received	-	-	-	-	15	-	16	19	38	41	41	49	50	50	58	21	17
Licenses Issued	5	5	5	5	10	6	4	4	10	10	12	12	12	24	24	6	6
Bighorn Sheep Harvested	2	0	2	2	1	5	3	1	6	5	1	4	2	2	0	3	4
Percent Success	40	0	40	40	10	83	75	25	60	50	8	33	17	8	0	50	67

^aThe hunting season was closed in 1970.

Moser (1955) analyzed three rumen samples collected from rams harvested in the Clark's Peak area in September, 1953 and 1954. Grasses comprised 82.7 percent of the diet (by volume), browse 13.1 percent, and forbs 4.2 percent. The more important plants in the samples were Carex nigricans, Muhlenbergia montana, Poa alpina, Holodiscus dumosus, Jamesia americana, and Senecio fendleri.

Courtney Crawford reported that livestock use on the Rawah Area occurs June to September. Cattle use is moderate and limited to the lower areas; domestic sheep use is rated as moderate and extends throughout the alpine. Deer and elk use in the Rawah range is very light.

Mortality information is extremely limited for this herd. Moser and Pillmore (1954) reported: "Three sheep, a lamb, a yearling, and a mature ewe were found on the Cache la Poudre." Unfortunately, the lamb and yearling were not found in time to perform an autopsy, but Game Manager Clois E. Till took the ewe to the School of Veterinary Medicine, Colorado State University, where death was attributed to verminous pneumonia resulting from heavy lungworm infestation. Pillmore (1962) found that 9 of 10 bighorn lungs (hunter harvest) from the Poudre herd in 1953, 1955, and 1958 were infected with lungworms, and that 2 of 2 lung samples from Clark's Peak, 1953, were also infected.

Anderson (1953) reported:

"On January 23 a two and one-half year old ram was observed with symptoms of lungworm (deep, noisy coughing) in the Larimer Tunnel vicinity. A young ewe also exhibited the same actions on February 22 in Washout Gulch. A sick ewe was discovered on March 9, and died on March 10."

An autopsy performed at Colorado State University disclosed verminous pneumonia as the cause of death. This ewe was also heavily infested with ticks.

Anderson (1953) and Simmons (1961) found no evidence of predation on bighorns while studying this herd. Anderson reported mountain lions (tracks), coyotes, and bobcats in the area. Simmons (1961) reported that the bighorns did not seem concerned by golden eagles flying over head; and he observed no instances of eagle predation on bighorns.

Jones and White (1951) reported bighorns licking dirt on an old cattle salt ground one-half mile above Kinnikinick; later, they established a new salt ground at Washout Gulch. Jones and Moser (1953) placed 50 pounds of salt in the Cache la Poudre drainage, and Moser (1954) reported use (pounds) by month, 1953: 0, 1, 0, 2, 4, 5, 3, no data, 4.5, 1.5, and no data, February-December, respectively. He reported, in 1955, that block salt was utilized at the rate of 1.7 pounds per month by Cache la Poudre sheep. Moser treated some salt blocks with phenothiazine for parasite control in bighorn sheep, but the animals did not use them to any extent. Bighorns presently (1970) are commonly seen using salt blocks put out for them by local residents.

Human use along the Poudre Canyon and in the Rawahs has greatly increased in recent years. In Poudre Canyon such use is concentrated along the river and, with the exception of deer hunters, likely has little effect on the sheep. Many people have been observed parked along the highway watching bighorns, readily seen from the highway almost any time of the year. They seem to be unconcerned about this scrutiny. Hikers, campers, and fishermen in the Rawah Wild Area are more limited in the northern end of the range. Bighorns in this area tend to flee while humans are still a considerable distance away. The effect of human presence on bighorn herds is only speculative, and likely variable from one area to another.

ST. VRAIN DRAINAGE-SOUTHERN ROCKY MOUNTAIN NATIONAL PARK

The St. Vrain drainage and southern portion of the Rocky Mountain National Park were historical bighorn sheep range. Walter Schuett (W.C.O.) believed there may have been a remnant population in the area, for occasionally sheep sightings have been reported by hikers and fishermen. Two half-curl rams were seen near Granby by Bill Brandes (W.C.O.) on several occasions in May and June, 1970. These rams could have moved down from the high country around the southern end of the Park. George Jones and Claude White, Division of Wildlife, saw 50 sheep between Arapahoe Peak and James Peak; Cliff Moser recorded 25 in the Arapahoe Peak area in 1958 and estimated the herd at 30. The area should be examined as a possible sheep reintroduction site.

GEORGETOWN-EMPIRE

Distribution

Bighorn sheep in this area occupy a triangle formed by U. S. Highways 6 and 40 north of Georgetown and the area north of Empire to the James region. Most of the area is public land with a few scattered tracts of private land intermixed (Fig. 7). Woodward (1969) stated:

"The bighorn sheep winter range in this area is north of Highway 6-40 from Dumont to Empire to Georgetown. The bighorn sheep utilize the steep hillsides next to the highway. These hillsides are characterized by rocky outcroppings and loose shale slides. The overstory consists of a few scattered ponderosa pine (Pinus ponderosa) and Douglas fir (Pseudotsuga mensiesii). The major shrubs which make up the understory are fringed sagebrush (Artemisia frigida), mountain mahogany (Cercocarpus sp.), rabbitbrush (Chrysothamnus sp.), and skunkbrush (Rhus trilobata). The principal grasses are blue grama (Bouteloua gracilis), mountain muhly (Muhlenbergia montana), Indian ricegrass (Oryzopsis hymenoides) and sleepy grass (Stipa robusta)."

Other plants encountered by Woodward on a range survey in this locality are listed in Table 6.

The Georgetown sheep spread into the alpine during summer, although a few individuals remain yearlong on winter range. Jones and White (1950) reported:

"A summer survey of the Georgetown area failed to reveal . . . a summer distribution of the Georgetown herd. All timberline areas from the head of Bard Creek east to Georgetown were covered on foot. No sheep were observed and no sign was seen to indicate the presence of sheep in the timberline areas. Eight sheep, three rams, three ewes and two yearlings were observed at a summer bedground immediately above Silver Plume. Since no sheep were seen on the lower winter ranges it is possible that the majority of the herd were ranging below timberline. This seems to be borne out by surveys from preceding summers when 40 to 50 sheep were observed at different times on the winter ranges from Georgetown to Silver Plume."

Population Trend

The Georgetown herd apparently increased until the late 1950's and then declined. There were a few native sheep in the area when 32 bighorns

Table 6. Plants on range transects, Georgetown winter bighorn sheep range, August, 1967.

TREES

Juniperus scopulorum

Rocky Mountain juniper

SHRUBS

Artemisia frigida

Fringed sagebrush

Cercocarpus montanus

Mountain mahogany

Chrysothamnus sp.

Rabbitbrush

Rhus trilobata

Skunkbush

Ribes sp.

Currant

Symphoricarpos albus

Snowberry

FORBS

Cryptantha virgata

Miners candle

Erigeron sp.

Daisy

Grindelia squarrosa

Curlycup gumweed

Oenothera sp.

Evening primrose

Opuntia sp.

Pricklypear

Penstemon sp.

Beardtongue

GRASSES

Agropyron sp.

Wheatgrass

Bouteloua gracilis

Blue grama

Bromus carinatus

Mountain brome

B. tectorum

Cheatgrass brome

Festuca arizonica

Arizona fescue

Muhlenbergia montana

Mountain muhly

Oryzopsis hymenoides

Indian ricegrass

Sitanion hystrix

Bottlebrush squirreltail

Sporobolus cryptandrus

Sand dropseed

Stipa robusta

Sleepy grass

(3 rams, 20 ewes, 7 lambs, and 3 yearlings) were released on Douglas Mountain on October 29, 1946. A second group of 14 sheep, consisting of 2 rams, 8 ewes, 2 lambs, and 2 yearlings, were released March 3, 1949. Jones had reported 48 animals in 1948 (Table 7). Jones and White (1949) reported 65 sheep and, in 1950, 71 sheep (24 rams, 19 ewes, 18 lambs, and 10 yearlings). In 1952, White observed 42 sheep (9 rams, 27 ewes, and 13 lambs) above Georgetown, all just below timberline.

Table 7. Bighorn sheep counts, Georgetown-Empire, 1948-1968.

Date	Type of Survey ^a	Ewes	Lambs	Rams	Yearlings	Unclassified	Total
1948	G	28	--	2	12	--	48
1949	G	21	16	10	4	--	51
1949	G	--	--	--	--	65	65
1950	G	19	18	24	10	--	71
1951	G	27	13	9	--	--	42
2- 9-53	G	24	17	16	12	--	69
3-26-54	G	13	--	5	5	4	27
12-20-56	G	42	18	17	10	--	87
11-60	G	8	6	3	4	--	21
2-13-66	G	12	3	2	--	--	17
2-23-67	G	16	4	3	--	--	23
1968	A	--	--	--	--	32	32

^a G = ground; A = aerial.

On February 9, 1953, a total of 69 sheep (16 rams, 24 ewes, 17 lambs, 12 yearlings) were counted along Highway 6; and 27 (5 rams, 13 ewes, 5 yearlings, and 4 unclassified) were counted here on March 26, 1954. On December 20-21, 1956, Moser classified 87 bighorns (17 rams, 42 ewes, 18 lambs, and 10 yearlings) in the Georgetown triangle, and 21 head (3 rams, 8 ewes, 6 lambs, and 4 yearlings) were observed November, 1960 (Jones 1962). Hibbs counted 17 sheep (2 rams, 12 ewes, and 3 lambs) on February 13, 1966; and 23 (3 rams, 16 ewes, and 4 lambs) on February 23, 1967.

Lynch and Hector (1971) estimated the present population at 75 animals for the Georgetown-Empire herd. Moser 1962 estimated 135 head and White (1949) 65 head. These counts followed the same trend: increasing until the late 1950's, then decreasing.

Lamb:ewe ratios and yearling counts were high during years the herd was increasing. Moser's lamb:ewe ratios for years 1949 through 1956 were: 50:100, 95:100, 48:100, no record for 1952, 73:100, 50:100, 84:100, and 61:100, respectively. The yearling counts were also high during those years, indicating a good lamb survival. Then, as the herd apparently began to decline, Hibbs recorded a lamb:ewe ratio of 25:100 in 1966 and 25:100 in 1967.

Early investigators found that ground surveys were best conducted during the winter months when the sheep were concentrated on winter range. Due to the high winds generally present in this area, aerial surveys were extremely difficult. However, Moser (1959) reported: "Aerial census from a helicopter was gratifying from the respect that more sheep could be counted from the air than by a ground count conducted during the same day. . ."

Hunter Harvest

The Georgetown-Empire area has been open generally to hunting since 1953, combined as one hunting unit most years but separate in other years. The Georgetown area was closed 1954-1956, and the entire area was closed in 1959. Data in Table 8 are combined for both areas.

Seventeen hunting seasons have been held in this area, 38 rams have been harvested, and the average hunter success is 25 percent. The half-curl ram regulation was in effect in the years 1953-1957 and 1960-1965; the three-quarter-curl regulation was in effect in 1958 and 1966-1969. Hunters were more successful under the more liberal season, 32 percent to 16 percent, respectively. Hunters in 1970 were required to take a full-curl ram or larger; no rams were harvested.

Other Mortality and General Information

There is only scattered information on mortality, other than legal harvest, for this herd. Since the herd winters along the highway, bighorn sheep are occasionally killed by an automobile. Moser reported three ewes shot by deer hunters in 1949. Moser and Pillmore (1954) reported finding a five-year-old ram in a mine cabin above Georgetown. The ram had fallen through the roof, breaking his neck.

Pillmore collected lung tissue from 21 sheep in 1953-1959, and Dr. Lynn Griner, Colorado State University, found that 17 of the samples were infected with lungworms.

Moser evaluated bighorn utilization of salt blocks placed on the area. Use (percent of salt available) by month, January-December, 1955, was:

Table 8. Hunting seasons and harvest, Georgetown-Empire herd (1953-1970).

	Year																
	1953	1954	1955	1956	1957	1958	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Seasons ^a																	
Opening Date	9/3	9/11	9/3	9/1	8/31	11/15	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	9	9	9	16	9	16	16	17	16	37	23	22	18	23	23	24
Curl Regulation	1/2	1/2	1/2	1/2	1/2	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	Full
Applications Received	-	-	-	-	24	-	21	26	34	28	23	15	36	19	24	22	12
Licenses Issued	10	10	10	5	15	14	4	8	8	6	6	6	12	12	12	12	4
Bighorn Sheep Harvested	3	4	5	2	5	2	0	2	1	3	3	0	2	3	2	1	0
Percent Success	30	40	50	40	33	14	0	25	12	50	50	0	17	25	17	8	0

^a The hunting season was closed in 1959.

no data, 0.0, 7.7, 3.4, 0.2, 12.8, no data, 13.2, no data, 10.6, 6.8, and no data, respectively. He found that block salt was utilized at the rate of 1.7 pounds per month. Moser then placed phenothiazine in the blocks to determine if it would be of any therapeutic value in reduction of lungworm infestation. He reported (1956):

"None of the medicated blocks of salt which were placed on sheep ranges at Empire, Georgetown, and Pikes Peak were utilized to any appreciable extent. No work was done with a commercial salt block impregnated with phenothiazine which is now on the market. Data obtained over the past three years indicate that sheep do not utilize the 8 grams per day which is necessary in order that it be of therapeutic value."

There may be some competition between bighorn sheep and other ungulates. Domestic sheep and elk use on the bighorn summer range was rated as moderate. Deer use occurred on both summer and winter range, but was considered light.

Moser (1955) analyzed four rumen samples collected from rams harvested by hunters in September, 1954 and 1955. By volume, grasses comprised 55.4 percent of the diet, browse 38.7 percent, and forbs 5.9 percent. The most important food species were Carex nigricans, Kobresia bellardi, Muhlenbergia torreyi, M. montana, Poa alpina, P. rupicola, Artostaphylos uva-ursi, Polygonum bistortoides, and Sisyrinchium angustifolium.

MOUNT EVANS

Distribution

Robert Streeter (1969) regarded the Mount Evans bighorn population, 1966 to 1968, as composed of four female-lamb-yearling bands (Fig. 8), and quoted Jones and White (1950):

"The Chicago Creeks band occupied the northern part of the area, using the upper Chicago Creeks and Bear Creek watersheds. These sheep were observed at or above timberline, up to 14,260 feet elevation, during all seasons of the year, as had been reported previously."

In commenting on the Mount Evans herd, Streeter (1969) wrote:

"The Scott Gomer herd ranged southwestern and central portion of the Mt. Evans area, from the headwaters of the Scott Gomer and Three-mile Creeks to their confluence with Geneva Creek, the western area boundary. These sheep were both above and below timberline throughout the year, and may have intermingled with the Chicago Creek band. However, herd interchange, based on distribution data obtained by observation, hunter interviews, and Division helicopter flights, was considered insignificant.

"The Mt. Logan-Grant band used the southern portion of the area, from near the confluence of Geneva Creek and the North Fork of the South Platte River at Grant, to the east side of Mt. Logan, northeast of Grant. It was difficult to obtain data on this segment of the herd because the bands were widely scattered in timbered areas. The herd was not observed above timberline during the winter and early spring months.

"The bighorn sheep associated with Deer Creek, in the southeastern portion of the Mt. Evans area, were scattered throughout this watershed. This band consisted primarily of rams, although small groups of ewes were occasionally seen. The Deer Creek drainage was predominately below timberline. Intermingling of the Deer Creek and Mt. Logan-Grant bands probably occurred, mainly during the breeding season.

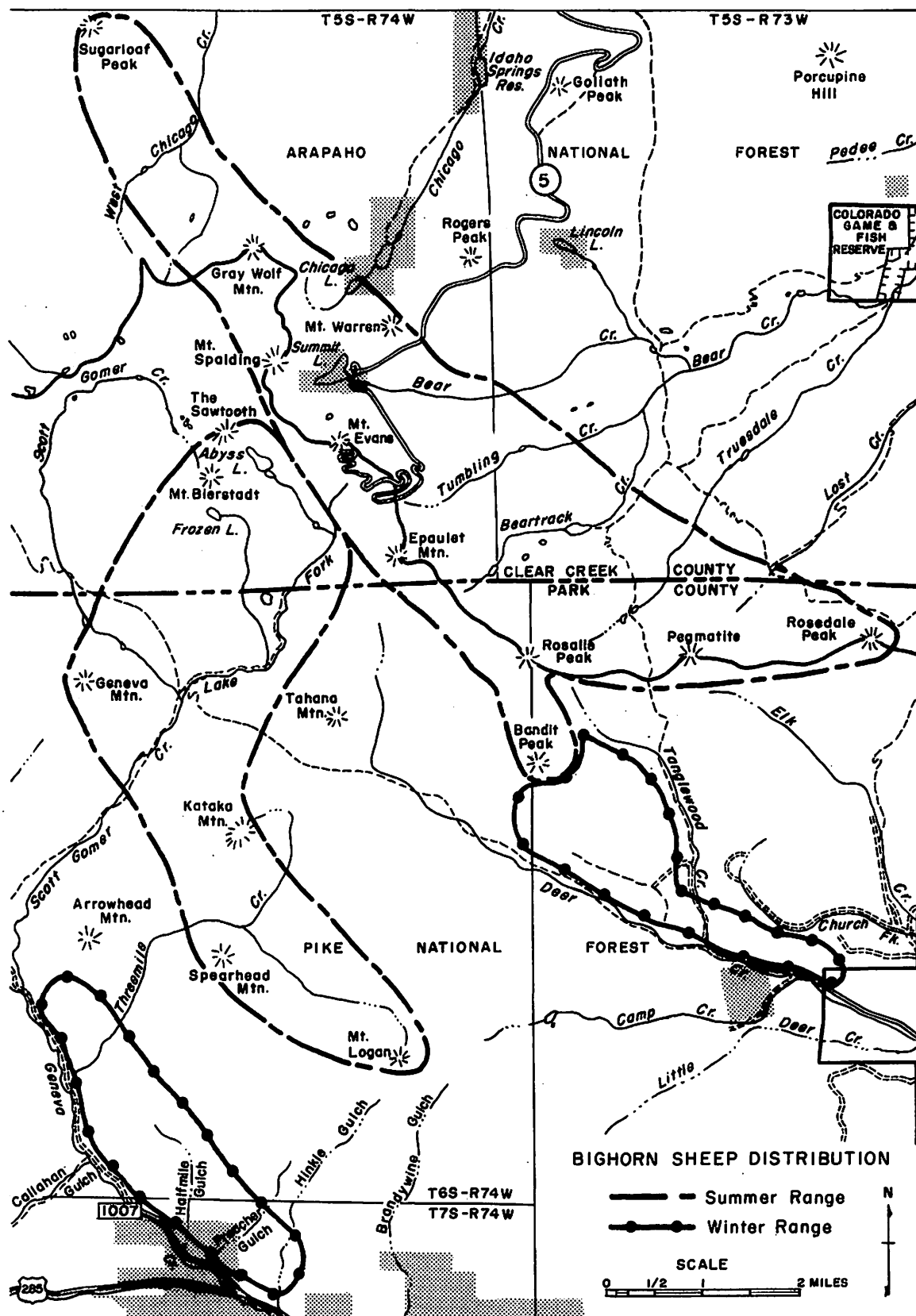


Fig. 8. Bighorn sheep distribution, Mt. Evans-Geneva Creek.

"Mt. Evans is approximately in the center of the alpine portion of the Mt. Evans study area (Fig. 9). Eight named peaks over 13,000 feet elevation are within a radius of three airline miles from Mt. Evans, 14,264 feet in elevation. Seven named peaks between 12,000- and 13,000-foot elevations are also within a radius of seven airline miles of Mt. Evans. Throughout, numerous glacial cirques are found at the heads of major drainages, mainly within three airline miles of Mt. Evans. The remainder of the alpine zone topography is composed of gently rolling to steep slopes, rock ridges and rock slides. The below-timberline portion of the area used by the sheep is predominantly southeast to southwest in aspect, with steep slopes, interspersed cliffs and rock slides."

Population Trend

The Geneva Creek (Mt. Logan-Grant) sheep was established with a transplant on February 28, 1945, where Geneva Creek joins Three-mile Creek (Fig. 10). The first plant consisted of 16 animals (8 ewes, 5 lambs, and 3 rams), and an additional plant of 7 ewes was made on January 16, 1948. The herd totaled 31 head in 1949 (Table 9). Jones and White (1949) commented:

"The sheep were released in a ponderosa pine zone with southern exposure, broken by steep, rocky slopes with steep side canyons, and dominated by a main ridge beginning at the head of Three-mile Creek. This north-south ridge provides continuous, virtually snow-free, southern exposure from Geneva Creek to the head of Three-mile Creek. The area is noticeably lacking in browse, but the understory of grasses is excellent both as to density and composition."

Jones (1950) reported 31 bighorns on Geneva Creek, 8 on Deer Creek, 27 on Mount Evans, and 16 on Gray's Peak for a total of 82 in 1950. White (1951) observed 33 animals on Three-mile Creek, October 26, 1955, and 33 on Mount Evans, May 31, 1956. A total of 41 bighorns (19 ewes, 4 lambs, 6 rams, and 12 unclassified) were observed on Geneva Creek, November 11, 1969.

Dale Hibbs reported 17 rams and 5 ewes on Mount Evans and Geneva Creek, September, 1966, and 15 rams and 3 ewes on August 9, 1966, both counts via helicopter. Other helicopter surveys in the area, March 27-28, 1969, gave the following results: Deer Creek, 28 (9 rams, 14 ewes, 5 lambs); Three-mile Creek 20 (1 ram, 16 ewes, 3 lambs); and Mount Evans, 76; an overall total of 126 sheep for the entire area. A total of 55 (20 rams, 18 ewes, 8 lambs, and 9 unclassified) were counted on an aerial survey in 1969.



Fig. 9. Alpine range on the north face of Mt. Evans. (Photo by George D. Bear)



Fig. 10. Geneva Creek and Three-mile Creek with Mt. Logan in the background. (Photo by George D. Bear)

Table 9. Bighorn sheep counts, Mt. Evans, 1949-1969.

Date	Type of Survey ^a	Bighorns Counted					Total	Remarks
		Ewes	Lambs	Yearlings	Rams	Unclassified		
1949	G	--	--	--	--	31	31	Geneva Creek
1950	G	--	--	--	--	82	82	Geneva Creek, Deer Creek, Mt. Evans, Gray's Peak
1951	G	14	9	--	7	3	33	Three-mile Creek
10-26-55	G	--	--	--	6	27	33	Mt. Evans
5-31-56	G	7	4	3	--	--	14	Mt. Evans
Sept. 1966	A	5	--	--	17	--	22	Mt. Evans, Geneva Creek
Aug. 1966	A	3	--	--	15	--	18	Mt. Evans, Geneva Creek
3-27/28-69	A	14	5	--	9	--	28	Deer Creek
3-27/28-69	A	16	3	--	1	--	20	Three-mile Creek
3-27/28-69	A	--	--	--	--	76	76	Mt. Evans
1969	A	18	8	--	20	9	55	Mt. Evans area
11-11-69	G	19	4	--	6	12	41	Geneva Creek

^aG = ground; A = aerial.

Streeter (1969) reported minimum classification totals for the three years he studied the Mount Evans herd as follows: 1966, 159 (32 rams, 78 ewes, 43 lambs, and 6 yearlings); 1967, 157 (37 rams, 71 ewes, 40 lambs, 9 yearlings); and 1968, 154 (28 rams, 73 ewes, 29 lambs, 24 yearlings). The average ram:ewe:lamb ratio was 43:100:59. The overall population trend of the herd is upward and, theoretically, it would attain twice its present size in 25 years at the current rate of increase. Streeter's classifications averaged over a three-year period for the four herd segments are: Chicago Creek, 44, 46, and 46; Scott Gomer, 61, 57, and 63; Mt. Logan-Grant, 39, 46, and 31; and Deer Creek, 15, 9, and 14.

The Mount Evans herd has shown population increase during the past 25 years. Jones counted 82 sheep in the late 1940's. Streeter estimated minimum population of 160 in 1966-1968; and the combined estimate of Wildlife Conservation Officers Charles Hector, Tom Lynch, and Tom Sherrill in 1969 was 153.

Hunter Harvest

Bighorns have been hunted on the Mount Evans area since 1953, and 278 licenses have been issued during the 18 hunting seasons involved. The harvest has consisted of 67 rams, for a hunter success of 24 percent. In 1970, regulations required full-curl or larger rams; in 1958, 1959, and 1966-1969 they required three-quarter-curl or larger rams; and the half-curl ram limitation was in effect during the other 11 hunting seasons (Table 10). Hunters were more successful (30%) under the half-curl than three-quarter-curl limitation (24%). No rams were harvested in 1970 when the full-curl ram regulation was in effect.

Other Mortality

As in most Colorado bighorn herds, lungworms were found to be common in the Mount Evans herd. Pillmore (1959) detected lungworms in a ram killed by a hunter that year, and Streeter (1969) found 91 percent occurrence of lungworm larvae in 171 fecal samples. The net effect of lungworms on the Mount Evans bighorn herd is unknown.

Jones (1953), reporting mortality of Geneva Creek bighorns, stated that during January, 1952, 14 animals, 6 rams and 8 ewes were found dead. Two had been killed with a .22 caliber rifle. On February 2, 1952, a yearling ewe was taken to Colorado State University where autopsy disclosed that hemorrhagic septicemia was responsible for the death.

Streeter (1969) found the remains of 28 bighorns while studying the Mount Evans herd and determined the ages of 20. Forty-five percent of the mortalities occurred in the 0-1 year age class. A 15-year-old ram

Table 10. Bighorn sheep hunting seasons and harvest, Mount Evans area, 1953-1970.

	Year																	
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Seasons																		
Opening Date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/16
Duration (Days)	11	9	9	9	16	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl Regulation	1/2	1/2	1/2	1/2	1/2	3/4	1/2	1/3	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	Full
Applications Received	-	-	-	-	9	-	20	11	35	82	87	66	92	121	141	97	107	47
Licenses Issued	10	10	10	5	10	10	6	6	15	40	24	18	18	36	18	18	18	6
Bighorn Sheep Harvested	1	3	3	0	2	0	0	0	3	14	13	7	3	10	2	3	3	0
Percent Success	10	33	33	0	20	0	0	0	20	35	54	39	17	29	11	17	17	0

and two 13-year-old rams were the oldest animals found. Streeter, in preparing mortality and annual increment, commented: "Based on the 44 percent mean lamb survival and the 9 percent mean breeding population mortality as calculated for the Mount Evans area, the theoretical population would have had a positive growth of 2.5 percent annually."

He also computed a population density of four sheep per square mile. He lacked sufficient data to relate population density with bighorn sheep mortality and natality, but believed that bighorn populations may be responsive to population density changes.

Streeter (1969) briefly studied the nutritional values of four vegetative species in Mount Evans alpine zone. Samples of Agropyron trachycaulum, Poa rupicola, Festuca ovina, and Kobresia bellardi were collected in October, November, December, and March and analyzed for crude protein, crude fat, crude fiber, ash, calcium, and phosphorus. Evaluation of results was limited, however, because the nutritional requirements for bighorns is unknown. Lacking this base, Streeter used nutritional requirements of domestic sheep in his evaluation, concluding that crude protein, and calcium, and the calcium:phosphorus levels were lower than these minimal requirements. Since nutrition affects reproduction, milk production and the general health of both adults and lambs, it is a vital limiting factor in bighorn sheep populations. It is imperative, therefore, that the nutritional requirements of bighorn sheep be determined.

Streeter (1969) did not observe bighorn predation in any form while working at Mount Evans, and concluded that it did not have an influencing effect on this sheep population. He found evidence of bighorn sheep in 7 of 14 coyote scats, but did not determine how the predators obtained such food. Red foxes, coyotes, and golden eagles were common, and a mountain lion was seen on the area.

Range Competition and Human Influences

Range competition is primarily limited to deer, elk, and goats, but these uses on the bighorn range were light. Deer use on the Deer Creek winter range was moderate. Cattle grazed the Deer Creek range to a limited extent during the summer months. Rutherford estimated the Mount Evans goat population at 100 animals; however, the main range of these animals is below timberline.

Human activities on the Mount Evans bighorn range is heavy, and sheep are harassed in many ways: chased by dogs, photographers, trail-bikes and snow-mobiles. The latter two are commonly used in the areas. Charles Hector (W.C.O.) believes human activities along the road to the summit of Mount Evans have tended to drive sheep using that area to more southerly ranges.

SOUTH PLATTE RIVER CANYON

Distribution and Population Trend

The range of this bighorn herd is primarily the rocky canyon of the South Platte River near Waterton (Fig. 11), which provides both summer and winter pasturage. The entire area is relatively low, 7,000 feet elevation, bordering the plains.

The South Platte River herd has decreased greatly during the last 25 years. Moser (1956) reported counting 13 rams and 36 ewes, lambs, and yearlings on November 30, 1955. In 1962, he estimated this herd at 50 animals. Charles Hector (W.C.O.) estimated the present (1970) population at 18. Hector observed a half-curl ram and seven lambs in July, 1969, and stated they were the first ram or young he had observed since 1964. Annual ground and aerial surveys should be conducted to establish basic population data. Restocking should be based on the capability of the area to support a larger population, determined by standard range surveys.

Mortality and Other Factors

The South Platte herd was hunted through 13 consecutive seasons, 1954-1966 (Table 11). A total of 92 licenses were issued during this period and 43 rams were harvested for a hunter success of 47 percent. The three-quarter-curl ram limitation was in effect in 1958, 1959, and 1966; the half-curl ram regulation was in effect all other years. Hunter success for the two types of seasons was 31 and 53 percent, respectively. Only two rams were harvested in 1965 and 1966, supporting Charles Hector's report of few large rams in the herd.

Information on parasite infestations in South Platte sheep is limited to work in 1958. Pillmore examined lung tissue from six bighorns from the canyon and found all of them host to lungworms. Five of the animals were hunter kills and a sick yearling found in April. Pillmore (1959) reported:

"The Waterton animal was emaciated, hardly able to stand. There was a heavy infestation with winter ticks, and internally the pathology was largely confined to the lungs. . . probable necrotic areas were noted on the liver. The lungs had many adhesions, pneumonia was reported present, and there was a heavy lungworm infection with both species represented."

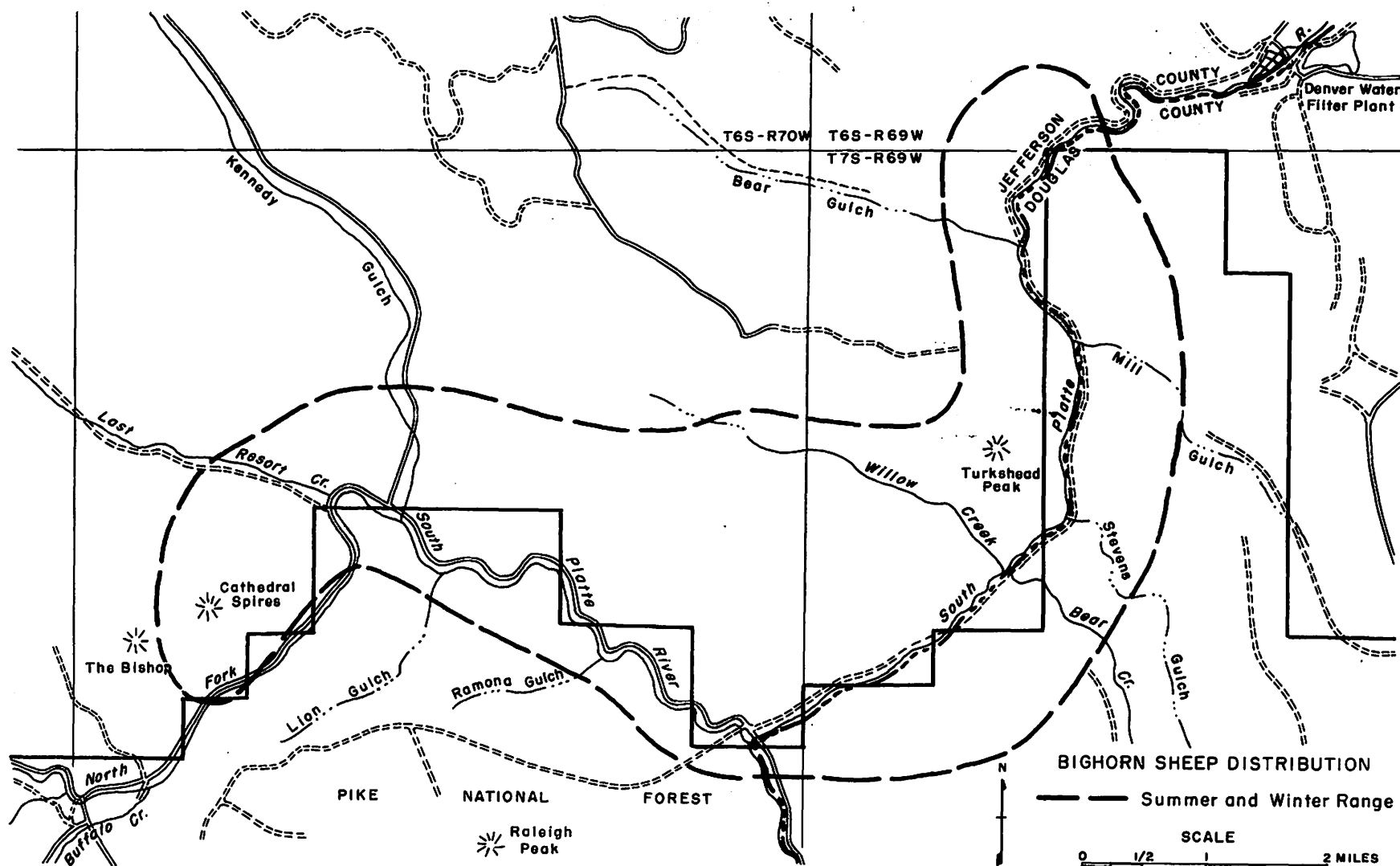


Fig. 11. Bighorn sheep distribution, South Platte River Canyon.

Table 11. Bighorn sheep hunting seasons and harvest, South Platte River Canyon herd, 1954-1966.

	Year												
	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
Hunting Season Opening Date	9/11	9/3	9/1	8/31	11/15	11/14	11/5	11/18	11/17	11/16	11/21	11/20	11/19
Duration (Days)	9	9	9	16	9	9	9	9	9	9	16	11	12
Curl Regulation	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4
Applications Received	-	-	-	13	-	32	47	48	39	30	22	36	43
Licenses Issued	5	5	8	8	6	8	8	6	6	6	6	6	12
Bighorn Sheep Harvested	1	4	4	3	5	3	4	5	5	2	5	2	0
Percent Success	20	80	50	38	62	50	50	62	93	33	83	33	0

Hector reported that range competition with other ungulates was low and that human activities were high. Domestic livestock do not graze the bighorn ranges and deer-elk use was light. Elk occur on the area from October through April and deer all year. Since the range is only a short distance from a large population center (Denver), human activities along the river are certain to remain high. Motorcycles and other trail machines are used along the river road. The combined disturbance of people and machines obviously has an adverse effect on the bighorn herd.

TARRYALL-KENOSHA MOUNTAINS

Distribution

Spencer (1943) described the range and distribution of the Tarryall-Kenosha Mountain bighorn herd as follows:

"The Tarryall Mountain range extends for some 15 miles between the north and south forks of the South Platte River, 50 miles northwest of Pikes Peak on the Pike National Forest in Colorado. The topography varies from meadow lands in the Tarryall Valley to the roughest and wildest areas found on the Pike National Forest. The range is of granitic and basaltic origin, with elevations from 8,600 to more than 12,000 feet. Large areas burned over some 75 years ago are now revegetated with aspen, shrubs, grasses, and forbs. The main winter ranges are on south exposures where the principal type is an open stand of ponderosa and bristlecone pines, and associated species. Alpine meadow types are found on the higher ranges, especially above timberline.

"One third of the Tarryall sheep remain at or above timberline yearlong, except for a short period when heavy spring snows force them into the aspen type just below timberline. The rest of the herd spends the summer in the high country but migrates to lower elevations for the balance of the year. It was found that regardless of weather conditions these migrations, which are but a few miles in extent, take place about the same time each year and over the same routes.

"Ewes and lambs in small numbers and a few of the younger rams make their appearance on the lower Tarryall ranges in October. Chronological observations show that the number of sheep gradually increases until the height of the breeding season is reached in November. As the breeding season progress, the ewes and lambs congregate in larger groups. During early December, 105 sheep have been counted in one band. In January, there is a tendency for the larger groups to disband and scatter. The old rams go off by themselves and are seldom found with the ewes and lambs until the next fall.

"The older ewes are the first to leave the winter range. The migration to higher ranges starts in April and by May 15 most of the ewes will be found on or near the areas used as lambing grounds. The rams and young sheep may not go to the high country until June. As many as 45 rams were observed in one bunch on the summer range."

Distribution of this herd has narrowed since the die-off in 1953. Bighorns previously occurred throughout the Tarryall and Kenosha mountains and, as the herd increased, wintered in the more southerly ranges around Wilkerson Pass. Sheep were also found in the Wigwam Park and Cheesman Reservoir areas to the east. Presently, the bighorn range is limited to the Tarryall Mountains north of the town of Tarryall, and in the Kenosha Mountains (Figs. 12 and 13).

The sheep have a seasonal shift in elevation, summering in the alpine and other high ranges, then moving to lower areas to winter. Jones (1949) noted that spring storms and deep snows in the high country would delay the migration back to the summer range; also, the sheep were scattered during winters with little snow accumulation. White and Jones (1950) wrote:

"The effect of the dry season on the Tarryall and Kenosha herds is abnormal only in the earliness normal herd movements occur. The rams normally split into small bands and scattered early. During the first part of June these bands may be found almost anywhere in the Tarryalls."

Sheep in the Tarryalls summer around North Tarryall Peak, Topaz Mountain, Bison Mountain, McCurdy Mountain, and South Tarryall Peak. In the fall they descend to the areas along Tarryall Creek to winter (Fig. 14). The lower range is a typical ponderosa pine zone with numerous broken rocky ridges. This is primarily public land with a few tracts of privately owned land along Tarryall Creek. Common plant species are ponderosa pine, shrubby cinquefoil, fringed sage, a wide variety of forbs, blue grama, and mountain muhly. Sheep in the Kenosha mountains also summer throughout the high country. A portion of this group descends to Long Gulch to winter. Jones (1950) reported that this group remained in the alpine the year-round.

Population Trend

The Kenosha bighorn population has gone through a very dramatic cycle. Die-offs occurred in 1885 and in 1923-24, and the herd increased steadily from this population low, permitting the transplanting program initiated in the late 1940's. Claimed to be one of the largest bighorn sheep herds in the United States in the early 1950's, the die-off during the early years of that decade nearly extirpated it. Increase in numbers has been extremely slow during the last 15 years, the present (1970) population being only an estimated 100 sheep. There is suitable range for several times this number of bighorns.

Spencer (1943) commented on disease and the age and sex composition of the Tarryall herd as follows:

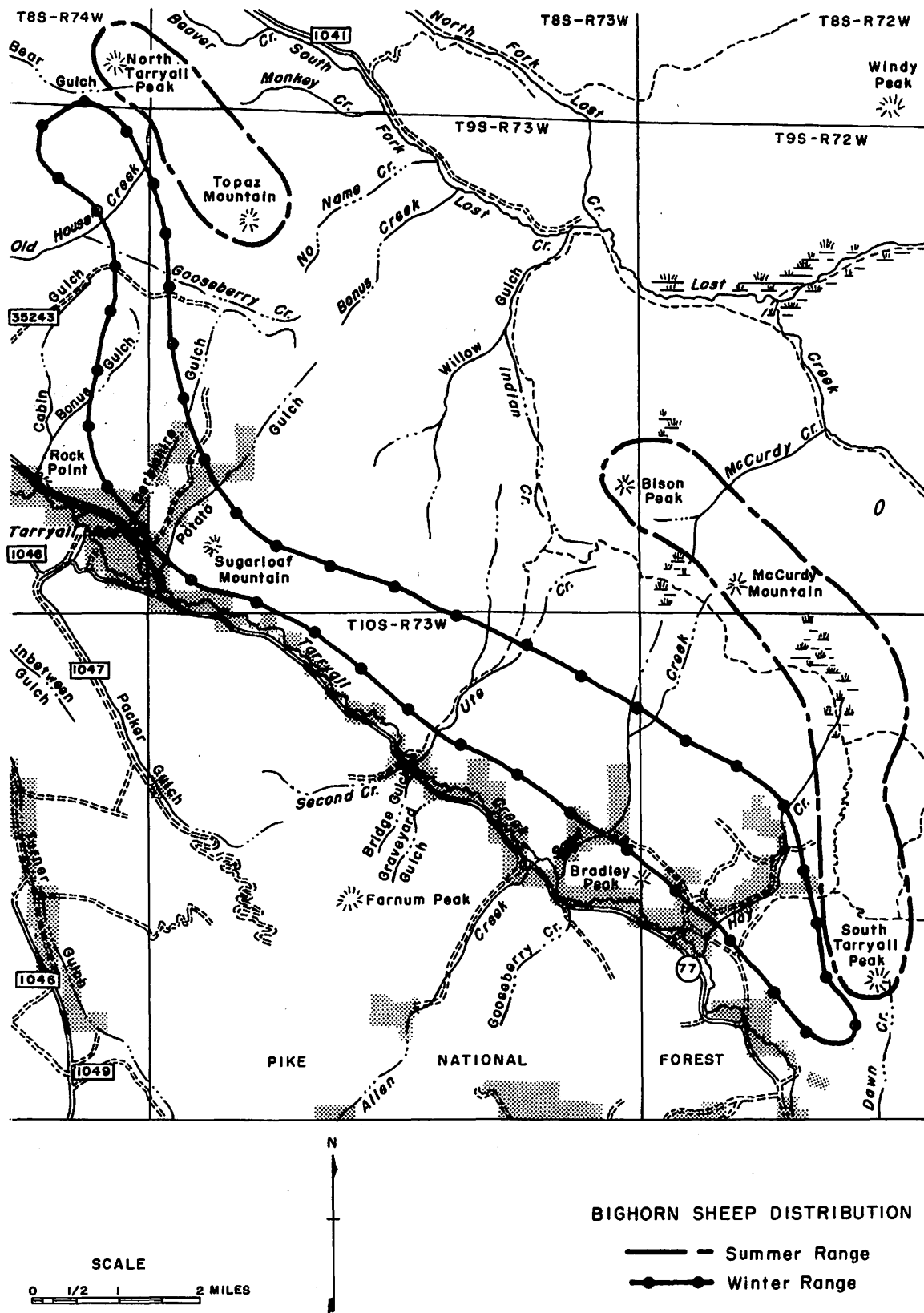


Fig. 12. Bighorn sheep distribution, Tarryall Mountains.

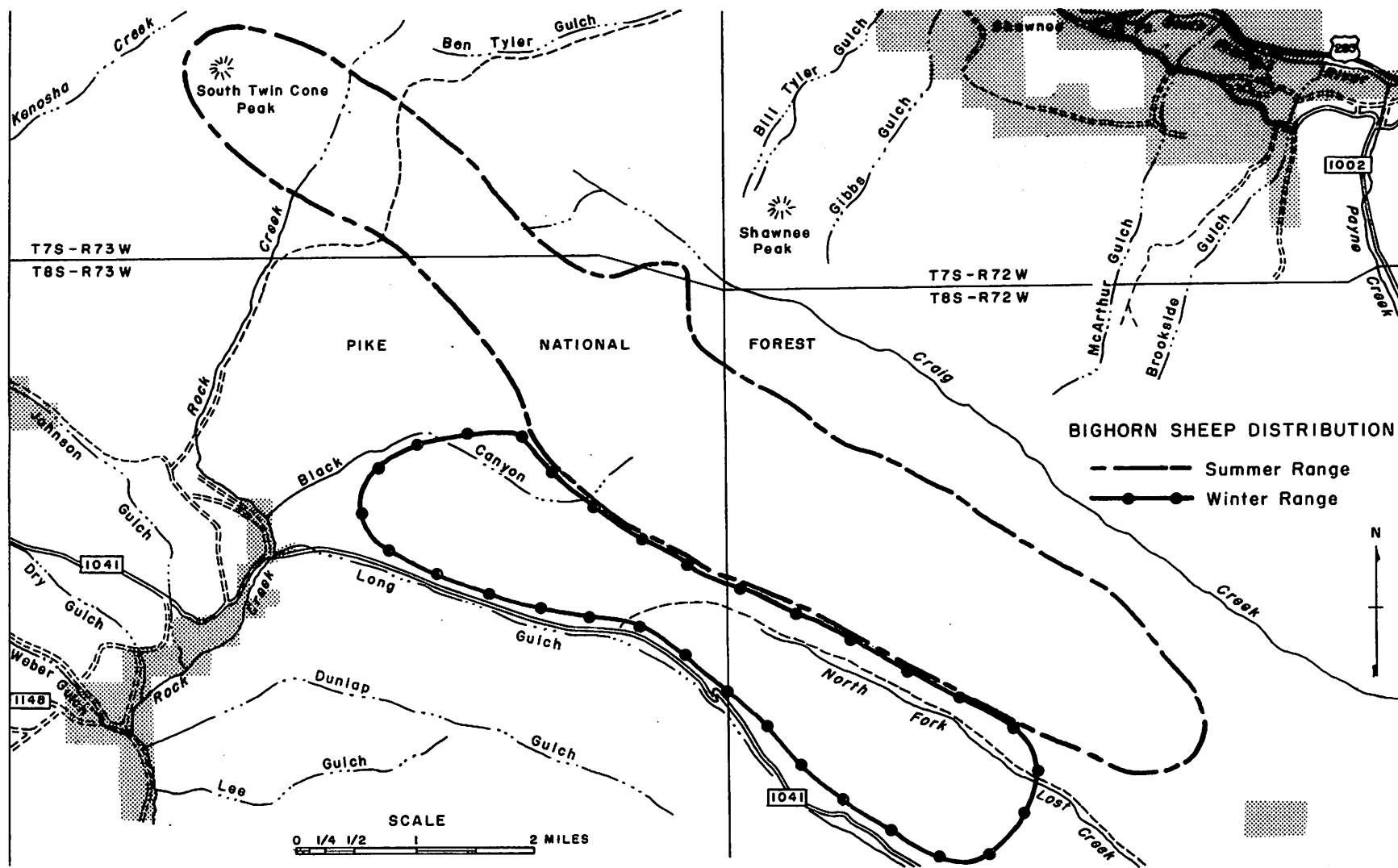


Fig. 13. Bighorn sheep distribution, Kenosha Mountains.

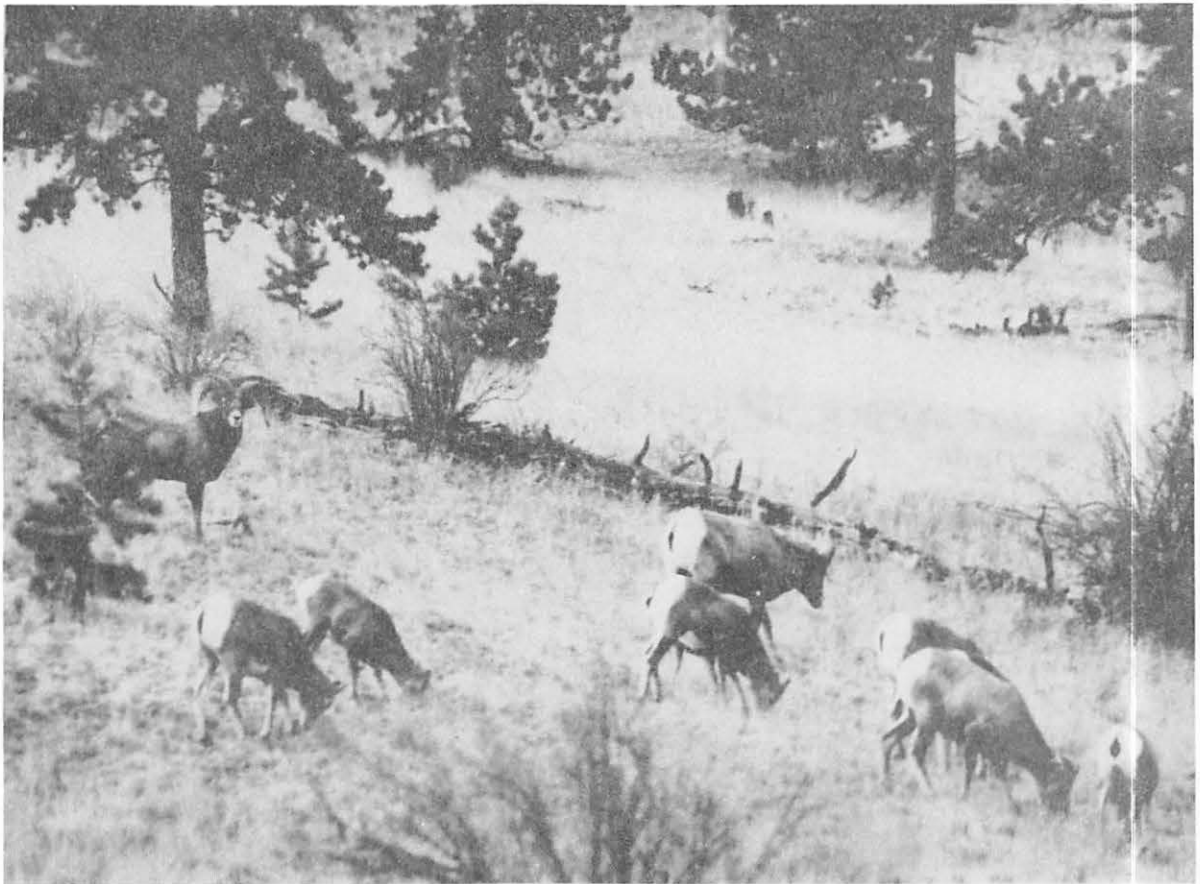


Fig. 14. Bighorn sheep on the Tarryall Creek winter range. (Photo by George W. Jones).

"These mountains once supported an outstanding herd of Rocky Mountain bighorn sheep (Ovis canadensis canadensis). Severe losses of bighorns experienced in 1885 were believed to have been caused by psoroptic mite. In 1923-24, the herd was almost destroyed by what appeared to be an epidemic of hemorrhagic septicemia. A census shortly after the epidemic showed that only a few individuals had survived."

Spencer (1943) classified 388 sheep (147 ewes, 80 lambs, 117 rams, and 44 yearlings) in his survey of November, 1940, reporting:

"Based on the number of old ewes counted, the lamb crop at that time was 78 percent. This was encouraging, since the critical period for the lambs has been passed. The increase for the herd, based on the 1939 counts was approximately 32 percent, a small portion of which was the result of a better census. The count also showed that 70 percent of the 1939 lambs had survived as yearlings.

"A few sheep, estimated at 20, not included in the 1940 census, were on a portion of the range not covered at that time. The total number in the herd was close to 400."

According to Jones and White (1949):

"The final census for the Tarryall and Kenosha herds showed a total number of 786 sheep. However, several small groups of sheep have drifted away from the Tarryall toward Cheesman Reservoir and Wilkerson Pass. Counting these and the sheep which were missed, the total population for the Tarryall and Kenosha Mountains is between 900-1,000 sheep."

These workers conducted an intensive classification of the herd during a four-month period (November through February) in 1945-46 and 1948-49 (Table 12). The lamb:ewe:ram ratio for the two winters were 49:100:91 and 58:100:85, respectively. The lamb:ewe ratios were considered fair, while the ram:ewe ratios were very high. Lamb mortality determined for the McCurdy Mountain band was approximately 22 percent in the winter of 1948-49, interesting since the yearling:ewe ratio (36:100) in the overall census of 1948-49 was also 22 percent lower than the lamb:ewe ratio. The yearling:ewe ratio in 1945-46 was 43:100, indicating good lamb survival. These figures, of course, are representative of a healthy and growing herd.

The severe die-off in this herd occurred in 1953. Moser (1954) stated that George Jones estimated that only 30 sheep survived the Tarryall herd die-off and that only 14 were left in the Kenosha herd. Hibbs

Table 12. Bighorn sheep counts, Tarryall and Kenosha Mountains, 1940-1970.

Date	Type of Survey ^a	Bighorns Counted				Unclasi- fied	Total	Remarks
		Ewes	Lambs	Yearlings	Rams			
Nov. 1940	G	147	80	44	117	-	388	Census in Tarryall Mtns.
Nov. 1945	G	418	235	183	350	-	1186	(Throughout Month,
Dec. 1945	G	397	220	170	336	-	1123	(Tarryall Valley
Jan. 1946	G	253	123	109	249	-	734	(
Feb. 1946	G	351	160	143	322	-	976	(
July, 1948	G	28	14	-	-	-	42	Twin Cones
July, 1948	G	-	-	-	12	-	12	Black Canyon
July, 1948	G	7	3	-	17	-	27	McCurdy Mtn.
Nov. 1948	G	316	162	114	268	-	860	(
Dec. 1948	G	317	174	124	278	-	893	(Throughout month,
Jan. 1949	G	182	105	58	140	-	505	(Tarryall Valley
Feb. 1949	G	264	182	97	234	-	587	(
June, 1949	G	47	40	-	-	-	87	Hay Cr., Long Gulch, Three Mile, Rock Cr.
Jan. 1951	G	-	-	-	-	187	187	Lost Park
Jan. 1954	G	-	-	-	-	14	14	Spruce Campground
Jan. 1954	G	-	-	-	1	9	10	Sugarloaf Mtn.
Dec. 1960	G	-	-	-	-	43	43	China Rock, Graveyard, Sugarloaf Mtn.
Apr. 1961	G	7	-	5	-	-	12	Sugarloaf Mtn.
1966	G	12	4	1	9	-	26	Tarryall Mtn.
Jan. 3, 1970	G	32	7	-	5	-	44	Hay Cr.
Jan. 4, 1970	G	10	-	-	4	-	14	Sugarloaf Mtn.
Jan. 10, 1970	G	-	-	-	5	-	5	N. side Long Gulch
Jan. 12, 1970	G	1	1	-	-	-	2	Sugarloaf Mtn.
Feb. 4, 1970	G	9	2	-	4	-	15	Ute Cr.

^aG = ground; A = aerial.

and Rutherford (1968) wrote that counts made by Department personnel in 1965 revealed approximately 70 sheep in the herd. It built up very slowly after the big die-off in 1953. Bill Forgett (W.C.O.) estimated the present population at 100 sheep, and his counts in the winter months of 1970 (Table 12) showed a very low lamb:ewe ratio, 19:100.

Earlier investigators indicated that the Tarryall and Kenosha mountains were extremely difficult to census from the air due to ground cover. The most practical method for gathering population data appears to be by ground surveys of the winter range.

Hunter Harvest

The first hunting season on the Tarryall range was in 1953. The area was closed to hunting in 1954, 1957-59, but has been hunted in all other years. The Tarryall and Kenosha mountains were separate hunting units in 1953 and 1955-56; however, data presented in Table 13 are representative of the entire area. A total of 126 permits have been issued and 26 rams harvested for a hunter success of 20 percent. The half-curl ram regulation was in effect during 1965; the three-quarter-curl 1966-1969; and the full-curl in 1970. Hunter success under the half-curl limitation was 25 percent and 8 percent under the three-quarter-curl. One ram was harvested in 1970 when the full-curl or larger regulation was in effect. The year the die-off was in full progress (1953), 40 licenses were issued but only eight rams were harvested.

Other Mortality

Spencer (1943) reported as follows on parasites and diseases in the Tarryall herd 1937-1940:

"During this study, parasites and disease were responsible for no known loss. The following parasites were present in this herd: External. - The winter tick (Dermacentor albipictus) was very common, but had no serious effect on the bighorn. Magpies were observed picking ticks from the sheep during the spring months. Internal. - Examination of fecal samples of bighorn sheep from different portions of the range and from many individuals showed the presence of at least four species of coccidia: Eimeria arloingi, Eimeria faurei, parva and Haemonchus spp. Two species of stomach worms, Ostertagia marshalli and Ostertagia spp. were found. No lungworms were found.

"Three young sheep with a marked diarrhea were found in December 1940. Examination of fecal samples revealed that they had the heaviest parasitic infestation of any samples examined from the Tarryall herd. Six species, four coccidia

Table 13. Bighorn sheep hunting seasons and harvest, Tarryall and Kenosha mountains, 1953-1970.

	Year													
	1953	1955	1956	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting Season														
Opening Date	9/3	9/3	9/1	8/21	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	9	9	16	16	17	16	37	23	22	18	23	23	24
Curl Regulation	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	Full
Applications Received	-	-	-	15	10	7	8	16	24	19	18	26	13	13
Licenses Issued	40	5	5	4	4	4	6	6	10	10	11	8	8	5
Bighorn Sheep Harvested	8	1	0	0	0	2	4	4	3	0	1	1	1	1
Percent Success	20	20	0	0	0	50	67	67	30	0	9	12	12	20

and two stomach worms, as shown above, were found. The sheep appeared to be in good health otherwise and were able to harbor the parasites with no serious results. No other sick or ailing sheep were observed during the entire study."

Fecal samples collected by Larry Kautz in 1942 and examined at Colorado A & M College showed a moderate to high infection of the "feed lot disease organism" (Eimeria arloingi) in nearly all samples. The infection rate was considerably higher than in the similar samples collected by Herbert Wallace in 1940. On the basis of this information, Arthur Carhart (1943) wrote:

"Probably the most threatening infection we have in the bighorns is a coccidium (Eimeria arloingi) which causes the "feed lot" disease in domestic sheep. It often is the cause of heavy loss among domestic sheep, particularly among lambs. With it are several other closely related organisms, coccidia, most of them of the Eimeria group.

"The alarming feature of this whole picture is the fact that such a percentage of the Tarryall flock apparently is carrying a load of disease and parasites that if an epidemic starts rolling, we probably will have loss in that flock that will knock it down in somewhat the same way that it has died off in the past . . . The number of sheep may be over the carrying capacity of their specific foods on the range. Not necessarily gross forage, but perhaps some of the minor forage plants essential to the bighorns health. Second, we have these animals close grouped in rather congested areas, and that is a first condition fundamental to epidemic. Third, we have the bighorns carrying close to a lethal load of organism right now. It apparently is building. Probably by the very fact that increased contamination of bed grounds, in turn increases the infestation pickup, which in turn increases the contamination on the bedgrounds--a vicious mounting spiral. Finally, even though no outward situation may develop to lower present vitality, the fact that the trouble can build up and keep building, by this increasing contamination of bedgrounds, may bring this situation to a point where no bighorn can carry the build-up load."

Carhart recommended dispersing the flock either through limited hunting or a transplanting program.

Trapping and transplanting were initiated in 1944 and continued until 1953. A total of 242 bighorns were trapped out of the herd and moved to various parts of Colorado to supplement other herds or start new ones. The main trap sites were at Sugarloaf Mountain, China Rock, and Spruce Camp, all winter ground concentration areas (Fig. 15). A corral-type trap developed here proved to be very successful, details of which are given by Moser (1962) in The Bighorn Sheep of Colorado.



Fig. 15. Bighorn sheep trap used in the Tarryall Mountains, 1940's.
(Photo by George Jones)

Moser and Pillmore (1954) further described the Tarryall bighorn lungworm epidemic:

"The decline, which apparently began in the fall of 1952 and took a heavy toll of Pikes Peak and Tarryall bighorn sheep during the winter and spring, has been diagnosed as caused by verminous pneumonia. Dr. L. A. Griner of the School of Veterinary Medicine, Colorado A & M College, Fort Collins, made the diagnosis from some of the infected animals which he was able to examine and autopsy. Heavy infestations of the lung nematode involved have been identified as Protostrongylus stilesi (Dikman 1931) by Dr. O. W. Olsen, Zoology Department."

Although students of Colorado A & M College and members of the Game and Fish Department participated in two counts of dead sheep, most of the mortality on the Tarryall and all of the losses on the Kenosha were compiled by George Jones (1953):

"The sheep started dying on the Tarryall from lungworms about January 26, 1953. It hit each individual herd, working 16 miles northwest along Tarryall Creek, taking 37 days to reach the last herd on the west end of the sheep range.

"To date, we have found 157 rams, 126 ewes, and 62 yearlings a total of 345 animals. Twenty-one of the 157 rams were yearling rams. Losses included all age classes, yearling to sheep 14 years of age."

Moser and Pillmore (1954) first noticed dead sheep in the Kenosha mountains on July 23, 1953. The recorded loss included 32 ewes, 16 rams, and 18 lambs, for a total of 66 on the area (Figs. 16 and 17).

Moser and Jones (1954) commented thus on the Tarryall bighorn sheep disease situation:

"At the beginning of the severe die-off due to lungworm infestations it was felt that the spring lamb crop would suffer accordingly. As observations progressed, it was found that lamb survival was indeed very low. Taking the three herds (Pikes Peak, Kenosha, and Tarryall) into consideration, the span of lungworm outbreak was in effect during the entire period of gestation, conception and parturition. In animals stricken by lungworm conception did not occur or reabsorption took place. In animals unaffected by the outbreak during the period of gestation (Kenosha), lambs born later died. Unfortunately, from an investigative standpoint, none of the lambs found alive were collected for examination to determine if they were harboring lungworm infestations. Consequently, it is not known whether the lambs died as a result of lungworms or as a result of other causes such as malnutrition or starvation."

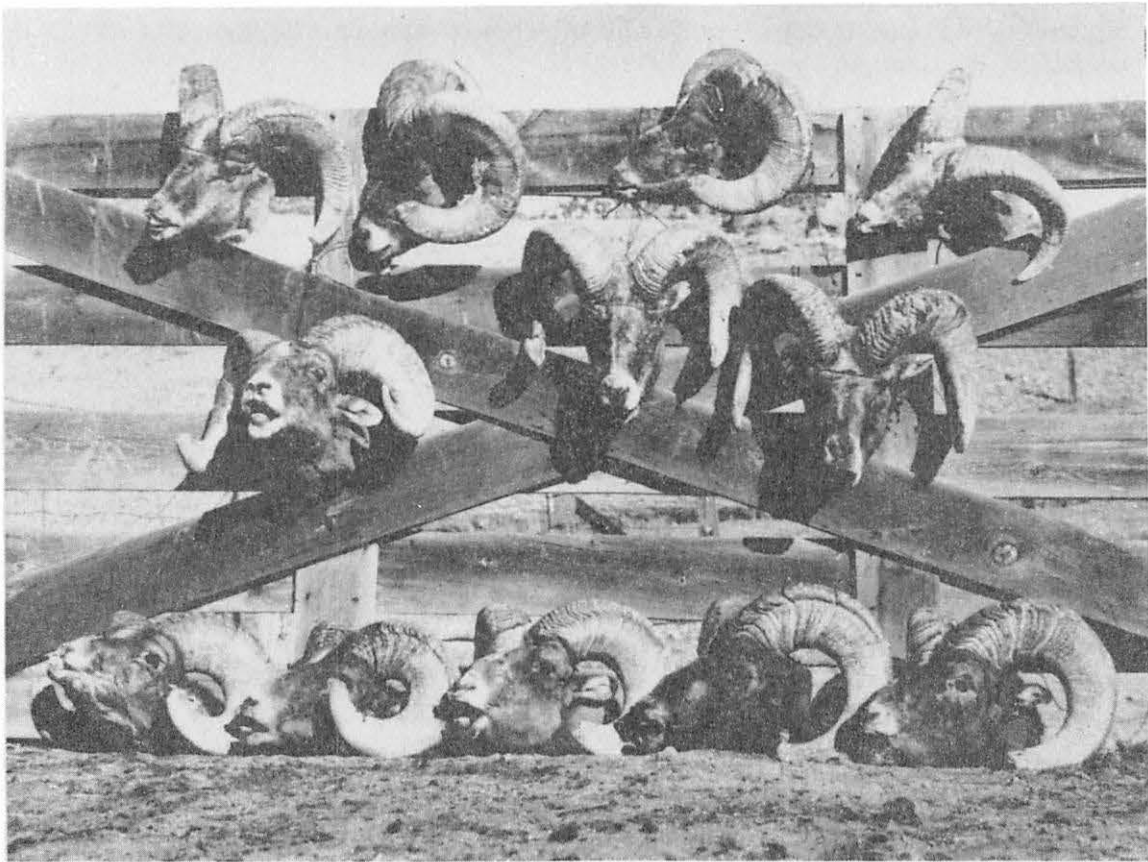


Fig. 16. Rams found during the die-off in the Tarryall herd, 1953.
(Photo by Ebb Warren)



Fig. 17. Young bighorn found during the die-off in the Tarryall herd, 1953. (Photo by George Jones)

Spencer (1943) reported that coyotes and eagles were common on the study area, but predation on sheep was minimal. He found two yearlings that had been killed by coyotes. Rodents were the main food item in the coyote scats and eagle pellets he examined.

Later investigators believed coyote predation to be significant in this herd. In the winter of 1948-49, cyanide guns and 1080 stations markedly decreased the number of coyotes observed on the Tarryall winter range. White and Jones (1950) stated:

"For the past two seasons it became increasingly evident that the coyote population in the Kenoshas was becoming larger. On several occasions coyotes were observed to attack ewes with lambs and even threatening large rams. In the fall of 1949, in cooperation with District Trapper Charles H. Vavak, a series of cyanide stations were established in the Kenosha Mountains that covered the nine-mile length of the Kenosha winter range. By mid-May a total of 25 coyotes had been picked up at these stations, and results were noted during the June lambing surveys. The ewes were definitely less spooky and traveled further from the cliffs in search of food."

A yearling bighorn was reportedly killed by a coyote on Sand Creek on November 15, 1940 (Wallace 1940). Jones (1947) reported: "... found two lambs that had been killed by coyotes on the 26th of June during an 11-inch snowfall. The coyotes had come over a small ridge and taken the lambs by surprise." White and Jones (1950) found a yearling ram on Rock Creek that had been killed by a coyote.

There are two records of mountain lion predation for this herd. A trapper found a ewe lion-killed in November, 1940 (Wallace 1940). Jones and Moser (1953) reported: "On September 8, a three-year-old ram was killed by a mountain lion on Bison Creek. The ram had been partially eaten, and the carcass was covered with refuse in the manner characteristic of the lion family."

No recorded evidence of eagle predation on the sheep was found. Early investigators reported eagle predation as insignificant, even though eagles lived and nested in the area.

Range Competition and Human Influences

Competition with other ungulates apparently has never been much of a problem for the Tarryall herd. Competition was apparently minimal during the years the herd increased rapidly following the 1923-24 die-off. More concern was expressed at that time concerning over-concentration of the bighorns themselves, as indicated by Carhart's (1943) comments quoted earlier in this report. Spencer (1943) wrote:

"Cattle are grazed on the more accessible portions of the bighorn summer range in the high country and also on some of the winter range, portions of which are privately owned. Prairie dogs are abundant on portions of the lower ranges. A few mule deer are also found in the Tarryall Mountains, but there are no elk and no domestic sheep on the ranges. At the present time, range competition is not at all serious and conflicts are of minor importance."

Bill Forgett (W.C.O.) rated cattle, deer, and elk use on the sheep range as moderate, but did not believe it was having any effect on the sheep herd. Cattle use occurred June to October, elk use all year, and deer use was primarily during the summer months.

Spencer's (1943) report on bighorn food habits in the Tarryall Mountains is as follows:

"The principal plants grazed were determined mostly by direct observation and "follow-up" methods, since few stomachs were available for analysis of contents. It was found that a wide variety of plant species was included in the bighorn diet, although certain plants were preferred.

"On the summer range, sedges and clover were the most important plants grazed. A few of the others grazed at that time were such grasses as Festuca spp., Deschampsia caespitosa, Kohleria cristata, Muhlenbergia montana, Calamagrostis canadensis, Trisetum spicatum, and Poa pratensis. Browse plants taken were: Populus tremuloides, Ribes inebrians, Jamesia americana, Rosa spp., Picea engelmannii, and Salix glaucops.

"A great variety of forbs were grazed on the summer range. Quite noticeable among them were Polygonum douglasii (flowers only), Cirsium spp., Mertensia siberica, Caltha sp., Eriogonum spp. (flowering tops only) and Myostis alpestris.

"Newly-opened aspen and engelmann spruce buds appeared to be highly palatable. Rams were observed climbing into dwarf spruce trees at timberline with their forelegs to get to buds they were unable to reach while standing on the ground.

"Several stomach samples obtained from sheep illegally killed or taken by predators while on the lower ranges, showed that Artemisia frigida was highly palatable and sometimes amounted to 84 percent of the food taken. Next in order were Festuca spp., Prunus melanocarpa, and Muhlenbergia montana.

"Some of the other plants grazed or browsed while sheep were on the lower ranges were: GRASSES.-Poa

pratensis, Agrostis spp., Calamagrostis canadensis, Bouteloua gracilis and Blepharoneuron tricholepis. GRASSLIKE.-Carex filifolia and Juncus spp. FORBS.-Achillea spp., Actinia richardsoni, Eriogonum spp., Alsine spp., Polygonum douglasii, Cirsium spp., Salsola and Leontodon. BROWSE.-Ribes inebrians, Rubus parviflora, Rosa spp., Salix spp., Jamesia americana, Populus tremuloides, Dasiphora fruticosa, Chrysothamnus spp., Pinus ponderosa, Pinus aristata, Juniperus communis and Spirea sp.

"The total stomach contents of a yearling sheep, killed by coyotes, were air-dried and found to weigh approximately six ounces.

"Bighorns on winter range did not bother haystacks or eat hay scattered for cattle. They did eat barley, cut for hay, while in the windrow."

Moser (1955) analyzed one bighorn rumen sample from the Tarryall Mountains in September, 1953. By volume, grasses comprised 68.0 percent, browse 32.0 percent and forbs 0.0 percent. The more important plant species identified were: Festuca arizonica, Muhlenbergia montana, Jamesia americana, and Potentilla fruticosa.

Bill Forgett reported human activity on the area as moderate. Hunters, campers, hikers, fishermen, etc. were common, but did not appear to be having much effect on sheep distribution. Jones and White (1950) wrote:

"One of the major problems to contend with is a large number of amateur photographers who flock into Tarryall Valley on weekends during clear weather. These invasions rendered the China Rock trap virtually useless during the past season and have necessitated its removal from view of Highway 77."

Salt blocks were placed on the sheep range in the Tarryall and Kenosha mountains in the late 1940's and early 1950's, and bighorns readily used the salt. On Bison Mountain the bighorns stopped eating dirt at an alkali bog once the salt blocks were placed. It was found that bighorn movements could be altered to a limited extent by the use of salt stations.

RAMPART RANGE

Frank Colley (1970) gave the following general account of the Rampart bighorn herd:

"This is not a native herd. It originated in February 1946 with 14 sheep trapped near Tarryall and liberated at Green Mountain Falls. Transplant was made at the request of Pike National Forest. Liberation point was not well chosen and the mountain sheep went to the Rampart Range rather than Pikes Peak. One ram was killed the first night by an ore train on the Midland Railroad.

"The area used by mountain sheep on the Rampart is by their choice restricted to all of Queens Canyon (Camp Creek), Red Mountain and Upper West Monument Creek including Stanley Canyon (Fig. 18). Elevation ranges from about 6,000 to 9,000 feet above sea level. A probably suitable area to the north has never been used.

"The herd did well until 1958, reaching a total of 60-70 and supporting a limited hunter harvest of 5 rams in 1957-58. The herd was stricken by lungworm, including pneumonia, in 1958 and has never recovered. Now (1970) it is estimated at about 20 animals. The primary limiting factor appears to be lack of lamb survival. Predation may be contributing to this loss. The area has a fairly high coyote and bobcat population and is also lightly used by mountain lions. A generally moderate to heavy brush and tree cover in the overall area may be detrimental to mountain sheep in relation to predators. Significant numbers of sheep, mostly ewes, are known to have been killed by trigger-happy deer hunters in season. If this herd does recover, it will be advisable to afford needed protection from this loss by special regulations on deer hunting in the area.

"Use of mineral supplement in this area has not been successful. Mountain sheep prefer straight salt which is readily available to them at numerous salt grounds maintained for cattle and horses. Some preliminary work on nutrition done by Bob Keiss indicates a shortage of sulphur. Sulphur salt put out the winter of 1969-70 has been used. It is too early to tell results, if any. This herd is in serious trouble and definite information is needed on corrective measures to be taken."

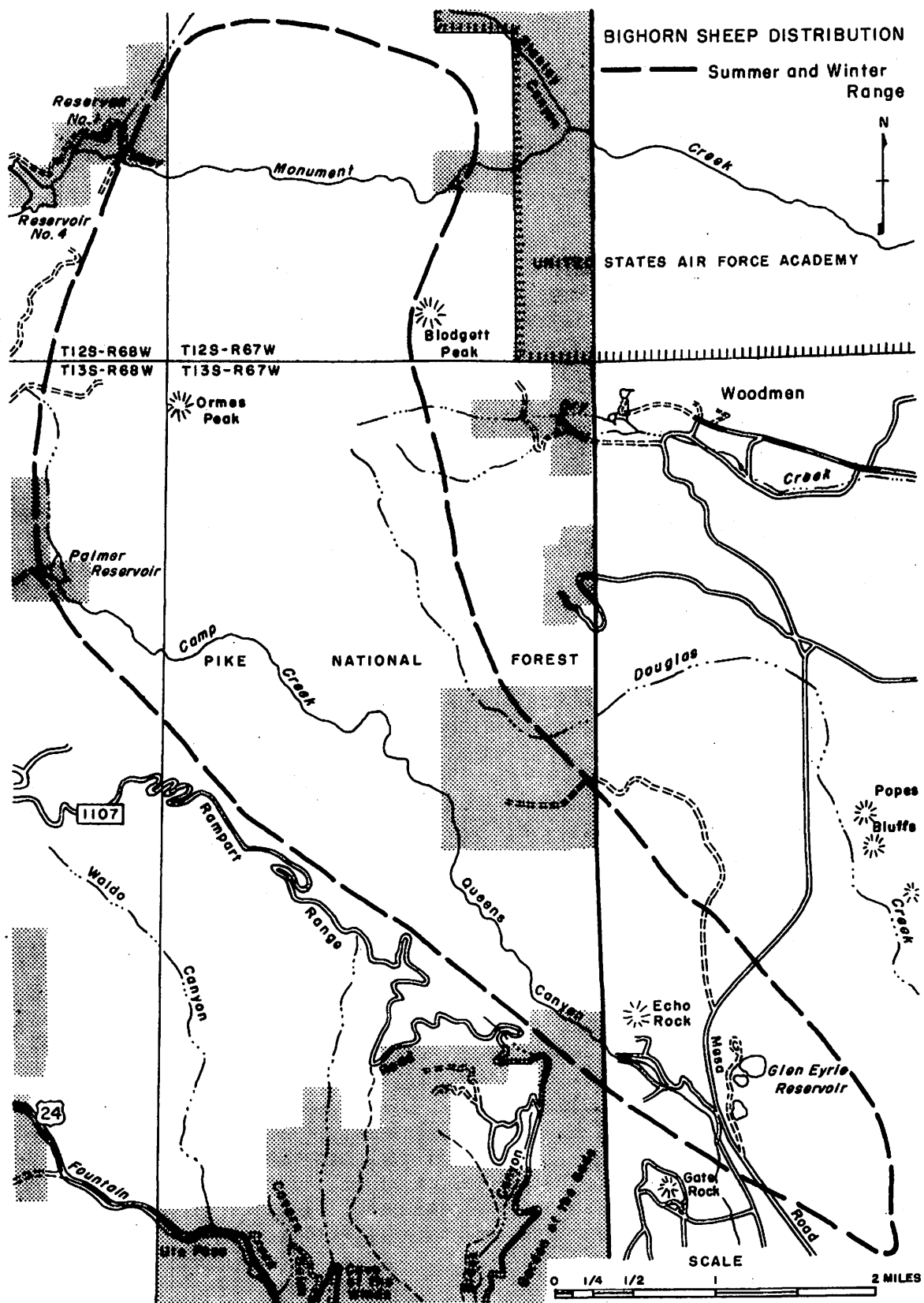


Fig. 18. Bighorn sheep distribution, Rampart Range.

Pillmore (1961) prepared a detailed report of mortality for the Rampart bighorn herd:

"On November 9, 1959, Mr. Don Enright, a staff member of the Navigators at Glen Eyrie, telephoned me to report that four dead bighorns had been found in the vicinity of Glen Eyrie. This report was investigated immediately and the four dead ones were found also one which was near death when found and died when it fell from a cliff.

"The first of the dead sheep was a yearling ram. This sheep was not examined in great detail because it had been dead for several days. There was a little fat present on the brisket and in the body cavity. The air passages of the lungs contained considerable fluids. The apical, cardiac, and the antero-ventral portion of the diaphragmatic lobes were adhered to the thoracic wall with both soft and fibrinous adhesions. The lungs were enlarged and congested and lungworm infection was demonstrated throughout the posterior tip of the diaphragmatic lobe but with no well-defined lesions being noted.

"A young but mature ewe was examined next. She had moved a few feet from a pawed out bed by a rock near the creek where she had apparently spent some time before death. The ewe was badly emaciated. On necropsy the pathology seemed confined to the thoracic cavity. The entire right apical and cardiac lobes were one large abscess containing a pint or so of creamy pus which had little odor. All of the anterior and ventral parts of the lung were consolidated, necrotic, and contained many abscesses. The dorsal part of the lung was pink and spongy. Along the dorsal margin were several lungworm lesions which were well-defined and nodular though most of these lesions were near the posterior tip of the lungs. Both Protostrongylus rushi and Protostrongylus stilesi were present. No lungworms or their larvae could be demonstrated in the consolidated portion of the lung.

"Not far from this ewe a lamb was found which was also emaciated. The pathology was similar to the ewe except there was no spongy tissue in the lung and all the abscesses were smaller. A greater amount of solidification present near the Posterior tip of the diaphragmatic lobes suggested lungworm infection of the diffuse type but no further examination was made because of the decomposition which had taken place.

"Two other lambs were found, one dead and the other near death. These were transported to the regional office in Colorado Springs for necropsy and further study. On opening the thoracic cavity, adhesions of the apical and cardiac lobes were encountered and there was a large hemorrhagic area in the ventral part of the thoracic cavity, perhaps the result of a fall or bruise. The mediastinal lymph nodes were enlarged and hemorrhagic. A large, purulent abscess involved the right apical lobe. There was a red hepatization of the left apical and the cardiac lobes, and there was considerable congestion and diaphragmatic lobes were filled with lungworm eggs and larvae. This lamb was also found along the creek. Another lamb was alive when first seen. Its glazed expression and total lack of interest caused us to suspect that something was wrong with it. When I approached, a mature ewe which seemed normal ran off and the lamb was reluctant to move until I got within about 30 feet. It then got to its feet and moved off rather stiffly. I noted nasal discharge and the difficulty with which it moved down the rocks where it finally fell. This animal was not so emaciated as the last and the lungs contained no abscesses, the adhesions were soft. The lungs were enlarged and consolidated with red hepatization of the apical, cardiac and ventral part of the diaphragmatic lobes. There was an area of extensive and intense lungworm infection at the tip of the diaphragmatic lobes which was outlined from the rest of the lobe by a dark congested or hemorrhagic zone. A purulent exudate was noted in the nasopharynx. I took the lungs of this lamb, since it was so fresh, to Laramie where Mr. George Post made inoculations of culture media. In a letter, dated 25th of November, he reported that he had obtained pure cultures of a Diplococcus and later that he had recovered a Pasteurella.

"On the 29th of November, I received word that there was a sick ewe at the mouth of Queens Canyon which allowed people to walk up on it and pet it. This was about 4:30 p.m. and when I arrived there a little after 5:00 she was dead. Necropsy findings were similar to those of the lamb above in the absence of abscesses, soft adhesions, and red hepatization of the apical and cardiac lobes. There was marked emphysema and consolidation of parts of the lung. A heavy lungworm infection was present with both Protostrongylus rushi and Protostrongylus stilesi present. Both an adult male and a female of Protostrongylus rushi were recovered from the mouth of this ewe. The trachea and bronchi contained a bloody and frothy exudate. The heart and lungs together weighed seven pounds. Mr. Post also cultured both a Diplococcus and a Pasteurella from this lung.

"On December 8, a sick ram was seen by an assistant, Mr. John Goettl, but he was not able to catch it and lost sight of it. The same evening I located a ram with the spotting scope to the north of Glen Eyrie. It would lie down, get up, feed for a very short time, then lie down again. In searching this same area on the morning of the 10th, a ram was found which appeared to have been killed by a predator, probably a coyote. The thoracic cavity was intact and the entire ventral part of this cavity was solidified by adhesions. The pericardium adhered to the heart on one side and the lungs on the other, and the lungs to the thoracic wall. The apical, cardiac, and ventral part of the diaphragmatic lobes were consolidated and contained many small abscesses. The lungs and heart together weighed nine pounds. From these lungs, too, Mr. Post obtained both the Diplococcus and Pasteurella.

"On December 12, a ewe was found dead next to one of the buildings at Glen Eyrie and the lungs were much the same as those of the first ewe examined on the 9th of November, including the fact that the lungworm infection was confined to the most normal portion of the lungs.

"One of the most intriguing things about the mortality of bighorns at Glen Eyrie is the fact that the symptoms and diagnosis of conditions in the penned sheep which had been separated from their mother herd for about a year for the ram and nearly two years for the ewes paralleled the conditions in the Glen Eyrie area dead sheep. Considerable coughing was noted in bighorns at Glen Eyrie in the early part of September. The consolidation of the apical lobes in both groups of sheep, nasal discharges in both groups, and the loss of flesh in both groups certainly suggest synchronization. If this is the case it is certainly a long-term chronic infection and one which manifests itself as a result of conditions of progressive weakening from parasitism, weather, or stress of some other nature. Certainly there was no direct association of the lungworm infections found and the pneumonia."

Pillmore collected lung samples from 11 sheep in the area in 1955, 1957, and 1959, which were examined by Dr. Lynn Griner, Colorado State University. All sheep were infected with lungworm larvae.

According to Pillmore (1959), he and Dr. Hertzberger, veterinarian at Cheyenne Mountain Zoo, necropsied a ram from Glen Eyrie and reported:

"The lung consolidation of the posterior portions of the diaphragmatic lobes and typical lungworm lesions extending along the dorsal margin of the entire lobe. Dissection of the air passages of one of the lungs was made and the adults of Protostrongylus rushi were found in the terminal bronchioles in the area of consolidation; dissection of the other lung was made after it had cooled and the adults of this species were found clustered in the lumen of the primary bronchus. In general, the intensity of the infection was comparable to that of the Buffalo Peaks and Cache la Poudre areas."

Table 14. Bighorn sheep counts, Rampart Range, 1950-1967.

Date	Survey	Type of bighorns counted				Total	Remarks
		Ewes	Lambs	Yearlings	Rams		
4/50	G ^a	9	7	--	4	20	Queens Canyon
6/65- 5/66	G	39	--	--	10	40	The highest single count was 15 head
1967	G	11	2	--	6	19	

^a
G = ground.

PIKES PEAK

Distribution

The Pikes Peak herd occupies the mountains that extend 10 to 20 miles west of Colorado Springs, a large area characterized by little difference between summer and winter range since sheep use all of it year-round. There is some seasonal difference in use, but sheep are seen in the upper areas at all times of the year. Above timberline, the range is used lightly on the east face, most on the south and west faces. Below, timberline, use is restricted largely to the southern and western aspects. The usable upper limit appears to be about 13,500 feet elevation. The lower range limit is about 9,000 feet, though deep snow occasionally causes a few sheep, mostly rams, to go lower for short periods (Colley 1970). Colley also reported that bighorn use west of Sentinel Point to Fourmile Creek has been increasing since 1966 (Fig. 19).

"The bighorn sheep winter range is located on the southeast side of the Pikes Peak complex. The main bighorn sheep area is from the head of Oil Creek south to Bison Reservoir and Bull Park. During the winter the bighorn sheep utilize high windswept ridges at elevations of 11,000 to 12,000 feet.

"The ewes and lambs are found in the Oil Creek and Beaver Creek drainages and around Bison Reservoir. This is essentially the northern and western part of the range. It is an ideal area for lambing because it is characterized by steep slopes and rocky outcroppings which are almost inaccessible.

"The rams are usually found on or near Sheep Mountain which constitutes the southern and eastern part of the range. An old spruce-fir burn on the south side of Sheep Mountain is heavily utilized by the rams.

"The predominant plants on the winter range are Carex (Carex sp.), wheatgrass (Agropyron sp.), fescues (Festuca sp.), cinquefoils (Potentilla sp.), and alpine avens (Geum turbinatum)."

Other plants that Woodard encountered in surveys are listed in Table 15. A list of plants in the enclosure on Pikes Peaks is presented in Table 16.

Jones and White (1950) also reported that all rams observed were on Sheep Mountain, and that ewes and lambs were scattered from Bison Reservoir to Upper Beaver Creek along the ridge which separates Fourmile Creek from Horsethief Park.

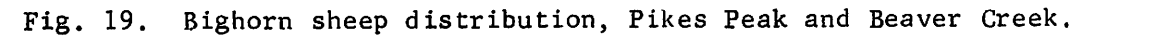


Table 15. Plants encountered on range transects conducted on the Pikes Peak winter bighorn sheep range, June, 1967 (Woodard 1967).

Scientific Name	Common Name
<u>Trees</u>	
<u>Juniperus scopulorum</u>	Rocky Mountain juniper
<u>Shrubs</u>	
<u>Salix</u> sp.	Willow
<u>Potentilla fruticosa</u>	Shrubby cinquefoil
<u>Forbs</u>	
<u>Achillea lanulosa</u>	Western yarrow
<u>Allium</u> sp.	Wild onion
<u>Antennaria</u> sp.	Pussytoes
<u>Arenaria fendleri</u>	Sandwort
<u>Cirsium</u> sp.	Thistle
<u>Eriogonum</u> sp.	Buckwheat
<u>Geum turbinatum</u>	Alpine avens
<u>Oxyria</u> sp.	Sorrel
<u>Potentilla</u> sp.	Cinquefoil
<u>Saxifraga rhomboidea</u>	Snowball saxifrage
<u>Sedum</u> sp.	Stonecrop
<u>Sibbaldia procumbens</u>	False strawberry
<u>Silene acaulis</u>	Moss campion
<u>Trifolium dasyphyllum</u>	Alpine clover
<u>T. nanum</u>	Dwarf mat clover
<u>Grasses</u>	
<u>Agropyron</u> sp.	Wheatgrass
<u>A. scribneri</u>	Scribner wheatgrass
<u>Carex</u> sp.	Sedge
<u>Festuca ovian</u>	Sheep fescue
<u>Juncus</u> sp.	Rush
<u>Poa</u> sp.	Bluegrass
<u>Trisetum spicatum</u>	Spikes trisetum

Table 16. The following list of plants identified in the Pikes Peak enclosure as compiled by Dr. H. D. Harrington in 1954 (Moser 1954).

Grasses

Calamagrostis purpurascens
Agropyron scribneri
Festuca ovina
Trisetum spicatum
Bromus ciliatus
Poa rupicola
Poa longiligula or
P. fendleri
Agrostis idahoensis

Trees

Populus tremuloides
Pinus aristita
Picea engelmannii

Forbs

Penstemon virens
Penstemon whippleanus
Pedicularis parryi (utilized)
Achillia lanulosa
Epilobium angustifolium
Cirsium sp. (wooly)
Solidago decumbens
Arenaria fendleri
Potentilla pulcherrima
Fragaria sp.
Taraxicum 2 spp. (util.)
Artemisia spithamea
Antennaria umbrinella
Allium reticulatum
Hymenoxys grandiflora
Polemonium delicatum
Draba aureum
Draba streptocarpa
Castilleja occidentalis
Crepis runcinata
Saxifraga rhomboidea
Sedum stenopetalum
Smilacina stellata
Gentiana sp.
Lychnis drummondii
Cerastium arvense
Valeriana (just outside)

Shrubs

Potentilla fruticosa
Ribes
Juniperus communis var.
montanus
Salix glauca var. glabrescens
Salix planifolia
Rubus strigosus

Sedges

Carex spp.
Luzula multiflora

Population Trend

Pikes Peak is historical sheep range for sighting records date back to the early explorers and travelers. The first recorded survey of the area was by Jones in 1949, when he counted 205 head (Table 17). He counted 147 in 1951 and 297 in 1952. Frank Colley estimated the 1952 population at 250-300 bighorns. The lamb:ewe ratios from 1949 to 1956 were 48:100, 79:100, 65:100, 7:100, 85:100, no record for 1955, and 56:100, respectively. An extensive die-off reduced this herd in the winter of 1952-53, as in the Tarryall Mountains and Kenosha Mountains. The following is Frank Colley's (1970) personal account of the Pikes Peak herd since the die-off:

"Estimated population in 1953 was 30 to 40 mountain sheep. Observations thereafter consisted of recording all sheep seen, noting as to rams, ewes and lambs of the year. This was not intended nor used as a census but did well establish that while there was always a proportionately large number of lambs in June, the number had noticeably decreased by September. There appeared to be little, if any, loss of lambs thereafter. Using September 1, therefore, as a cutoff date, it appeared that lambs at that time comprised 10% to 12% of the total. This allowed for such slow herd growth that in 1962 the estimated total had reached only 80 sheep.

"Research and management then seemed to consist largely of just partially counting the survivors and offered nothing of any real help. I, therefore, decided to try to get the sheep to use a mineral supplement. This was based on known beneficial results attained from feeding mineral supplement to livestock and further knowledge of mineral deficiencies on Pikes Peak. In fact, the Peak is credited with being short of everything except granite. Blocks of flavored and unflavored mineral supplement were first tried in the fall of 1962 but were only lightly used. A few selected areas were also fertilized in 1962 with a commercial product as a perhaps indirect approach. This resulted in a noticeable improvement of vegetative growth which apparently went unnoticed by the sheep.

"Midsummer 1963 was marked by use of a Carey Salt Company product, the formula for which is attached. This was well used by the sheep and has been in constant use since. However, this is no longer made in block form except on orders of 10 tons or more. The same formula in crystal form is available and well received by mountain sheep but may be subject to considerable wind erosion loss during winter storms. Since winter

Table 17. Bighorn sheep counts, Pikes Peak, 1948-1970.

Date	Type of Survey ^a	Bighorns Counted				Unclassi- fied	Total	Remarks
		Ewes	Lambs	Yearlings	Rams			
1948	G	6	3	2	18	-	29	Sheep Mtn.
1949	G	90	43	34	38	-	205	Pikes Peak
1950	G	78	39	29	45	-	192	Pikes Peak
1951	G	43	34	18	52	-	147	Pikes Peak
1952	G	103	97	52	45	-	297	Pikes Peak
1953	G	2	2	0	6	-	10	Pikes Peak
8-26-55	G	-	-	-	8	-	8	Pikes Peak
8-27-56	G	16	9	7	11	-	43	Pikes Peak
1964	A	-	-	-	-	109	109	Pikes Peak
1966	A	-	-	-	-	127	127	Pikes Peak
1966	G	158	63	8	65	40	334	Accumulation of all yearlong
1968	A	-	-	-	-	154	154	Pikes Peak
6-15-67	A	-	-	-	48	-	48	Sheep Mtn. - may be duplications
1969	A	118	46	-	49	11	224	Pikes Peak
1970	A	-	-	-	-	107	107	Only partial count

^aG = ground; A = aerial.

is probably the critical time for supplementary diet, some adjustments may be necessary. Recorded sightings of mountain sheep as previously noted, indicates that since significant use of mineral supplement in 1963, the lamb survival has materially increased. Using the same September 1 date as before, the lamb count has, each year, been 30% to 33% of the total sheep sighted. It cannot be positively proved that this is not a matter of coincidence. However, it would seem to be stretching such coincidence rather thin.

"This increased lamb survival is further reflected in the helicopter counts started in 1964, a report of which is attached. Following the 1965 count, a total of 22 sheep were live trapped and trucked to the Badlands National Monument, South Dakota, in payment for mountain goats. On a personal follow-up trip, it was learned that of the 14 adult ewes so transplanted, 12 had lambs in 1965, but all lambs and some adults had died. A similar high loss of lambs had occurred until 1968. Supplemental feeding of rolled oats begun then had resulted in a satisfactory survival of lambs than and thereafter. No count was made in 1965 on Pikes Peak. The count of 1966 showed a total of 127 sheep. No count again in 1967. The 1968 count was 154 sheep and the count in 1969 was 224. The 1969 count was also noteworthy because of finding nearly 100 sheep in one group at about 12,000 feet elevation near Colorado Springs Reservoir 2 in the 7 Lakes complex. Also, with two observers for the first time, a sex-age ratio showed a lamb content of slightly less than 29% of the total herd.

"The 1970 count of the Peak proper was only partially successful. Dangerous turbulence caused an abort on the first attempt. A second run was made later but with poor light and little snow cover it resulted in a probably partial count of 107. A heavy snow in October had caused an observed considerable movement of sheep to the 4 Mile area with a resulting count there of 83 sheep. It is not likely that a complete count can ever be attained in this area, there being too much cover. It is also possible there had been some movement of sheep to an area below Middle Beaver Creek as occasionally occurs during heavy snow. A lack of helicopter time prevented checking that area.

"Definite information is needed on what sheep require and to what extent such requirements are being met by available forage. Assuming deficiencies, at what time are such deficiencies most critical and how may they best be corrected. Barring exact information on carrying capacity, it would be considered that this herd is near the maximum.

"A rough estimate made in conjunction with Pike Forest personnel, indicates about 32,000 acres within the general sheep range. However, probably half of this is bare rock and otherwise non-productive as to forage. Of the remaining area about 10,000 acres may be considered as prime mountain sheep range and 6,000 acres as of limited usefulness. This figures out to somewhere around a minimum of four acres per sheep each month. This is probably resulting in over-use of some areas.

"In the absence of a complete range analysis, it is believed very important that this herd be held at present numbers or slightly reduced. Favored procedure would be live trapping 35 to 50 sheep annually for transplant. This has been attempted each of the last two years with small success. The previously successful technique of baiting with salt is no longer effective because of the wide distribution of salt bearing mineral supplement. An attempt will be made to produce grains at trap site as an "ice cream and cake" sort of inducement. Should this not be productive it now appears the alternative would be to take the required number of ewes by hunter harvest. This can only be considered as the lesser of two evils, the other one being a probable major loss by disease, as in 1952."

Colley estimated the 1970 population to be 280-300 sheep.

Hunter Harvest

Hunting seasons for the Pikes Peak herd have been held since 1953. Hunters were required to take rams of one-half curl or larger in the years 1953-1957 and 1960-1964, and three-quarter curl or larger in 1958-59 and 1965-1970 (Table 18). Hunters have had very high success in this area. A total of 152 licenses were issued during the 18-year period and 74 rams were harvested for a success of 49 percent. Hunter success under the two types of regulations (half-curl and three-quarter curl) were 51 percent and 47 percent, respectively.

Frank Colley's (1970) comments on the curl-regulations are as follows:

"Experience and observation with permitting the taking of 1/2 curl rams indicated that this was not a desirable practice. A 1/2 curl ram is not a good trophy but it seems the ego of many hunters requires taking such a ram rather than making no kill at all. During the time when such 1/2 curl rams were lawful, the hunter harvest on Pikes Peak was composed of slightly over 56% rams less than 3/4 curl. The older rams were being underharvested and being lost to old age. This in effect created a double drain on the ram herd and had to be compensated for by curtailing the number

Table 18. Hunting seasons and harvest, Pikes Peak, 1953-1970.

	Year																	
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season																		
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	9	9	9	16	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	full
Applications received	--	--	--	--	15	--	3	10	7	28	17	43	51	74	74	53	96	147
Licenses issued	10	6	7	7	5	6	4	4	6	6	6	8	8	12	15	15	15	12
Bighorn sheep harvested	6	1	1	3	3	2	2	2	4	2	4	7	4	5	8	8	9	3
Percent success	60	17	14	43	60	33	50	50	67	33	67	88	50	42	53	53	60	40

of sheep permits on Pikes Peak. Efforts to have the minimum legal limit reset to 3/4 curl were not immediately successful. Such 3/4 limit was, however, eventually established first on Pikes Peak, later on other areas. On the Peak at least, this has made possible an increase in the number of permits, thereby creating a somewhat greater recreational opportunity."

Other Mortality

The first recorded mortality in the herd was associated with the 1952-53 die-off, which reduced the herd from an estimated 300 to 30 or 40 head. In November 1952, Mr. Ray Phillips of the Forest Service, while on field duty, found a sick ewe in the vicinity of Woods Lake at the western edge of the Pikes Peak sheep range. She was in such poor condition that Mr. Phillips was able to approach close enough to destroy the animal by hand. The carcass was taken to Colorado College at Colorado Springs where subsequent diagnosis determined that heavy infestation of lungworms, Protostrongylus stilesi, were responsible for the emaciated condition of the animal. This was the first report of sickness among the sheep on Pikes Peak (Moser and Pillmore 1954). A total of 48 mature sheep (24 ewes and 24 rams, which included 9 yearlings but no lambs) were found dead during the die-off. Table 19 gives ages of 28 of these sheep.

Table 19. Age class of 28 deceased bighorn sheep, Pikes Peak (Moser and Pillmore 1954).

	Young (1-3)	Mature (4-9)	Old (10+)	Total
Rams	7	9 ^a	0	16
Ewes	4	5	3	12
Total	11	14	3	28

^a All in 8 to 10 year class.

A dead 2 1/2-year-old ram, found November 14, 1952, near Cathedral Park, was taken to Colorado A & M College. Dr. Lynn Griner, Veterinary Medicine Department, made the following report:

"Lungs: Anterior ventral lobes consolidated and congested. Lungworm larvae observed microscopically in secretion in bronchi. Dorsal foci of bronchopneumonia.

Spleen: Thysanosoma actiniodes found in duct.

Stomachs: Abomasal parasitism, Ostertagia sp.

Intestines, small: Hyperemic enteritis, Nematodirus sp.

Postmortem diagnosis: Pneumonia (verminous) parasitism.

Pathological diagnosis: Verminous pneumonia.

The causative organism has been temporarily identified as Protostrongylus sp."

Frank Colley's (1970) account of the die-off was:

"In early September, 1952, three rams were found dead on Upper Boehmer Creek. All were found on a steep hill with heads downhill. Greenish-white discharge at mouth and nostrils. Not emaciated. Lungs of the only one examined had dark red blotchy appearance. Other dead sheep were found or reported until about the end of January, 1953. One ewe from West Beaver Creek and one young ram from Cathedral Park were posted at C.S.U. Reports indicated heavy infestation of lungworm with death due to verminous pneumonia. These, and other sheep were backtracked from the place where found. All had, in final moments, been able to move only downhill with much falling and struggling on the ground."

Pillmore conducted an intensive study of lungworm and snail populations in the Pikes Peak area. In 1959 he found both Protostrongylus rushi and P. stilesi in lungs from a ram shot by a hunter. In lung samples from 14 rams killed by hunters in the period 1953-1959, 12 were infected with lungworm. In connection with parasitological inquiry, Pillmore studied the various species of snails on Pikes Peak and determined the incidence of infection by lungworm larvae for several species. He was in the process of publishing these findings on the life cycle of the lungworm when he resigned to accept another appointment.

Colley (1970) reported that predation did not appear to be a serious factor in herd mortality. Golden eagles, coyotes, mountain lions, and bobcats occur, though primarily below timberline. Colley also reported seeing ravens harrassing ewe and lamb groups by diving at them.

Range Competition

A small population of deer, which finds summer range on the entire area, usually moves in during early May and out toward the last of September. Competition with bighorns is slight, if any. Deer hunters are not attracted to the Pikes Peak area and pose no material problem at present.

Some deer do winter in the Four Mile area. Trigger-happy deer hunters occasionally kill a sheep there (Colley 1970).

Colley (1970) reported that a very few elk drift in from the north side of the Peak during the summer, but usually move out in late summer. Very rarely do elk spend the winter on this range.

Cattle offer no competition. A few Forest Service permittees use a small portion of the lower range during July, August, and September. Because sheep prefer straight salt to mineral supplement, cattle salt grounds create only minor problems, not likely to be serious (Colley 1970).

Domestic sheep are not in or close to the area presently occupied by bighorns. One band of domestic sheep used private lands within the area during the summer of 1952. To alleviate this competition, the Game and Fish Department purchased 630 acres of this land in 1954 (Colley 1970).

Moser (1955) analyzed five rumen samples from rams harvested by hunters in September of 1953 and 1954. By volume, grasses comprised 67.4 percent of the diet, browse 24.6 percent, and forbs 8.0 percent. The most important species were: Agropyron idahoensis, Bromus ciliatus, Jamesia americana, Juniperus communis, Penstemon whippleanus, and Sedum intergrifolium.

Human Influences

Most of the Pikes Peak range proper is on the Pike National Forest or on Colorado Springs watershed land, little threatened by cabin developments which have affected so much of the general area. The Four Mile sheep range is mostly on land owned by W. E. Mueller, a practicing conservationist, and his management is favorable to use of the area by mountain sheep. This ranch may be on the market at some future time and should be purchased by the Division when available (Colley 1970).

Colley rates human activities on the area as moderate. Hikers, hunters, rockhounds, photographers, and tourists riding the cog railroad constitute the main recreational groups. He also stated, ". . . numerous hunters hopeful of drawing a sheep permit and scouting the area all summer are apparently restricting sheep use on Sheep Mountain during that time."

White (1951) reported that activities by Camp Carson soldiers on the bighorn ranges had scattered the sheep, resulting in reduction of the trend count that year. Also, Jones and White (1951) reported: ". . . in May, the road to Bison Lake was closed and locked by the City of Victor, which will lessen disturbances to the sheep near Bison Lake."

Several salting or mineral supplement programs have been conducted by the Division. Jones and Moser (1953) wrote:

"It is quite evident that salt is an important item in the diet of bighorn sheep, particularly in those timberline areas lacking in minerals. There are no figures on the rate of consumption, but it is variable in different areas. In areas where natural mineral licks are situated the establishment of salt stations have curtailed the rate of use of the natural licks, but has not stopped use entirely. Individual sheep in the Pikes Peak herd are still observed eating dirt on occasions in spite of the excellent salt stations established there."

The station on Pikes Peak is one of the best examples of herd control by salt station establishment. Prior to salting, sheep were numerous around Bison Reservoir because of a salt station near the caretaker's house. These sheep became relatively tame, and many pictures were taken of them by residents of Victor and Cripple Creek. In June, 1950, a major salt station (250 pounds of block salt) was placed four miles from the reservoir. As a result, the sheep are now remaining in a more inaccessible area, and it is now very infrequent that sheep are observed in the vicinity of the reservoir (Jones and White 1953).

As cited earlier in this report, Frank Colley began a salt supplement program in 1963. There was an increase in lamb ratios during this period, and Colley believed the additional mineral was responsible. He further comments:

"Management needs a great deal of exact background information. The recently inaugurated use of mineral supplement is believed to be of considerable benefit, but far from a cure-all. As presently used, this is a sort of shotgun affair. It seems quite probable that some minerals are being supplied in too great amounts, other perhaps in insufficient amount, and possibly some desired elements not supplied at all."

BEAVER CREEK

After studying the Beaver Creek herd, Colley (1970) reported:

"This is a small and troubled herd in Middle Beaver Creek Canyon below Skaguay Reservoir in Teller County (Fig. 19). Once estimated at about 40 mountain sheep, there may now be less than 20. The loss is apparently due to the pattern of lungworm concentration, followed by pneumonia.

"Access to the area was once fairly good via a cable car operated by the Southern Colorado Power Company to a hydro-electric plant in the canyon. With this plant closed and the cable car inoperative, access is much limited."

Hunting seasons for the Beaver Creek herd were allowed during the four-year period of 1958-1961. The three-quarter-curl ram regulation was in effect in 1958 and 1959; two rams were harvested for a hunter success of 17 percent. The half-curl ram regulation was in effect in 1960 and 1961; three rams were harvested for a hunter success of 19 percent.

ARKANSAS RIVER-TEXAS CREEK

There is very little information concerning the Arkansas River-Texas Creek herd. These sheep occupy the range immediately north of the Arkansas River, immediately northeast of Texas Creek, and use Texas Creek and Echo Canyon east to Parkdale. Stanley Ogilvie, Area Supervisor, believed distribution has been determined by the development of springs in the "Bigshore" area by the Bureau of Land Management, eliminating need for the sheep to go down to the Arkansas River for water. The range is in the pinyon-juniper vegetative zone and is rough, rocky and dry. Shrubs and scattered ponderosa pine stands are most prevalent on the higher northern extension of occupied area.

In the late 1950's the herd consisted of an estimated 150 sheep (Moser 1962), but there is currently only a remnant population of approximately 20 animals (Table 20). Decline appears to have occurred at about the time of the extensive die-offs in the Tarryall Mountains, Kenosha Mountains, and Pikes Peak region. It is speculated that the herd is an overflow from Pikes Peak during years when this population was high. There is considerable range suitable for bighorns in the Arkansas River-Texas Creek area, holding some hope for herd increase in the future.

Bighorns were hunted on the Arkansas River-Texas Creek area from 1953 through 1961 (Table 21). Hunter success was fairly high (56%) for nine years, but was highest during the earlier years (1953-1956). Afterwards the ram harvest declined to zero the last two seasons, apparently the time of the primary herd die-off.

Pillmore (1955) studied the incidence of lungworm infestation in the herd along with the alternate host population of snails, reporting:

"The Arkansas Canyon area is generally poor snail habitat. Dead Creohelix shells are scattered over the area, but living ones are found in local more favorable sites. No snails of the genera Pupilla or Vertigo were collected; although they probably do exist locally within this area."

Pillmore collected 24 lung samples from the herd during the hunting seasons in 1953-1955. Dr. Lynn Griner, Colorado State University, collaborated in the infestation and 20 herds were sampled. Strangely enough, the Arkansas River-Texas Creek herd was the only one in which all samples were negative. Lungworm infection, therefore, was either absent or at a very low level. Pillmore (1956) examined 66 fecal samples from the herd in 1954-55 and found only one sample positive for lungworm larvae.

Grazing by other ungulates on the bighorn range is generally light. Cattle use was rated moderate by Ogilvie and occurred in late summer. Deer use was rated as moderate and is heaviest during the summer and winter. A few elk frequent the bighorn range during summer and winter. Human activities are light and limited to a few hikers and rockhounds.

Table 20. Bighorn sheep counts, Arkansas River Canyon, 1950-1971.

Date	Type of Survey ^a	Bighorns Counted				Unclassified	Total	Remarks
		Ewes	Lambs	Yearlings	Rams			
Late 1950's	G	96	-	-	32	-	128	Est. 150 head in herd
Apr., 1958	G	13	2	-	4	-	19	Texas Creek
1960-61	G	17	-	-	5	-	22	Greenhorn Mtn.
Aug. 1961	G	5	3	-	-	-	8	Bridgeport
1969	G	-	-	-	-	6	6	
Mar., 1970	G	-	-	-	-	8	8	Spikebuck below Texas Cr.
Jan., 1971	G	3	2	-	4	2	11	Spikebuck below Texas Cr.

^aG = ground .

Table 21. Hunting seasons and harvest in the Arkansas River-Texas Creek area (1953-1961).

	1953	1954	1955	1956	1957	1958	1959	1960	1961
Hunting season									
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26
Duration (days)	11	9	9	9	16	16	16	16	16
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2
Applications received	--	--	--	--	22	--	7	3	4
Licenses issued	10	8	15	10	10	6	4	3	4
Bighorn sheep harvested	8	6	11	6	2	2	2	0	0
Percent success	80	75	73	60	40	33	50	0	0

Moser (1955) analyzed 11 rumen samples from rams harvested by hunters in September of 1953 and 1954. By volume, grasses, browse and forbs comprised 80.2, 13.7, and 6.1 percent of the diet, respectively. Plant species common in the samples were: Agropyron smithii, Festuca arizonica, Oryzopsis hymenoides, Poa pratensis, Holodiscus dumosus, Quercus gambelli, Eriogonum jamesii, and Senecio fendleri.

SANGRE DE CRISTO RANGE

Distribution

The Sangre de Cristo Range is extremely rugged and only a few miles wide. It rises abruptly from the flat San Luis Valley (7,900 feet elevation) to towering peaks, many over 13,000 feet, and drops abruptly into the West Mountain Valley on the east (Fig. 20). The summit of the range has typical spruce-fir vegetation and oakbrush-ponderosa pine follow at progressively lower elevations.

The range of the Sangre de Cristo bighorn herd has been greatly reduced in recent years. The sheep presently summer on the alpine areas from Mendano Pass to Horn Peak, approximately 15 miles to the northwest, although few are seen north of Humbolt Peak (Fig. 21). Fifteen years ago this herd occupied the alpine areas throughout the northern part of the Sangre de Cristo Range. Don Crane (W.C.O.) and Dan Riggs (W.C.O.) received scattered, unconfirmed reports of sheep in the northern part of this range. Bighorn sheep also occupied Mt. Blanca and Spanish Peaks to the south, where Jones (1944), on two occasions, counted 8 and 6 sheep. These areas are apparently void of bighorns today.

Bighorns now winter in the oakbrush type on the lower west slope of the Sangre de Cristo Range from near Crestone south to the Great Sand Dunes, elevation approximately 8,000 feet. Dan Riggs reported that bighorns occasionally winter in the Medano Pass area, and a few animals winter on the alpine ranges.

Population Trends

The Sangre de Cristo herd was apparently doing fairly well until a very rapid decline began a few years ago. In 1942, 85 sheep (42 rams and 43 ewes and lambs) were counted, presumably from the ground (Table 22). On March 15, 1945, 14 sheep (1 ram, 7 ewes and 6 lambs) were trapped in the Tarryall Mountains and released on Cottonwood Creek on the Luis Maria Baca Grant. Jones and White (1949) commented:

"The sheep were released in a ponderosa pine zone at the foot of the Crestone Needles. Very little about this herd has been learned since they were released. It is believed that the steep forest-covered slopes from release point to timberline, which contain few features of good winter bighorn range, have caused the sheep to drift elsewhere. There is some domestic sheep competition above timberline. Dry summers causing loss of forage have forced the sheep to range higher than they normally do. This, plus competition on summer range, have prevented a normal increase of sheep in the area."



Fig. 20. Sangre de Cristo Range with the San Luis Valley in the foreground. (Photo by George D. Bear)

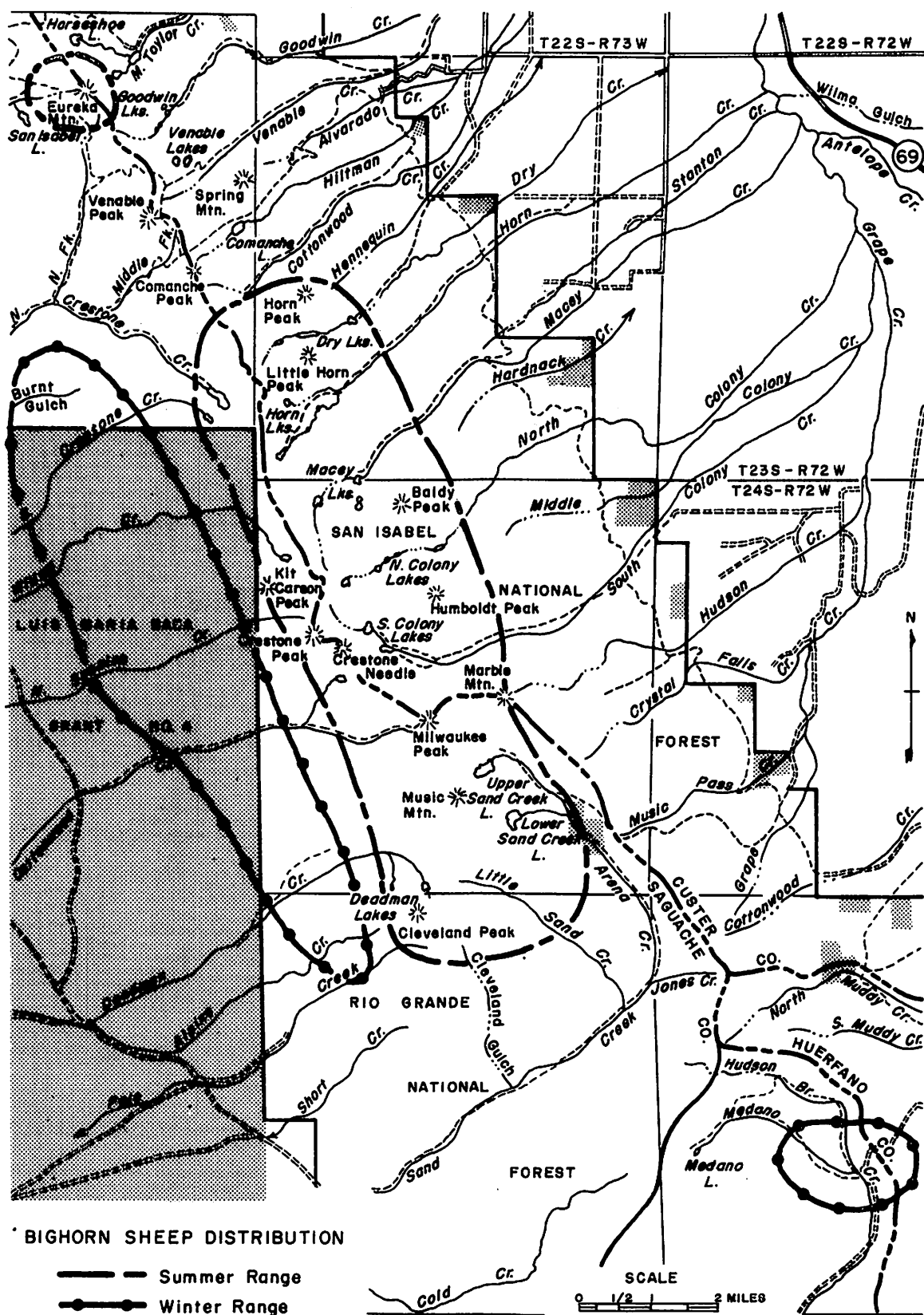


Fig. 21. Bighorn sheep distribution, Sangre de Cristo Range.

Table 22. Bighorn sheep counts, Sangre de Cristo Range, 1942-1970.

Date	Type of Survey ^a	Bighorns Counted				Unclassi- fied	Total	Remarks
		Ewes	Lambs	Yearlings	Rams			
1942	G	43	-	-	43	-	85	
1952	G	-	-	-	-	44	44	Crestone Area
9-60	G	6	3	1	4	-	14	Crestone Lake
1-62	G	16	-	11	7	-	34	Sand Creek
8-10-66	A	15	9	-	10	-	34	Entire range
8-21-66	A	12	6	-	12	-	30	Entire range
2-29-67	A	3	2	-	12	-	17	Entire range
9-68	G	5	6	-	3	-	14	N. Crestone
9-11-69	G	-	-	-	-	13	13	Cleveland Park
1969	A	-	-	-	-	29	29	Entire area
5-28-69	A	10	4	5	5	-	24	Sand Cr., Deadman Cr.
7-3-69	G	18	15	3	-	-	36	Sand Cr.
6-3-70	G	18	13	3	-	-	34	Sand Cr.

^aG = ground; A = aerial.

Jones and White (1952) reported 44 bighorns in the Crestone area. By 1956 there were an estimated 135 (Moser 1962). In September, 1960, a total of 14 sheep were observed at Crestone Lake, Gibson Peak, and Cotton Lake. In January, 1962, 34 bighorns were seen on Sand Creek. Dale Hibbs reported the 34 sheep after an aerial survey of the Sangre de Cristo Range on August 10, 1966; 30 head on August 21, 1966; and 17 head on February 29, 1967. Hibbs reported 67 sheep (9 rams, 56 ewes and 2 lambs) during the summer of 1967. Don Crane (W.C.O.) reported 1 ewe and 2 lambs on North Crestone Creek, and 4 ewes, 4 lambs and 3 rams on North Crestone Peak in a ground survey, September, 1968. On September 11, 1969, he recorded 13 ewes and lambs on Cleveland Peak, and 21 bighorns were classified on an aerial survey in 1969.

Thomas Woodard made counts of bighorns in the Sand Creek and Deadman Creek area while studying lamb mortality in 1969-70. On a helicopter flight, May 28, 1969, he counted 24 bighorns (5 full-curl rams, 10 ewes, 4 lambs and 5 yearlings). His counts later in the summer indicated a very high mortality in the lambs during both years.

This herd has declined rapidly in recent years. The population estimate in 1956 was 135 sheep. Dan Riggs estimated the present population at 50-60, and Don Crane believed there may be as many as 85 head. However, fewer sheep have been seen in recent years, and these not in areas occupied 10 years ago. High mortality among young animals is the most probable cause of the decline.

It is very difficult to obtain bighorn counts on the Sangre de Cristo Range. Ground surveys are extremely difficult, time consuming and incomplete due to the rugged and inaccessible terrain. Winter trend counts, using aircraft, have also been difficult because of high winds and frequent storms. Observers believe aerial trend counts should be conducted during the summer months, and this should be investigated to the end of more reliable population data for the herd.

Hunter Harvest

Bighorns were hunted on the Sangre de Cristo Range from 1953 through 1969, except in 1959 (Table 23). The season was also closed in 1970. Success was 26 percent for 57 rams harvested by 221 licensed hunters. Hunters were required to take three-quarter-curl or larger rams in 1958 and 1966-1969.

The 49 rams taken during the 11 seasons under the half-curl regulation gave a hunter success of 31 percent, and the eight rams taken during the five seasons of three-quarter-curl limitation gave a hunter success of only 12 percent. Surveys have indicated a high ratio of large rams in the herd, but they are difficult to locate because of the rough terrain.

Table 23. Bighorn sheep hunting seasons and harvest, Sangre de Cristo Range (1953-1969^a).

	Year															
	1953	1954	1955	1956	1957	1958	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Season																
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16
Duration (days)	11	9	9	9	16	16	16	16	17	16	37	23	22	18	23	23
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4
Applications received	--	--	--	--	14	--	23	22	42	71	64	77	85	90	47	53
Licenses issued	10	10	20	13	10	6	12	12	14	20	18	16	20	20	10	10
Bighorn sheep harvested	5	7	4	1	2	0	3	4	4	8	9	2	1	4	1	2
Percent success	50	70	20	8	20	0	25	33	29	40	50	12	5	20	10	20

^a Hunting season closed in 1959 and 1970.

Other Mortality

As in other Colorado herds, Sangre de Cristo bighorns are infested with lungworms. Pillmore collected lung tissue from sheep killed by hunters in 1953-1955 and found that all were positive for this parasite. Woodard (1971) collected fecal samples from 26 adult sheep and 22 lambs in the herd and found all adult and 14 lamb samples were likewise positive for lungworm larvae. He reported:

"Pillmore (1959) advanced the theory that bighorn lambs are infected with lungworm prenatally. Third-stage larvae cross the placenta barrier, enter the fetus and then develop when the lungs become functional upon parturition. Results of fecal analysis of samples collected in the Sangre de Cristo Mountains were inconclusive in support of this theory. Three lamb fecal samples collected on July 3, 1969, were positive for lungworm larvae. These samples had been dropped prior to July 3 but the exact dates were unknown. Three lamb samples known to have been dropped on July 15, 1970, were positive for lungworm larvae. The prepatent period for P. stilesi is 30 to 60 days (Forester and Senger, 1964), so infection occurred in these lambs before or shortly after birth. However, infection could have been transplacental, transmammary, or by ingestion of infected snails."

Woodard (1971) found many bighorn carcasses and bones during his study; however, only two lambs collected purposely were suitable for necropsy by Colorado State University veterinary personnel. Woodard's report is as follows:

"Gross and microscopic pathology on the two bighorn sheep lambs collected in August and September, 1970. (Adcock and Stuart, 1970; Jaenke and Hopkins, 1970) indicated two types of pneumonia were present. Both showed verminous pneumonia of Protostrongylus stilesi origin and bronchopneumonia of unknown origin. Pasteurella sp. organisms were isolated from lung tissue of both animals. A gram negative diplococcus (Neisseria sp.) was isolated from lungs of the animals collected on September 9. The significance of these isolates is unknown. However, much of the histopathology given in the reports indicates possible lungworm involvement. As shown by neutrophilic and lymphocytic infiltration, atelectasis and infiltration of inflammatory cells (chiefly plasma cells). The lamb collected on August 6 showed purulent and fibrinopurulent exudate material in alveolar tissue. The lamb collected on September 9 showed lung tissue which was consolidated to the point that alveolar tissue was obliterated in some areas."

Woodard observed ewe-lamb groups on his study area during 1969-70 and found ratios of 100:83 and 100:72, respectively, both very high. These ratios were reduced to 100:17 by September, 1969, and to 100:22 in September, 1970. The heavy lamb mortality coincided with cold temperatures and increased precipitation in late summer. Based on findings via fecal analysis and lamb necropsy, he concluded that diseases and parasites were likely factors contributing to lamb mortality, as were weather conditions and possibly nutrition. He did not believe predators contributed to lamb mortality on the area studied.

Range Competition and Human Influences

Alpine areas in the Sangre de Cristo Range were heavily utilized by domestic sheep in the early 1950's. It is believed that domestic sheep offered competition with the bighorns and limited bighorn increase. Such competition was apparently present until the bighorn herd started declining. There are no domestic livestock grazing on the Sangre de Cristo bighorn ranges at present (1971). Riggs and Crane evaluated elk use on the bighorn range as light and deer use as moderate. Deer are more likely to be competitors on the winter range when they are concentrated on the lower slopes used as a winter range by bighorns, although Woodard (1971) believed there may have been competition on the summer range as well. He stated:

"There was possible summer competition between bighorn sheep and mule deer (Odocoileus hemionus) in the study area in 1969 and 1970. The sheep always avoided the lush alpine basins in which deer were frequently observed. The sheep, in contrast, stayed on or near the crests of ridges and were seldom observed below 12,000 feet in elevation."

Moser (1955) examined one rumen sample taken from a ram harvested in September. By volume, grasses comprised 63.4 percent, browse 20.3 percent, and forbs 16.3 percent of the diet. Important plant species identified in the sample were: Poa alpina, Poa rupicola, Salix nivalis, and Senecio fendleri.

Human use on the bighorn range is light; however, concentrations near the Sand Creek lakes apparently had an effect on bighorn distribution in that area. Woodard (1971) wrote:

"The sheep's inability to adjust to human presence and their apparent hesitancy to compete with mule deer were apparent for this limited range use. Many fishermen and hikers utilize the Sand Creek area of the Sangre de Cristo Mountains during the summer months. Human presence in this area appeared to force the bighorn sheep to stay in escape cover above 12,000 feet elevation at most times.

The sheep often moved down close to Upper Sand Creek Lake to areas of relatively lush and dense vegetation during the month of June in 1969 and 1970. However, when more people started using the area as summer progressed, the sheep stayed near the crests of the highest peaks at all times."

BUFFALO PEAKS

Distribution

The Buffalo Peaks area is northeast of Buena Vista in the Arkansas River drainage (Fig. 22). Streeter (1969) studied the indigenous sheep herd from 1966 to 1968 and the area description is:

"The two Buffalo Peaks are situated in the north-central part of the study area. The west peak is 13,326 feet in elevation and is joined to the 13,200-foot east peak by a precipitous rim 13,276 feet in elevation at its low point. The north side of the two peaks and rim is formed by a glacial cirque which drops to 11,500 feet elevation. The sides of the cirque basin are a series of vertical cliffs and steep rock slides. The upper portion of the cirque walls and the rim are presently used as a lambing area. The west, south, and east slopes of both peaks are a mosaic of extensive rock slides, cliffs, and vegetated ridges. Vegetated ridges and peaks extend west and northeast from Buffalo Peaks, with elevations up to 12,917 feet.

"The geology of the alpine zone is predominantly mixed volcanics. Granitic strata appear in the cirque walls, and marine sediments are found in the cirque basin. Cross (1883) briefly described the geology of the Buffalo Peaks cirque basin.

"Elevations of the southern portion of the Buffalo Peaks study area vary from 8,800 to 11,000 feet. Slope aspects are southeast to southwest. Topography is composed of cliffs, large boulder fields, rock slides, and steep, rocky slopes. Geology of the southern portion of the study area is of granitic and sedimentary origin.

"Vegetation in the Buffalo Peaks study area is typical of the alpine, sub-alpine and montane zone (Marr 1961). Timberline occurs between 11,500 and 11,700 feet elevation. The lower southern portions of the study area border on the chaparral zone. Transition from the chaparral zone to the alpine zone is rapid, occurring in less than 5 air miles."

A list of plants collected on Buffalo Peaks by Dr. Harrington, Colorado State University, is given in Table 24.

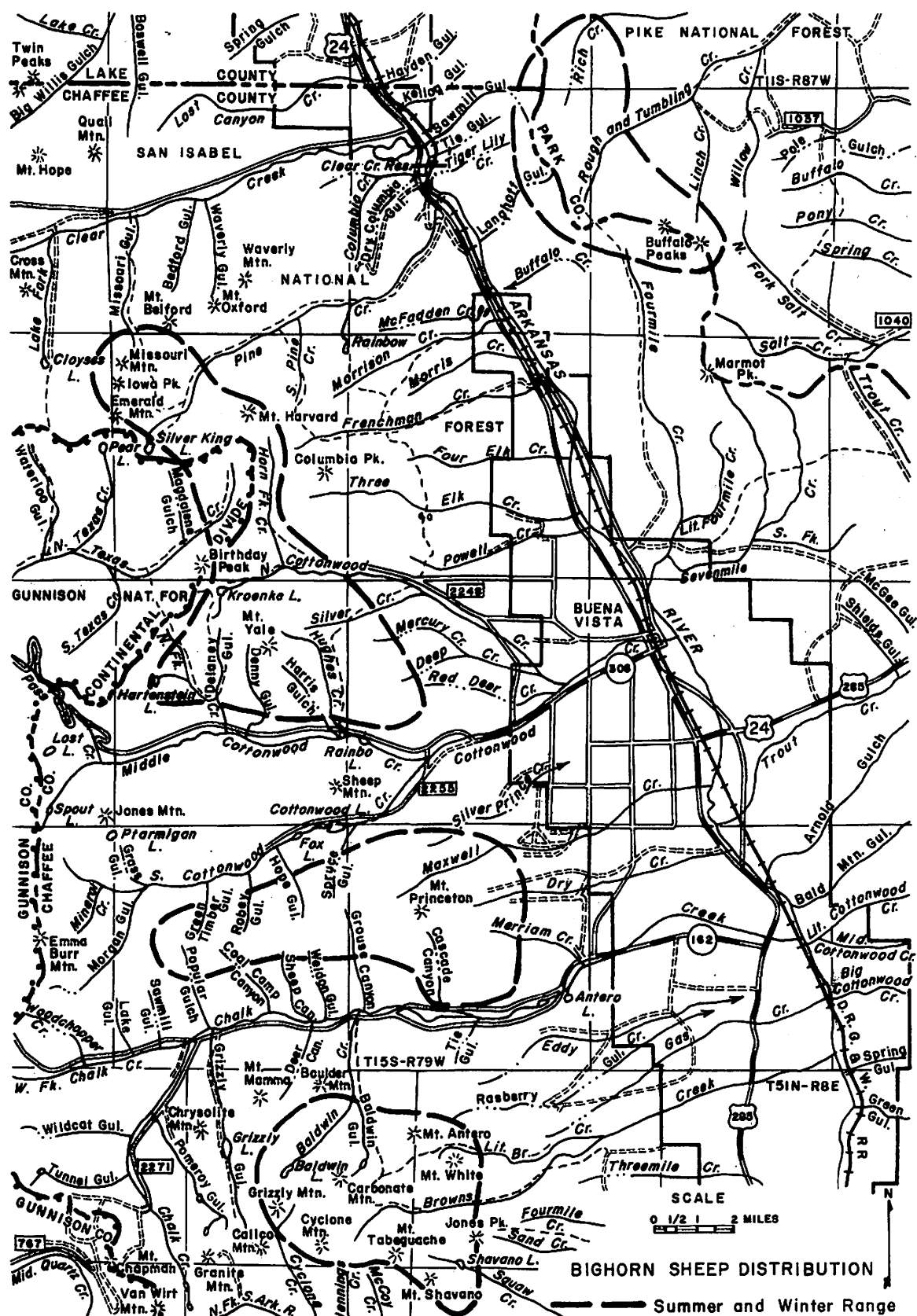


Fig. 22. Bighorn sheep distribution, Collegiate Range and Buffalo Peaks.

Table 24. List of plant species identified in the Buffalo Peaks area by Dr. H. D. Harrington, June, 1954^a.

<u>Sambucus pubens</u>	<u>Mertensia ciliata</u>
<u>Festuca idahoensis</u>	<u>Potentilla fruticosa</u>
<u>Aquilegia caerulea</u>	<u>Vernonica wormjoldii</u>
<u>Thlaspi alpestre</u>	<u>Trisetum spicata</u>
<u>Salix planifolia</u> var. <u>nelsonii</u>	<u>Pedicularis groenlandica</u>
<u>Senecio harbourii</u>	<u>Achillea lanulosa</u> spp. <u>alpicola</u>
<u>Phacelia sericea</u>	<u>Eriogonum flavum</u>
<u>Silene acaulis</u>	<u>Antennaria anaphaloides</u>
<u>Claytonia megarrhiza</u>	<u>Cystopteris fragilis</u>
<u>Draba lanceolata</u>	<u>Thalictrum alpinum</u>
<u>Cardamine cordifolia</u>	<u>Delphinium barbeyi</u>
<u>Hymenoxys acaulis</u>	<u>Penstemon hallii</u>
<u>Eritrichium elongatum</u>	<u>Delphinium alpestre</u>
<u>Descurainia richardsonii</u>	<u>Haplopappus pygmaeus</u>
<u>Phlox caespitosa</u>	<u>Stellaria longipes</u>
<u>Arenaria obtusifolia</u>	<u>Caltha leptosepala</u>
<u>Androsace septentrionalis</u>	<u>Pedicularis scopulorum</u>
<u>Cerastium arvense</u>	<u>Gentiana fremonti</u>
<u>Potentilla diversifolia</u>	<u>Arenaria fendleri</u>
<u>Trifolium nanum</u>	<u>Trifolium parryi</u>
<u>Trifolium dasyphyllum</u>	<u>Saxifraga bronchialis</u>
<u>Taraxicum ceratophorum</u>	<u>Mertensia bakeri</u>
<u>Castilleja occidentalis</u>	<u>Arenaria rubella</u>
<u>Eriogeron pinnatisectus</u>	<u>Hymenoxys grandiflora</u>
<u>Zygadenus elegans</u>	<u>Arabis drummondii</u>
<u>Senecio amplexans</u> var. <u>holmii</u>	<u>Senecio crocatus</u>
<u>Erigeron simplex</u>	<u>Senecio harbourii</u>
<u>Heuchera nivalis</u>	<u>Saxifraga rhomboidea</u>
<u>Penstemon whippelii</u>	<u>Senecio integerrimus</u>
<u>Pedicularis parryi</u>	<u>Draba crassifolia</u>
<u>Draba aurea</u>	<u>Potentilla rubricaulis</u>
<u>Lychnis drummondii</u>	<u>Polemonium viscosum</u>
<u>Erigeron leimeris</u>	<u>Senecio carthamoides</u>
<u>Sedum turbinatum</u>	<u>Sedum integrifolium</u>
<u>Salix glauca</u> var. <u>glabrescens</u>	<u>Artemisia scopulorum</u>
<u>Artemisia spithamea</u>	<u>Angelica grayi</u>
<u>Oreoxis alpina</u>	<u>Pseudocymopterus montanus</u>
<u>Salaginella densa</u>	<u>Agropyron bakeri</u>
<u>Poa longiligula</u>	<u>Deschampsia caespitosa</u>
<u>Poa rupicola</u>	<u>Poa interior</u>

^a Moser 1954

Bighorn sheep in the Buffalo Peaks area changed range-use patterns from the mid-1950's to the present time (1971). Previously, the animals foraged in the chaparral zone, as evidenced by observations at salt stations during all seasons of the year (Sailer 1967). The sheep, primarily females, were harvested in the chaparral zone during hunting seasons (Moser 1968). Breeding activities also were observed in the zone (Jordan 1967). Large numbers of females, yearlings and lambs were observed to summer above timberline (Ogilvie 1968, Pillmore 1968), but most animals wintered below the alpine zone. A trail between the alpine and chaparral zones was found to be used regularly by bighorn sheep (Pillmore 1968). Thus, during the 1950's, the chaparral and lower montane zones were used throughout the year and the alpine zone was used mainly as a summer range; however, some animals were observed above timberline in all seasons (Pillmore 1968).

Sightings of bighorn sheep below the timberline region were reported only six times from 1966 to 1968 by U. S. Forest Service personnel, ranchers, and construction men. Eight hunters during the 1966 bighorn sheep season used an airplane, four-wheel-drive vehicles and horses to cover the area. Only one bighorn sheep, a male, was observed below timberline during the three-week season. All personal observations of bighorn sheep, 1966 to 1968, were recorded above timberline except for four instances of an old burn area adjacent to timberline (Streeter 1969).

Population Trend

The population trend of the Buffalo Peaks herd has been downward during the last 15 years. High bighorn counts in the 1950's were 97 and 85 (Table 25). At this time, bighorns were still seen in areas surrounding the Peaks--Four Mile Creek, Marmot Peak, Weston Pass, and Horseshoe Mountain. Moser (1962) estimated the population at 150 head in the late 1950's. The herd is presently reduced to a group of sheep ranging primarily on the Buffalo Peaks alpine and areas to the north at the head of Rick and Rough and Tumble creeks. Counts in recent years have varied from 20-45 animals. There appears to be 40-50 bighorns in the population at present (1971).

Aerial census is extremely difficult here during winter because of high winds. Moser (1957) commented:

"At the beginning of this study it was thought that aerial counts would be more successful if made during the winter months when the sheep would be concentrated to a greater degree on their winter range. During the various flights which were made during the winter months a total of two hours and twenty minutes were utilized on actual counting of sheep with only 34 sheep being seen. It was then decided that perhaps counting would be more successful if made during the summer when the sheep could be at higher elevations. Consequently, on July 27, 1956, a total of

Table 25. Bighorn sheep counts, Buffalo Peaks, 1944-1970.

Date	Type of Survey ^a	Ewes	Lambs	Yearlings	Rams	Unclassi- fied	Total	Remarks
1944	G	--	--	--	--	47	47	Buffalo Peak
5-12-54	A	71	1	--	--	--	72	" "
5-18-54	G	59	2	--	7	--	68	Rams seen on Wildhorse Creek
6-22-55	G	24	17	--	--	--	41	Buffalo Peak
7-26-55	G	50	26	--	--	21	97	" "
7-29-55	G	--	--	--	--	85	85	East Peak
10- 2-55	G	--	--	--	--	45	45	Buffalo Peak
10-10-55	G	4	3	--	30	14	51	" "
10-23-55	G	--	--	--	12	34	46	" "
11-26-55	G	3	2	--	--	40	45	" "
3- 6-56	G	32	12	--	14	8	66	" "
5-21-56	G	21	12	--	--	--	33	Between East and West Peaks
3- 6-56	G	32	12	8	14	--	66	Fourmile Creek
7-27-56	A	--	--	--	--	42	42	Buffalo Peak
Aug. 1960	G	8	6	6	--	--	20	Horseshoe Mtn.
Sept. 1960	G	12	7	4	4	--	27	N. E. Rim
March 1961	G	--	--	--	5	--	5	N. Hiway 24
March 1961	G	2	--	4	--	--	6	Mosquito
1964	A	--	--	--	--	27	27	Buffalo Peak
7-23-65	G	11	11	6	--	--	28	" "
1966	G	20	11	4	3	--	38	" "
4-26-66	G	21	--	6	2	--	29	Horseshoe Mtn.
1967	G	16	12	2	3	--	33	Buffalo Peak
7- 3-67	G	16	8	--	--	--	24	" "
1968	G	17	8	--	3	--	26	" "
1969	A	--	--	--	--	20	20	" "
1970	A	--	--	--	--	18	18	Partial survey
Summer 1970	A	32	10	--	4	--	46	Helicopter

^aG = ground; A = aerial

one hour and fifty minutes flying time was spent on aerial census of the Buffalo Peaks bighorn sheep herd. The area covered extended from approximately four miles south of Marmot Peak north to the horseshoe basin west of the town of Fairplay. This area comprised the entire range for this particular sheep herd.

"Only 42 bighorn sheep were observed on the south slope of East Buffalo Peak. This herd was located in open meadows above timberline, but due to wind currents it was impossible to reduce the air speed or get close enough to accurately determine the sex or approximate age of the animals. Some lambs were seen but from the air it was impossible to tell how many there were.

"A considerable amount of the time was spent strip flying the area north of Buffalo Peaks where the rams are usually located during the summer months but no rams were located. Almost invariably rams can be located in this area by ground coverage, either foot or horseback.

"Aerial census work conducted in other states indicated that good counts could be made by air, but the areas where this work was conducted was at considerably lower elevations than that which an airplane has to operate in the mountains of Colorado. Many times a flying schedule would have to be postponed due to impractical flying conditions, and then when a flight could be made it might have to be interrupted before completion because of turbulent air."

Don Minnich, a management biologist, unsuccessfully attempted aerial surveys on Buffalo Peaks in the winter of 1970. He was very successful on a survey conducted via helicopter during the summer months, obtaining one of the highest counts for this area in several years. Minnich recommended aerial-trend counts in summer rather than in the winter.

Hunter Harvest

Bighorn hunting seasons were permitted for the Buffalo Peaks area from 1953 through 1966, the only area where an either-sex season has been permitted (Table 26). These seasons were in 1954, 1957, and 1958, with 70, 70, and 50 either-sex permits, respectively, being issued. The harvest for the three seasons was 24 adult rams, 12 yearling rams, 45 adult ewes, and 8 lambs, and hunter success varied from 46 to 48 percent. Prior to the either-sex seasons the herd had been increasing rapidly, overusing parts of the range. The purpose of these seasons, therefore, was to stabilize population increase and disperse concentrations of sheep. Results are unknown since the population suffered abnormally rapid decline, presumably from disease, after the hunting season of 1958.

Table 26. Bighorn hunting seasons and harvest, Buffalo Peaks area, 1953-1966.

	Year													
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
Season														
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28
Duration (days)	11	9	9	9	16	16	16	16	16	17	16	37	23	22
Regulation														
Rams only	1/2	--	1/2	1/2	--	--	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4
Either sex (ES)		ES			ES	ES								
Applications received														
Applications received	--	--	--	--	39	--	43	26	29	46	39	36	31	36
Licenses issued														
Licenses issued	10	70	10	20	70	50	10	10	10	10	10	10	16	10
Bighorn sheep harvested														
Bighorn sheep harvested	9	33	1	4	32	24	2	3	3	8	2	3	2	1
Percent success														
Percent success	90	47	10	20	46	48	20	30	30	80	20	30	12	10

Streeter's (1969) speculation on either-sex hunting in this herd was:

"Either-sex hunting appears to have had detrimental effects on the Buffalo Peaks bighorn sheep population. Approximately 20% to 30% of the population was killed during each of the three either-sex seasons. One result, accomplishing the management objective set, was to reduce the population. The change could have resulted because the portion of the Buffalo Peaks population using the lower montane and the chaparral zones was overharvested, and only the segment of the population remaining above timberline survived. The additional effects of . . . pressure as well as the increased number of deer and elk hunters could have initiated a change in the pattern of range use for the survivors, forcing them to range at and above timberline during the greater portion of the year."

Rams-only permits were issued during the other 11 hunting seasons, during which hunters harvested 38 rams for a success of 30 percent. The three-quarter-curl ram regulation, 1959 and 1966, resulted in the harvest of only three sheep for a success of 15 percent. During nine seasons under the half-curl regulation, hunters took 35 rams for 33 percent success.

Other Mortality

Streeter (1969) was able to determine ages for 17 of 26 bighorn carcasses found, 59 percent in the 0-1 year age class, indicating high lamb mortality. The age of the oldest male was 10 years, and the oldest female was 8 years old. During the study (1966-1968), Streeter determined a lamb survival of 18 percent and calculated an annual negative growth of 12 percent in the breeding population. Assuming this rate of mortality, the herd would have become extirpated in 31 years.

Streeter (1969) also speculated on the effect of population densities on mortality. He calculated the alpine range density of the decreasing Buffalo Peaks herd to be seven sheep per square mile (1966-1968) and that of the increasing Mt. Evans herd to be four per square mile. The calculated pre-die-off (1954-1956) density of the Buffalo Peaks herd was 14 per square mile. Therefore, increased intraspecific interactions caused by increased population density could, in turn, increase nutritional stress by limiting the amount of individual feeding time and where and when individuals were able to forage. Also, as population density increased, less forage would be available to individual sheep. These interactions could limit reproductive success, increase mortality, and decrease the herd's resistance to diseases and parasites.

Poor forage may also be a consideration in malnutrition. To evaluate this factor on the Buffalo Peaks range, Streeter (1969) collected samples of one sedge and three grasses during October, November, and December, 1968, and the chemical analysis is given in Table 27. The data are of limited value because the samples covered only a three-month period of the year, and the nutritional requirements of bighorns are unknown. However, Streeter did find that the crude protein and phosphorus content of the four plants was below the minimal requirements for domestic sheep, and may cause decreased reproduction and weak lambs.

Lungworm infestations are evident in the Buffalo Peak herd. Pillmore (1961) collected lung samples from 81 bighorns during the period of 1954-1958, all of which were positive for lungworm larvae. He also examined 234 fecal samples from the area in 1954-55, and found lungworm larvae in 178, or 76 percent. Streeter (1969) found 84 percent of 122 fecal samples positive for lungworm larvae. Pillmore also identified the species of snails on the Buffalo Peaks range, determined the incidence of lungworm larvae in the snails, and used this area for other phases of his studies on the life cycle of the lungworm. His more detailed report is pending.

Streeter (1969) reported he did not observe predation of any sort on bighorn sheep and did not believe it influenced the population. Red foxes, coyotes and golden eagles were more or less common on the area. Evidence of bighorn sheep was not found in red fox scats, but did occur in 4 of the 17 coyote scats.

Range Competition

Grazing on the bighorn range by other ungulates was generally light. Domestic cattle use was very light, and domestic sheep permits have not been issued for this area for over 20 years. Deer use all portions of the bighorn range, but large deer herds are found only in the lower mountain and chaparral zones formerly occupied by bighorns. According to Streeter (1969):

"The elk population in the Buffalo Peaks area is thought to have increased. Moser (1968) did not observe elk use in the above timberline portions of Buffalo Peaks area in the 1950's. A total of 256 elk were killed in the area from 1946 to 1961, and the same number were killed during the 1962-1968 period. Herds of elk as large as 85 animals were observed above timberline during the 1966 to 1968 study."

Moser (1955) analyzed 27 rumen samples of bighorn sheep harvested by hunters in September, 1953 and 1954. By volume, grasses comprised 70.2 percent, browse 20.6 percent, and forbs 9.2 percent of the diet. The more important species were: Carex nigricans, Festuca idahoensis, Muhlenbergia montana, Poa rupicola, Trisetum spicata, Potentilla fruticosa, Salix glauca, Mertensia alpina, and Trifolium nanum.

Table 27. Chemical composition in percent of one sedge and three grass species, Buffalo Peaks alpine zone, 1968 (Streeter 1969).

Species	Sampling Month	Crude Protein	Crude Fat	Crude Fiber	Ash	NFE	Ca	P	Ca:P
<u>Agropyron</u> <u>trachycaulum</u>	Oct.	7.35	1.54	42.24	6.41	42.46	0.32	0.08	4.0:1
	Nov.	5.52	4.24	47.57	5.90	36.77	0.35	0.10	3.5:1
	Dec.	5.95	1.01	44.51	7.08	41.45	0.39	0.05	7.8:1
<u>Poa</u> <u>rupicola</u>	Oct.	6.49	1.44	45.45	5.97	40.65	0.31	0.07	4.4:1
	Nov.	6.07	1.59	43.88	6.22	42.24	0.34	0.07	4.9:1
	Dec.	6.24	0.89	42.49	5.83	44.55	0.33	0.06	5.5:1
<u>Festuca</u> <u>ovina</u>	Oct.	6.45	2.15	54.70	16.26	20.44	0.48	0.12	4.0:1
	Nov.	5.92	1.98	41.94	--	43.37	0.36	0.10	3.6:1
	Dec.	5.52	1.02	47.42	7.56	38.48	0.38	0.10	3.8:1
<u>Kobresia</u> <u>bellardi</u>	Oct.	6.12	0.22	42.99	7.54	43.13	0.70	0.07	10.0:1
	Nov.	6.35	3.45	37.65	7.86	44.69	0.80	0.05	16.0:1
	Dec.	6.23	2.56	40.46	9.40	41.35	0.77	0.05	15.4:1

MOUNT SILVERHEELS-PARK RANGE

There is a small herd of bighorns that range the rugged mountains along the northern edge of South Park (Fig. 23). Very little is known about this herd; apparently they remain in the alpine throughout the year. Fifteen head were counted on Mount Silverheels in 1970.

Historically, this was part of the Kenosha herd. Prior to 1940, bighorns were commonly seen about 1.5 miles southeast of Jefferson Lake and on Red Mountain near Fairplay. They ranged throughout the Park Range. This area should be evaluated for potential transplant sites.

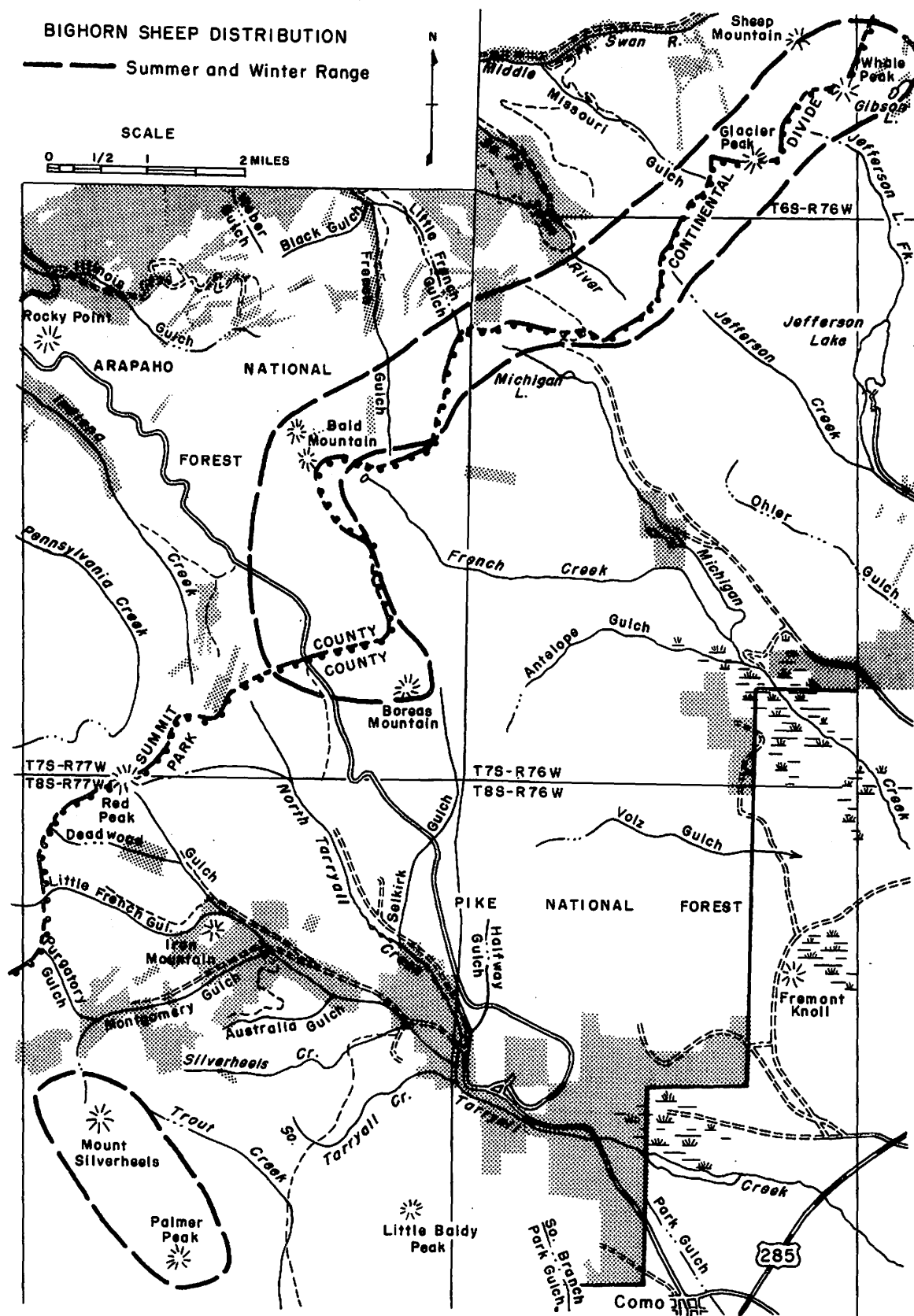


Fig. 23. Bighorn sheep distribution, Mount Silverheels-Park Range.

COLLEGIATE RANGE

Distribution

The Collegiate Range ascends abruptly from the Arkansas River Valley (7,000 feet) to peaks over 14,000 feet in elevation. Bighorn sheep summer on the alpine reaches of the several peaks involved. Although some animals descend to lower elevations in winter, others spend this season on alpine range. Wintering grounds are at the foot of Mt. Princeton on Chalk Creek and at the foot of Mt. Yale on Cottonwood Creek (Fig. 22). According to Hibbs and Rutherford (1968):

"From the counts that have been made, it is apparent that there are a few sheep on each major mountain within the Range, the largest herds being found on Mt. Antero, Mt. Princeton, and Mt. Yale. It appears that there is little movement by sheep between mountains except for a few rams that possibly move from one mountain to another during the rut. Most ewes and lambs probably live out their entire lives on one major mountain."

Distribution of the Collegiate Range herd has decreased in recent years. In the late 1940's bighorns existed from north of Twin Lakes to the Mountain of the Holy Cross, and that area appears to be void of bighorns at present (1971).

Population Trend

The herd, formerly in declining status, has recently begun to increase. Jones counted 152 head in the herd in the late 1940's, and Ogilvie (1972) stated, "In 1953-54 this range supported an estimated population of 300 bighorns, this included the Leadville portion of the Collegiate Range."

Moser (1962) estimated herd size at approximately 200 sheep, and Hibbs and Rutherford (1968) reported:

"The Collegiate Range sheep herd has decreased from good numbers of sheep during the 1950's to an estimated population of less than 75 animals at the present time. It is speculated that the gradual decline in sheep numbers can be attributed partially to lungworm disease, but there are probably other factors affecting the herd."

Ogilvie (1972) estimated the population at 90-100 head, as follows: Chalk Creek, 20; Cottonwood Creek, 30; Pass Creek, 15; Mt. Harvard-north, 15; and miscellaneous areas, 10.

Counts of the Collegiate Range herd are too few to establish a trend in lamb:ewe ratios (Table 28). Total counts generally have ranged from

20 to 30 head on the lower winter ranges in recent years. The Collegiate Range is difficult to census with aircraft, and the alpine ranges are far too extensive to census on foot. Wintering grounds on Chalk Creek and Cottonwood Creek can be censused by workers on the ground.

Mortality and Miscellaneous Information

Mortality records are primarily limited to hunter harvest. Sheep have been hunted in the Collegiates since 1953 (Table 29). A total of 407 licenses were issued during the 18 years, 1953-1970, and 31 rams were harvested for a hunter success of 8 percent. The half-curl ram regulation was in effect during 1953-1957 and 1960-1965, and 25 rams were harvested for a success of 9 percent. The three-quarter-curl ram regulation was in effect in 1958-59 and 1966-1969, and six rams were harvested for success of 5 percent. No sheep were harvested under the full-curl ram limitation in 1970. As a matter of course, hunters were most successful under the most liberal regulation.

Pillmore (1956) collected lung samples from four bighorns taken by hunters in 1953 and 1954, and found all positive for lungworm larvae. He reported:

"In 1954, a ewe was observed to undergo similar and repeated periods of coughing, and an attempt to collect the animal was unsuccessful. This was on Chalk Creek southwest of Buena Vista, where Mrs. J. Love, a long-time resident, reports that she has noted such coughing among sheep in the past and that sometimes these sheep died. Also she believed that these sheep never increased much over forty head."

Ken Wagner (W.C.O.) and Ogilvie reported elk use on the bighorn range as light to moderate during the summer months. Deer use was moderate and occurred during the summer and fall. Mountain goats occupy the sheep range all year and their use was rated as light to moderate. Rutherford estimated the goat population at 300 head. Domestic sheep do not graze the range presently occupied by bighorns; however, Oliver Franklin (W.C.O.) reported extensive domestic sheep grazing in the northern portion of the mountain range formerly occupied by bighorns.

Human activities on the bighorn range were rated moderate to heavy, the latter especially during summer in the more accessible range in the Chalk Creek and Antero Peak areas. Poaching causes some loss in the region of Chalk Creek.

A salt-supplementation program was undertaken in the Collegiate Range for several years, and Jones and White (1950) reported:

"It has been increasingly evident that salt is very important to bighorn sheep. The figures have not been completed on the rate of consumption but it does vary in different areas. As an example, a 50 pound block of white salt will last 5 to 6 months on Cottonwood Creek west of Buena Vista and from 9 to 12 months on adjacent Chalk Creek, where the herd size is approximately the same.

Table 28. Bighorn sheep counts, Collegiate Range, 1948-1971.

Date	Type of Survey ^a	Bighorns Counted					Total	Remarks
		Ewes	Lambs	Yearlings	Rams	Unclassified		
2-24-48	G	19	-	-	-	-	19	Chalk Cr. and Cottonwood Cr.
May, 1949	G	6	-	5	8	-	19	Chalk Cr.
May, 1950	G	9	-	7	1	-	17	Chalk Cr.
May, 1950	G	16	-	-	2	-	18	Cottonwood Cr.
Mar. 1961	G	19	-	12	18	-	49	Cottonwood Cr. and Chalk Cr.
Mar. 1961	G	-	-	-	-	54	54	Cottonwood Cr. and Chalk Cr.
1961-62	G	13	8	9	9	-	39	Collegiate Area
1965-66	G	10	4	-	5	-	19	Collegiate Area
1966	A	-	-	-	-	29	29	Collegiate Area
4-3-67	G	10	4	5	8	-	27	Collegiate Area
1967	A	-	-	-	-	23	23	Collegiate Area
2-9-67	G	10	5	4	4	-	23	Collegiate Area
Summer, 1967	G	2	1	-	-	-	3	Collegiate Area
1968	A	-	-	-	-	1	1	Collegiate Area
July, 1969	A	-	-	-	-	9	9	Mt. Princeton
Mar. 1970	A	-	5	-	-	17	22	Cottonwood Cr.
Mar. 1970	A	-	-	-	1	-	1	Jenning Cr.
April, 1971	G	-	-	-	-	5	5	Chalk Cr.
Aug. 1971	A	-	6	-	-	14	20	Mt. Princeton

^a G = ground; A = aerial.

Table 29. Bighorn sheep hunting seasons and harvest, Collegiate Range, 1953-1970.

	Year																	
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season																		
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	9	9	9	16	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	full
Application received	--	--	--	--	19	--	20	34	25	24	48	44	72	65	22	46	38	13
Licenses issued	10	14	30	30	30	30	30	30	30	30	30	30	30	30	15	4	4	4
Bighorn sheep harvested	3	2	0	3	3	1	2	0	3	2	5	3	1	0	3	0	0	0
Percent success	30	14	0	10	10	3	7	0	10	7	17	10	3	0	20	0	0	0

"During the quarter, a heavily used mineral salt lick was located on Cottonwood Creek, west of Buena Vista. Seven head, 2 rams and 5 ewes, were observed eating the soil in November. The salt lick was formed when a cut was made through a talus slope during construction of the road up Cottonwood Creek. The sheep have to stand on the roadbed when using the salt lick."

Moser (1955) analyzed four rumen samples from harvested rams in September, 1953 and 1954. By volume, grasses comprised 78.3 percent, browse 11.4 percent, and forbs 10.3 percent of the diet. Vegetative species most common in the rumen samples were: Carex nigricans, Muhlenbergia montana, Phleum alpinum, Poa alpina, Holodiscus dumosus, Salix nivalis, Mertensia alpina, Sedum integrifolium, and Trifolium nanum.

Hibbs (1956) studied the food habits of mountain goats in the Collegiate Range (Tables 30 and 31), and reported:

"When the goats were on the high wind-swept slopes above timberline, they fed on many of the same plants utilized during the summer. Heavy use was noted in some areas on Carex and Poa species. On lower-elevation, winter range limited use was made of Rocky Mountain maple (Acer glabrum), mountain mahogany, squaw currant, and willow (Salix spp.).

"Thus, the food habits studies showed that grasses and grass-like plants composed the greater part of the goats' diet throughout the year. However, limited browsing of woody plants occurred during the winter. Kobresia, Scribner wheatgrass, blue grasses, clover, and Carex were the plants preferred on the high summer range. Extensive use also was made of mountain muhly, Arizona fescue, and Thurber's fescue on the low winter range.

"In the winter when deep snows cover the vegetation above timberline and before the winds have blown the ridges free of snow, mountain goats and mountain sheep were found occupying the same wintering grounds. If the goats and sheep were confined to these areas for extended periods, competition could become a serious factor. However, the goats moved to and from these mutually utilized wintering areas and seldom remained in them for more than a few days. Thus, competition between goats and sheep was minimal."

Table 30. Contents of four stomach samples from mountain goats, Collegiate Range, August-September, 1964 (Hibbs 1965).

Scientific Name	Common Name	Goat Number			
		1	2	3	4
GRASS AND GRASS-LIKE					
<u>Kobresia bellardi</u>	Kobresia	2 ^a	23	20	2
<u>Poa spp.</u>	Bluegrass	5 ^b	10	8	--
<u>Agropyron scribneri</u>	Wheatgrass	T	5	8	1
<u>Carex spp.</u>	Carex	3	--	1	T
<u>Trisetum spicatum</u>	Trisetum	5	--	1	--
<u>Halictotrichon mortonianum</u>	Alpine oat	--	1	3	--
<u>Festuca ovina</u> var. <u>brachyphylla</u>	Sheep fescue	T	T	--	2
<u>Bromus anamolus</u>	Nodding brome	--	--	--	15
Unidentified grass material		70	55	50	40
FORBS					
<u>Trifolium spp.</u>	Clover	5	5	4	11
<u>Arenaria fendleri</u>	Fendler's sandwort	--	--	2	1
Unidentified forbs		10	1	3	15
SHRUBS					
<u>Vaccinium spp.</u>	Huckleberry	T	--	--	T
<u>Arctostaphylos uva-ursi</u>	Kinnikinnick	--	--	--	3
<u>Potentilla fruticosa</u>	Shrubby cinquefoil	--	T	--	8
<u>Betula glandulosa</u>	Mountain bog birch	--	--	--	1
<u>Salix spp.</u>	Willow	--	--	T	T
TREE					
<u>Pseudotsuga menziesii</u>	Douglas fir	--	--	--	1
Total		100	100	100	100

^a Percent of total stomach sample.

^b T = trace.

Table 31. Mountain goat food preferences as determined by direct observation, Collegiate Range, 1964-65 (Hibbs 1965).

Plant Species	Summer		Winter		Importance
	Number of Observations	Percent of Diet	Number of Observations	Percent of Diet	
GRASS AND GRASS-LIKE					
<u>Kobresia bellardi</u>	1,183	35.5	121	5.7	high ^a
<u>Agropyron scribneri</u>	957	28.7	85	4.0	high
<u>Poa spp.</u>	532	15.9	251	11.8	high
<u>Muhlenbergia montana</u>	--	--	575	27.1	high
<u>Halictotrichon mortonianum</u>	61	1.8	--	--	low
<u>Festuca thurberi</u>	--	--	61	2.9	low
<u>Carex spp.</u>	271	8.1	228	10.8	mod.
<u>Festuca arizonica</u>	--	--	495	23.4	high
<u>Luzula spp.</u>	24	0.7	--	--	low
<u>Deschampsia caespitosa</u>	30	0.9	--	--	low
<u>Trisetum spicatum</u>	50	1.5	--	--	low
<u>Koeleria cristata</u>	15	0.5	--	--	low
<u>Stipa robusta</u>	--	--	47	2.2	low
<u>Festuca ovina</u> var. <u>brachyphylla</u>	100	3.0	--	--	low
FORBS					
<u>Heracleum lanatum</u>	20	0.6	--	--	low
<u>Trifolium spp.</u>	30	0.9	--	--	low
<u>Haplopappus macronema</u>	5	0.2	--	--	low
<u>Mertensia spp.</u>	10	0.3	--	--	low
<u>Arenaria fendleri</u>	2	0.1	--	--	low
<u>Eriogonum spp.</u>	4	0.1	--	--	low
<u>Potentilla spp.</u>	30	0.9	--	--	low
<u>Senecio spp.</u>	5	0.2	--	--	low
<u>Heuchera bracteata</u>	4	0.1	--	--	low
SHRUBS					
<u>Salix spp.</u>	--	--	94	4.4	low
<u>Acer glabrum</u>	--	--	30	1.4	low
<u>Sambucus pubens</u>	--	--	75	3.5	low
<u>Ribes cereum</u>	--	--	40	1.9	low
<u>Cercocarpus montanus</u>	--	--	18	0.9	low
Total	3,333	100.0	2,120	100.0	--

^ahigh = 10%; mod. = 5 to 10%; low = 5%.

TAYLOR RIVER

Distribution and Range

The Taylor River bighorn herd occupies nearly the same range today as it did 30 years ago. Hibbs and Woodard (1969) described the winter range as follows:

"The bighorn sheep winter range in this area is northwest of the Taylor River from Almont to approximately five miles upstream. This area consists of steep mountain sides next to the river and is characterized by rock outcroppings and loose shale slides. The overstory consists of a few scattered ponderosa pine (Pinus ponderosa). Many different shrubs were common, the most prevalent being fringed sagebrush (Artemisia frigida), big sagebrush (Artemisia tridentata), and rabbitbrush (Chrysothamnus spp.). The most common grasses are Indian ricegrass (Oryzopsis hymenoides), mountain muhly (Muhlenbergia montana), and needle and thread grass (Stipa comata)."

Hibbs and Woodard (1969) conducted paced-Parker transects in three localities on this bighorn winter range. The average plant density index for the three transect areas were 51.3, 48.3, and 40.7.

Bighorns move up the Taylor River Canyon to the Taylor Reservoir area to summer and some sheep migrate into the alpine areas north of the reservoir (Fig. 24). Wildlife Conservation Officer, Robert Rosette, has reported that bighorns are beginning to use the south side of the Taylor River Canyon more than they have in past years.

Population Trend

The Taylor River herd has been static for many years. Wallace (1940) counted 35 sheep, and reported a count of 27 (5 rams, 18 ewes, and 4 lambs) by Forest Service personnel in 1939. Jones counted 24 bighorns (4 yearlings, 12 ewes, and 8 lambs) above the Taylor Reservoir during October, 1950. He reported 50 sheep for this herd in 1952. Jones (1961) counted 29 (10 rams, 13 ewes, and 6 yearlings), and in 1962, he counted 13 (2 rams, 7 ewes, and 4 lambs). Rosette also reported 14 sheep in the herd in 1962.

Annual helicopter counts, 1968-1970, in February or March, were as follows: 29 bighorns (13 ewes, 4 lambs, 3 3/4-curl rams, 6 1/2-curl rams, and 3 1/4-curl rams); 28 (7 ewes, 5 lambs, 6 3/4-curl rams, 1 1/2-curl ram, and 4 1/4-curl rams); 34 (15 ewes, 7 lambs, 10 3/4-curl rams, and 2 1/2-curl rams); and 29 (13 ewes, 3 lambs, 10 3/4-curl rams, and 3 1/2-curl rams).

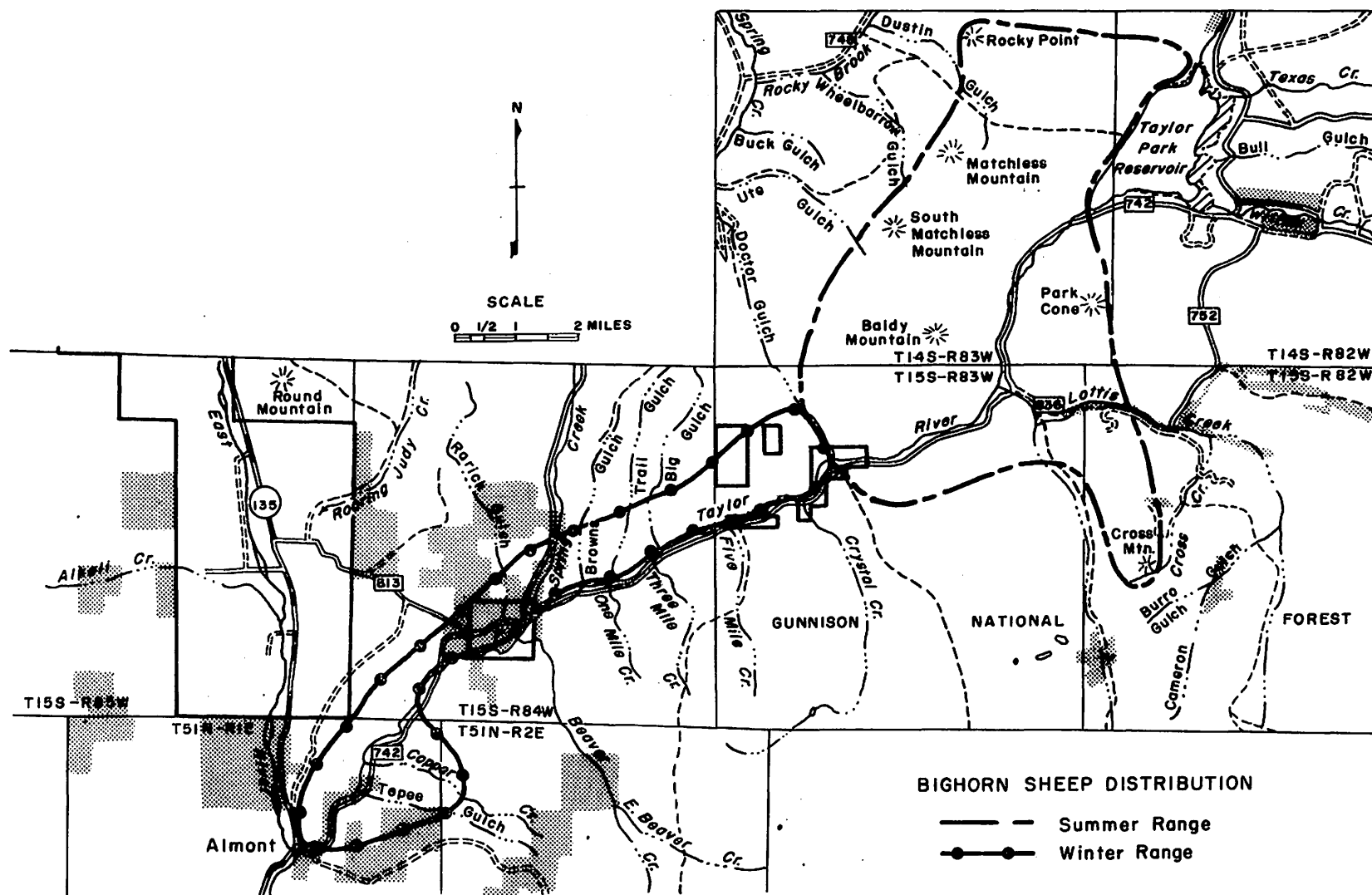


Fig. 24. Bighorn sheep distribution, Taylor River Canyon.

Rosette estimated the present herd at 35-40 animals, comparable to the 35 counted in 1940. Apparently the herd increased to about 50 head in the 1950's, and then decreased to less than 15 in the early 1960's. It increased again, but has recently remained static at 35 head. In view of lamb crops of 40 to 50 per 100 ewes, and some indication of survival to the yearling age class (1/4-curl rams), this herd should be increasing slightly. Possibly the limited size of suitable range and heavy competition with other ungulates serve to limit the number of bighorn sheep on the range, a supposition until more data are obtained on herd dynamics and limiting factors.

Hunter Harvest

The first hunting season for the Taylor River herd was in 1953; since, seasons have been authorized in 1954-1956, 1961-62, and 1969-70 (Table 32). Permits have been for rams only, and hunters were allowed 3/4-curl or larger rams only in 1969 and 1970; in all other years the 1/2-curl regulation was in effect. Permits and harvest by years are: 1953, 7, 4; 1954, 20, 8; 1955, 10, 4; 1956, 5, 2; 1961, 4, 0; 1962, 6, 1; 1969, 5, 2; and 1970, 6, 2. Percent success for the 8 years is 37 percent. Success was lowest in 1961 and 1962 (0 and 17%), coinciding with the low population, approximately 15). Success in other years was relatively high, greater than 40 percent. Counts generally showed a very high ram:ewe ratio which, in conjunction with the half-curl limitation, likely contributed to high success in these years.

Other Mortality Factors

Information concerning mortality due to factors other than legal harvest is very limited for the herd. Kautz collected 12 fecal samples in February, 1942, and had them analyzed for parasites at Colorado State University. These samples were reported relatively free of disease and parasites. Lung tissue collected from hunter-killed bighorns by Richard Pillmore in 1953, 1954, and 1955 was likewise examined at Colorado State University. Of 13 samples, 10 were infected with lungworm. Jones and White (1949) reported on the unusual death of a ram:

"On February 12, a 13-14 year old ram died at the home of J. R. Ramsey on the Taylor River. A post mortem performed by Technician C. D. Tolman of Salida, revealed the indirect cause of death to be a severely impacted tooth. Unable to masticate his food, the ram swallowed it whole, resulting in a primary compaction between the abomasum and duodenum. The ram was fed native hay forming a secondary compaction in the rumen and consequently the animal died."

Range Competition

Competition between other wildlife and bighorn sheep has occurred on the Taylor River winter range for the last 20 years at least. Jones and

Table 32. Bighorn sheep hunting seasons and harvest, Taylor River, 1953-1970.

	Year							
	1953	1954	1955	1956	1961	1962	1969	1970
Hunting season ^a								
Opening date	--	9/11	9/3	9/1	8/26	8/18	8/16	8/15
Duration (days)	--	9	9	9	16	17	23	24
Curl regulation	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4
Applications received	--	--	--	--	4	4	28	37
Licenses issued	7	20	10	5	4	6	5	6
Bighorn sheep harvested	4	8	4	2	0	1	2	2
Percent success	57	40	40	40	0	17	40	33

^a Hunting season was closed 1957-1960 and 1963-1968.

White surveyed the area in 1950 as a possible bighorn transplant site, rejecting it because of severe competition with deer and elk. Rosette has reported that there is currently (1971) heavy deer and elk use on the bighorn winter range, although the sheep use areas too steep for other ungulates. Deer, elk, and mountain goat use is light on the bighorn summer ranges. Cattle use is also light. Presently, no domestic sheep graze the bighorn ranges; however, the U. S. Forest Service has traded some land to a sheep rancher on the south side of the Taylor River. This may be of consideration in the future.

Hibbs and Woodard (1969) reported the following bighorn, deer and elk days of use, based on pellet counts, for the winter range on the steep mountain sides next to the Taylor River: bighorn sheep, 25 days; deer, 4.6 days; and elk, 5.8 days.

Moser (1955) analyzed seven rumen samples from harvested rams in September, 1953 and 1954. By volume, grasses comprised 81.4 percent, browse 12.6 percent and forbs 3.3 percent of the diet. The most common plant species were: Festuca ovina, Kobresia bellardi, Muhlenbergia montana, Poa alpina, Picea engelmanni, Salix glauca, and Senecio fendleri.

Human Influences

Human influences appear to be considerable on the herd. There is heavy recreation use along the south side of the Taylor River, likely keeping bighorns from using this part of the range. However, the river also acts as a barrier to human movement onto the area occupied by bighorns on the north side. Sheep are along the highway while on the winter grounds, and Rosette reported evidence of poaching near the road.

Wallace (1940) found that the sheep were attracted to salt put out by the attendant at Taylor Dam. Apparently the sheep still occasionally come down to the attendant's house to graze during the summer months.

WEST ELK PRIMITIVE AREA

The West elk bighorn herd range is approximately 25 miles northwest of Gunnison. Here, the sheep occupy alpine range through the year. There are extensive cliffs along the drainages leading down from the alpine, it is very possible that bighorns make some use of them, especially for shelter and overlooks. Bighorns were found as far north as Gunnison Mountain in the early 1940's, but recent surveys have not revealed sheep in this area. A rancher (Grant Ferrier, Crawford) reported seeing 5 ewes and 5 lambs near Porcupine Cone on two occasions in late July, 1969. In winter, bighorns concentrate on the windswept ridges on either side of Mill Creek, North Baldy, and West Elk Mountain (Figs. 25 and 26).

Jones made the following sightings in the 1950's: East Soap Creek, 12 sheep; West Elk Mountain, 28; and Gunnison Mountain, 12. One ram was seen on West Elk Mountain in 1968. Five ewes were observed from fixed-wing aircraft in the alpine west of Castle Peak on July 6, 1970. The following bighorns were counted via helicopter on February 16, 1971: total 18 (9 ewes, 5 lambs and 4 rams), all on alpine range. A search in the lower cliffs failed to disclose any sheep or sheep sign. Cliff Coghill (W.C.O.) estimated this herd at 40-50 sheep.

There is no domestic sheep or cattle use on the West Elk bighorn range. Deer and elk use is light and limited to the summer months. Human activities are generally light, occurring mostly during the early hunting seasons.

Evidence indicates that this herd has decreased in number during recent years and there appears to be considerable suitable range free of domestic livestock grazing. The area should be considered for future sheep transplants.



Fig. 25. Bighorn sheep range along South Castle Creek, West Elk Primitive Area. (Photo by George D. Bear)

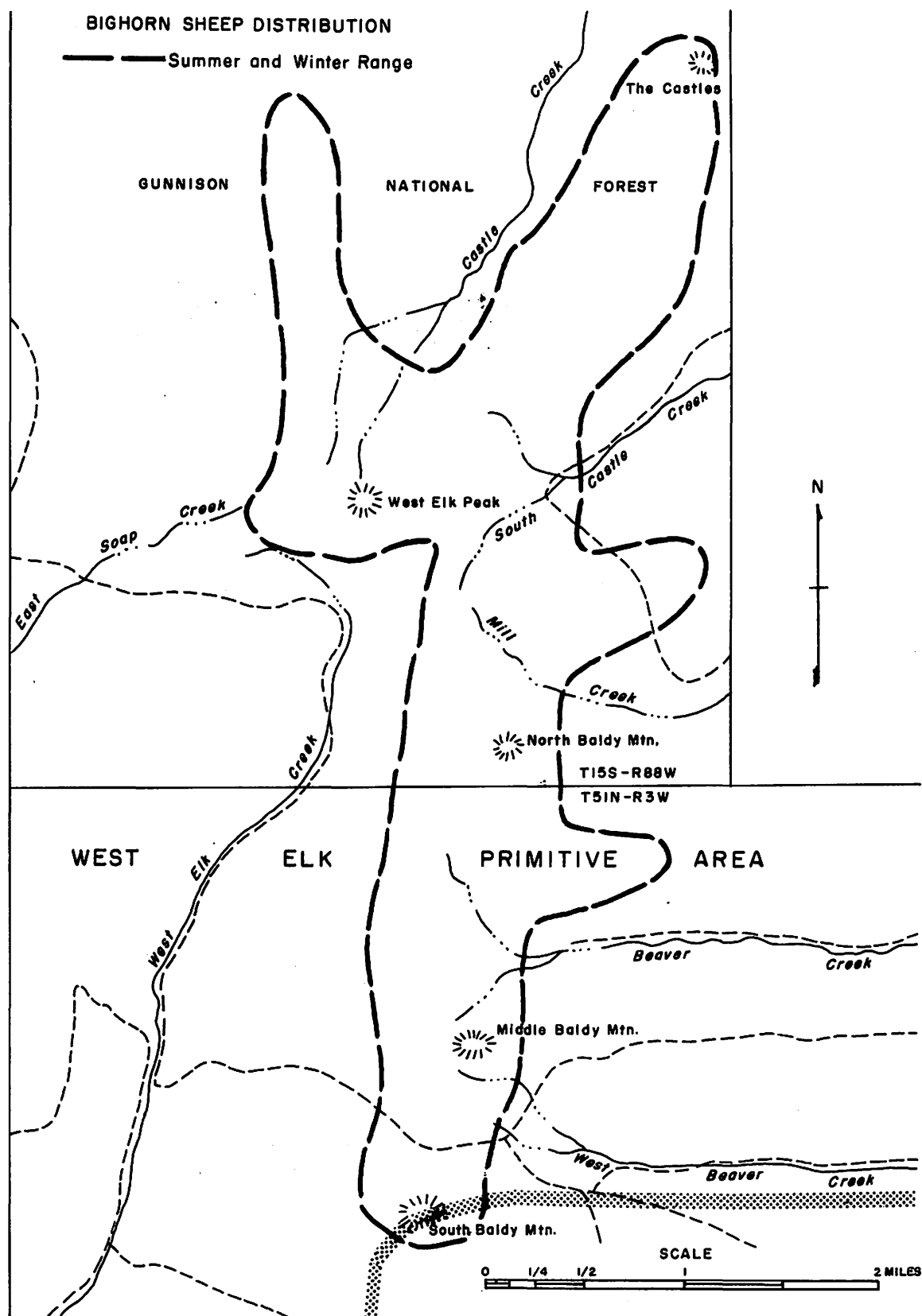


Fig. 26. Bighorn sheep distribution, West Elk Primitive Area.

BLACK CANYON OF THE GUNNISON

This is an extremely rugged canyon area in a juniper-oakbrush vegetative type at approximately 7,700 feet elevation on the Gunnison River 35 miles west of Gunnison. This appears to be a very good sheep area.

An elderly Gunnison rancher said large herds, 150-200 bighorns, wintered in the valley from Gunnison to Sapinero during the early 1900's. Jones (1948) counted eight head (6 ewes and 2 lambs) on the north side of the canyon. In 1953 he reported 27 including five rams. Jones (1962) reported two rams at the canyon. Construction workers at the Marrow Point Dam reported seeing a half-dozen sheep in 1968. No bighorns were observed on intensive helicopter surveys in the Black Canyon during 1970 and 1971. This herd appears to have dwindled from sizable numbers at the turn of the century to only a remnant herd at the present date (1972). Consideration should be given to transplanting new sheep into the area.

Human activities have increased along the Black Canyon, attracted by the new reservoirs, but due to extreme ruggedness of the terrain the bighorns should be able to find seclusion (Fig. 27). The terrain also limits competition from other ungulates. Many of the southwest exposures remain free of snow during the winter months.



Fig. 27. Black Canyon of the Gunnison River at Marrow Point Reservoir.
(Photo by George D. Bear)

TRICKLE MOUNTAIN-ANTERO MOUNTAIN

Distribution

Most of the bighorns in this herd range in the ponderosa pine and bunchgrass areas 15-20 miles west of Saguache at elevations of 8,000-9,000 feet. Hibbs (1967) conducted a vegetation survey of the range and described it as follows:

"The major overstory in the canyons is a dense stand of pinon-juniper (Pinus edulis and Juniperus scopulorum) and scattered ponderosa pine (Pinus ponderosa). A number of shrubs make up the understory cover in the canyons, but squaw currant (Ribes cereum), fourwing saltbush (Atriplex canescens) and mountain mahogany (Cercocarpus montanus) are the major species. It was found that the predominant grasses, both on the mesas and in the canyons, were blue grama (Bouteloua gracilis), Arizona fescue (Festuca arizonica), and carex (Carex sp.), in decreasing order of abundance."

The species of plants that were encountered on the range survey as regular transect hits or as composition hits are shown in Table 33.

The bighorns are concentrated around Trickle Mountain during the winter, mainly on the north side of Saguache Creek between Sheep Creek on the west and Jack's Creek on the east (Fig. 28). On occasions they have been known to cross to the cliffs on the south side of Saguache Creek and on Hoagland Hill. Local residents said that, during one winter of deep snow, some bighorns were sighted on the rocky hillsides northeast of Saguache. The south-facing slopes of Trickle Mountain are most generally free of snow during the winter, thus the sheep can readily find forage. They also frequent the hayfields along Saguache Creek. Cliffs and rocky slopes above the creek offer escape cover.

The sheep spread out into surrounding areas during the summer, although a portion of the herd remains on the range around Trickle Mountain. Lamb-ewe groups can be found in almost any of the rocky areas along Sheep Creek and East Pass Creek (west of Trickle Mountain) to the cliffs just below the summit of North Pass. They also range in the rocky areas in the vicinity of Taylor Canyon and Benny Creek, east of the summit of Cochetopa Pass.

Dale Hibbs traced the movement of several large rams from the Trickle Mountain winter range to a summer range in the alpine area around Antero Mountain, a distance of approximately 20 miles. A few ewes have been observed on Antero Mountain during summer months; no sheep have been found in this area during the winter. It is possible the lambs and ewes migrate back to Trickle Mountain with the rams; however, they may winter in the area adjacent to the alpine summer range.

Table 33. Plants encountered on range transects, winter bighorn sheep range, May, 1966 (Hibbs 1967).

Scientific Name	Common Name
TREES	
<u>Pinus ponderosa</u>	Ponderosa pine
<u>P. edulis</u> (Englm.)	Pinon pine
<u>Pseudotsuga menziesii</u>	Douglas fir
<u>Juniperus scopulorum</u>	Rocky Mountain juniper
SHRUBS	
<u>Artemisia frigida</u>	Fringed mountain sage
<u>Cercocarpus montanus</u>	Mountain mahogany
<u>Ribes cereum</u>	Squaw currant
<u>Chrysothamnus parryi</u>	Rabbitbrush
FORBS	
<u>Atriplex canescens</u>	Fourwing saltbush
<u>Opuntia polyacantha</u>	Prickly pear cactus
<u>Pediocactus simpsonii</u>	Pincushion mountain cactus
GRASSES	
<u>Bouteloua gracilis</u>	Blue grama
<u>Carex</u> sp.	Sedge
<u>Festuca arizonica</u>	Arizona fescue
<u>F. ovina</u>	Sheep fescue
<u>Koeleria cristata</u>	Junegrass
<u>Muhlenbergia montana</u>	Mountain muhly
<u>Sitanion hystrix</u>	Bottlebrush squirreltail
<u>Stipa robusta</u>	Sleepy grass

BIGHORN SHEEP DISTRIBUTION

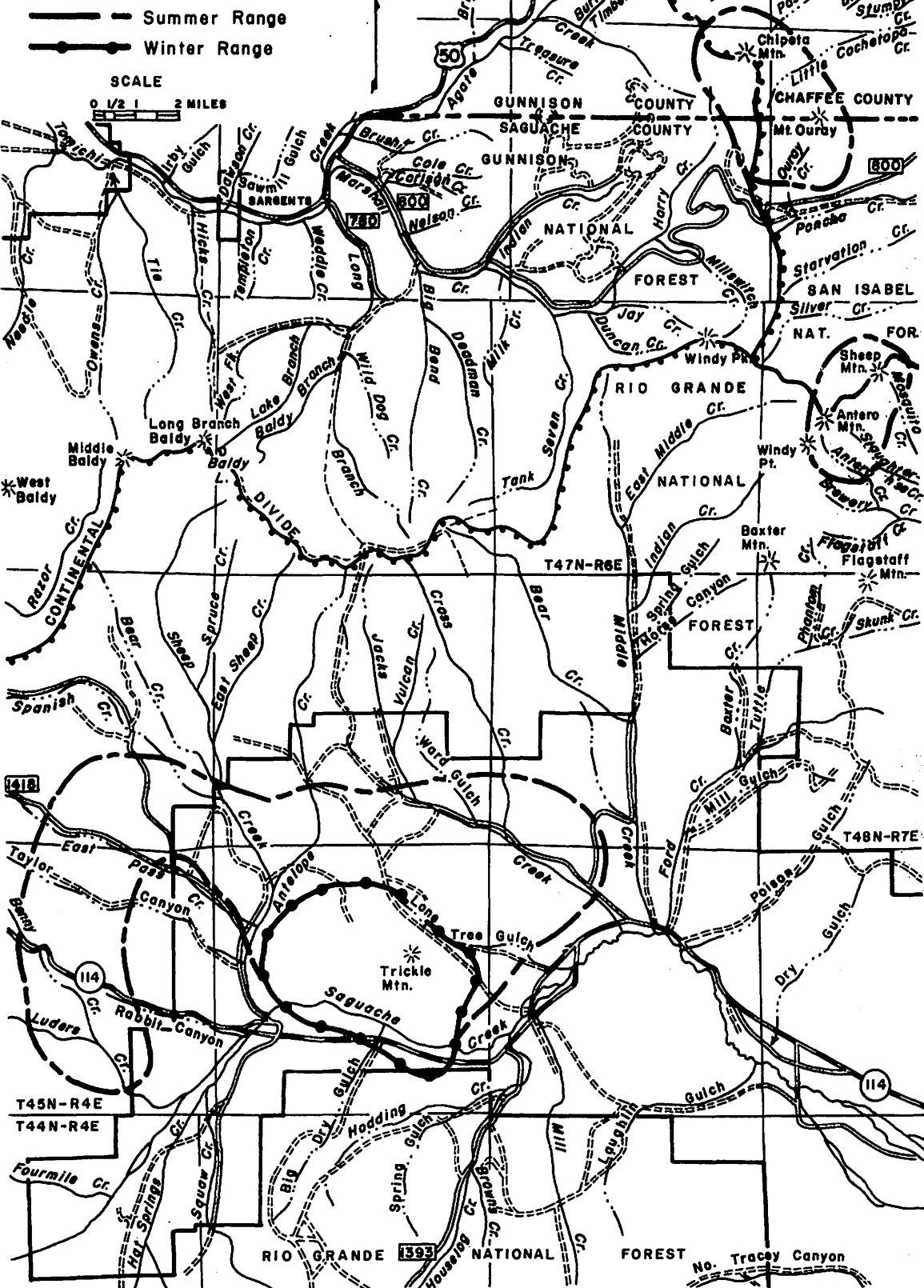


Fig. 28. Bighorn sheep distribution, Trickle Mountain-Antero Mountain, and Mt. Ouray.

Historically, a separate herd of sheep ranged the alpine in the Antero Mountain area (Marshall Pass). Don Crane reported that miners hunted bighorns on Middle Creek at the turn of the century; and Steve Waters saw eight sheep at Baldy Lake in 1928. Prior to 1966 this area was a separate hunting unit. Jones classified 38 animals (24 ewes, 5 lambs, and 9 rams) on Sheep Mountain and Ouray Mountain in June, 1960. Field personnel (Ogilvie and Wagner) reported a few sheep remaining in the Mt. Ouray and Chipeta Mountain area.

Population Trend

The Trickle Mountain herd was established from a bighorn transplant on the rim of Saguache Creek (T44S, R82W) on February 15, 1951 (Fig. 29). Fifteen sheep (8 ewes, 4 lambs, and 3 rams) were in the first release. According to Jones and White (1951):

"The Saguache operation up to the time of release may be termed highly successful. The area selected for the release had been under observation for two years and has been found to possess all the desired factors of good bighorn sheep habitat."

On July 25, 1952, two lambs were observed with three ewes on Benny Creek. Jones and Moser (1953) stated:

"Taylor Canyon, which is approximately seven miles long, and runs in a northwest direction from its confluence with Bear Creek, is the route of travel from Trickle Mountain on Bear Creek to the Cochetopa Pass country. The north side of the canyon is rimrock, and affords an excellent migration route between summer and winter range. The seven sheep were observed on Cochetopa Pass in the rocky area where Benny Creek crossed Colorado 114."

This herd continued to increase in following years. Jones counted 36 bighorns in 1961. Dale Hibbs' highest count in 1965 on Trickle Mountain was 48, and on Antero and Chipeta mountains the highest count was 17. However, he believed there were approximately 125 sheep in the herd. In aerial surveys 77 bighorns were counted on Trickle Mountain in 1966 and 98 in 1967. A total of 117 sheep were classified in an aerial survey in January, 1968, and 111 on March 9, 1969. In ground surveys, Don Crane classified 20 sheep on Antero Mountain on July 14, 1969, 101 on North Pass and Trickle Mountain on August 16, 1969, and 106 on Trickle Mountain (Dabney Ranch) on December 30, 1969. A total of 114 sheep were counted on Trickle Mountain (ground) on January 6, 1970; and 110 on an aerial survey on March 16, 1970. Crane classified 122 sheep in the area on an aerial survey on February 22, 1971 (Table 34). Don Crane estimated the population at 165-175 head.



Fig. 29. Bighorn sheep release on Saguache Creek, February 15, 1951.
(Photo by Claude White)

Table 34. Bighorn sheep counts, Trickle Mountain and Antero Mountain, 1952-1971.

Date	Type of Survey ^a	Bighorns Counted					Total	Remarks
		Ewes	Lambs	Yearlings	Rams	Unclassified		
July 25, 1952	G	3	2	-	2	-	7	Benny Creek
June, 1960	G	24	5	-	9	-	38	Ouray Mt.-Sheep Mt.
1961	G	-	-	-	-	36	36	Saguache
Aug. 6, 1965	G	3	3	-	9	2	17	Antero Peak
May 4, 1966	G	27	11	-	5	5	48	Trickle Mtn.
Mar. 13, 1966	A	-	-	-	-	77	77	Trickle Mtn.
Mar. 1967	A	-	-	-	8	90	98	Trickle Mtn.
Jan. 7, 1968	A	54	39	-	24	-	117	Trickle Mtn.
Aug. 20, 1968	G	24	29	-	3	-	56	Trickle Mtn.
Mar. 9, 1969	A	51	21	-	13	26	111	Trickle Mtn.
July 14, 1969	G	5	3	3	9	-	20	Antero Peak
Aug. 16, 1969	G	56	40	-	5	-	101	N. Pass-Trickle Mtn.
Nov. 22, 1969	G	22	12	-	6	-	40	Sheep Cr.
Dec. 22, 1969	G	82	20	-	12	-	114	Trickle Mtn.
Dec. 30, 1969	G	40	22	-	8	36	106	Trickle Mtn.
Feb. 10, 1970	G	18	6	-	8	5	37	Trickle Mtn.
Feb. 14, 1970	G	11	4	-	13	-	28	Trickle Mtn.
Mar. 17, 1970	A	56	28	-	22	-	110	Trickle Mtn.
June 20, 1970	G	48	24	10	6	-	88	Trickle Mtn.-N. Pass
Feb. 13, 1971	G	71	19	-	27	-	117	Trickle Mtn.
Feb. 22, 1971	A	62	27	-	33	-	122	Trickle Mtn.

^a G = ground; A = aerial.

The Trickle Mountain herd, therefore, has done very well since the transplant nearly 20 years ago. Very likely some interchange occurs with the Antero Mountain and the LaGarita herds, possibly via Saguache Creek, especially by rams exploring new territory. The lamb crop appears to be good each year, but there appears to be some lamb mortality between summer and winter counts. Ram:ewe ratios are fairly high, and Don Crane has reported a high proportion of rams over three-quarter-curl in this herd.

Hunter Harvest

The present hunting unit was originally two separate units, the Trickle Mountain or Sheep Creek Unit and the Marshall Pass or Poncha Pass Unit. Marshall Pass includes Antero Mountain, which was combined with the Trickle Mountain Unit in 1966 when Hibbs observed bighorn movement between the areas. Hunting in the Marshall Pass area occurred from 1954 through 1964; the season was closed in 1960. During the 10 seasons, 73 licenses were issued, 9 rams were harvested, and hunter success was only 12 percent (Table 35). Nearly all the rams were taken during the first few hunting seasons.

Hunting was permitted on the Trickle Mountain Unit in 1953, after which the area was closed until 1960; seasons have been allowed from 1960 to the present, 1970, (Table 36). Since the Marshall Pass area was combined with this unit in 1966, data for the period 1966-1970 are representative of the combined area. A total of 131 licenses have been issued and 55 rams harvested for a success of 40 percent. The area is readily accessible by numerous roads. Many hunters use vehicles to a great extent and do only limited walking as compared to most sheep areas. Accessibility is likely one of the major factors in high hunter success, in addition to the fact that the herd is large and healthy. The three-quarter-curl ram limitation was in effect 5 years, 1958, 1959, 1966, 1967, and 1970; the half-curl ram limitation held in other years. As might be expected, hunter success was lower under the more restrictive regulation, 34 and 44 percent, respectively.

Other Factors

Information concerning parasites, diseases and other sources of mortality is negligible. Six pellet groups were examined for lungworm larvae in 1968 and all were positive.

The Trickle Mountain range is grazed by cattle, deer, elk, and antelope. Don Crane rated cattle and deer use as moderate, and elk and antelope use as light. Deer use the range mostly during the winter, but a few deer remain in the low country through the year. Elk use the low country as a wintering area, then disperse to the higher forested ranges during the summer. The bighorn range is grazed by cattle, primarily during the fall,

Table 35. Bighorn hunting seasons and harvest, Marshall Pass area, 1954-1964.

	Year ^a									
	1954	1955	1956	1957	1958	1959	1961	1962	1963	1964
Hunting season										
Opening date	9/11	9/3	9/1	8/31	8/30	8/29	8/26	8/18	8/24	8/22
Duration (days)	9	9	9	16	16	16	16	17	16	37
Curl regulation	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2
Applications received	--	--	--	5	--	4	2	9	3	4
Licenses issued	10	15	10	10	6	6	4	4	4	4
Bighorn sheep harvested	2	3	2	1	0	0	1	0	0	0
Percent success	20	20	20	10	0	0	25	0	0	0

^a Hunting season closed in 1960. Area was combined with the Trickle Mountain Unit in 1966.

Table 36. Bighorn hunting seasons and harvest, Trickle Mountain area, 1953-1970.

	Year ^a													
	1953	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season														
Opening date	9/3	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	3/4
Applications received	--	--	6	9	12	10	12	16	19	36	37	48	51	78
Licenses issued	7	6	6	6	6	8	12	11	12	12	11	10	9	15
Bighorn sheep harvested	4	1	3	6	1	4	4	1	7	1	6	6	3	6
Percent success	57	17	50	100	17	50	33	9	58	8	55	60	33	40

^aHunting season closed 1954-1957.

winter and spring. Antelope use the range around Trickle Mountain through the year but remain more on the flat terrain. Deer and elk use the alpine range lightly around Antero Mountain during the summer. In general, there is likely only limited competition between bighorns and the other ungulates, but Don Crane believes this herd is nearing range capacity and should be stabilized at its present size.

Human activity on the area is generally limited to hunters, artifact collectors and a few fishermen along the creeks. People moving around in the area cause the sheep to shift locations, but does not appear to be of much importance at present.

SAN LUIS PEAK

Distribution and Range

Limited information indicates that the San Luis Peak bighorn herd may have extended its range in recent years. The summer range extends throughout the alpine area around Baldy Chato, Stewart Peak, Baldy Alto, San Luis Peak, south to Machin Lake, and west through the alpine areas on Mineral Mountain and Baldy Cinco (Fig. 30). It is only in recent years that bighorns have been counted in aerial surveys on the western portion of the range. Local ranchers claim that there has always been sheep movement between San Luis Peak and Mineral Mountain.

Lambing grounds are on south exposures and rugged cliffs of Baldy Chato, Baldy Alto, and Organ Mountain. Herds of older rams, for the most part, are seen south of Organ Mountain in the Canyon Diablo and Machin Lake areas during the summer months, with a few individuals on Mineral Mountain.

The main portion of the San Luis herd winters on alpine areas above 12,500 feet elevation, especially on the windswept ridges of Baldy Chato, Baldy Alto, and Organ Mountain. A few bighorns winter at timberline on Mineral Mountain, and a small group (rams) winter in the cliffs just north of Cathedral (Fig. 31). This area is a bunchgrass-ponderosa pine type at approximately 8,000 feet elevation. A local rancher, Forest Cadwell, said that approximately 30 rams wintered here during the late 1940's, but only 4 to 6 winter here at present (1971). Cadwell reported seeing a group of rams far down on Spring Creek during October, 1971; apparently they were moving to low winter range.

Population Trends

This bighorn herd has shown marked increase in numbers during the last few years. Jones and Moser counted 32 in 1952; and Moser counted 26 (11 rams, 9 ewes, and 6 yearlings) on February 17, 1953. Hibbs counted 40 sheep (8 rams, 17 ewes, 9 lambs, and 6 yearlings) on June 23, 1966. A total of 39 were counted in an aerial survey in 1969.

In an aerial survey on May 19, 1970, 34 bighorns (20 ewes, 12 rams, and 2 unclassified) were observed. The following counts were made via aerial and ground surveys: June 16-18, 1970, ground--64 (26 ewes, 13 lambs, 13 yearlings, and 12 rams); February 27, 1971, helicopter--74 (33 ewes, 21 lambs, 8 3/4-curl rams, 9 1/2-curl rams, and 3 unclassified); July 24-26, 1971, ground--96 (48 ewes, 34 lambs, and 14 yearlings); and September 20, 1971, helicopter--131 (63 ewes, 34 lambs, 25 rams, and 9 unclassified).

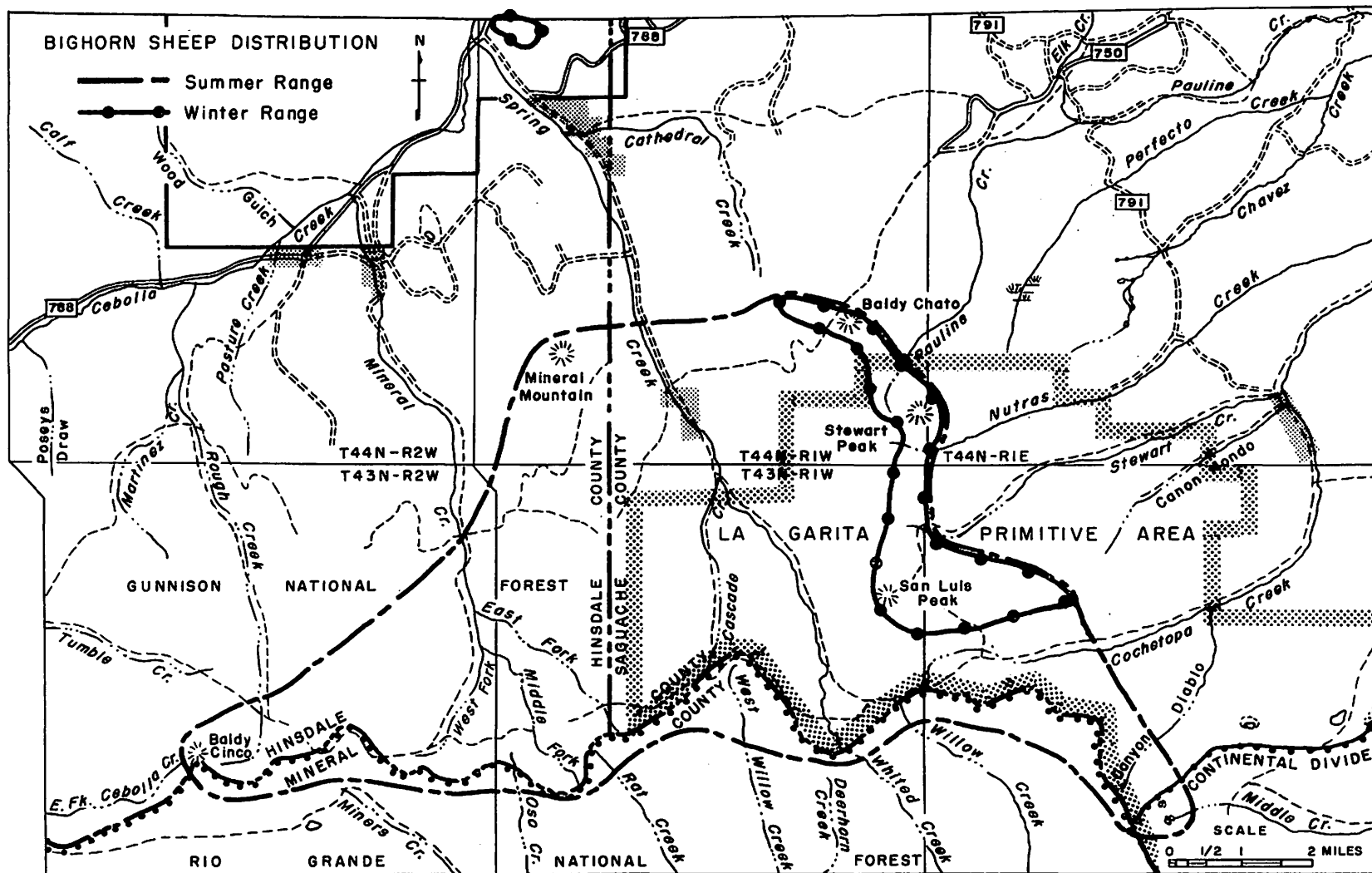


Fig. 30. Bighorn sheep distribution, La Garita Primitive Area.



Fig. 31. Bighorn sheep winter range, Cebolla Creek. (Photo by George D. Bear)

In the counts enumerated above, 35-40 bighorns were counted on each survey up to 1969; there were 74 head in 1970 and 133 head in 1971. About 50 yearlings per 100 ewes were observed on the ground survey in 1970, and 29 per 100 ewes in 1971, both counts indicating good lamb survival.

Hunter Harvest

The San Luis Peak herd was subjected to hunting in 1954, 1956, and 1959-1970 (Table 37). Only a small portion of the area was open to hunting in 1954 and 1956, but in 1959 and thereafter the entire area was open. In 1956, an either-sex season, no sheep were harvested. The one-half curl ram regulation was in effect during the following years: 1954, 1960-1965 and 1968, resulting in the harvest of 15 rams for a hunting success of 27 percent. The 3/4-curl ram regulation was in effect in 1959, 1966-67, and 1969, but only one ram was taken, a success of 4 percent. Full-curl regulation was in effect in 1970 and six hunters killed three rams for a 50 percent success ratio.

Other Mortality Factors

Very little information is available concerning mortality in the San Luis herd. A surveyor (U. S. Geological Survey) working in the LaGarita Wilderness Area, August, 1971, claimed to have found the remains of several bighorn sheep on LaGarita Peak during the mid-1950's. A local rancher, Forest Cadwell, also claimed to have found several dead rams near Cathedral during the period 1957-1959. It would appear, therefore, that there may have been a die-off in the herd during the mid-1950's.

Range Competition

Competition for range forage occurs on both summer and winter ranges of the San Luis bighorn sheep. Elk and deer graze alpine ranges in summer, as well as the winter range in winter. Ronald Blumberg (W.C.O.) rated elk use as moderate and the deer use as light.

Both the Coleman and Hazzard ranches grazed domestic sheep over the eastern part of the bighorn alpine range east of Spring Creek until 1961, when they discontinued raising sheep. Melvin Coleman, Sr. stated that he agreed to a 10-year (1969-1979) non-use agreement with the U. S. Forest Service regarding this grazing allotment. Both Coleman and Hazzard presently graze cattle on some of the alpine willow flats, well below the alpine range used by bighorn sheep.

Table 37. Bighorn sheep hunting seasons and harvest, San Luis Peak area, 1954-1970.

	Year ^a													
	1954	1956	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season														
Opening date	9/11	9/1	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	9	9	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	ES ^b	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4	full
Applications received	--	--	8	--	--	12	15	17	16	16	17	18	18	10
Licenses issued	15	5	6	10	6	8	10	10	10	5	6	6	6	6
Bighorn sheep harvested	0	0	0	5	1	0	4	3	0	0	0	2	1	3
Percent success	0	0	0	50	17	0	40	30	0	0	0	33	17	50

^a Area expanded in 1959 to present size; closed seasons in 1955, 1957, and 1958.

^b Either sex

The western half of the bighorn range west of Spring Creek still receives heavy use by domestic sheep. However, the U. S. Forest Service has closed the alpine area to domestic sheep grazing, effective in 1972 for only one year, at which time only cattle grazing will occur in the lower valleys.

The winter range on Cebolla Creek (near Cathedral) has been used by cattle during fall months. State-owned lands in the locality were fenced in 1970 to exclude livestock use.

It is interesting to note that bighorn concentrations now occur in alpine areas recently excluded from domestic sheep grazing. Even though it may be coincidence, this herd began to increase in number several years after livestock grazing was eliminated.

Human Influence

Human influences are very light in this area, limited mainly to hunters in season and hikers during the summer. Sheep are able to find seclusion in the extensive cliff areas. Rams on the lower winter range come into contact with people along the road, but little or no management problem has developed to date (1971).

LAKE CITY

Distribution and Range

Very little information is available on the historical distribution of bighorns on the upper portion of the Lake Fork of the Gunnison River and the herd on Henson Creek. The two herds appear to be separate ones, although movement likely occurs between them and the Ouray and Pole Mountain herds. The Henson Creek herd summers on the high alpine north-west of Henson Creek (Fig. 32), and wintering grounds are at a lower altitude above Henson Creek.

The Lake Fork herd summers on alpine south of the Lake Fork of the Gunnison River (Fig. 32). Winter grounds are on Cataract Gulch, Boulder Gulch and along the Lake Fork. Wallace (1940) reported that part of the Pole Mountain herd migrates to the Cataract Gulch area to winter. The small band of bighorns that recently appeared on Pole Mountain may be a fragment of the Lake Fork herd.

Population Trends

The range of the Lake City bighorn herd is very difficult to census, and it is unlikely that the data presented are fully representative of the population. More information is needed to evaluate sheep movement between this and other areas. The following aerial survey summaries give findings for 1968-1971: 1968, 30 (7 rams, 13 ewes, and 10 lambs); 1969, 98 (24 rams, 47 ewes, and 27 lambs); 1970, 13 (2 rams, 8 ewes, and 3 lambs); February, 1971, 5 rams; and September, 1971, 16 (5 rams, 7 ewes, and 4 lambs). Ronald Blumberg estimated that a total of 70 sheep, 40 on Lake Fork and 30 on Henson Creek, now (1971) make up the population. Obviously, more accurate and detailed surveys of the herd are needed.

Hunter Harvest

The first hunting season involving the Lake Ford herd was in 1969, implemented by 8 applications, 6 licenses, and the harvest of 1 ram. In 1970, six licenses were issued but the harvest was zero. In 1969, the three-quarter-curl ram regulation was in effect and the full-curl ram regulation held in 1970.

Range Competition-Human Influences

Ronald Blumberg considers that livestock competition and human harassment affect bighorn distribution and possibly hold bighorn numbers down. Domestic sheep use is heavy on the alpine ranges during the summer, but cattle use is light and limited to the summer. Deer and elk use are light to moderate on a year-long basis.

Human use, in the form of hikers, campers, jeep-tours, and limited mining occur on this sheep range but, due to the roughness of the terrain, their influence is generally light.

SAPINERO MESA

This small herd was established by two transplants in January and August, 1970. A total of six sheep (3 ewes, 1 lamb, 1 yearling ewe, and 1 ram) were released on Sapinero Mesa, approximately 9 miles south of the town of Sapinero, on the east side of the Lake Fork of the Gunnison River. Two ewes and 2 lambs were sighted in September, 1971. More bighorns should be released here to make it a worthwhile transplant and increase chances of success.

OURAY-COW CREEK

Distribution

The Ouray-Cow Creek herd winters along the Uncompahgre River near Ouray, downstream to Dexter Creek, Cutler Creek and to East Baldy Peak. A second smaller wintering ground lies along Cow Creek in the general Ramshorn Ridge and Red Creek area (Fig. 33). Wallace (1940) described the range as follows:

"The winter range of the mountain sheep at Ouray is restricted to a few benches on the mountain facing the Uncompahgre River and a very small amount of the bottom land on both sides of the river, below the town of Ouray. The mountain sides are very steep and some of the benches are difficult for a man to reach, especially in the winter, though the sheep travel about over the mountain sides without much difficulty.

"The faces of the mountains directed toward the river present a mixture of sedimentary formations with intrusions of igneous rock which become more numerous and massive at lower elevations. This area is about two-thirds covered by mining claims, gold and silver being the principal products mined. Much of the ore contains a great deal of lead and iron. The sedimentary formations also carry considerable iron. Warm mineral springs are rather widely scattered throughout the area."

Wallace (1940) also gave the following vegetative data for the Uncompahgre River winter range. "The vegetation on two portions of the winter range was found to be as follows:

Twin Peaks Area (West of the river)		Lake Lenore Area (East side of the river)	
	%		%
Trees		Trees	
<u>Abies concolor</u>	50	<u>Abies concolor</u>	15
<u>Pinus flexilis</u>	tr.	<u>Pinus edulus</u>	1
		<u>Pinus ponderosa</u>	5
		<u>Picea engelmannii</u>	1
		<u>Populus tremuloides</u>	1
		<u>Juniperus scopulorum</u>	5
Shrubs		Shrubs	
<u>Quercus</u>	35	<u>Quercus</u>	40
<u>Prunus melanocarpa</u>	5	<u>Symphoricarpus</u>	15
<u>Holodiscus dumosa</u>	5	<u>Cercocarpus montanus</u>	15
<u>Ribes</u>	3	<u>Rosa</u>	1
<u>Rosa</u>	2	<u>Salix</u>	1
		<u>Alnus</u>	tr.
Weeds		Weeds and Grasses	
Very little available		None available	
Grasses			
None available			

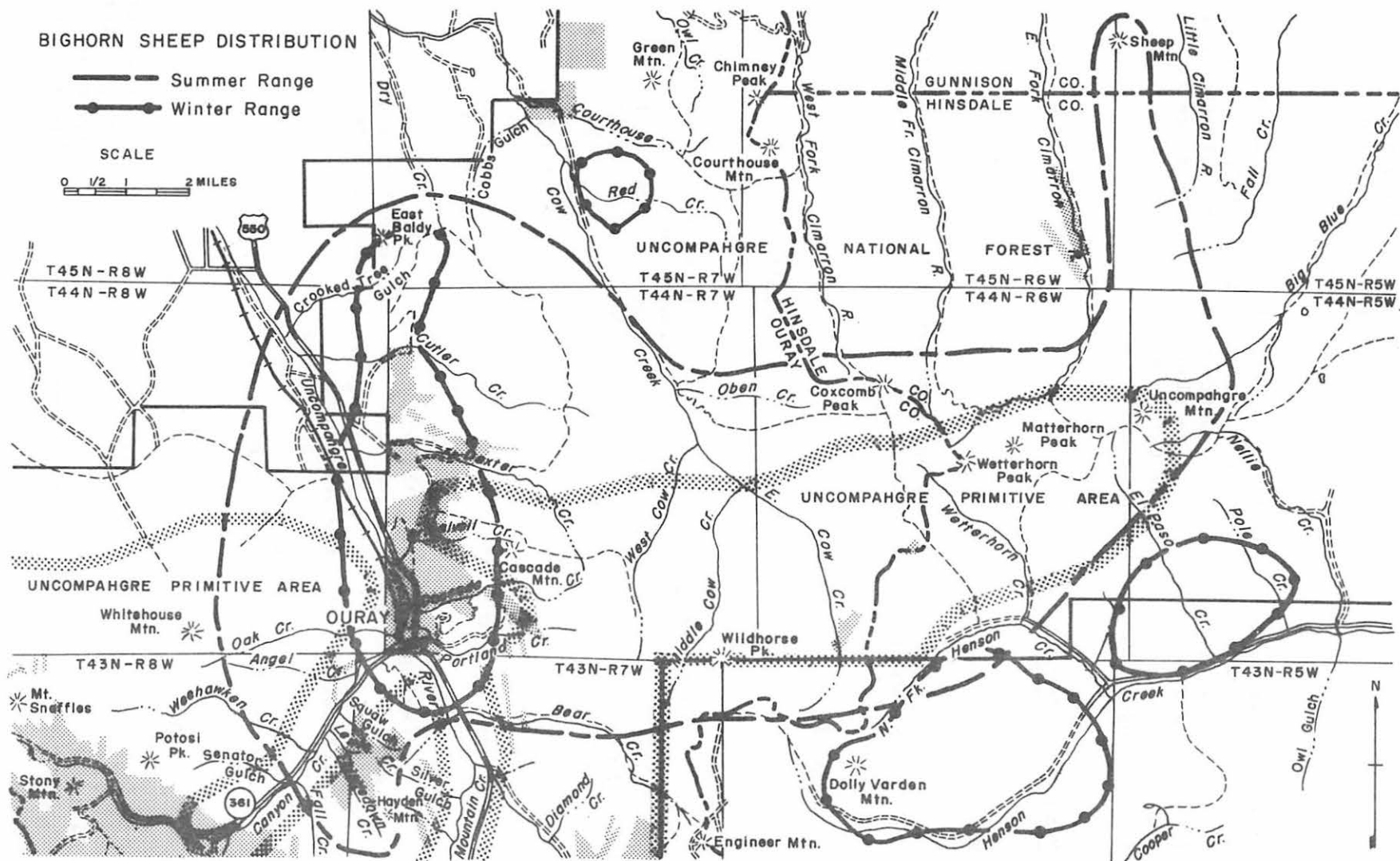


Fig. 33. Bighorn sheep distribution, Ouray-Cow Creek.

"These two areas are representative of the winter range found on the two sides of the river. A considerable amount of grasses and weeds must have been present but this was made unavailable to the sheep by the snow."

Bighorns migrate to the alpine and other higher elevations west of Ouray; however, the major portion of the winter range is in the higher elevations east of Ouray near Coxcomb Peak, Wetterhorn Peak and Wildhorse Peak (Figs. 34 and 35). The eastern portion of the summer range is used by bighorns wintering in the Lake City area. It is, therefore, likely that some mixing of the two herds occur.

Population Trends

Wallace (1940) wrote:

"In the Annual Fish and Game report for Ouray District for November 7, 1921, the following wildlife census is given (all estimates):

Mountain sheep	1,000	Bobcat	35
Deer	250	Lion	0
Black bear	55	Wolf	0
Coyote	200	Grizzly bear	0

From this time on the reports showed the slow decrease of mountain sheep. Predators were estimated to increase, particularly the coyotes and bobcats, for several years but were decreasing markedly by 1925, according to the District Ranger's estimates. In a letter of February 21, 1924, the District Ranger reports a band of mountain sheep near the town of Ouray made up as follows: 102 adults, 13 lambs. This is not a very good lamb crop, though it is not an alarming figure, as it indicates a 40% survival of lambs through the middle of the winter. The sheep were reported by the District Ranger to be holding their own but not increasing up to 1923, though he believed the former estimates of numbers were too high. In each annual game and fish report thereafter the sheep are reported as slowly decreasing. Very few dead animals were ever found by anyone. A scarcity of lambs became more evident, as was learned by interview with local residents. No further sex-age counts were recorded or remembered by anyone."

Jones classified bighorns in the Ouray area as follows: April, 1949--17 bighorns; summer, 1960--43 bighorns; 1961--52 bighorns; and in the town of Ouray, February, 1962--12 bighorns (Table 38). Department personnel conducted the following classification counts with a helicopter during the winters of 1968-69 and 1970-71: 74 and 2, respectively. A total of 34 unclassified sheep were observed during a ground survey on March 19, 1970. Carl Roy estimated the 1971 population to be 90 bighorn sheep.



Fig. 34. Bighorn sheep winter range east of Ouray. (Photo by George D. Bear)



Fig. 35. Bighorn sheep summer range between Ouray and Lake City.
(Photo by George D. Bear)

Table 38. Bighorn sheep counts, Ouray-Cow Creek, 1949-1970.

Date	Type of Survey ^a	Bighorns Counted				Unclassi- fied	Total
		Ewes	Lambs	Yearlings	Rams		
Apr. 1949	G	14	-	-	3	-	17
1960	G	13	5	1	24	-	43
1961	G	16	12	10	14	-	52
Feb. 1962	G	4	-	3	5	-	12
1968	A	38	17	-	15	9	79
1969	A	22	9	-	11	32	74
1970	A	-	-	-	2	-	2
3-19-70	G	-	-	-	-	34	34

^aG = ground; A = aerial.

This herd is much smaller at present than in the 1920's. Early reports indicated that there were poor lamb crops and that the herd was slowly declining. Counts in the 1960's showed fair lamb crops with several yearlings in the herd each year. From this scant information it appears that the herd may be static or may have slowly increased in recent years.

Hunter Harvest

The first hunting season for the Ouray-Cow Creek herd was in the fall of 1958, and open seasons have been allowed annually since (Table 39). Hunters were limited to three-quarter-curl or larger rams in 1958 and 1959; the curl limitation was reduced to one-half-curl, 1960 to 1965; the three-quarter-curl regulation held during 1966 and 1967; the limitation was reduced to one-half-curl in 1968; three-quarter-curl in 1969; and full-curl in 1970. Four permits were allowed each year, 1958-1965, 12 in 1967, and 8 in 1968-1970.

Harvests of rams, by regulation, was: Half-curl, 8; three-quarter-curl, 3; and full curl, 0. Hunter success for the 13-year period was 15 percent.

Other Mortality Factors

Few dead sheep were found on the Ouray-Cow Creek range even during the early years of decline. Wallace (1940) reported seeing two ewes with large bare spots on their necks and bodies; also another ewe and a smaller sheep in poor condition and coughing a great deal. Jones and White (1950) stated:

"No evidence was ever found to show why the Ouray sheep herd should disappear so abruptly in 1930-31. Although it is known that present day sheep herds in Colorado are reluctant to eat native hay, it is not believed that this is the sole reason for the disappearance of the Ouray sheep herd. No evidence was uncovered to show an epidemic of either hemorrhagic septicemia or stomach or lung worms at that time.

"The present bighorn sheep herd. . . in the Ouray Amphitheater is neither vigorous nor healthy. Several specimens . . . secured in the 1948-49 winter season, showed every indication of extreme malnutrition. The appearance of lambs in the Ouray herd is a rarity. None have been observed by the authors in the past three years."

Predation did not appear to be a factor in the Ouray area bighorn decline. Early reports indicated that coyotes and bobcats were common; there were no records of these predators killing sheep. In the winter of 1934-35 a number of police dogs in Ouray were disposed of because they chased the sheep, but this apparently had no effect on the decline of the herd.

Table 39. Bighorn hunting seasons and harvest, Ouray area, 1958-1970.

	Year												
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season													
Opening date	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4	full
Applications received	--	7	4	5	6	4	9	9	9	15	13	23	12
Licenses issued	4	4	4	4	4	4	4	4	4	12	8	8	8
Bighorn sheep harvested	0	0	4	0	1	0	1	0	0	0	2	3	0
Percent success	0	0	100	0	25	0	25	0	0	0	25	38	0

Range Competition

Competition for range forage is limited mainly to the summer range. Carl Roy and Harvey Cox (W.C.O.'s) estimated the present (1971) domestic sheep use light to moderate. They estimated elk and deer use of bighorn ranges light and limited to the summer range.

Early reports, however, indicate severe competition between domestic livestock and bighorn sheep for range forage. Wallace (1940) commented:

"There is a large area of summer range available covering a broad strip down the center of Ouray District of the Forest, but this is of very poor quality because of overgrazing with domestic sheep. He further stated that the bighorn winter range was closed to domestic livestock; and the winter range was so deeply covered with snow that there was little available browse.

"In 1922 a herd of seven elk was introduced into the Ouray District. They have increased rapidly, so that now there are probably about 300 head of elk in the district. These animals compete with sheep for forage. It is not likely elk are the limiting factor in the decrease of the mountain sheep at present, though they may have some influence now and may have had more in the past. In any event that it would seem to be a mistake to introduce elk in a region where sheep are doing well. This view should be considered carefully by anyone who wants to introduce elk into Lost Park and Tarryall Mountains at the present time. A number of people have approached me on the subject of transplanting elk into this area. . . the only place in Colorado where the sheep are doing well. I have not missed any opportunity to throw cold water on all such proposals."

Jones and White (1950) stated:

"The local residents tell of seeing bighorn sheep in the cliffs of the Ouray amphitheater and between there and Courthouse Peak in the summer. So it is probable that the sheep are not summering in the vicinity of Engineer Mountain which lie south of the amphitheater. Engineer Mountain, at the head of Henson Creek and Bear Creek and Handie's Peak and Red Cloud Mountain, are all sustaining heavy use by domestic sheep. The vegetation is receiving severe or destructive use in all areas where domestic sheep range. Erosion, both sheet and gully, is exhibited in an active degree. Many slopes have been contoured to the destruction of plants and has caused active erosion. Erosion in this area is very rapid once the heavy mat of alpine cover is broken."

Human Influence

Wildlife conservation officers report that human activities are moderate on the bighorn ranges and mostly on the summer range. This usage is in the form of hiking, camping, hunting and jeep tours, and has increased in recent years as in most areas throughout the state.

Early reports indicate that human influence was more limited to the winter grounds where sheep were given supplementary feeding (Figs. 36 and 37). Jones and White (1950) reported:

"The first sheep to appear at the town of Ouray came down from the west side April, 1911. The group consisted of eight mature rams. The town people fed the sheep alfalfa. Since large amounts of alfalfa were transported to Ouray to feed a large number of horses used in mining activities, no one person had to buy hay to feed the sheep. However, during succeeding winters the herd increased until estimates reached over 100. By 1920 the City started buying alfalfa to feed the sheep. During this period the sheep reached an amazing degree of tameness, climbing into railroad boxcars and top of haystacks after alfalfa and exhibiting no fear of the town people whatsoever. The practice of feeding the sheep at city expense continued until 1929, at which time the Colorado Game and Fish Department purchased hay for the sheep for the first time. The winter of 1929, the Department commissioned John Donald to buy the hay at State expense and feed it to the sheep whenever he thought they needed it. However, Mr. Donald purchased native hay instead of alfalfa. The sheep came down as usual in 1930, but refused to eat the native hay. At the beginning of winter in 1930, there were an estimated 50-60 sheep. By spring this number dropped to 5-10. There was a period from 1931-1937 when there were no sheep except a few which came down from the west and attempts were made to feed them ground alfalfa at State expense. These sheep then disappeared and no more sheep came down until the early 1940's at which time small bands began drifting into the Ouray Amphitheater from the east side."

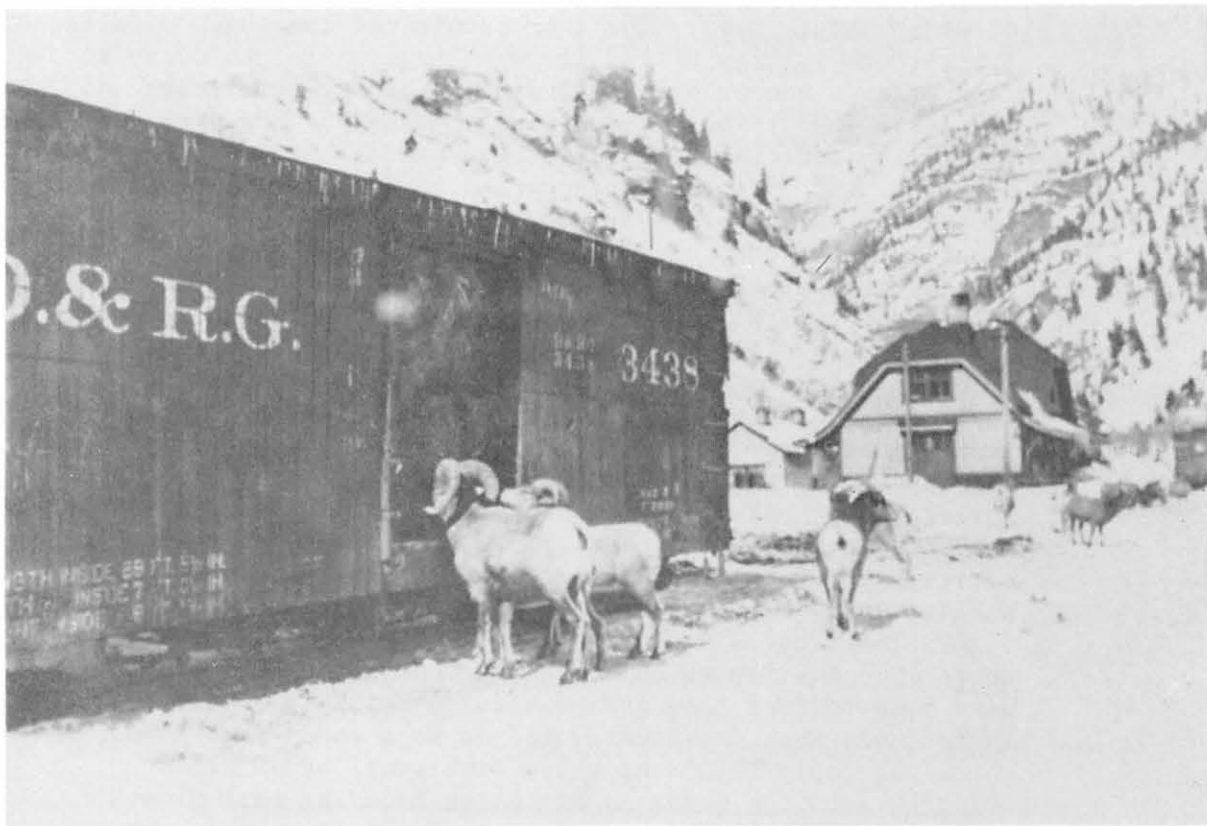


Fig. 36. Bighorn sheep eating hay from railroad car in Ouray, 1940's.
(Photographer unknown)



Fig. 37. Bighorn sheep on Ouray feeding-ground, 1940's. (Photographer unknown)

POLE MOUNTAIN

Distribution

Present day seasonal ranges of the Pole Mountain bighorn herd coincide generally with their historical distribution. The sheep summer throughout alpine areas from Pole Mountain north to Cataract Gulch and Bent Peak and winter on the rocky pinnacles at the southeast corner of Pole Mountain, still in alpine area (Figs. 38 and 39).

Kautz (1941) reported that the main portion of the herd used the alpine north of Pole Mountain until early July when domestic sheep moved into the area. At this invasion the bighorns shifted abruptly to Pole Mountain. Wallace (1940) found that the sheep wintered mostly on the south-facing slope of Pole Mountain in aspen and subalpine meadows; also, some migrated north to winter at Carson and Cataract Gulch. He (Wallace 1940) outlined the spring range as follows:

"The portion of Pole Mountain used by the mountain sheep for their spring range is about 7 miles long and 3 miles wide. The entire mountain forms nearly an equilateral triangle with each side bounded by broad valley bottoms.

"In the month of May the sheep appeared to divide their time about equally between the alpine meadows and the sub-alpine meadows and aspen groves. There did not appear to be more than half the number of sheep present as appeared later. Tracks on the trails, particularly Lost Trail (coming in from the east and northeast) indicated that a number of sheep came into the area from elsewhere in May.

"In the first half of June most of the sheep stayed on top of the mountain in the alpine meadows. About the middle of the month the flies became so bad that for the remainder of the month and the first half of July the sheep did not spend much time on top but stayed mostly in the aspen groves. The ewes which were lambing, however, would nearly always go up into one of two inaccessible places in the cliffs near the top of the mountain about two days ahead of time and remain there with their lambs for one or two days after the lambs arrived. After that they would stay in the alpine meadows for about one week, in spite of the flies. When I returned to Pole Mountain, August 16, I found the flies nearly all gone and the sheep back on top of the mountain."

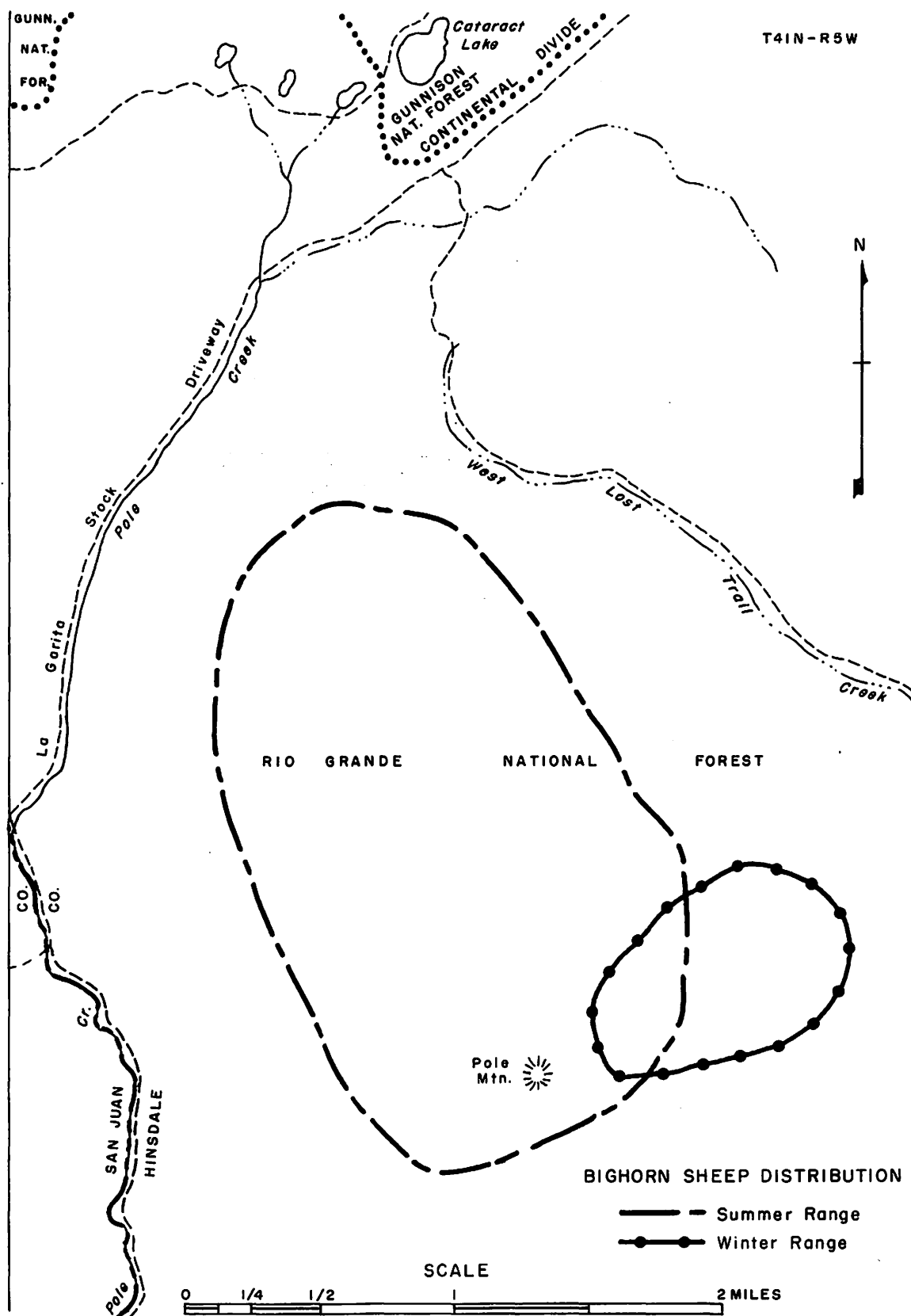


Fig. 38. Bighorn sheep distribution, Pole Mountain.



Fig. 39. The Castles, bighorn sheep winter range on Pole Mountain.
(Photo by George D. Bear)

Kautz (1941) described the Pole Mountain range as follows:

"Pole Mountain, between West Lost Trail Creek and the Rio Grande above the Farmer's Union Reservoir is a rough broken country topping out above timberline into a rolling alpine plateau. The elevations of Pole Mountain proper lies between 10,500 and 13,500 with a natural stock barrier of rimrock on the south and east side at about 11,000 feet which is only negotiable in the larger draws and occasional breaks. The north slope has a few cliffs with much loose decomposed granite and gravel with large sharp boulders and fingers of timber in the more sheltered places.

"The larger draws running up Pole Mountain from the southeast side open out into good size alpine basins of willow, bog birch, carex and such grasses as Deschampsia caespitosa, Poa and Calamagrostis. The soils of Pole Mountain are chiefly a coarse granite rubble mixed with adobe-like clay. On the east end there is more clay resulting from the decomposing and washing of the peculiar chalk-like cliffs. The soil in the lower meadows is very shallow in places and composed of a coarse sandy loam. The willow basins are of a sandy loam with much organic matter included. Pole Mountain contains several distinct types other than the two timber types, coniferous timber contains little or no palatable feed and aspen which contains small amount of Carex and Fragaria.

"The semi subalpine meadows around the base of Pole Mountain, which are dry during part of the year, contain Dasiphora fruticosa and Salix as the chief browse species; with Penstemon, Potentilla, Iris missouriensis, Achillea, Senecio, and Fragaria as the more important weeds; and the more important grasses and grass-like plants are Carex, Deschampsia caespitosa, Poa, Phleum, Koeleria and Agropyron pauciflorum.

"There is a grass type on the high ground which extends in places to above the rimrock cliffs and in small parks which is chiefly Festuca arizonica, Festuca ovina, Festuca thurberi, Blepharoneuron, Agropyron pauciflorum and Muhlenbergia montana. The scattered browse of this type are Dasiphora, Rosa, Salix, Ribes and Lepargyrea.

"On the gravel steep slopes below the cliffs and slides is a small type of Festuca arizonica and Festuca thurberi.

"The wet alpine meadows already mentioned contains a great deal of willows and bog birch, Carex, Deschampsia, Poa, Juncus, Phleum, Pyraea, Salidago and Senecio and are in places quite boggy and soft.

"Probably the largest type is the alpine plateau which has sustained willows as the chief browse with Elyna, Carex, Trisetum, and a short alpine Trifolium make up the largest part of the remaining vegetation."

Population Trend

Wallace (1940) estimated the pre-1940 bighorn herd on Pole Mountain at 150 animals. His estimate of big game on this area in 1940 was: mountain sheep, 98; elk, 78; mule deer, 30; and bear, occasional, both black and grizzly.

Wallace (1940) classified 65 bighorns in June-July, 1940, as 16 rams, 8 yearlings (both sexes), 6 two-year-olds (all ewes), 23 ewes and 12 lambs. One day during this period he counted 75 sheep, but was unable to get sex-age classes.

Kautz classified 84 sheep (23 rams, 37 ewes, 20 lambs, and 4 unclassified) on Pole Mountain during July 6-8, 1941. He felt that the herd was barely holding its own.

Jones and Moser reported 22 bighorns on Pole Mountain in 1952. Moser (1962) reported counting 36 bighorns prior to December, 1956, with an overall population estimate of 40 animals.

In the summer of 1969 a hiker reported seeing 14 sheep. A ground survey, December, 1969, disclosed a small band of 4 ewes, 3 lambs and 1 yearling on the southeast side of Pole Mountain relatively free of snow. Eleven sheep (unclassified) were reported to have been seen on the southeast side of Pole Mountain during March, 1971.

There is too little information to indicate the trend of the Pole Mountain population. The herd is certainly far below historical numbers, and a transplant would likely aid in bringing numbers up to a higher productive status. It would appear that there is adequate range to support approximately 50 animals on a sustained basis, if other ungulates do not increase.

A small band of bighorn sheep ranged Bristol Head Mountain until 1922-23, and a forest ranger reported seeing 5 or 6 animals at about that time. Hunters evidently eliminated the herd (Wallace 1940). Previously, Joy (1910) reported: "There is a few mountain sheep on Bristol Head, Mr. Larson, Geologist, U. S. Geological Survey, having counted 14 at the head of Boulder Creek in the later part of June." Residents at Creede said there were bighorns on Bellows Creek until the 1950's. These areas appear to be good potential bighorn ranges and should be considered as transplant sites.

Three rams were noted in the Creede area in the winter of 1969-70. After extensive searches in the Willow Creek, Farmer's Creek, and Bellow Creek areas, it was decided that they were strays from the LaGarita herd and that no other sheep were in the area.

Hunter Harvest

Hunting seasons were allowed in Pole Mountain area from 1953 to 1956. Apparently the half-curl or larger ram limitation was in effect. The number of permits issued and rams harvested during the 4 years are respectively: 10 permits, 4 rams; 10 permits, 1 ram; 15 permits, 2 rams; and 20 permits, 1 ram. Hunter success for the four-year period was 15 percent. Therefore, after the first season, success was very low, even under the half-curl regulation.

Other Mortality Factors

Observations on mortality and parasite infections are limited to reports by investigators working on Pole Mountain in the 1940's. Wallace (1940) reported finding three rams that appeared to have died from old age. He also found two dead lambs and a mature ewe during the summer, but the cause of death was not determined. He also reported a few sheep with severe coughing spells. Wallace (1940) collected fecal pellets from three mature bighorns on Pole Mountain and had them examined at Colorado State University. All were positive, and the most abundant parasites were: Eimeria arloingi, E. faurei, E. parva, Moniezia spp., Ostertagia marshalli and lungworm larvae.

Pillmore (1961) had Dr. Lynn Griner, Colorado State University, examine lung tissue from bighorns shot during the hunting seasons of 1953, 1954 and 1955. Samples from six sheep were examined and all were infected with lungworm larvae.

Wallace (1940) and Kautz (1941) wrote that coyotes were common in the Pole Mountain region and became generally abundant after domestic sheep moved onto the range. However, both workers felt that predation by coyotes, bobcats and eagles was minimal. Wallace (1940) reported coyotes eating and carrying off a partly decomposed lamb thought to have died of natural causes. He also found sheep hair in two coyote scats, but the number of scats examined is unknown.

Wallace (1940) collected samples of eight species of grasses (during July and October), two soil samples, and one sample of bighorn bone, later analyzed at Colorado State University. The report on these samples is as follows:

"It would appear in cross-checking the analysis of these samples against ordinary hay and similar forage analysis made by the Colorado Experiment Station, that there is no deficiency in nutritive values in these big-horn foods at Pole Mountain. The calcium and phosphorus, for the most part, is in about the right proportions and relatively adequate. There were two Colorado soil samples and one sheep bone sent into Colorado State. The bone was from a lamb probably dead of natural causes, picked up on the Pole Mountain area, shortly after the lambing season. The soil samples were from that area to get a cross check on what would be found in some of the typical rock-earth beds in that section and to discover if there was sufficient calcium and phosphorus present.

"There is one point in the rock-soil samples that might be worth passing consideration. While there is plenty of calcium, phosphorus is light. It is out of balance, perhaps, in its relationship. And it is rather well known that it is detrimental to have a serious unbalance in proportions in diets as it is to have inconclusive deficiencies. In fact, a diet that is deficient in amount but still has good balance is better than one in which there is a general abundance but with one or the other of the more essential elements grossly out of balance. And that might be an indication in this instance, of an unbalance that is serious in just that respect."

Range Competition

Wallace and Kautz reported that competition on the bighorn range was minimal during 1940-41, there being adequate forage for all animals present. Wallace (1940) reported:

"From the records of the office of the Rio Grande National Forest at Monte Vista some historical data was obtained on April 26, through the courtesy of Forest Supervisor John Baird. About seven sections of high range surrounding Pole Mountain were closed to domestic stock in the early 1920's to preserve forage for mountain sheep. The long period of closure to domestic stock resulted in a splendid forage cover. The entire top of the mountain is still reserved for mountain sheep."

Kautz (1941) stated that bighorns used the alpine areas north of Pole Mountain until domestic sheep moved into the area in July, at which time the bighorns moved south into the protected area.

Wallace (1940) presented figures on domestic stock use in the Pole Mountain area:

"The meadows surrounding the mountain are all grazed by domestic livestock. Actual figures were obtained from the various herders in charge of the herds. These are as follows:

Sheep -- 1,995 head on West Lost Trail Creek,
July 6 to Sept. 26.

Sheep -- 948 head on Pole Creek, July 6 to Sept. 17.

Cattle -- 306 head on south face and west end of
Pole Mountain, July 1 to Sept. 30.

"The mountain sheep feed on the range allotted to the cattle on the south face of the mountain to a considerable extent, they also cross the domestic sheep range on West Lost Trail Creek, but do not stay and feed in the bottom where domestic sheep feed. All of this domestic stock range affords sufficient forage for all animals using it."

Due to the livestock closure on Pole Mountain, the only other ungulates to use the range in the early 1940's were deer and elk. Apparently usage was very light and limited mostly to summer and fall months. In recent years Pole Mountain was opened to domestic sheep. Glen Hinshaw (W.C.O.) reported in 1970 that the U. S. Forest Service had taken measures to restrict livestock grazing on the bighorn winter range on the south-east side of Pole Mountain. It is hoped that this measure to protect winter-range forage will result in bighorn herd increase. Mr. Hinshaw reported elk use moderate and deer use light on the range.

Domestic sheep grazing in the area appears to have been decreasing since the 1940's, cattle usage has remained almost static, and elk use is increasing. Records for cattle and horse permits on the Rio Grande Forest have remained between 14,700 to 16,000 since 1944; sheep and goat permits peaked out at 132,400 in 1944 and decreased to 46,900 in 1964. Wallace estimated the 1941 elk population on Pole Mountain at 78. Raymond Boyd, biologist, counted (helicopter survey) elk on Pole Mountain in 1963, 1964, and 1966, the number being 143, 204, and 184, respectively.

Therefore, with increasing elk numbers and the opening of the bighorn range to livestock grazing in recent years, bighorn sheep have been subjected to greater range competition.

Moser (1955) analyzed five rumen samples collected from harvested sheep in September, 1953 and 1954. By volume, grasses comprised 90.9 percent, browse 9.1 percent, and forbs 0.0 percent of the diet. The most common plants in the samples were: Carex nigricans, Kobresia bellardi, Festuca thurberi, and Salix planifolia.

Human Influence

Wallace and Kautz stated that elk hunters during 1940-41 tended to scatter the bighorns. Poaching was also reported to be somewhat of a problem during those years. Wallace (1940) wrote:

"Formerly, there was no legitimate reason for anyone to go on top of the mountain, where most of the spring and summer range lies, except in the big game season when the top of the mountain is hunted for deer and elk. Now that the area is becoming built up with dude ranches and tourists, are attracted in larger numbers, some tourists are going up on the mountain to see the sheep. There is no thought of harm to the sheep in this hunting and tourist activity, but it does tend to scatter the sheep to ranges less suitable and they are not so well protected.

"It would be highly desirable to prohibit hunting on top of Pole Mountain. This would mean closing an area 4 miles long and about 2 miles wide, corresponding roughly to the area closed to domestic stock. It would be unwise to close a larger area than this for the reason that deer and elk are both found on this range and should not be allowed to build up to the point where they will give the sheep serious competition. Some measure should also be taken to discourage tourists from going on top of the mountain at least for the next few years, until a fair-sized herd has built up."

Glen Hinshaw reported human use on the bighorn range to be light, occurring mainly in the fall hunting seasons.

BLANCO BASIN

Very limited information is available for this herd, and its present (1971) status is unknown. Hunters in past years have reported seeing bighorns in the high areas around Nipple Mountain, Fish Lake, and Flattop Mountain. Jones counted 21 sheep at the head of the South Fork of Blanco River in 1944. Herb Browning found two rams while conducting a survey of the area in 1971, using a helicopter. It appears that the herd may summer in the high areas at the headwaters of the Blanco River; the winter range is unknown. Intensive ground surveys are needed to determine herd status and distribution.

The first Blanco Basin hunting season was in 1956, after which the season was closed until 1963. Seasons were permitted 1963 to 1969, but the area was closed after that year (Table 40.) During the eight hunting seasons, five were controlled by the half-curl ram limitation. Nine rams were harvested, all taken in 1963, 1964, and 1965, seasons when half-curl rams were legal. No sheep were harvested during the last four hunting seasons, and hunters in 1969 did not observe bighorns of any age or sex. Overall hunter success was 19 percent for the area.

Table 40. Bighorn hunting seasons and harvest, Blanco Basin, 1956-1969.

	Year ^a							
	1956	1963	1964	1965	1966	1967	1968	1969
Hunting season								
Opening date	9/1	8/24	8/22	8/28	8/28	8/26	8/17	8/16
Duration (days)	9	16	37	23	22	18	23	23
Curl regulation	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4
Applications received	--	2	4	4	8	8	6	3
Licenses issued	10	6	6	6	6	6	6	2
Bighorn sheep harvested	0	4	2	3	0	0	0	0
Percent success	0	67	33	50	0	0	0	0

^a

The hunting season was closed 1957 through 1962 and in 1970.

SHEEP MOUNTAIN

Distribution and Population Trends

The Sheep Mountain bighorn herd occupies the range north of Wolf Creek Pass to Table Mountain and west to Beaver Creek (Fig. 40). The animals are found through the year on the alpine areas and in the rocks and cliffs above Borns Lake on Beaver Creek. During winter, sheep in the alpine are confined to windswept ridges and south exposures from Mt. Hope to Sheep Mountain.

It would appear that the herd decreased and then remained nearly stable in recent years. Jones counted 38 sheep in the area in 1944. He observed 70 (8 rams, 4 ewes, 2 yearlings, and 56 unclassified) in 1961. Winter helicopter surveys disclosed the following: 1968--47 (24 ewes, 13 lambs, and 10 rams); 1969--37 (18 ewes, 10 lambs, and 9 rams); 1970--14 (9 ewes, 3 lambs, and 2 rams); and 1971--33 (15 ewes, 9 lambs, and 9 rams). Earl Cochran (W.C.O.) estimated the population to be approximately 40 bighorns. Due to limited winter range and use by other ungulates and humans, herd numbers are likely at carrying capacity.

Mortality

Sheep Mountain bighorns have been hunted since 1953, except for a closed season in 1956 (Table 41). A total of 159 licenses were issued 1953-1970 and 16 rams were harvested during the 17 seasons for a success of 10 percent. Fourteen of the 16 rams were taken during the 11 seasons with the half-curl ram regulation. The three-quarter-curl ram regulation held for 5 years, but only two rams were harvested. No sheep were harvested in 1970 when the full-curl ram regulation controlled sheep hunting activities.

Little information is available on other sources of mortality. Pillmore (1954) collected lung tissue from three harvested sheep and had them examined at Colorado State University. All were positive for lungworm larvae.

Range Competition and Human Influences

The alpine range used by bighorns receives moderate to heavy use by other ungulates during summer. Numerous elk use the alpine range in early summer before domestic sheep are driven in. Deer graze the alpine and adjacent areas through the summer.

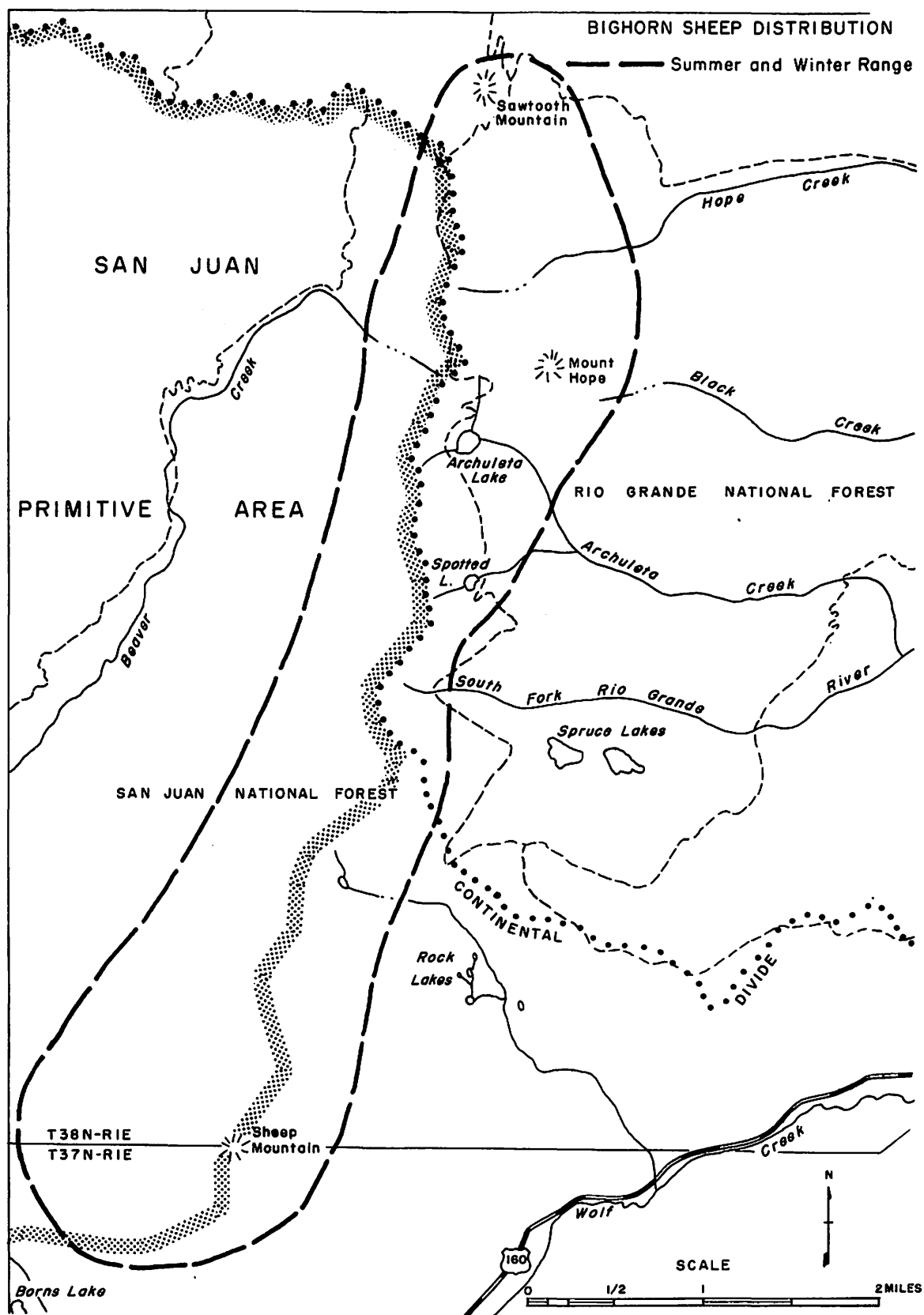


Fig. 40. Bighorn sheep distribution, Sheep Mountain near Wolf Creek Pass.

Table 41. Bighorn sheep hunting seasons and harvest, Sheep Mountain herd, 1953-1970.

	Year ^a																
	1953	1954	1955	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season																	
Opening date	9/3	9/11	9/3	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	9	9	16	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4	full
Applications received	--	--	--	12	--	10	11	8	12	3	5	4	5	2	9	21	10
Licenses issued	10	10	10	15	10	10	10	15	15	6	8	6	6	6	6	10	6
Bighorn sheep harvested	0	3	0	2	0	0	2	1	1	2	0	2	0	1	1	1	0
Percent success	0	33	0	13	0	0	20	7	7	33	0	33	0	17	17	10	0

^aArea closed to hunting in 1956.

Mr. Cochran rates human use on the area as moderate. There are numerous horseback riders and hikers who use the Continental Divide Trail which goes through the center of the bighorn range. There is some hunter activity, depending on weather conditions during the fall. These activities very likely influence bighorn distribution on the Sheep Mountain range.

CIMARRONA PEAK

Bighorns in this herd winter and summer on the same areas, but winter range is more restricted in size due to snow. The herd occupies alpine areas at the headwaters of Weminuche Creek, Hossick Creek, Cimarrona Creek, and Williams Creek, and they also frequent the cliffs on the timbered slope north of Milk Creek (Fig. 41).

There appears to have been very little change in the population during the last 27 years. Jones observed 30 bighorns here in 1944, and Herb Browning (W.C.O.) estimated the present (1970) herd at 35-40 animals. A total of 42 sheep (26 ewes, 11 lambs, and 5 rams) were counted on a helicopter flight in January, 1968; and 34 (21 ewes, 8 lambs, and 5 rams) were counted via helicopter in January, 1969. During a ground count at the head of Weminuche Creek in August, 1969, 28 sheep (17 ewes, 7 lambs, 3 yearlings, and 1 ram) were recorded. The low number of yearlings indicated poor lamb survival over winter. Eleven sheep were counted during aerial flights in 1970, and 33 (including 24 lambs and ewes and 4 rams) were counted in 1971.

Mortality

Cimarrona Peak bighorns have been hunted since 1954, although the season was closed in 1955 and 1956 (Table 42). Hunting permits have been decreased from 10 to 2 over the 17-year span, 1954-1970. The 107 licenses issued resulted in the harvest of 23 rams for a success of 21 percent. Nine of the 15 hunting seasons were controlled by the half-curl ram regulation with a kill of 18. During the 5 years of three-quarter-curl control only five rams were taken by hunters. No sheep were harvested in 1970 under the full-curl ram regulation.

Richard Pillmore collected lung tissue from three bighorns in 1953 and 1954 and, at Colorado State University, all were found to be infected with lungworms. The low number of yearlings observed in the 1969 ground survey indicated a high lamb mortality, but proof awaits the collection of more evidence.

Other Factors

Herb Browning believed domestic sheep on bighorn range through the summer may affect this herd adversely. Domestic sheep heavily graze the alpine range used by bighorns, thus reducing the amount of forage available. The U. S. Forest Service plans to eliminate domestic livestock grazing on alpine range after 1970, a regulation very likely to benefit bighorn sheep. Deer and elk also utilize the alpine ranges through the summer, but the extent of use is uncertain.

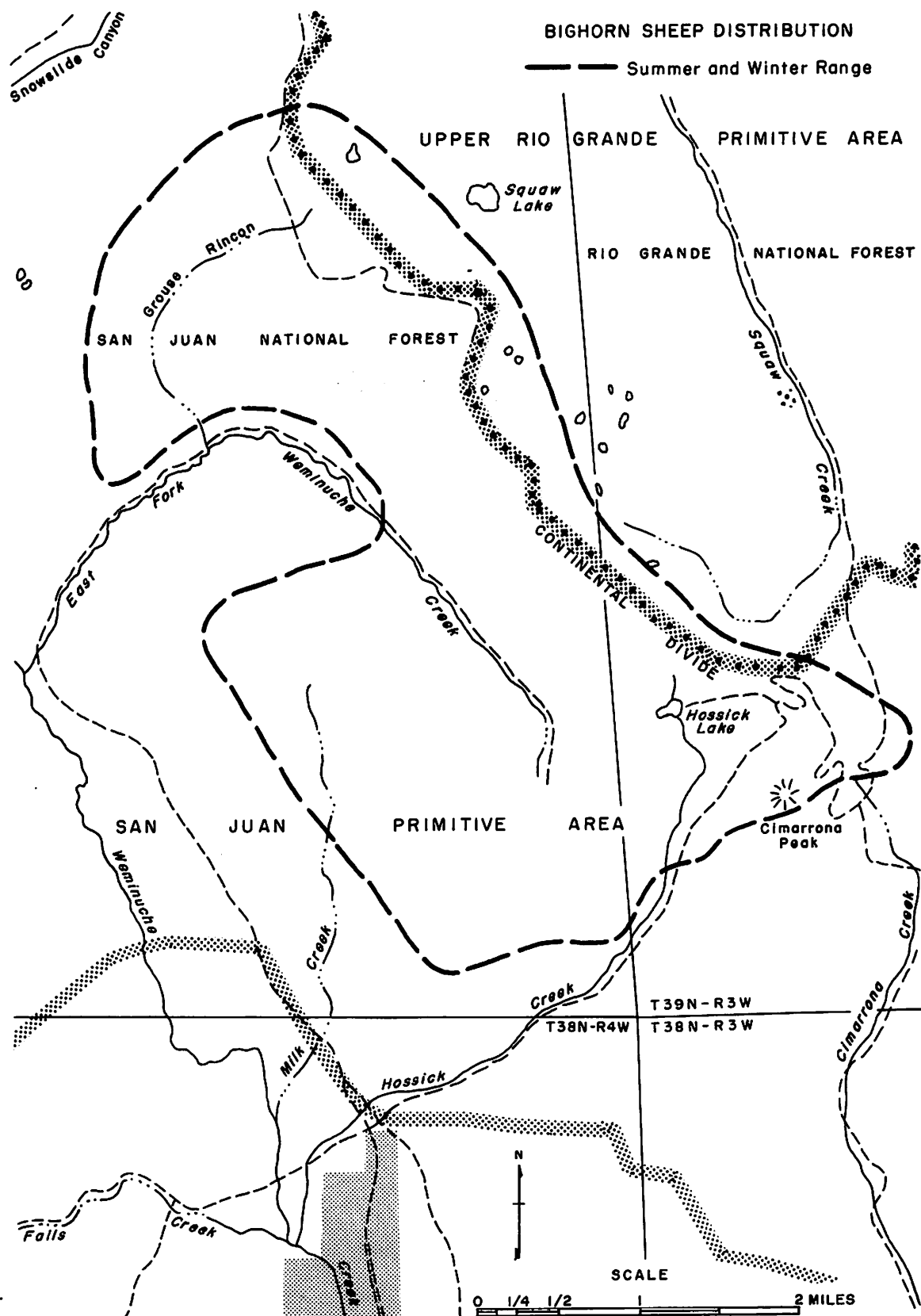


Fig. 41. Bighorn sheep distribution, Cimarrona Peak.

Table 42. Bighorn sheep hunting seasons and harvest, Cimarrona Peak area, 1954-1970.

	Year ^a														
	1954	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season															
Opening date	9/11	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	9	16	16	16	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4	full
Applications received	--	10	--	12	11	12	16	16	7	14	7	7	6	4	--
Licenses issued	10	10	10	10	10	10	10	6	6	6	6	6	3	2	2
Bighorn sheep harvested	2	1	1	1	2	6	4	0	1	0	0	2	2	1	0
Percent success	20	10	10	10	20	60	40	0	17	0	0	33	67	50	0

^a Area closed to hunting in 1955 and 1956.

Moser (1955) analyzed six rumen samples from rams taken by hunters in September, 1953 and 1954. By volume, grasses comprised 76.2 percent, browse 12.5 percent and forbs 11.3 percent of the diet. The most common species identified in the samples were: Festuca ovina, Phleum alpinum, Salix glauca, and Mertensia alpina.

Human influence on the Cimarrona Peak range, is moderate and limited to hikers, campers, fishermen and hunters during summer and early fall.

VALLECITO

Distribution and Population Trend

The Vallecito bighorn herd summers and winters on alpine range bounded by Los Pinos River, Flint Creek, and Lake Creek (Fig. 42). Winter range is limited more or less to windswept ridges east of Emerald Lake. Reports from residents indicate that a portion of the herd, years ago, wintered in the downstream cliffs on the Los Pinos River. During summer the sheep spread over the alpine range to the north, some rams as far north as the Rock Lake area. Packers have reported seeing lambs and ewes moving across Los Pinos River toward Graham Peak and Flag Mountain. Gene Bassett (W.C.O.) said a ram was killed on Graham Peak in the 1950's. Aerial surveys here during winter have failed to reveal any sheep or sign of use. It appears, therefore, that the area east of Los Pinos River may receive occasional bighorn visitation during the summer and fall.

The herd is very small, due mainly to the limited size of the winter range now available. It is doubtful that the herd can be substantially increased in numbers. A total of 8 bighorns (5 ewes and 3 rams) were counted via fixed wing airplane in November, 1969. In January, 1968, 16 (7 ewes, 3 lambs, and 6 rams) were counted via helicopter; in February, 1969, 11 (5 ewes, 1 lamb, and 5 rams); in March, 1971, 9 (4 ewes, 2 lambs, and 3 rams); and in August, 1971, 8 (4 ewes, 1 lamb, and 3 rams). These aerial trend counts have indicated a steady decrease in the herd. The lamb:ewe ratios on winter range have been very low.

Mortality

Information on herd mortality is limited to hunter harvest data. The first hunting season for the Vallecito area was in 1953, after which the season was closed in 1957 and remained closed until 1962. It was closed again in 1964 (Table 43). Only 10 rams were harvested for the low hunter success of 11 percent. Nine of the 10 rams were taken during the four-year period prior to closures, 1953-1956, when the half-curly ram regulation was in effect and larger numbers of licenses were issued. Only one ram has been taken in the last eight seasons.

Domestic sheep are grazed throughout the alpine occupied by the bighorns. It would benefit bighorns if domestic livestock grazing could be restricted from the key part of the bighorn range east of Emerald Lake. A few deer and elk use this range during summer, but they probably offer little competition to bighorn sheep. Human use (hikers, campers, horsemen and hunters) is heavy along the main drainages, but it offers little harassment to bighorns on alpine range.

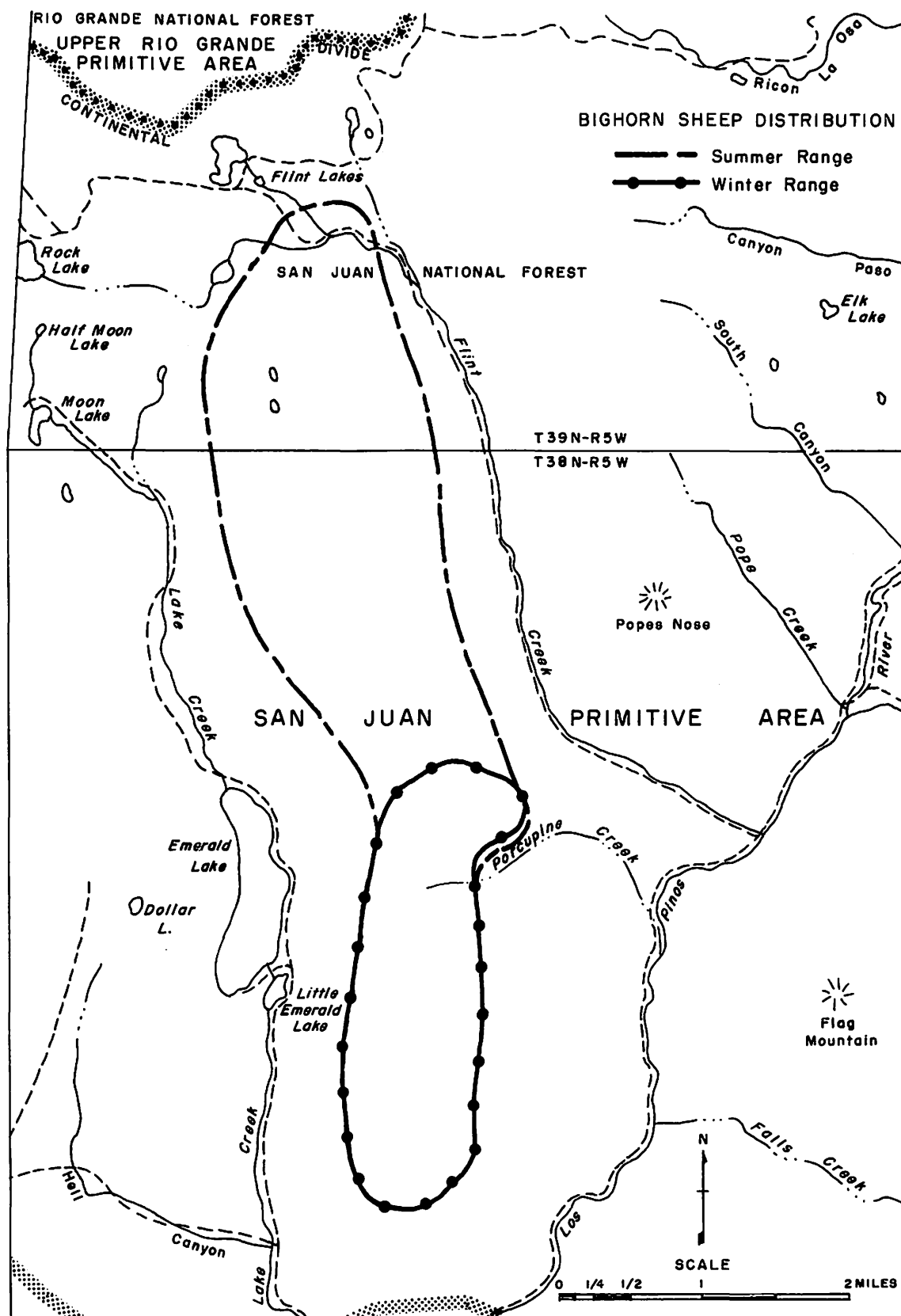


Fig. 42. Bighorn sheep distribution, Vallecito.

Table 43. Bighorn sheep hunting seasons, Vallecito area, 1953-1970.

	Year ^a										
	1953	1954	1955	1956	1963	1965	1966	1967	1968	1969	1970
Hunting season											
Opening date	9/3	9/11	9/3	9/1	8/24	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	11	9	9	9	16	23	22	18	23	23	24
Curl regulation	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4	full
Applications received	--	--	--	--	4	4	8	3	10	2	11
Licenses issued	10	21	15	20	6	6	6	6	6	4	4
Bighorn sheep harvested	4	2	2	1	0	0	0	0	1	0	0
Percent success	40	10	13	5	0	0	0	0	17	0	0

^a Area closed to hunting 1957-1962 and 1964.

WILSON PEAK-DOLORES RIVER

In July, 1970, a lumberjack reported seeing an estimated 15 bighorns in the alpine just below the summit of Mt. Wilson (14,205 feet elevation). This is the only information available on the present status of bighorns in the Wilson Mountains Primitive Area, approximately 20 miles west of Silverton. Jones reported 10 bighorns for the Dolores River area in 1952. Richard Teague wrote, April 13, 1962:

"The old time residents recall bighorn sheep in all of the lower Dolores River Canyon from Slick Rock downstream in Bedrock, Paradox, and Gateway areas prior to the turn of the century. I have also been told that mountain sheep existed in the lower Mancos Canyon down to the San Juan as well as the lower McElmo areas."

Most of the Dolores River drainage, therefore, is historical bighorn range. In the Mt. Wilson and Lizard Head areas intensive ground surveys are needed to determine the status, and the possibilities of increasing, the bighorn herd.

Six hunting permits were issued for the Wilson Peak-Dolores River herd in 1966, but hunters did not see a single bighorn during the only hunting season so far approved for the area.

MESA VERDE NATIONAL PARK

Historical records of bighorn sheep in Mesa Verde National Park date back to pictures carved on rocks by Indians hundreds of years ago. The sheep apparently disappeared from this locality after the turn of the century, and they also disappeared from other low lands in southwestern Colorado at about the same time. In January, 1945, 14 sheep (3 rams, 7 ewes, and 4 lambs) were released on Soda Creek. Jones and White (1949) reported:

"The group was released in a pinyon-juniper type, heavily interspersed with thick clumps of serviceberry (Amelanchier spp.) and mountain mahogany (Cercocarpus spp.) For reasons not definitely known, the released sheep did not like the vicinity of the release point. Within 6 months after release they appeared on Weber Mountain immediately east of Mesa Verde and approximately 9 miles from the release point. Since then one sight record has been noted within the Park when a tourist saw one large ram in the summer of 1948. Recent investigations have shown that the sheep are working the entire circumference of Weber Mountain and have permanent bed grounds at various points along its edge. They have established their winter range on the southeastern or Weber Creek side, above the Pearl Haddon Ranch. However, they have been seen at the extreme end of Weber Mountain on the Don Philips Ranch in the summer. Weber Mountain is nearly flat-topped, ringed with cliffs, and for this reason the winter and summer range are the same as to altitude and vegetative type."

The herd still occupies the area around Weber Mountain at the present date.

The Soda Creek transplant was successful and by 1949 sheep had increased to approximately 29 head. The population was estimated at 50 in 1960, after which the herd apparently decreased for some unknown reason. Ranger Allen Atchinson (Mesa Verde National Park), interviewed on July 9, 1969, said the population then was 25-30 sheep. In June, 1969, 7 ewes and 3 lambs were sighted from a helicopter at Pine Canyon. There is great need to update information on the Mesa Verde bighorn population and for determining their relationship to other ungulates in the area.

ROAN CREEK-PARACHUTE CREEK

An estimated 40-50 bighorns ranged along Roan Creek in 1898 (Cowan 1940). Five rams were observed on the falls of Book Cliff on Parachute Creek in 1948, the first known sighting of sheep here in recent times. They were feeding on the oaks along the oil shale cliffs. Jones and White (1950) reported seeing four sheep on Roan Creek and six sheep on Parachute Creek. One ram was seen on Roan Creek in November, 1960. Local ranchers claim there is a remnant herd in this area.

BATTLEMENT MESA

Distribution

Bighorn sheep on Battlement Mesa summer and winter along the narrow hogback north and northwest of Collbran, which extends from Horsethief Mountain to Horse Mountain (Fig. 43). Sheep were commonly found eastward in the Mamm Peak area in the late 1940's and 1950's; however, they have been seen only rarely in that locality during recent years.

Battlement Mesa is about 7,500-8,300 feet in elevation. Southern exposures are very steep, eroded hillsides with sparse vegetative cover. Northern exposures have a heavy shrub (primarily oakbrush) and conifer cover interspersed with grassy parks (Fig. 44).

Population Trend

The sheep are often scattered in the brush-covered areas, and are difficult to locate and classify either by aircraft or on the ground. Aerial surveys should be scheduled in winter when the sheep are grouped. In 1950, 14 were counted on Mamm Peak; in January, 1961, 17 (7 rams, 6 ewes, and 4 yearlings) were classified; in July, 1961, 9 (2 rams, 4 ewes, and 3 lambs) were counted on Mamm Peak; and in February, 1962, 19 (6 rams, 8 ewes, and 5 yearlings) were recorded on Sunnyside. About 4 years later, 21 sheep were counted in 1966, and 34 (19 ewes, 9 lambs, and 6 unclassified) were counted during the winter of 1968-69, both counts via aerial surveys. The latter between Horsethief Mountain and Anderson Gulch. On January 23, 1970, 29 (13 ewes, 7 lambs, and 9 rams) were counted on a helicopter flight.

From these limited data, it appears that the herd may have increased slightly in the 1950's and early 1960's, and it seems somewhat static now. Suitable range is limited in area and very little free water is available during the hot, dry summer. The herd likely is at capacity size for the range. Water developments would help make more of the range suitable for sheep, and investigation to this end is recommended.

Mortality and Other Factors

Battlement Mesa bighorns have been hunted since 1960 (Table 44). During the 11 seasons, 63 licenses have been issued and 14 rams harvested for a success of 22 percent. The half-curl ram regulation controlled the harvest during eight seasons; the three-quarter-curl ram limitation was in effect for two seasons; and the full-curl ram regulation served for one season. No bighorns were taken under the full-curl limitation, and the harvest rate was about the same for the other two regulations. Hunting access is limited to foot travel and a few knowledgeable horsemen, thus, the area is difficult to hunt.

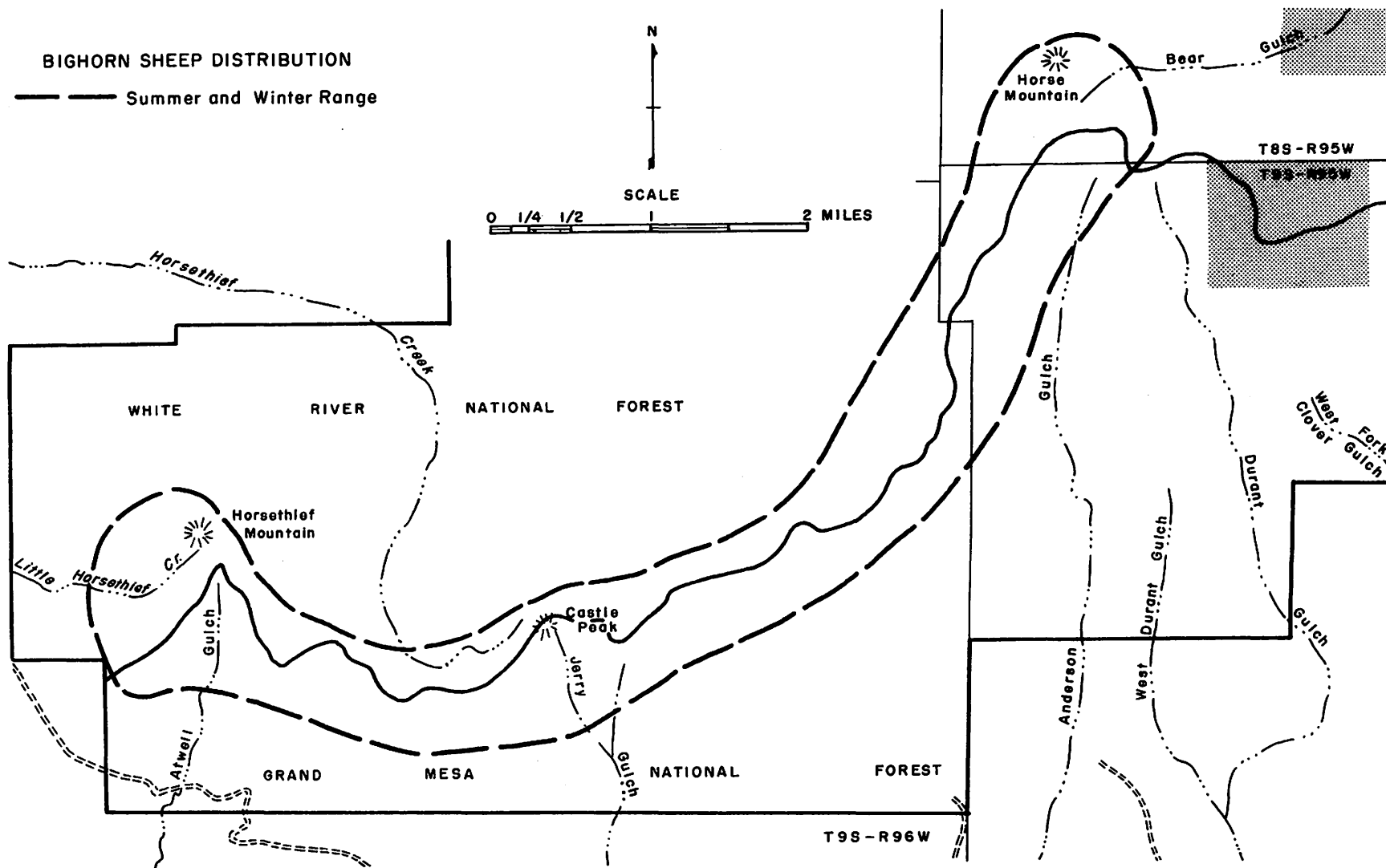


Fig. 43. Bighorn sheep distribution, Battlement Mesa.



Fig. 44. Battlement Mesa, Horsethief Mountain, and Castle Peak in the background. (Photo by George D. Bear)

Table 44. Bighorn sheep hunting seasons and harvest, Battlement Mesa area, 1960-1970.

	Year										
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Hunting season											
Opening date	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16	8/15
Duration (days)	16	16	17	16	37	23	22	18	23	23	24
Curl regulation	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	1/2	3/4	full
Applications received	2	4	10	8	6	10	12	5	9	7	7
Licenses issued	4	6	6	6	6	6	6	5	6	6	6
Bighorn sheep harvested	0	1	0	2	2	2	2	3	0	2	0
Percent success	0	17	0	33	33	33	33	60	0	33	0

There is little competitive grazing on the bighorn range. Harold Lanning (W.C.O.) said that deer and elk use is light but on a yearlong basis, and that cattle use is only on areas adjacent to the bighorn range. Human activities are limited to only a few hunters and hikers.

RIFLE HOGBACK

Range in the vicinity of Rifle Creek and the Hogback north of Rifle was surveyed in January, 1948, disclosing 14 bighorns. An additional transplant, in an attempt to establish an effective breeding population, was recommended. On January 16, 1948, 17 sheep (4 rams, 8 ewes, and 5 lambs) were released at the head of the Hogback, 12 miles north of Rifle. Jones (1949) wrote:

"The sheep were released in the pinyon-juniper zone which is typical of the Rifle area. Since their release the sheep have traveled along the Hogback to the Holmes coal mine. Their present range extends from the coal mine to Rifle Gap. Their winter and summer range is the same as to altitude and vegetative type, but varies in direction of exposure."

The sheep were semitamed by a local rancher, leading to hay loss, and he asked to have them removed. On February 19, 1952, 23 of the bighorns were trapped and transported to Ladore Canyon in Moffat County. Six sheep were thought to have been left in the Hogback area. Furman Dunham (W.C.O.) reported:

"The 3 rams and 3 ewes remaining after the trapping could be seen occasionally in the Rifle Gap area and further north. Each spring usually one lamb would be seen for a while and then disappear; none ever grew up that I knew of. After a few years this little herd started to decrease. First, 2 ewes came up missing and at one time the smallest ram appeared to be injured. Nothing was seen of the sheep for a couple of years, then about 1960 one ewe was observed for a short time. That was the last sheep I've seen in that area."

Bighorns were hunted in the Rifle area in 1954 and 1955, involving 5 and 8 permits, respectively. No sheep were harvested.

GLENWOOD CANYON

Distribution

Bighorns in the Glenwood Canyon herd, for the most part, occupy the north side of the Colorado River from Mitchell Creek eastward to French Creek (Fig. 45). On rare occasions sheep have been seen on the south side of the Colorado River. The range consists of very steep canyon walls several thousand feet high, interspersed with rugged cliffs and dense stands of oakbrush and juniper (Fig. 46). The river is approximately 6,000 feet elevation and the rim of the canyon is approximately 10,000 feet.

During summer, the bighorns are found almost anywhere between the Colorado River and the rim of the canyon. However, during winter, they occupy the lower slopes where the snow accumulation is minimal.

It would appear that the historical distribution of the herd extended throughout this general area. Very likely, the Glenwood and Clinetop herds were one group, but separated into the two as their numbers decreased. William Robinson (Commissioner, Colorado Game, Fish and Parks) recalled seeing bighorns in Deep Creek Canyon, north of the present range, during the 1930's. Jones and Moser (1953) reported four bighorns on Trapper's Peak. There has been reports of a few sheep in the Dome Peak area in recent years.

Population Trend

Jones (1948) examined the Glenwood Springs area to ascertain its suitability as a sheep transplant site and decided it qualified for this purpose. Subsequently, 17 bighorns (4 rams, 9 ewes, and 4 lambs) were trapped in the Tarryall Mountains and, on December 5, 1947, released between No Name Creek and Grizzly Creek.

By December, 1949, there were 22 sheep in the herd; in 1950, 28; and in February, 1953, 21 (5 rams, 6 ewes, 5 yearlings, and 5 lambs) were observed above the highway buildings (Table 45). The number of yearlings and lambs indicated good productivity and fair survival. In January, 1956, 17 sheep (7 rams, 8 ewes, 1 lamb, and 1 yearling) were classified.

The herd appeared to reach peak numbers in 1960, after which a rapid decline became evident. James Reser's (W.C.O.) highest count was 31 bighorns in January, 1960. Gunner Magnus, owner of the orchard at Grizzly Creek, claimed that 40 head frequented his apple orchard. After 1960, winter counts decreased progressively: 1961, 24; 1962, 11; 1963, 13; 1964, 9; and 1965, 11. Dale Hibbs counted 10 (2 rams, 6 ewes, and 2 lambs) in December, 1965, and 9 sheep (4 ewes, 2 lambs, and 3 rams) were in the herd in 1969.



Fig. 46. Bighorn sheep near Grizzly Creek. (Photo by George D. Bear)

Table 45. Bighorn sheep counts, Glenwood Canyon, 1949-1970.

Date	Type of Survey ^a	Bighorns Counted					Total	Remarks
		Ewes	Lambs	Yearlings	Rams	Unclassified		
12-49	G	-	-	-	-	22	22	
1950	G	-	-	-	-	28	28	
2-23-53	G	6	5	5	5	-	21	
1-56	G	8	1	1	7	-	17	
1-60	G	-	-	-	-	30	30	
1961	G	-	-	-	-	24	24	Winter on Grizzly Cr.
1962	G	6	4	-	1	-	11	Winter on Grizzly Cr.
1963	G	6	6	-	1	-	13	Winter on Grizzly Cr.
1964	G	-	-	-	-	9	9	Winter on Grizzly Cr.
1965	G	-	-	-	-	10	10	Winter on Grizzly Cr.
12-65	G	6	2	-	2	-	10	Winter on Grizzly Cr.
12-69	G	4	2	-	3	-	9	Winter on Grizzly Cr.
12-70	G	1	1	-	-	-	2	Winter on Grizzly Cr.

^aG = ground; A = aerial.

Five sheep were trapped out of the Glenwood Canyon herd at Grizzly Creek in December, 1970, and moved to the Little Hills Experiment Station, and at least three sheep (1 ewe, 1 young ram, and 1 lamb) were still in the area in December, 1971. Reser believed that there were 10-12 wilder sheep up in the rimrock. Helicopter and ground surveys failed to disclose other sheep, but the canyon is extremely difficult for census purposes, and a small band of sheep could easily be overlooked. A transplant to supplement the residual herd should be considered.

Hunter Harvest

Since the Glenwood Canyon and Clinetops areas were combined as a single hunting unit, the data reported here are representative of both. Hunting seasons have been allowed continuously, 1953 through 1969; the season was closed in 1970 (Table 46). During the 17 seasons, 12 (1953-1957, 1960-1966, and 1968) were regulated by the half-curl limitation, and five (1958-59, 1966-67, and 1969) by the three-quarter-curl regulation. The harvest was 23 rams under half-curl hunting, and 7 rams under three-quarter-curl hunting. As to be expected, success was slightly higher during half-curl than during three-quarter-curl regulation, 24 to 16 percent, respectively. Overall hunter success was 21 percent.

Hunters apparently had difficulty in finding legal rams in these two herds, except for tamed animals at Grizzly Creek. The terrain is very steep and the shrub cover dense, making the few legal rams extremely difficult to locate.

Other Mortality

Jones noted the overgrazed condition on portions of the bighorn range in Glenwood Canyon in the early 1950's. Moser and Pillmore (1954) wrote:

"Two mature ewes and one old ram were found dead in the rimrock of Glenwood Canyon. The cause of death was undetermined, but the immediate vicinity was noted to be in extremely over-utilized condition. If overuse of range and over-concentration of animals are indeed the prime cause for heavy build-ups of parasites, this area is a good example of the first condition."

Pillmore collected lung samples from five sheep killed in the area in 1953 and 1954, and four of them were infected with lungworms.

The herd continued to build up through the 1950's, but declined rapidly thereafter. Dale Hibbs caught a ram here in 1965 that was in extremely poor condition. It died a short time later at the Fort Collins Research Center. Necropsy showed that it was heavily infested with lungworms and

that little functional lung tissue remained. An old ewe was found in October, 1969, in extremely poor flesh and too weak to stand. Necropsy showed that she was likewise heavily parasitized with lungworms and that little functional lung tissue remained. Other sheep in the herd coughed a great deal and had considerable nasal discharge. Fecal samples were collected from each sheep in the herd, and laboratory analysis revealed high larval counts (600-900 per gram of feces) for each animal. Three sheep (a yearling ram, and 2 adult ewes) were killed by automobiles on the highway in December, 1970 (Fig. 47). It was then decided to move the rest of the tamed sheep to Little Hills Experiment Station for controlled studies on lungworm.

Classified counts in the Grizzly Creek orchard indicated a good lamb drop; however, observers commented on the lack of yearlings in the herd. In 1962, Reser counted 6 ewes and 4 lambs; in 1963, 6 ewes and 6 lambs; in 1969, 4 ewes and 4 lambs; and in 1970, 4 ewes and 2 lambs. These counts substantially confirmed high lamb mortality.

Range Competition and Human Influences

Competition for the Glenwood Canyon range is primarily limited to deer and elk, since domestic sheep use only the extreme western part of the area. Deer and elk use the lower slopes of the canyon during winter, and to a very limited extent during the summer. Reser rated deer and elk use as moderate.

The range is extensive and very rugged, insuring suitable bighorn habitat. Despite these characteristics, the sheep tended to bunch near Grizzly Creek instead of spreading out. Here, heavy sheep, deer, and elk use resulted in severe depletion of forage along the lower slopes of Grizzly Creek, and this condition is considered an important factor in the decline of the herd.

Moser (1955) analyzed three rumen samples collected from rams harvested in September, 1953 and 1954. By volume, grasses comprised 73.5 percent, browse 26.5 percent, and forbs 0.0 percent of the diet. Plants most common in these samples were: Festuca ovina, Festuca thurberi, Quercus gambelli, and Salix glauca.

Soon after their release in 1947, the sheep concentrated in the apple orchard at Grizzly Creek during the winter. Residents and tourists made near pets of them, and objected to a hunting season. The tamed sheep were, of course, susceptible to poachers, and they were not afraid of automobiles. As a result, several were killed on the highway, creating an undesirable situation. This circumstance led to removal of bighorns using this part of the Glenwood Canyon range.

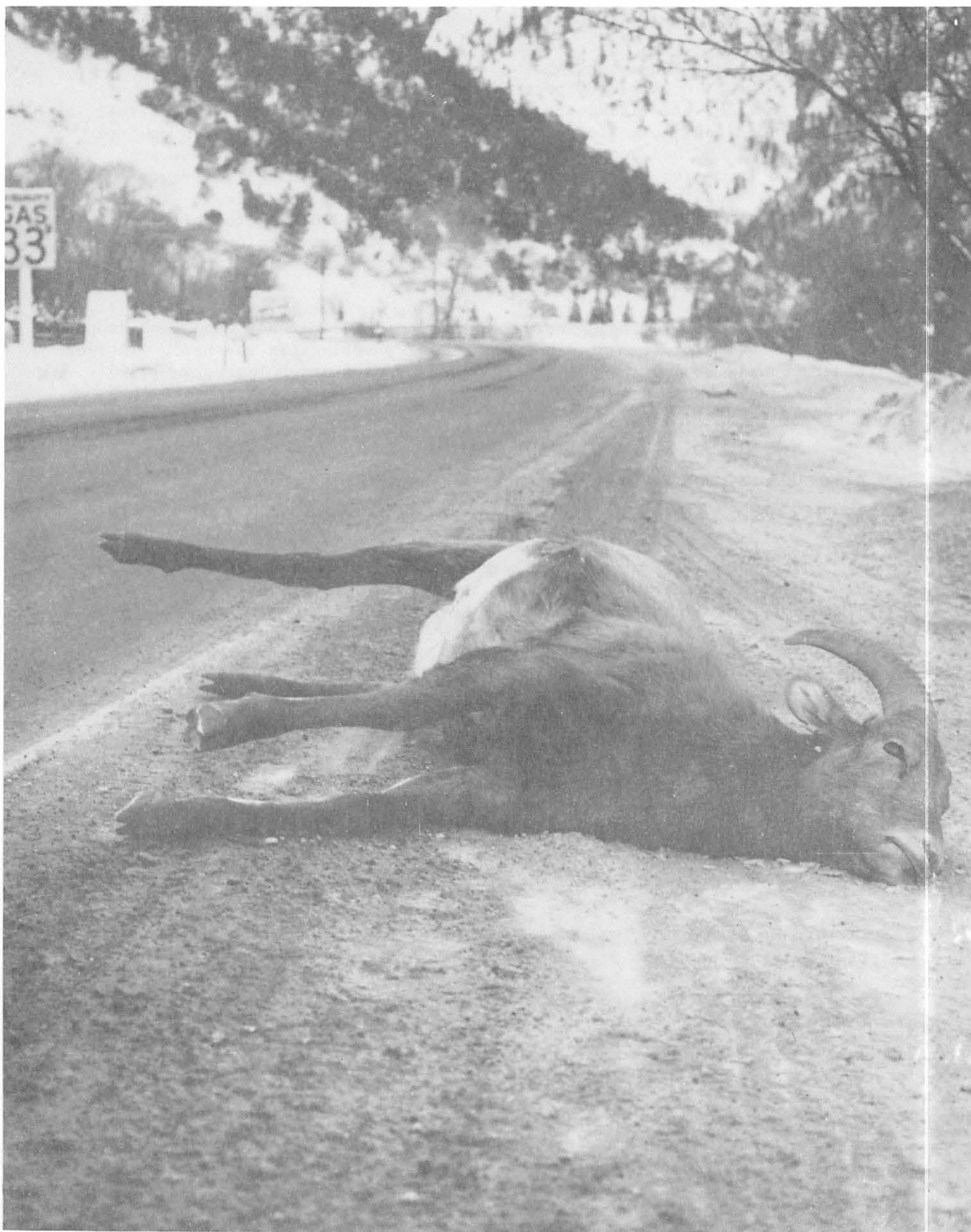


Fig. 47. Ram killed by automobile, December, 1970. (Photo by Dale Reed)

Table 46. Bighorn sheep hunting seasons and harvest, Glenwood Canyon and Clinetop Mesa, 1953-1969.

	Year ^a																
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Hunting season																	
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26	8/17	8/16
Duration (days)	11	9	9	9	16	16	16	16	16	17	16	37	23	22	18	23	23
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	3/4
Applications received	--	--	--	--	3	--	5	4	3	17	10	6	4	4	4	11	7
Licenses issued	7	5	10	10	10	10	10	10	10	10	10	5	5	5	10	5	8
Bighorn sheep harvested	2	3	3	1	1	1	3	2	3	3	2	0	3	0	1	0	2
Percent success	29	60	30	10	10	10	30	20	30	30	20	0	60	0	10	0	25

^a Area closed to hunting in 1970.

CLINETOP MESA

Distribution and Population Trend

The Clinetop Mesa area is very similar to the Glenwood Canyon range: juniper-oakbrush interspersed with rugged cliffs. Information is very limited for this sheep herd. Due to the dense shrub and tree cover, big-horns are difficult to locate from ground or aircraft. They range from East Elk Creek to Main Elk Creek, and the summer and winter ranges are nearly the same, except the sheep are restricted more to southern exposures during the winter (Figs. 48 and 49). Elevation is approximately 6,500 feet, and very little snow accumulates on south exposures. This area is also a winter range for deer and elk.

A resident at New Castle, Melvin Lykes (lumberjack), was interviewed on December 10, 1969. He stated that there were 38 sheep in the Clinetop herd during the 1930's. He generally saw the sheep on lower Deep Creek and, occasionally, up higher on Deep Creek and East Elk Creek, the same range occupied at present (1971). In 1954-1956, 21 sheep were counted and the estimated population in 1958 was 28. In December, 1960, 15 were counted (2 rams, 6 ewes, 4 lambs, and 3 yearlings); and in April, 1961, 18 (5 rams, 8 ewes, and 5 yearlings) were counted. On February 17, 1971, a helicopter count disclosed 15 sheep (9 ewes, 3 lambs, and 3 rams). From these limited data it appears that the herd had decreased only slightly during the last 25 years, but it is likely much smaller than the more historic herds.

Mortality and Other Factors

Mortality information is limited to hunter harvest, given under the Glenwood Canyon section of this report.

The area occupied by sheep is also a wintering area for deer and elk, and it is assumed that some competition for forage exists between these species. Human activities are generally confined to roads and main drainages.

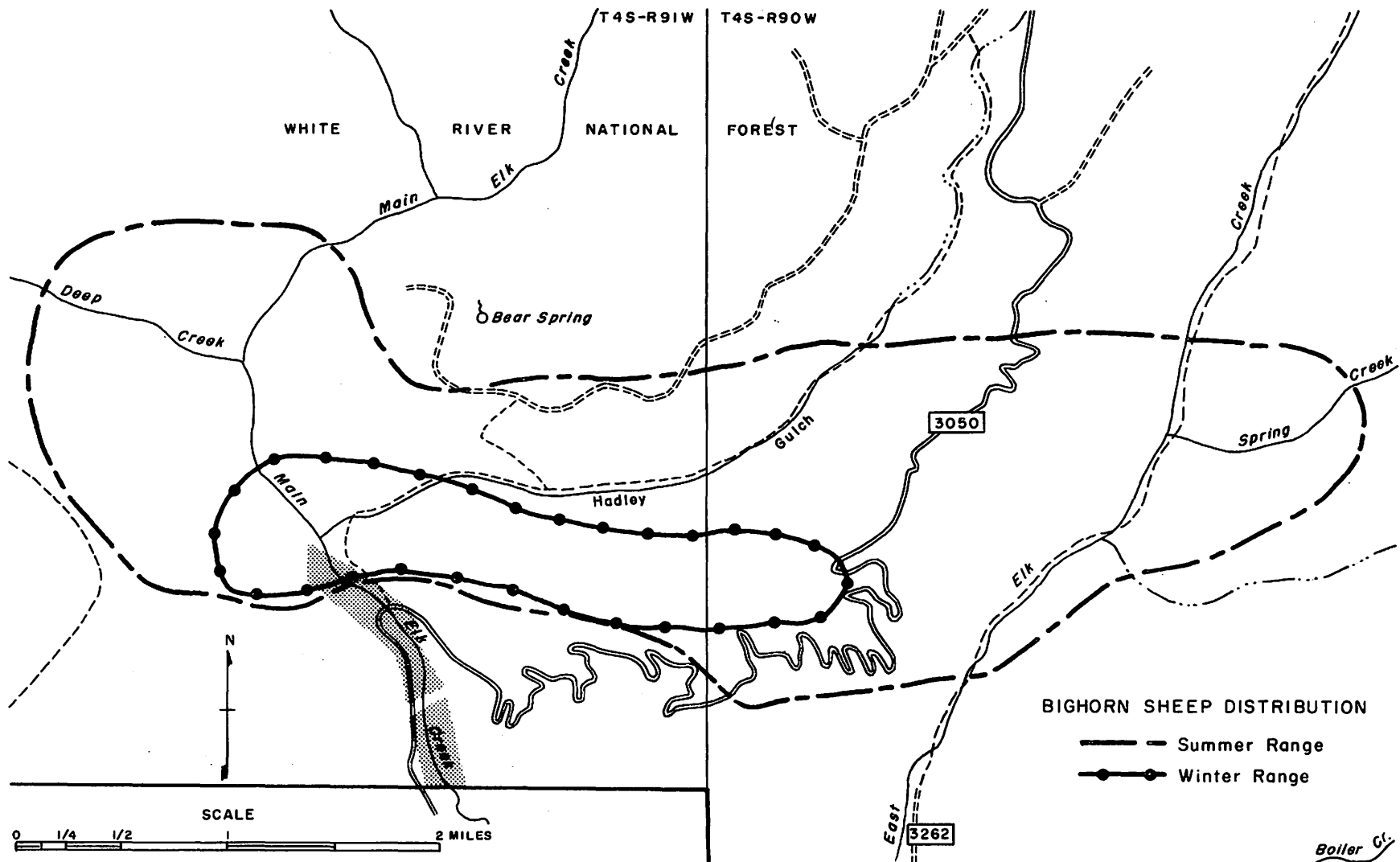


Fig. 48. Bighorn sheep distribution, Clinetop Mesa.

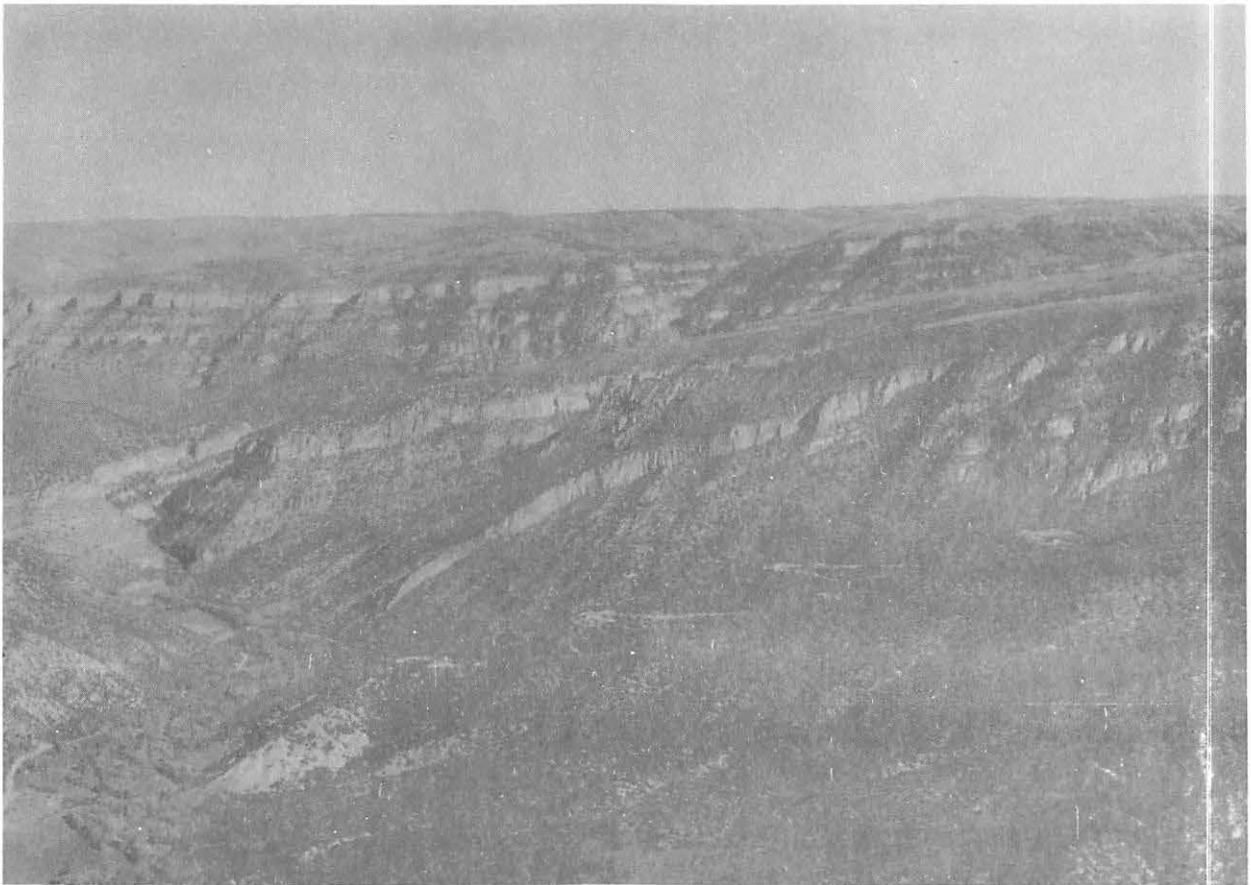


Fig. 49. Aerial view of the Clinetop Mesa bighorn range. (Photo by George D. Bear)

REDSTONE

Distribution

The Redstone bighorn herd winters in the Crystal River valley near the town of Redstone. Winter range extends upstream from Redstone for about 2 miles and downstream for about 9 miles and, for the most part, involves the lower slopes of the east side of the river (Fig. 50). Elevation is approximately 7,500 feet.

The Redstone is similar to the Glenwood Canyon and Clinetop Mesa areas-- steep slopes dominated by oakbrush and interspersed with cliffs which offer escape cover to the sheep. During summer, bighorns move toward the alpine ranges east of the winter range (Fig. 51). Several peaks on this high range extend over 13,000 feet elevation. The alpine summer range is also used by bighorns wintering in the Snowmass area, and mixing between the Redstone and the Snowmass herds is considered likely.

Population Trends

Available information is inadequate regarding the population trend, but the herd appears to have been static or decreasing slightly during the last 25 years (Table 47). Jones counted eight sheep near Avalanche Creek on April 15, 1946, and 23 sheep (all ewes) on Crystal River the next day. Mike Stone (W.C.O.) reported counts from ground surveys in the following areas: 1963, at the head of Kline Creek, 17; 1964, Redstone Cliffs, 6; 1965, Hot Springs, 13; 1965, East Creek near Redstone, 11; 1967, Elk Mountain, 13; 1967, Lead King Basin, 7; 1968, Avalanche Creek, 5 (6 were counted on an aerial survey); 1969, Redstone Cliffs, 6; and 1969, north side of Silver Creek Pass, 8 rams. Stone estimated the present (1971) population at 20-30 bighorns. Moser (1962) estimated approximately 53 head.

As indicated by the above, Stone stressed the need for more reliable inventory information, emphasizing systematic and detailed ground counts when sheep are on winter range. The dense shrub cover on the Redstone range likely make aerial counts impractical. Aerial surveys on summer range should be evaluated; however, the extensiveness of this area may preclude such census.

Miscellaneous Information

Information concerning mortality in the herd is negligible. Few of the sheep have been classified as to sex and age, and there is no evaluation of the overall herd structure. Harvest data are included with those for the Snowmass unit. Pillmore collected lung tissue from a harvested ram in 1954 and found the animal infected with lungworm.

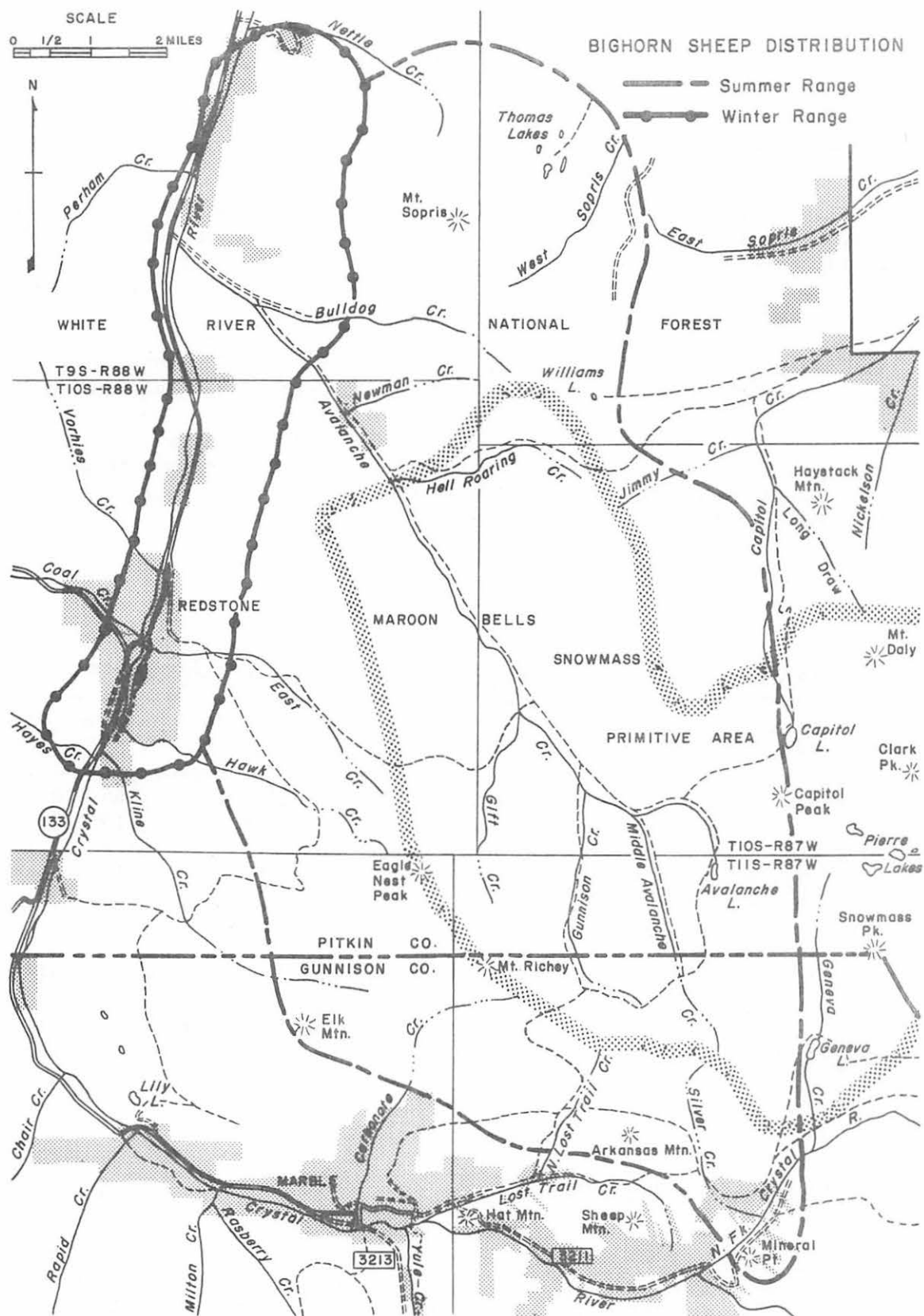


Fig. 50. Bighorn sheep distribution, Redstone.



Fig. 51. Aerial view looking down the Avalanche Creek drainage. (Photo by George D. Bear)

Table 47. Bighorn sheep counts, Redstone, 1946-1969.

Date	Type of Survey ^a	Bighorns Counted					Total	Remarks
		Ewes	Lambs	Yearlings	Rams	Unclassified		
4-15-46	G	6	-	-	2	-	8	Avalanche Cr.
4-16-46	G	15	8	-	-	-	23	Crystal River
1963	G	-	-	-	-	1	1	Avalanche Cr.
1963	G	-	-	-	-	1	1	Redstone
1963	G	-	-	-	-	17	17	Head of Kline Cr.
1964	G	-	-	-	-	2	2	Avalanche Cr.
1964	G	-	-	-	-	6	6	Redstone
1964	G	-	-	-	-	3	3	N. of Schofield Park
1965	G	-	-	-	-	2	2	Red Wine Point
1965	G	-	-	-	1	-	1	Head of Bulldog Cr.
1965	G	-	-	-	-	13	13	Hot Springs
1965	G	-	-	-	-	11	11	East Cr. near Redstone
1965	G	-	-	-	-	6	6	Hays Cr.
1965	G	-	-	-	-	2	2	Main Avalanche Cr.
1966	G	2	-	-	-	-	2	Avalanche Cr.
8-66	G	3	1	-	-	-	4	Capitol Peak
1967	G	-	-	-	-	13	13	Elk Mtn.
1967	G	-	-	-	-	7	7	Lead King Basin
7-2-67	G	3	-	-	-	-	3	Avalanche Cr.
4-19-68	G	2	-	-	-	1	3	Avalanche Cr.
5-21-68	G	-	-	-	5	-	5	Avalanche Cr.
2-21-69	A	3	1	-	2	-	6	Avalanche Cr.
4-28-69	A	1	-	-	-	-	1	E. of Perham Cr.
5-5-69	G	-	-	-	-	6	6	Redstone
8-69	G	-	-	-	8	-	8	Silver Cr. Pass

^aG = ground; A = aerial.

Stone reported domestic sheep use on the bighorn range as moderate, and that it occurred June 15 to August 31. He also reported that elk and deer use was light and that these species used the same winter and summer ranges as the bighorns. Human activities are light and limited to backpackers, fishermen and hunters.

SNOWMASS

Distribution and Population Trend

The Snowmass bighorn herd ranges 5 to 10 miles south of Aspen in the Snowmass Primitive Area and adjacent areas. The sheep summer throughout the alpine and other high country draining into Snowmass, Maroon and Castle creeks. The western portion of the summer range extends into alpine areas occupied by the Redstone herd, which also winters in the lower valleys. Three of the main winter ranges are on Willow, East Maroon and Conundrum creeks (Figs. 52 and 53). This is largely public land; however, there are some small tracts of private land on the winter ranges.

The Snowmass herd has declined markedly in recent years. White (1951) reported 23 bighorns (15 ewes and 8 lambs) on the south side of Maroon Creek near timberline. In the late 1940's, Jones observed 22 sheep at Snowmass Mountain, 37 above Marble, 16 on West Maroon Peak, 32 on Castle Peak, 13 on Grizzly Mountain, and 9 on Mt. Massive. It appears that only a very few sheep are left in the latter two areas at the present time (1971). In June, 1956, 27 sheep were seen at Maroon Bells by Richard Denney, biologist, and Robert Terrill (W.C.O.). In September, 1960, 18 (7 ewes, 5 lambs, and 6 yearlings) were observed at Pearl Pass; in June, 1961, 8 (3 ewes, 2 lambs, and 3 yearlings) were near Ashcroft; and in October, 1961, 13 (5 ewes, 4 lambs, and 4 yearlings) were seen near Maroon Lake.

Robert Terrill reported that the herd has decreased in number in late years. He counted 62 bighorns (including 11 rams) between Castle Creek and Crystal River while hunting 13 years ago. Terrill also reported as late as 1956 he would see 25 to 33 sheep wintering in the Maroon Lake area; in recent years he has observed only 4 or 5 animals each spring. He estimated the present population at 20-30. Moser estimated 130 in the Snowmass herd in 1958.

More detailed information is needed concerning the population structure of the herd, as mentioned for the Redstone area. Systematic ground surveys should be made on the winter range, and a series of aerial surveys, both summer and winter, are prerequisite to meaningful evaluation of population trends and mortality data.

Mortality

For practical purposes, the harvest for both Redstone and Snowmass bighorns are included in the following data, constituting the only mortality information for either herd. The herds were hunted 1953 through 1964, when both areas were closed because of poor hunting success. A total of 100 licenses were issued during the 12 seasons, and 13 rams were harvested for a success of 13 percent. Hunters were limited to half-curl or larger rams in all years except 1958 and 1959, when the three-quarter-curl regulation held (Table 48).



Fig. 53. Bighorn summer range in the Elk Mountains. (Photo by George D. Bear)

Table 48. Bighorn sheep hunting seasons and harvest, Snowmass-Redstone, 1953-1964.

	Year											
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Hunting season												
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22
Duration (days)	11	9	9	9	16	16	16	16	16	17	16	37
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2
Applications received	--	--	--	--	13	--	14	22	15	11	24	17
Licenses issued	5	6	6	8	10	10	10	10	10	10	10	5
Bighorn sheep harvested	0	2	1	3	0	1	1	2	0	3	0	0
Percent success	0	33	17	38	0	10	10	20	0	30	0	0

Other Factors

Terrill believed that human activities had a limiting influence on the herd. He reported human use as heavy, mainly by hikers, campers, mountain climbers, and "hippies by the hundreds". There are two boys' organizations, The Ashcrofters Club and The Outward Bound School, active through the summer on bighorn summer range. The Aspen area has become a large recreational center and the impact of the people has been substantial. Terrill stated, "I surely believe that so many people, good roads leading into the area, and all the turmoil these people cause drive these animals out."

Domestic sheep are the primary bighorn competitors on the area. Terrill rated the domestic sheep use at moderate, but they graze the high country through the summer. Deer and elk use was rated as light, occurring primarily during the summer season.

BRUSH CREEK

Concerning the Brush Creek bighorn herd, Jones (1946) reported:

"Twenty-five head, sex not determined, were found on the East Fork of Brush Creek in the Holy Cross National Forest. Very good conditions with wintering on the south slope in the scrub oak where grass is available were noted. This area is open through the winter. Four rams were seen on Castle Mountain in the Holy Cross National Forest. This is not a good location for sheep. These rams were caught in a snow storm and could not get back on the Brush Creek side where they formerly wintered."

In 1947, 36 sheep were counted on Brush Creek. In 1948, 37 were counted, of which 8 were yearlings and 4 were rams. It was recommended at the time that a few rams be transplanted to this area from the Tarryall herd.

On March 9, 1950, 8 sheep (2 rams, 1 male lamb, 2 female lambs, and 3 ewes) were released on Brush Creek approximately 1 mile below the junction of East and West Brush creeks. Jones (1952) reported:

". . . on April 28-29, 8 sheep (4 rams and 4 ewes) were found dead on Brush Creek. The cause of death was attributed to starvation. Normally these sheep come down to the bottom of Brush Creek to feed and breed, returning to higher elevations at the end of the breeding season. An unusually heavy snowfall this winter trapped them at the lower elevation, and they found shelter in an unexposed area at the base of some steep cliffs. As the snow pack continued to build up the sheep were virtually trapped by snow in the small open pockets, and were unable to return to the open, wind-swept ridges where they normally winter. As the scant forage was consumed, starvation began, resulting in death of the animals. They were native to the area, and were not part of the sheep which were transplanted there from Tarryall."

There are no additional records for this herd. Marvin Smith (Area Supervisor) said that no sheep exist in the area at present (1971). Therefore, an apparently thrifty herd in the late 1940's and early 1950's completely died off in recent years. The feasibility of a bighorn transplant should be determined.

GORE RANGE

Distribution

Bighorn sheep in the Gore Range summer throughout the alpine (Fig. 54), part of an extremely rough mountain range with several peaks over 13,000 feet elevation. Since it is a primitive area, it is roadless except around the periphery. The bighorn winter range is restricted to much smaller areas because of deep snows, the best known along Booth and Pitkin creeks just above U. S. Highway 6 at approximately 8,500 feet elevation. It consists of very steep south-facing slopes interspersed with rough cliffs, and dense stands of aspen, serviceberry, and other shrubs on the slopes. A few bighorns also winter on the windswept alpine ridges at the head of Black, Slate and Boulder creeks.

Range of the Gore bighorns has been reduced in recent years. Paul Gilbert (Area Supervisor) stated that years ago part of the Gore Range herd lambled on Green Mountain, north of the present range, and that sheep ranged westward on to Slate Mountain. He said that, 10 years ago, a small group of sheep was seen on Inspiration Point 7 miles southeast of Kremmling. In 1951, 22 sheep (12 ewes, 7 lambs, and 3 rams) were reported on the Little Sheephorn, northeast of the Gore Range.

Population Trends

The Gore Range herd has declined very appreciably during the last 25 years (Table 49). In May, 1946, and October, 1947, 24 and 50 sheep, respectively, were counted on Booth Creek. Seven bighorns (1 ram and 6 ewes) were planted in the Gore Range on January 16, 1948. These and 26 others (18 ewes and 8 lambs) were seen in March, 1948. September 8, 1955, a Division pilot counted 39 sheep at various Gore Range locations. The following ground counts were made at Gore and Booth creeks: August, 1960, 25; March, 1961, 11; January, 1962, 20; winter, 1962-63, 20; 1963, 5; 1964, 25; 1965, 9; 1967, 9; 1968, 14; 1969, 12; 1970, 13; and 1971, 17. The winter counts were made by Al Orolsky (W.C.O.).

The following bighorn counts were made via helicopter: February, 1966, 16 (7 ewes, 4 lambs, 2 yearlings, 2 large rams, and 1 half-curl ram); February, 1971, 11 (3 ewes, 2 lambs, and 6 rams) on alpine range; and 17 (8 ewes, 1 lamb, and 8 rams) on Booth Creek; 1971 total, 28 (11 ewes, 3 lambs, 10 half-curl rams, and 4 three-quarter-curl rams).

The trend in counts was downward for a decade or more, but appears to have stabilized in recent years. The herd currently has a high ratio of rams. Lamb ratios on wintering grounds have been relatively low but, in view of the high ratio of young rams now appearing in the counts, it has evidently increased since the period of herd decline.

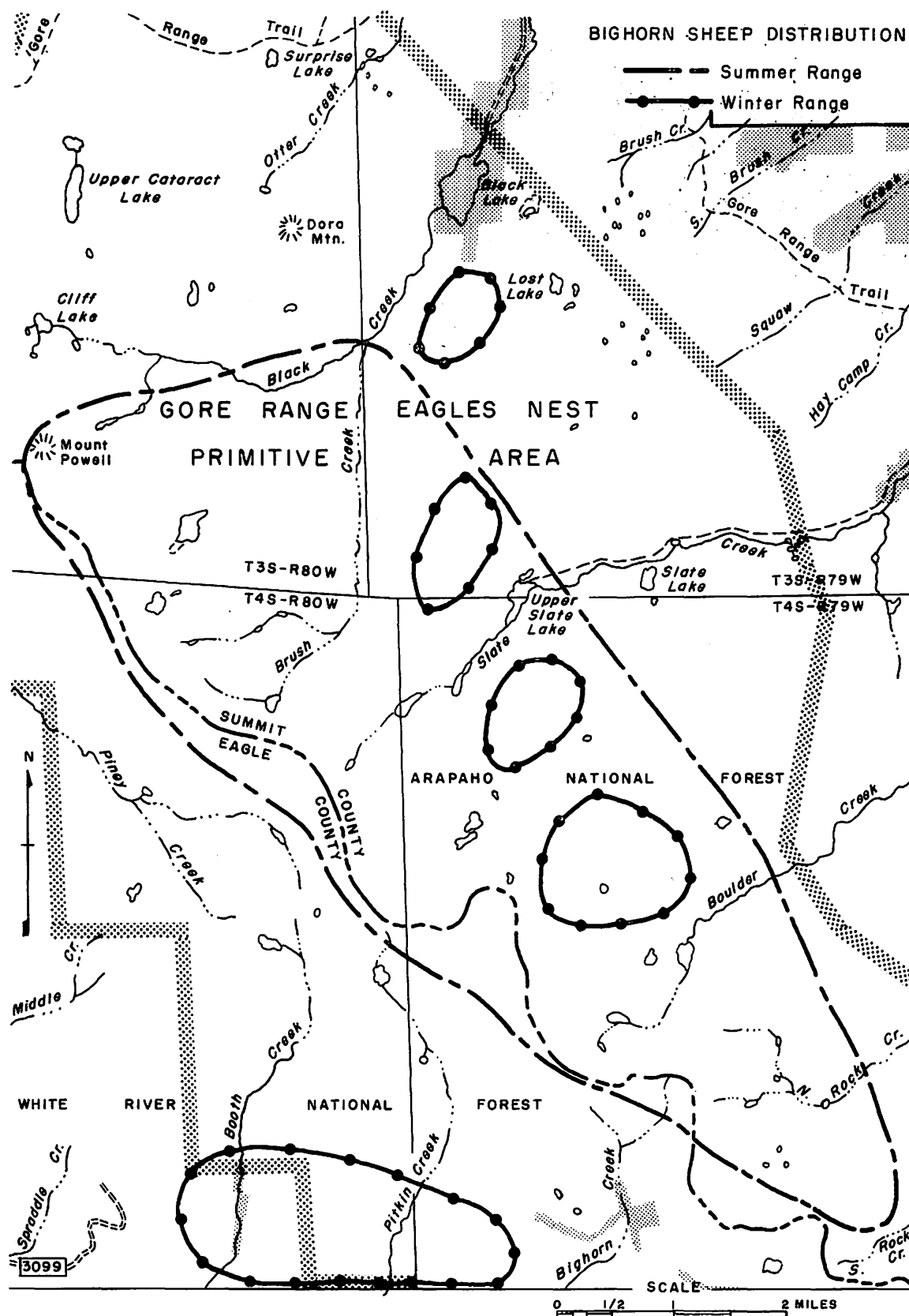


Fig. 54. Bighorn sheep distribution, Gore Range.

Table 49. Bighorn sheep counts, Gore Range, 1946-1971.

Date	Type of Survey ^a	Bighorns Counted					Total	Remarks
		Ewes	Lambs	Yearlings	Rams	Unclassified		
5-5-46	G	-	-	-	-	44	44	Booth Creek
10-47	G	-	-	-	-	50	50	Booth Creek
1-16-48	G	24	8	-	1	-	33	Gore Range
9-8-55	A	-	-	-	-	39	39	Gore Range
8-60	G	11	5	3	6	-	25	Gore Cr.-Booth Cr.
3-61	G	9	-	2	-	-	11	Gore Cr.-Booth Cr.
1-62	G	7	4	4	5	-	20	Gore Cr.-Booth Cr.
1962	G	11	4	-	5	-	20	Winter on Booth Cr.
1963	G	4	1	-	-	-	5	Winter on Booth Cr.
1964	G	12	5	-	8	-	25	Winter on Booth Cr.
1965	G	4	2	-	3	-	9	Winter on Booth Cr.
1966	A	7	4	2	3	-	16	Winter on Booth Cr.
1967	G	5	2	-	2	-	9	Winter on Booth Cr.
1968	G	7	5	-	2	-	14	Winter on Booth Cr.
1969	G	7	2	-	3	-	12	Winter on Booth Cr.
1970	G	9	1	-	3	-	13	Winter on Booth Cr.
1970	G	5	2	-	10	-	17	Winter on Booth Cr.
2-21-71	A	11	3	-	14	-	28	Gore Range-Booth Cr.

^a G = ground; A = aerial.

Hunter Harvest

Gore Range bighorns were hunted from 1953 through 1967; since, the season has been closed (Table 50). During the 15 seasons, 161 permits were issued and 5 rams were harvested for a success ratio of 3 percent, the lowest ratio for any herd in the state. The extreme ruggedness of the terrain makes the Gore country very difficult to hunt, and hunter success, regardless of the high ratio of rams in the herd, is very low. It is interesting that 3 of the 5 rams harvested were taken in a season when a large number (25) of permits were issued.

Other Mortality

The only recorded instance of mortality affecting the herd, other than hunting, is a two-year-old ewe found near Pitkin Lake, September 1, 1953, with film-coated eyes and totally blind. Blindness was diagnosed as common pinkeye, possibly contracted from domestic sheep. The necropsy was negative for external, liver, stomach and intestinal parasites, throat bots, and lungworms. Tapeworm cysts, for which coyotes are an alternate host, were found in the mesenteries.

Range Competition and Human Influences

Domestic sheep use the Gore bighorn range in late summer, and their proximity promptly and invariably moves bighorns out of the area. Paul Gilbert has reported that domestic sheep are gradually being phased out of this range. Orolsky rates deer and elk use as light, and limited to the spring, summer and fall. A small herd (approximately 10) of mountain goats occupy the alpine areas year-round. They are too few in number to offer much competition at present (1971).

Human use on the Gore Range is related primarily to hikers, campers, fishermen and hunters, mainly in the primitive area. The number of hikers has increased in recent years, but the influence is not measurable. A vast ski area (Vail Village) has been developed within a mile of the Booth Creek winter range and likely has an adverse effect on the suitability of this area for bighorn sheep. Domestic dogs are already an increasing problem in the village locality.

Table 50. Bighorn sheep hunting seasons and harvest, Gore Range, 1953-1967.

	Year ^a														
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Hunting season															
Opening date	9/3	9/11	9/3	9/1	8/31	8/30	8/29	8/27	8/26	8/18	8/24	8/22	8/28	8/28	8/26
Duration (days)	11	9	9	9	16	16	16	16	16	17	16	37	23	22	18
Curl regulation	1/2	1/2	1/2	1/2	1/2	3/4	3/4	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4
Applications received	--	--	--	--	2	--	14	12	18	10	17	11	17	39	24
Licenses issued	10	5	10	12	9	10	10	10	10	10	10	10	10	25	10
Bighorn sheep harvested	0	0	0	0	0	1	0	0	0	0	0	1	0	3	0
Percent success	0	0	0	0	0	10	0	0	0	0	0	10	0	12	0

^aArea closed to hunting after 1967.

MT. ZIRKEL

The Park Range is historical bighorn range, but appears to be void of bighorns at the present date. Jones observed 15 bighorns on Black Mountain, 25 head on Mt. Zirkel, and 22 head on Mt. Ethel on surveys conducted in the late 1940's. Jones (1948) reported 17 bighorns (rams, 10 ewes, and 3 lambs) in the Bigcreek Lake area. A rancher from Rawlins, Wyoming, who grazes domestic sheep in this area said he last saw bighorns in this range of mountains in the late 1950's. No bighorn sheep were sighted while conducting aerial surveys (helicopter) in this area in 1969 and 1970. The Park Range should be examined for a possible bighorn transplant site.

DINOSAUR NATIONAL MONUMENT

Distribution and Range

Bighorns occupy the extremely rugged Ladore Canyon of the Green River from Brown's Park to the Yampa River junction, and for a short distance along the Yampa River (Fig. 55). The canyon is very narrow, with sheer cliffs several hundred feet high, often extending for miles on either side of the Green. Bighorns find sanctuary and food on the narrow ledges and talus slopes along the bluffs (Figs. 56 and 57). Distribution is limited to the canyon bluffs and a bordering strip usually less than a mile wide. Wandering sheep, usually males, have occasionally been sighted upstream along the Yampa River as far as Cross Mountain, and downstream as far as Split Mountain. The bighorns move down into the canyon, nearer water, during the hot, dry summer, seeking more succulent vegetation. They move upward toward the rim-rock in the winter. However, mature rams isolate themselves in the side canyons during summer, and join the ewe groups in November (Barmore 1962).

The wide range in elevation, variation in slope, exposure and soils, and other area factors result in a complex pattern of plant communities. Barmore (1962) mapped and classified vegetation on 47,800 acres on and around the Dinosaur range, naming eight plant communities: Pseudotsuga menziessi; Pinus ponderosa; Juniperus-Pinus; Cercocarpus ledifolius; Cercocarpus-Amelanchier-Purshia; Artemisia tridentata; Artemisia-Grayia-Oryzopsis; and Acer-Phragmites-Equisetum. Barmore found that sheep utilized the Acer-Phragmites-Equisetum and Artemisia-Grayia-Oryzopsis communities most intensively, but Juniperus-Pinus was also important because it covers so much of the sheep range. He described these three plant communities in detail.

Bighorns occupied the Dinosaur section of the Green River bluffs in very early times, as indicated by the numerous pictographys, petroglyphs, and implements made of sheep horns excavated from caves of prehistoric Indians. Barmore (1962), after studying numerous records of early travelers and explorers and interviewing local residents, found that bighorns were common throughout the Monument, downstream into Utah, up the Yampa River to Cross Mountain, and up the Green River as far as the Flaming Gorge. Many of the upland sites, such as Zenobia Peak, Blue Mountain, and even north to Irish Canyon, were occupied by the animals. Nearly the entire canyon country, therefore, was original bighorn range.

Population Trends

Historically, as already mentioned, bighorn sheep in the Dinosaur area were more widely spread than now. Early reports indicate some decline in number about 1910. The herd apparently reached a population peak in 1925-1930, but was depleted by an extensive die-off about 1933. In 1951, Jess Lombard, Superintendent, stated that probably no bighorns were left in Dinosaur National Monument since his last observation was in 1944.

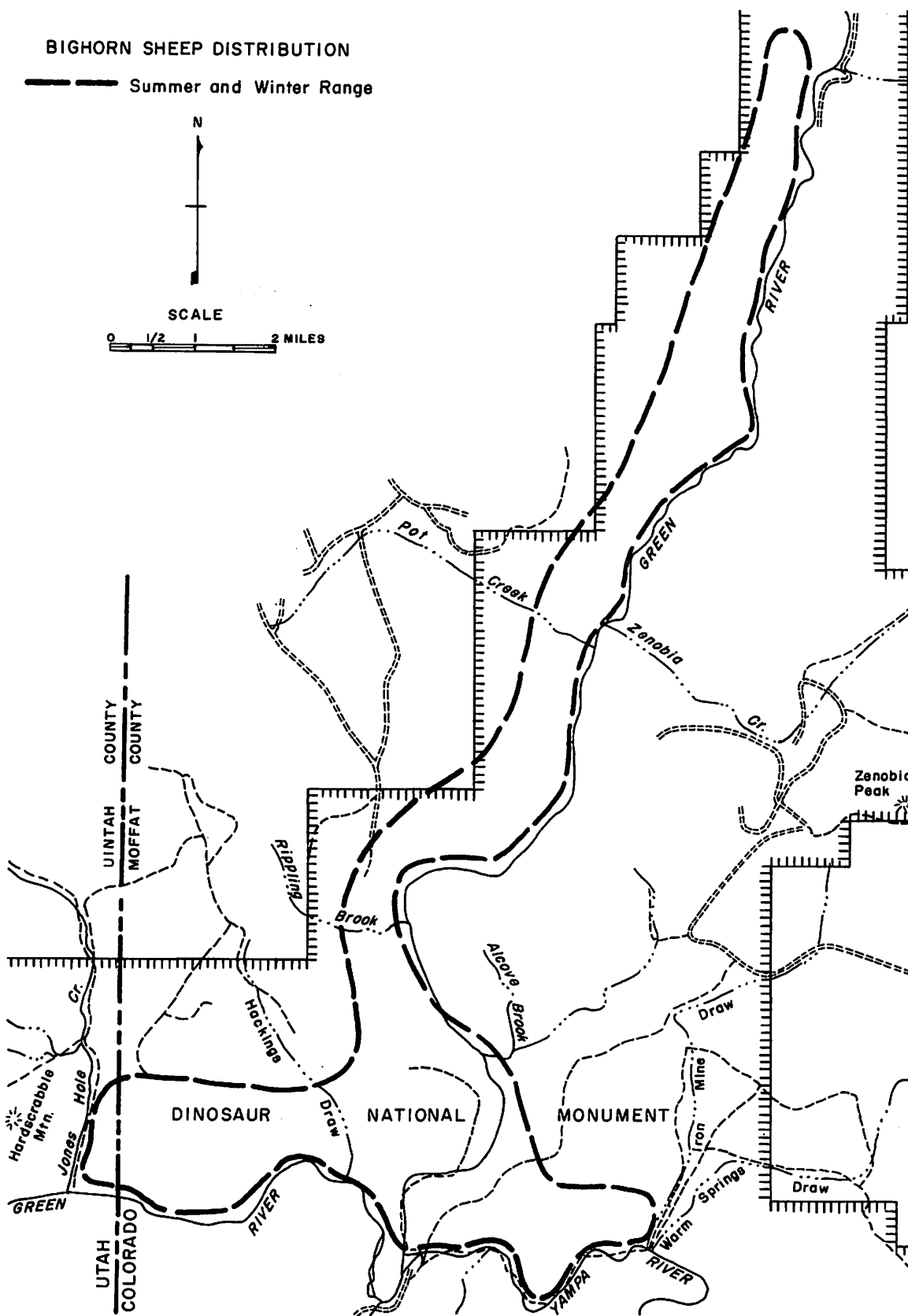


Fig. 55. Bighorn sheep distribution, Dinosaur National Monument.



Fig. 56. Aerial view of the bighorn sheep range in Dinosaur National Monument. (Photo by George D. Bear)



Fig. 57. Bighorn sheep habitat along the Green River. (Photo by George D. Bear)

On January 29, 1952, 15 sheep (3 rams and 12 ewes, lambs and yearlings) were trapped in the Tarryall Mountains and released at Buffalo Jack Springs, near the northeast side of the Monument. On February 19, 1952, 20 sheep were trapped on the Rifle Hogback and 17 bighorns (5 rams and 12 ewes) were released at Buffalo Jack Springs. Some of the 32 transplanted sheep were observed with increasing frequency in succeeding years in the vicinity of Ladore Canyon. Barmore studied bighorns here in 1958 and 1959, and estimated the minimum population at 127-140 animals. The lamb:ewe:yearling ratio was 44 lambs:100ewes:39 yearlings in the summer of 1959 (known duplications were eliminated). Assuming all sheep were descendants of the 1952 transplant, the annual increase was 16 percent. This was the last detailed census of bighorns in the Monument.

Monument personnel keep records of sheep observed by people floating the river, and they also make an annual census of sheep via a float-trip. Bighorns are commonly seen in the Ladore Canyon, and sheep have been observed up the Yampa River as far as Warm Springs.

A helicopter survey was attempted in February, 1971, but the census was abandoned because of stormy weather. Helicopter surveys in winter appear to be the most practical means for obtaining more detailed data on numbers and population structure. Such flights should be scheduled every 5 to 10 years to substantiate trends established by summer float trip reports.

Mortality

Barmore (1962) commented on the 1933 die-off in this herd:

"Both domestic and wild sheep were affected. Mr. Chew lost 400 domestic sheep from a flock of 2,000 about this time (personal communication). He attributed the die-off to both domestic and wild sheep to heavy infestation of sheep nose bot fly larvae (Oestrus ovis). Before the initial die-off, Mr. Chew commonly found dead bighorn sheep in the monument canyons.

"Dr. Kenneth Doult stated: 'It seems unlikely that the sudden, heavy mortality experienced by the Monument herd could have been caused by sheep bot fly larvae alone. This parasite has never been cited as the cause of a domestic or bighorn sheep die-off, but Allen (1961) suggested that secondary bacterial infections following a heavy infestation might cause such a die-off.'

"The sudden, heavy bighorn sheep mortality about 1933 was probably caused by the interaction of several factors. Bighorn sheep ranges inaccessible to domestic livestock may have remained in a comparatively good condition long after other areas had been heavily overgrazed. However, as the bighorn sheep population

increased, ranges used solely by them may have become overgrazed also. High animal populations and deteriorated range conditions resulted in severe inter- and intra-species forage competition between bighorn sheep, domestic livestock, and deer. Mormon crickets may have contributed significantly to range deterioration (Mahaffey 1942). Poor nutrition weakened both wild and domestic animals and lowered their resistance to attacks by parasites and disease organisms, including the sheep nose bot fly. Large numbers of weakened wild and domestic sheep on the same range would have encouraged the multiplication and spread of parasites and disease organisms to which both classes of animals were susceptible (Allen 1955). This combination of conditions has been cited by many investigators as the necessary prerequisite for a sudden and heavy bighorn sheep die-off (Beuchner 1960; Cowan 1951; Hunter and Pillmore 1954; Marsh 1938; Packard 1946; Pillmore 1957; and Potts 1938)."

Barmore (1962) collected and examined fecal samples for endoparasites, confirming the presence of the following in very low numbers: Eimeria sp., Oesophagostomum sp., Ostertagia sp., Nematodirus sp., Skjabinema sp., and Trichuris sp. Pillmore found Protostrongylus larvae in bighorn droppings examined in 1959, noting: "Most of the bighorns in the Ladore Canyon of the Green River were coughing, some rather severely during June of 1959."

Other sources of mortality appear to be negligible. Barmore (1962) obtained information for a few sheep illegally shot by deer hunters outside the Monument boundaries. He also commented that coyotes, bobcats, mountain lions, and golden eagles as potential bighorn predators, but found no evidence of such. He considered the mountain lion the most likely since they inhabit the same cliff-type range as bighorns. However, deer are more plentiful and easier prey for the huge cats.

Range Competition and Human Influences

Livestock and deer use on the range may have played an important role in bighorn distribution and population trends. Large numbers of horses and cattle were grazed here during the late 1800's and early 1900's. According to Barmore (1962), deer were considerably more abundant in the early 1900's and the bighorn numbers were high. Domestic sheep were introduced about 1920. Resultant overgrazing by the large number of animals caused the range to become deteriorated and the bighorn sheep herd became extinct.

Due to the extremely rugged terrain presently occupied by bighorns there is little competition with livestock or deer. Vegetation on the bighorn range is in good condition, reflecting light use. Conversely, upland areas above the rimrock and the flat open areas along the river show signs of heavy use, and Barmore (1962) commented:

"Deer and domestic livestock use of areas surrounding Ladore Canyon is probably partly responsible for the present restriction of the herd to rougher portions of Ladore Canyon. Deer and domestic livestock use of historic but presently unoccupied bighorn sheep habitat has probably slowed expansion of the herd in some of these areas. Every effort should be made to prevent a situation from arising where bighorn sheep must compete for forage with deer and/or domestic livestock on deteriorated range."

Human activities in Dinosaur National Monument has greatly increased in recent years. However, due to the extreme roughness of the terrain and resultant inaccessability there has been little encroachment on bighorn range except directly along the river on the flats and sandbars. It is unlikely that increased travel along the river is presently having much affect on the welfare of the bighorns.

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

















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APPENDIX

BIGHORN SHEEP DISTRIBUTION MAPS

LEGEND

 Hard Surface Road	 Perennial Stream
 Improved Road	 Intermittent Stream
 Unimproved Road	 Perennial Lake
 Trail	 Intermittent Lake
 Railroad, Cog Railroad	 Spring
 Interstate Highway	 Marsh
 United States Highway	 Glacier
 State Highway	 Mountain Peak
 Forest Road	 Primitive Area Boundary
 State Boundary	 Non Federal Land
 County Boundary	 Bighorn Sheep Distribution
 Range and Township Line	 Summer Range
 National Forest Boundary	 Winter Range
 Special Area Boundary	 Summer and Winter Range
 Continental Divide	