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Division of Wildlife Conservation
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DALL SHEEP

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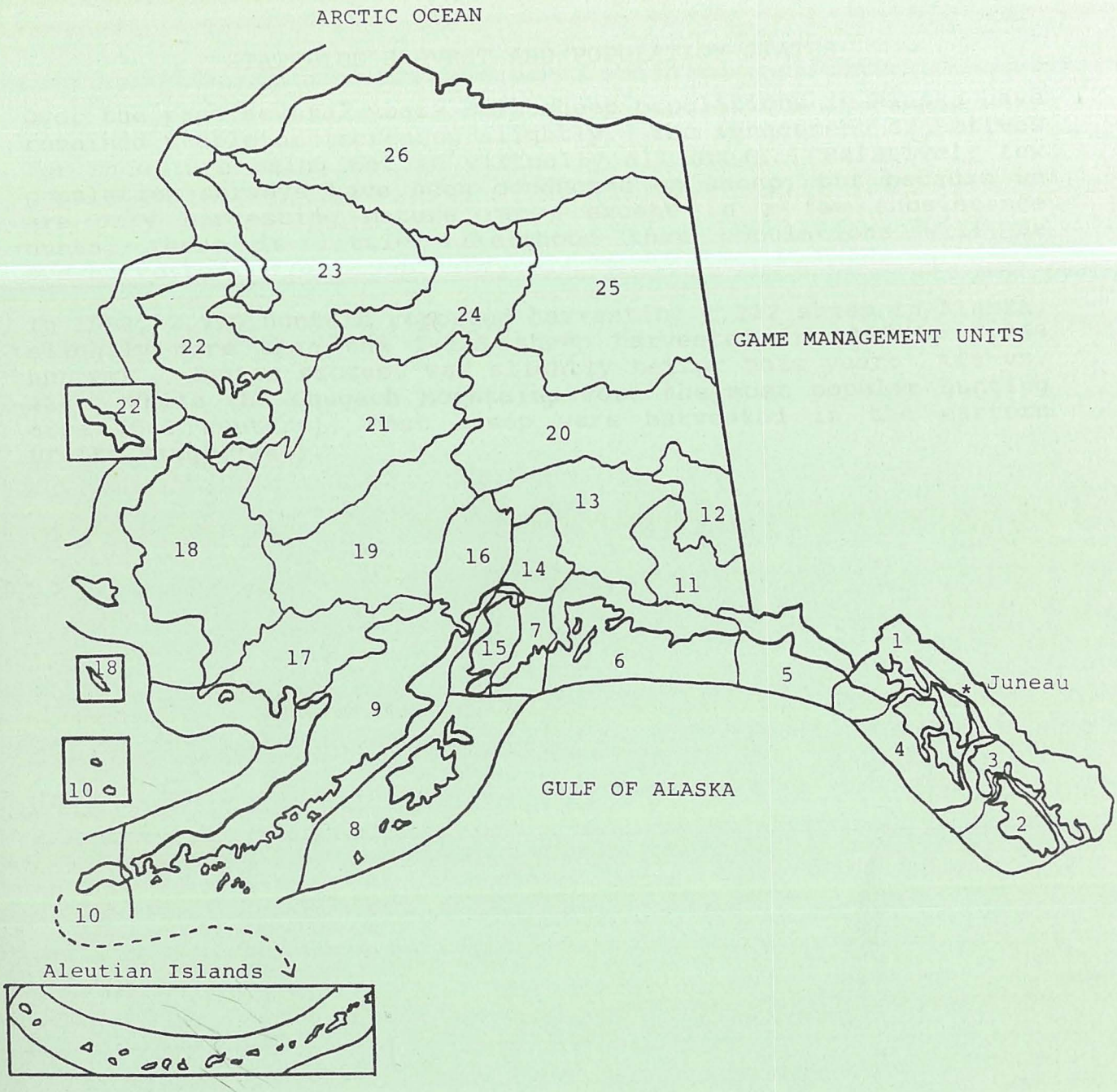
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STATEWIDE HARVEST AND POPULATION STATUS

Over the past several years Dall sheep populations in Alaska have remained stable or increased slightly. The management objectives for sheep are being met in virtually all areas. Relatively few population surveys have been conducted on sheep, but because we are only harvesting mature rams, except in a few subsistence hunts, there is little likelihood that populations will be overharvested.

In 1988, 2,790 hunters reported harvesting 1,232 sheep in Alaska, slightly more than the 1,188 sheep harvested in 1987 by 2,869 hunters. Hunter success was slightly better this year: 44% vs. 42%. While the Chugach Mountains were the most popular hunting area (548 hunters), most sheep were harvested in the eastern Brooks Range (244).

Summary of Dall sheep harvest data for 1987-88.

Mountain Range	Units (or portions thereof)	Reported harvest	Number of hunters	Average August horn length
Kenai Mountains	7 and 15	42	184	32.1
Alaska Range west and south of Denali National Park	9, 16, 17, and 19	157	222	35.9
Chugach Mountains	11, 13D, 14A, and 14C	152	548	33.1
Mentasta Nutzotin and northern Wrangell Mountains	12	222	427	34.3
Alaska Range east of the Johnson River (Tok Management Area)	12, 13, and 20	52	85	36.6
Talkeetna Mountains and Chulitna-Watana Hills	13A, 13E, 14A, and 14B	105	333	--
Delta Controlled Use Area The Eastern Alaska Range	20A, 20D, and 13B	42	106	36.0
Alaska Range east of Denali National Park	20A	154	404	34.2
White Mountains	20B, 20F, 25C, and 25D	1	15	34.5
Tanana Hills	20D and 20E	6	10	34.8
Western Brooks Range	23 and 26A	37	70	32.6
The Brooks Range within Gates of the Arctic National Park	24	18	--	--
Eastern Brooks Range	24, 25A, 26B, and 26C	244	386	35.1
	TOTAL OF AVERAGE	1,232	2,790	34.5

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STUDY AREA

GAME MANAGEMENT UNIT: 7 and 15 (10,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Kenai Mountains

BACKGROUND

U.S. Fish and Wildlife Service reports indicate aerial sheep surveys were initiated on the refuge portion of Kenai Mountain in 1949. Records after statehood (ADF&G & USFWS files) suggest the sheep population steadily in the Kenai Mountains increased from 1949 to 1968 before sharply declining until 1977 and 1978, when the lowest counts were recorded. Since the late 1970's, the sheep population has been rebuilding from its previous low levels; the impacts of weather and habitat are the controlling factors. Predation, regulated hunting, natural and disease-related mortalities have also played a part in controlling the size of the sheep population in the Kenai Mountains; however, they are not significant factors.

POPULATION OBJECTIVES

To maintain a population of sheep that will sustain an annual harvest of 25 legal rams.

METHODS

Sex and age aerial surveys were conducted throughout the Kenai Mountains sheep habitat in July. Population trend was tracked at Twin Lakes, Indian Creek, and Fox River. Harvest was monitored through harvest tickets and reports.

RESULTS AND DISCUSSION

Population Status and Trend

Data from trend count areas (Table 1) suggest sheep populations increased from 1981 to 1987. Because of poor survey conditions, only the Fox River count area was surveyed during 1988. This area showed a slight increase in total sheep; i.e., from 126 in 1987 to 130 in 1988. Because all 3 trend areas were not surveyed, a trend estimate cannot be provided for 1988.

Population Size:

The most complete recent survey was in 1987, when eight of 12 count areas were counted and 923 sheep were classified. Using the 1987 actual count and estimates for the other uncounted areas, 1,200-1,500 sheep on Kenai Peninsula. This estimate

includes approximately 225 sheep in the Cooper Landing Closed Area (Unit 7).

Population Composition:

A total of 130 sheep were classified during aerial sex and age composition surveys during 1987 (Table 1). The sample included 61 legal rams, 23 sub-legal rams, 80 ewes and yearlings, and 21 lambs. Lambs represented 16% of the total number of sheep observed, compared with the 3-year mean of 20% for previous trend counts.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters in Unit 7 and 15 is 10 August to 20 September. The bag limit is 1 ram with 7/8 curl or larger.

Human-induced Mortality:

Forty-two rams were harvested during the 1988 season, compared with 30 in 1987 (29% increase) and 24 as the previous 4-years average (a 43% increase) (Table 2). Harvest reports indicate 184 hunters spent 792 days hunting, and their success rate was 23%. This is the highest success rate in the last 5 years. Reports also showed that 83% (N = 41, 1 unk) of the harvest occurred prior to 1 September.

Mean horn length of rams killed by hunters was 32.1 inches, ranging from 27.5 to 36.5 inches. The mean age of these rams was 6.8 years, ranging from 4 to 10 years. Seven rams (17%) in the sample were 8 or more years of age.

Hunter Residency and Success. Thirty-four (85%, N = 40) of the 42 successful hunters during 1988 were Alaskan residents. Six (15%) were nonresidents, and two did not specify residency (Table 3). Unsuccessful hunters were represented by 134 (100%) residents and six whose residing was not unspecified. The 5-year average for percentage of participation by successful and unsuccessful hunters by residency is 90% residents, compared with 10% for nonresidents (N = 132).

Transport Methods. Transportation methods used by successful hunters during 1988 were boats 16 (41%), aircraft 11 (28%), highway vehicles 8 (21%), horses 4 (10%), and 3 unspecified method.

Natural Mortality:

Data is not available to assess the impact of predation; however, wolves, coyotes, and eagles are common throughout the Kenai Mountains and may significantly impact sheep numbers. Data

pertaining to natural or disease-related mortalities are also unavailable.

Habitat Assessment and Enhancement

According to Culbertson et al. (1980) the only significant sheep habitat enhancement documented for the Kenai Mountains resulted from the 1974 wildfire on Round Mountain in Subunit 15A. This fire burned approximately 50 acres at elevations of 2,500 to 3,500 feet on south-facing slopes (i.e., from the alder-brush zone through the alpine tundra zones). Culbertson et al. (1980) observed 40% more sheep per acre in the burned area than in the unburned area. Two important sheep food grasses, Trisectum spicatum and Festuca rubra were found to be more abundant and vigorous in the burned area, compared with adjacent unburned areas.

CONCLUSIONS AND RECOMMENDATIONS

Insufficient data were collected during 1988 to indicate population trend. Considering a harvest of 42 from a population of 1,275 sheep, approximately 3% of the population was harvested. The increasing harvest trend for sheep in the Kenai Mountains reflects increasing population size. No change in season or bag limit is recommended. The 29% increase in harvest from 1987 to 1988 probably reflects a combination of good weather, improved access, and high interest in sheep hunting.

A primary objective should be to develop a population data base that accurately reflects changes in sex and age composition and relative abundance within "representative" areas over time, as well as changes between areas. The 3 trend areas should be expanded to include 3 additional ones to more accurately assess population changes. Bear and Russian Mountains (Area No. 853) and Sheep Creek (Area No. 858) should be included as hunted trend areas. While the Cooper Landing Closed Area should also be counted annually as an unhunted area. Including areas such as Sheep Creek and Grant Lake (Area No. 839), which are areas on the "edge" of suitable sheep range, may serve as early indicators of weather or range-related population changes. The management objective for these units has been met for the last 3 years.

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Table 1. Sheep sex and age composition for trend count areas in Subunits 15 B and 15C (Twin Lakes [No. 855], Indian Creek [No. 856], and Fox River [No. 857]); in 1981, 1983, 1987, and 1988.

Year	Legal rams	Sublegal rams	Total	Ewes and yearlings	Lambs(%)	Unk	Total
1981	21	44	76[a]	191	56(17%)	9	332
1983	27	66	93	299	111(22%)	0	503
1987	27	126	153	362	123(19%)	0	638
1988[b]	6	23	29	80	21(16%)	0	130

[a] Eleven rams were unclassified.
[b] Data from Fox River (No. 857) count area only.

Table 2. Annual harvests for Unit 7 and 15 1984-1988.

Year	Rams
1984	19
1985	21
1986	25
1987	30
1988	42

Table 3. Hunter residency and success for Units 7 and 15 1984-1988.

	Successful				Unsuccessful		
Year	Local Resident	Nonlocal Resident	Nonresident	Total(%)	Resident	Nonresident	Total
1984	7	10	2	19 (12)	157	3	160
1985	11	9	1	21 (14)	148	3	151
1986	10	12	0	25[a] (21)	132	0	132
1987	15	11	4	30 (18)	148	6	159[b]
1988	22	12	6	42[c] (23)	134	0	184[d]

[a] Three successful hunters failed to reprot residency.
[b] Five unsuccessful hunters failed to report residency.
[c] Two successful hunters failed to report residency.
[d] Eight unsuccessful hunters failed to report residency.

STUDY AREA

GAME MANAGEMENT UNIT: 9, 16, 17, and 19 (4,600 mi^2)

GEOGRAPHICAL DESCRIPTION: Alaska Range west of Denali National Park

BACKGROUND

The Alaska Range West (ARW) divides the drainages of the Kuskokwim and Susitna Rivers; consequently, it has a north-south orientation. Dall sheep are found primarily on the western side of this range, because the eastern side receives too much snow. Moisture carried by warm air flowing northward up the Susitna River from Cook Inlet is deposited on the east side as the air cools. Along the west side of the ARW, there is a precipitation gradient. The more southerly portions of the ARW receive more snow than the northern parts, because moisture-laden air flows from Bristol Bay and Cook Inlet and drops precipitation on the southern ARW. In the northern areas adjacent to Mount McKinley, the climate is drier because the moisture source is limited to warm, moist air flowing eastward from Norton Sound.

Distribution of Dall sheep along the ARW varies from north to south and is determined by this precipitation gradient. Greater population densities occur in the northern areas where the climate is drier. Dall sheep, particularly in the southern areas of the ARW, exist at the limits of suitable habitat; consequently, rams in the ARW produce below-average-size horns (Heimer and Smith 1975). Sheep hunting in the ARW has provided an average of 9% of the statewide harvest of Dall rams over the last 18 years, suggesting the ARW has contributed rams to the statewide harvest in proportion to its population (Heimer 1985). About half of the annual ram harvest from the area is typically taken by nonresident hunters accompanied by professional guides (Whitman 1989). This demonstrates high public interest among both residents and nonresidents in ram hunting in the ARW.

Although federal and state laws define subsistence hunting as the highest priority among human uses, the Alaska Board of Game has found that historic use of Dall sheep in the ARW does not meet the currently accepted legal definition of subsistence. As a result, management goals established for Dall sheep in the ARW do not focus on human subsistence use. These goals define a program that focuses on protection of Dall sheep for human recreational uses.

The primary goal is to protect, maintain, and enhance the sheep populations of the ARW and their habitats in concert with other components of the ecosystem. The secondary goal is to provide for diversified human recreational use of Dall sheep. Hunting under aesthetically pleasing conditions is one of these uses.

Most of the past management effort the ADF&G has expended in the ARW centered on management of hunting because it was the predominant use of sheep in the ARW.

Original management plans for the area (ADF&G 1976) proposed that the entire ARW be managed to provide both consumptive and nonconsumptive uses of sheep; however, with Denali National Park at the northern end and Lake Clark National Park at the southern end of the ARW, nonconsumptive users currently have exclusive use of significant portions of the total ARW sheep populations. The remainder of the area is also exclusively available to nonconsumptive users for all but the 41 days per year when the hunting season is open. Hence it seems justifiable to continue to provide for regulated consumptive recreational hunting in the remainder of the area.

MANAGEMENT OBJECTIVES

To maintain the existing Dall sheep populations at recorded levels of abundance and productivity.

To sustain uncrowded hunting conditions through monitoring hunter participation, location and satisfaction.

To maintain a mean horn length of not less than 34 inches and a mean age above 7.5 years among harvested rams.

To maintain a reported harvest success of at least 50%.

METHODS

No field survey or inventory activities were conducted in the ARW during this reporting period. Conclusions about human use were based on analysis of hunter harvest reports.

RESULTS AND DISCUSSION

Population Status and Trend

Under normally prevailing environmental conditions in Interior Alaska recruitment and mortality are roughly balanced and sheep populations stable (Heimer 1988). No population data were gathered during this past year, but reports from guides or hunters indicated a stable population.

Population Size:

There is no reason to suspect that the population size has changed from that (ie., 3,000-5,000) reported by Whitman (1989).

Population Composition:

According to Heimer (1988), population composition varies from year to year as a function of lamb production, yearling recruitment, and adult mortality; these parameters are directly influenced by weather, natural predation, and hunting management. There were no notable changes in these factors during this reporting period.

Distribution and Movements:

Heimer (1988) also summarized the available movement data relating to Dall sheep. These data suggest that Dall sheep are loyal to traditional ranges and their movements are unlikely to change. Still, conversations with long-term residents revealed that sheep were formerly present in the Kuskokwim Mountains in northern Subunit 19A and the Sparrevohn Hills-Cairn Mountain area in southwestern Subunit 19A.

It seems likely that the presence or absence of sheep in the Sparrevohn Hills-Cairn Mountain area is probably a function of predation pressure in the area as well as the status of the sheep population in the mountains directly to the south. Inference from the distribution data in Murie (1944) and the National Park Service sheep counts (Singer et al. 1981) in Denali Park suggests that when conditions favor population growth (e.g., low predator populations and prolonged periods of favorable weather) Dall sheep populations expand their ranges into adjacent marginal habitats; when conditions are no longer favorable, sheep disappear from these habitats. If this hypothesis is correct and conditions become favorable for sheep in occupied habitats adjacent to the Sparrevohn Hills-Cairn Mountain complex, sheep may repopulate these hills again.

If sheep have existed in the Kuskokwim Mountains, they presumably exercised life strategies similar to those suggested for sheep in the Tanana/Yukon Uplands (Beasley 1989, Kelleyhouse and Heimer 1989), allowing sheep to exist in atypical habitats without ensuring long-term survival. Hence, extirpation of sheep from the Kuskokwim Mountains should probably be considered permanent. A successful transplant of sheep to this area is a unlikely.

Mortality

Seasons and Bag Limits:

The open season for subsistence, resident, and nonresident hunters in Units 9, 16, 17, and 19 is 10 August to 20 September. The bag limit for all hunters is 1 ram with a 7/8-curl horn or larger per hunter.

Human-induced Mortality:

The 1988 reported harvest was 157 rams (Table 1), the highest harvest on record. The horn length averaged 35.9 inches (Fig. 1), and mean age of rams was 8.9 years.

Two sheep were harvested in Subunit 9B in the extreme southern portion of the ARW, where habitat is only marginally suitable for sheep; most of this habitat is in Lake Clark National Park. An additional 13 rams came from the area between Big River and Telaquana River, where sheep densities are low.

In Unit 16, 24 sheep were reported harvested. The Skwentna River drainage produced the majority of this harvest (i.e., 17 rams, 71%). Four rams were harvested in the Yentna River area, and one was harvested in Unit 17.

Unit 19 contains vastly more suitable sheep habitat than any of the other ARW units, and it accounted for about 83% of the 1988 harvest. The Windy Fork of the Kuskokwim River and Sheep Creek drainages produced 35 rams, and the Tonzona/Pingston/Dillinger area an additional 34 rams.

Hunter Residency and Success. Forty-seven percent (n = 103) of the hunters in the ARW during 1988 were nonresidents (Table 2). Over the last 20 years, the percentage of nonresidents hunting in the ARW has averaged 38% (Table 1). During 1988 the success rates for nonresidents and residents were 83% and 62%, respectively. According to harvest reports, no ARW sheep hunters were residents of Unit 19.

Harvest Chronology. In the past, most of the sheep harvest has been during August; e.g., from 1983 to 1987, an average of 70% of the harvest occurred then. In 1988, 69% of the harvest was taken during August. Access to the ARW is generaly determined by flying conditions; consequently, inclement weather systems in the fall restrict that access.

Transport Methods. Since 1982 airplanes have provided 86% of the access in the ARW. During the 1988 season, airplanes were listed as the access method for 126 of 152 successful hunters (83%). Horses were used by 9% of successful hunters, and three-wheelers or other vehicles were used by 4%.

Natural Mortality:

Moderate winters over the last 6 years have resulted in below-normal mortalities. Predation does not occur on a level sufficient to depress the sheep population.

Habitat

Sheep populations in Interior Alaska exist in equilibrium with range resources (Heimer 1988). In areas where maritime weather

has greater influences, the probability of range-related nutritional problems arising is small, because warmer winters with more snow (or freezing rain) depress populations drastically (Nichols 1978). Maritime influences are predominant in the southern ARW, while the northern areas are similar to the ranges described by Heimer (1988).

Game Board Actions and Emergency Orders

There were no changes in regulations during this reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The management objective of providing aesthetically pleasing hunting opportunities was attained in the ARW during the reporting period. Although continued evaluation of sheep hunter harvest reports should ensure that the human side of the management equation will continue satisfactorily, most of the population status sections in this report rely more on the working hypothesis of sheep management in Interior Alaska than on data from the ARW. To decrease the probability that unforeseen problems will arise with sheep in the ARW, annual productivity, population status, and population trend data are necessary.

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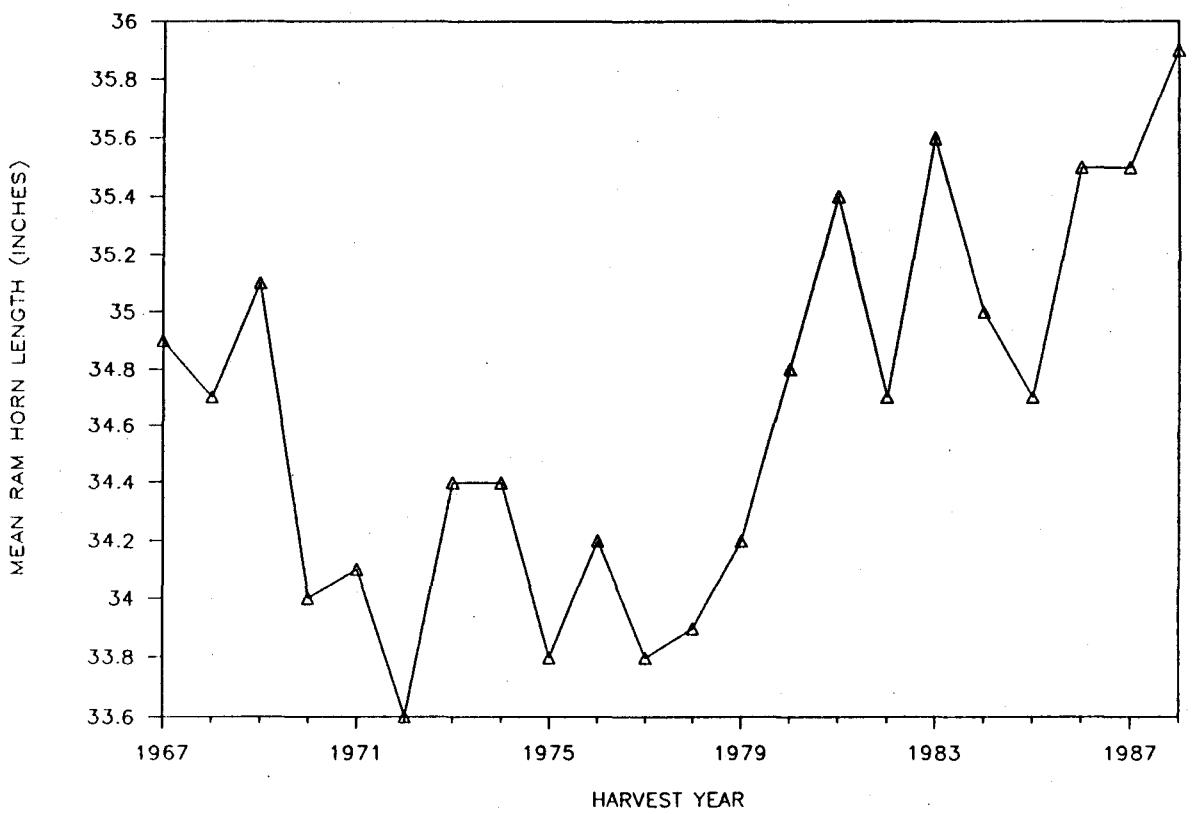

Figure 1. Reported mean ram horn lengths from the Alaska Range west of Denali National Park (ARW) from1967 thru 1988.

Table 1. Numbers of hunters, sheep harvested, and success rates for the Alaska Range west of Denali National Park (ARW) for the period 1962-88, Units 9, 16, 17, and 19.

Year	No. hunters	No. harvested	% Successful
1962	--	37	--
1963	--	44	--
1964	--	60	--
1965	--	71	--
1966	--	81	--
1967	97	65	67
1968	151	95	63
1969	154	104	70
1970	162	84	52
1971	156	71	46
1972	124	71	57
1973	211	119	56
1974	213	119	56
1975	190	99	52
1976	269	131	48
1977	297	138	46
1978	271	140	52
1979	166	91	55
1980	157	78	50
1981	141	93	66
1982	140	71	51
1983	176	90	51
1984	183	110	60
1985	137	83	61
1986	169	122	72
1987	220	139	63
1988	222	157	71

Table 2. Sheep hunter residency and success rates in the Alaska Range west of Denali National Park (ARW) during 1988.

Residence	Successful	Unsuccessful	Total	% Success
Unit 19	0	0	0	--
Anchorage	31	17	48	65
Other urban	35	24	59	59
Other rural	6	4	10	60
All residents	72	45	117	62
Other states	70	17	87	80
Aliens	15	1	16	94
All nonresidents	85	18	103	83
Unknown	0	2	2	--
Total	157	65	222	71

STUDY AREA

GAME MANAGEMENT UNITS: 11, 13D, 14A, 14C (13,200 mi^2)

GEOGRAPHICAL DESCRIPTION: Chugach Mountains

BACKGROUND

Dall sheep have been observed and hunted in the Chugach Mountains since at least the early 1900's. Systematic aerial composition surveys were first conducted during the late 1940's and have been continued sporadically since then.

Based on aerial survey data collected over the past 16 years, a minimum of 5,000 sheep inhabit the Chugach Mountains: Subunit 14C, 2,200 sheep; Subunit 14A, 750 sheep; Subunit 13D, 1,700-2,000 sheep; and Unit 11, 400 sheep. Because no severe winters have occurred since at least 1971, there has probably been no major change in the sheep population over this period.

The mean annual harvest from the Chugach Mountains over the past 2 decades has been 121 sheep; however, during the past three years harvests have exceeded 150 sheep. Hunting is regulated by a general open season in Subunits 14A and 13D, where approximately two-thirds of the total harvest occurs. In Subunit 14C, participation is limited by drawing permit, and in the Chugach Mountains portion of Unit 11 it is limited to local subsistence hunters.

POPULATION OBJECTIVES

To maintain a minimum harvest of 120, 7/8-curl or larger rams.

METHODS

Activities scheduled for FY89 included summer aerial sex and age composition surveys; identification and documentation of critical sheep habitat, including winter ranges, mineral licks, and lambing areas; and monitoring of the number and horn size of harvested sheep and harvest locations. Aerial sex and age composition surveys were completed only in Subunit 14C during July and August. Harvest data were obtained from the entire range. Budgetary constraints precluded any additional activities throughout the remainder of the Chugach Mountains.

RESULTS AND DISCUSSIONS

Population Status and Trend

Sheep numbers in the western end of the Chugach Mountains (Subunit 14C) have increased approximately 130% during the past decade. In Subunit 14A, numbers of sheep are thought to be stable or increasing slightly. Because of the absence of recent aerial surveys, the precise status of the sheep populations in Subunit 13D and Unit 11 is uncertain; however, given recent mild winters and current harvest levels, numbers of sheep are probably at or slightly above levels observed during the late 1970's and early 1980's.

Population Size and Composition:

Current population size and composition data are only available for Subunit 14C (Table 1). The population has remained fairly stable at about 2,100 sheep for the past 3 years. Since 1984 the percentage of legal rams has remained relatively stable, ranging from 7.5% to 9.6%. The percentage of young rams has remained relatively constant, but the percentage of lambs has decreased since 1984 (Table1). Data for Subunits 14A and 13D were last obtained in 1986 and 1984, respectively (Tables 2 and 3). Composition data for Unit 11 have not been collected since 1973 (Table 4). A lack of recent data precludes meaningful assessment of current herd composition from these portions of the Chugach Mountains.

Distribution and Movements:

General sheep distribution and movement patterns during the summer months have been documented from past aerial surveys. Major late-summer concentration areas have also been determined from harvest records and discussions with hunters. Although sheep are found throughout the entire mountain range below an elevation of 7,500 feet, concentrations vary greatly between drainages. In Subunit 14C, the Eagle River and the Eklutna-Goat Creek drainages support the greatest numbers of sheep. In Subunit 14A, large numbers of sheep frequent the upper reaches of Coal, Carbon, Carpenter, Wolverine, Metal, and Friday Creeks. In Subunit 13D, sheep are most abundant between the Nelchina and the Klutina Glaciers. In Unit 11, 80% of the sheep inhabit the Hanagita Ridge and the area from the Tana River to the Yukon Border.

Sheep frequent relatively snow-free windblown ridges above an elevation of 3,000 feet. Lambing areas are widely scattered and are usually located in proximity to precipitous terrain with a southern exposure. Major rutting areas are unknown.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters in Unit 11 and Subunit 14A and resident and nonresident hunters in Subunit 13D was 10 August to 20 September. The open seasons for resident and nonresident hunters in the Eklutna Management Area in Subunit 14C and the remainder of Subunit 14C are 6 to 30 September and 10 August to 30 September, respectively. The bag limit in all areas is 1 ram with 7/8-curl horn or larger. In the Eklutna Management Area (Subunit 14C), hunting by resident and nonresident hunters is permissible by drawing permit and bow and arrow only between 1 and 10 October; up to 105 permits will be issued. In the remainder of Subunit 14C, hunting is permissible by drawing permit only; up to 240 permits will be issued.

Human-induced Mortality:

In 1988, 152 sheep were taken in the Chugach Mountains, compared with the previous year's record harvest of 162 sheep. Although hunting has fluctuated substantially in different portions of the Chugach Mountains over the past 10 years, the mean harvest has increased and hunter success has remained relatively constant. An average of 100 sheep were harvested annually between 1979 and 1983. From 1984 through 1988, the mean harvest was 142 sheep (Table 5). Larger harvests are attributable to increased hunting pressure, increased opportunity through additional permits in Subunit 14C, and the greater numbers of sheep because of a series of mild winters. The total illegal harvest is unknown, but most of it probably occurs near Anchorage in Subunit 14C.

Hunter Residency and Success. In Subunits 14A and 14C, nonresident hunters have taken only 9 of 328 sheep (2.7%) during the past 5 years (Tables 6 and 7). In Subunit 13D, nonresidents composed 39% (127 of 323) of all successful sheep hunters over the past 5 years (Table 8). In the Unit 11 portion of the Chugach Mountains, both nonlocal residents and nonresidents are excluded from sheep hunting because it is entirely within the Wrangell-Saint Elias National Park. Despite this fact, harvest records over the past 5 years indicate 58% of the harvest (19 of 33 sheep) has been taken by nonresidents or nonlocal residents (Table 9). This "illegal harvest" is a result of inaccurate reporting or coding, for it is illogical to assume that hunters or guides would voluntarily report an obviously illegal kill to the Department. Closer scrutiny of harvest reporting and coding during 1988 resulted in zero reported harvests by nonresidents or nonlocal residents. Nonlocal residents composed 44% of all successful sheep hunters in the Chugach Mountains during 1988 and 47% of unsuccessful hunters. Most nonlocal residents hunted in Subunit 13D, where they accounted for 64% of the 1988 harvest.

Permit Hunts. Permit hunts occur only in the Subunit 14C portion of the Chugach Mountains (Table 10). The available number of permits has been increased from 120 to 345 over the past 5 years, primarily in response to the substantial increase in sheep numbers; 105 of the 345 permits issued in 1988 were for archery only. Forty-seven participating archers took 7 sheep. Of the remaining 240 permittees, 73 did not hunt, 128 hunted unsuccessfully, and 39 were successful.

Harvest Chronology. Twelve of 46 (26%) sheep harvested in 1988 in Subunit 14C were taken between 10 and 16 August (Table 11). The remaining harvest was spread evenly throughout the final 8 weeks of the season. In Subunit 14A during 1988, 48% of the harvest occurred during the first 2 weeks of the season (Table 12). In Subunit 13D, 41% of the harvest came from the 1st week of the season, 26% from the second, and 12% from the third (Table 13). The harvest in Unit 11 is too small for comparison.

Transport Methods. Methods of transport used by sheep hunters in Subunit 14C have not changed substantially during the past 5 years. Approximately 80% of all successful hunters utilized highway vehicles, and 3- or 4-wheelers were used by 10% of successful hunter (Table 14). In Subunit 14A, transport means were varied: 36% of successful hunters utilized aircraft; 30%, highway vehicles; 12%, boats; and 10%, horses (Table 15). In Subunit 13D, over 60% of the successful hunters utilized aircraft, and 18% used highway vehicles (Table 16).

Natural Mortality:

In areas where annual counts occur and the population remains static from year to year, natural mortality is approximately equal to the lamb increment minus hunting mortality. Lambs, old ewes, and old rams are most susceptible to natural mortality.

During the mild winters from 1979 through 1986, the population in Subunit 14C annually increased by a number nearly equal to the previous year's lamb count, minus the ram harvest. This indicated minimal winter mortality. Snow accumulation was significantly greater during the winter of 1987-88, and mortality was approximately equal to the 1987 lamb crop. The population has remained stable in 1988.

In December 1987, 16 sheep were killed in a snow avalanche above the Knik River in Subunit 14A. This represents one of the few documented cases of substantial natural mortality of sheep in the Chugach Mountains.

Habitat Assessment

Techniques for evaluating sheep winter range in Alaska have not been developed. Snow depth and hardness, rather than range quality or quantity, may be the primary determinant of winter

mortality. Funding for winter range evaluation during FY89 was unavailable.

Game Board Actions and Emergency Orders

Sheep hunting regulations in Subunits 14A and 13D and Unit 11 have remained unchanged during the past 5 years. A 130% increase in the population in Subunit 14C over the past 10 years has allowed an increase in the season length and the number of permits. In 1984, 120 drawing permits were issued, followed by a registration hunt with 159 participants; 180 drawing permits were issued during 1985 and 1986. In 1987 and 1988, 240 drawing permits and an additional 105 archery-only drawing permits were allocated. No Emergency Orders were issued during the past year.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Subunit 14C may be leveling off after a decade of annual increases. Winter mortality among lambs and old ewes on crowded winter range may prevent the population from increasing. Numbers of legal rams will likely continue to increase for several more years as large cohorts of young rams reach maturity. The population in Subunit 14A is stable; however the number of legal rams may be down from previous years, as indicated by a 1.5-inch decline in mean horn size in 1988, compared with that for 1987. The status of the population in Subunit 13D is uncertain. A 5% decline in the harvest and a 0.1-inch increase in mean horn size between 1987 and 1988 indicate that the population is probably stable. Little is known about the apparently small population in Unit 11, except that the harvest shows a definite upward trend over the past 3 years.

The harvest objective of a minimum of 120, 7/8-curl or larger rams for the Chugach Mountains was exceeded by 42 and 32 sheep in 1987 and 1988, respectively. This may have occurred because the Subunit 13D portion could support considerably more sheep than found during previous surveys. A thorough survey of all sheep habitat in Subunit 13D is needed to determine the current population level. If substantially more sheep are found there than previously thought, it may be appropriate to change the harvest objective. Surveys in the Unit 11 and Subunit 14A portions of the range should also be completed in order to bring all survey data up to date.

Harvests were monitored throughout the Chugach Mountains. Because of budgetary constraints no documenting of critical habitat has been done in recent years. Given the number of recent land use proposals, related primarily to mining in sheep habitat, efforts to acquire funding for habitat use studies within or adjacent to known sheep habitat should be pursued.

Several proposed regulation changes for sheep in Subunits 14A and 13D were prepared for the Board of Game's consideration during

their March 1989 meeting. The proposals advocated a 4/4- (full) curl regulation for all of Subunits 14A and 13D within the Chugach Mountains. They also offered the option of a permit drawing-permit hunt in the eastern portion of Subunit 13D and a controlled use area (from which aircraft are restricted) in Subunits 14A and 13D. The proposals were developed as a method of increasing mean horn size in an area capable of producing exceptionally large-horned sheep and to reduce harvests and hunting pressure from the record levels of the past 3-4 years. The Board adopted a full-curl regulation for the entire Chugach Range except, Subunit 14C, where any sheep will be legal under a limited-permit hunt.

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Table 1. Sheep population status as determined from aerial surveys in Subunit 14C, 1984-1988.

Year	Legal rams (%)	1/2-7/8 curl rams	Ewes + ≤1/2 curl rams	Lambs (%)	Total
1984	158 (8.6)	269	1,048	357 (19.5)	1,832
1985	138 (8.1)	299	979	294 (17.2)	1,710
1986	172 (8.3)	329	1,206	356 (16.2)	2,063
1987	162 (7.5)	427	1,228	352 (16.2)	2,169
1988	204 (9.6)	379	1,219	334 (15.6)	2,136

Table 2. Chugach Mountains sheep population status as determined from aerial surveys in Subunit 14A, 1984-1988.

Year	Legal rams (%)	1/2-7/8 curl rams	Ewes + ≤1/2 curl rams	Lambs (%)	Total
1984	56 (8.0)	117	380	149 (21.2)	702
1985	-- --	--	--	-- --	--
1986	51 (7.5)	153	371	106 (15.6)	681
1987	-- --	--	--	-- --	--
1988	-- --	--	--	-- --	--

Table 3. Sheep population status as determined from aerial surveys in Subunit 13D, 1983-1988.

Year	Legal rams (%)	1/2-7/8 curl rams	Ewes + ≥1/2 curl rams	Lambs (%)	Total
1983	31 (4.4)	0	593	79 (11.2)	703
1984*	17 (5.8)	12	202	60 (20.6)	291
1985	-- --	--	--	-- --	--
1986	-- --	--	--	-- --	--
1987	-- --	--	--	-- --	--
1988	-- --	--	--	-- --	--

* CA's different in 1984 versus 1983

Table 4. Chugach Mountains sheep population status as determined from aerial surveys in Unit 11, 1973.

Year	Legal rams (%)	Unidentified	Lambs (%)	Total
1973	53 (18.8)	199	30 (10.6)	282

Table 5. Annual subunit harvest of 7/8-curl or larger rams in the Chugach Mountains, 1984-1988.

	14A	14C	13D	11	Total[b]
1984	26[a]	41	57	1	128
1985	26[a]	26	49	3	109
1986	31	30	86	9	158
1987	34	39	77	11	162
1988	27	46	73	6	152

[a] Additionally, 1 ewe killed in 1984 and 6 in 1985.

[b] Total exceeds sum of subunits because some sheep are reported only by mountain range.

Table 6. Sheep hunter residency and success in Subunit 14A, 1984-1988.

	Successful				Unsuccessful			
Year	Local res.	Nonlocal res.	Non-res.	Total	Local res.	Nonlocal res.	Non-res.	Total
1984	10	14	4	28	35	51	1	87
1985	16	15	0	31	42	43	1	86
1986	12	18	1	31	45	60	0	105
1987	12	18	4	34	35	55	2	92
1988	14	10	2	26	40	42	1	83

Table 7. Sheep hutner residency and success in Subunit 14C, 1984-1988.

	Successful				Unsuccessful			
Year	Local res.	Nonlocal res.	Non-res.	Total	Local res.	Nonlocal res.	Non-res.	Total
1984	31	6	0	37	50	10	0	60
1985	25	1	0	26	54	2	0	56
1986	25	5	0	30	85	8	0	93
1987	30	9	0	39	143	19	4	166
1988	34	11	1	46	125	38	0	163

Table 8. Sheep hunter residency and success in Subunit 13D, 1984-1988.

	Successful				Unsuccessful			
Year	Local res.	Nonlocal res.	Non-res.	Total	Local res.	Nonlocal res.	Non-res.	Total
1984	3	30	18	51	18	129	14	161
1985	9	25	14	48	18	115	11	144
1986	7	31	44	82	16	130	11	157
1987	3	44	26	73	18	124	19	161
1988	0	44	25	69	16	108	27	151

Table 9. Sheep hunter residency and success in Unit 11, 1984-1988.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Non-res.	Total	Local res.	Nonlocal res.	Non-res.	Total
1984	0	0	5	5	0	4	1	5
1985	0	0	3	3	4	5	0	9
1986	5	0	4	9	2	1	0	3
1987	3	4	3	10	0	1	1	2
1988	6	0	0	6	1	2	1	4

Table 10. Sheep harvest data by permit hunt area in Subunit 14C, 1984-1988.

Permit hunt area	Year	Permits issued	Did not hunt	Unsuccessful	Successful	Applicants
Goat,	1984	44	14	26	4	819
E. Fork, Eklutna	1985	52	3	38	11	127
Hunter,	1986	48	13	24	9	614
Lake George	1987	75	25	35	15	660
	1988	75	18	46	11	1,285
Peters,	1984	32	13	18	1	406
Thunderbird,	1985	36	2	29	5	90
N. Eagle,	1986	40	14	17	9	295
	1987	45	9	27	9	346
	1988	45	19	18	8	770
S. Eagle,	1984	44	20	20	4	573
Bird,	1985	32	2	21	9	93
Ship,	1986	32	9	18	5	312
	1987	60	17	29	14	418
	1988	60	20	30	10	918
Late season	1984[a]	271	144	127	32	271
all hunt	1986	60	15	36	8	335
areas-gun	1987	60	35	24	1	337
	1988	60	16	34	10	553
Late season						
all hunt	1987	80	51	29	0	112
areas-archery	1988	80	48	30	2	159

Table 10 continued.

Permit hunt area	Year	Permits issued	Did not hunt	Unsuccessful	Successful	Applicants
Eklutna	1987	25	12	13	0	80
archery	1988	25	11	9	5	112

[a] Registration permit hunt.
(x) Number of ewes and young rams taken in addition to larger rams.

Table 11. Sheep harvest chronology in Subunit 14C, 1985-1988.

	8/10-16	8/17-23	8/24-30	8/31-9/6	9/7-13	9/14-20	9/21-27	9/28-10/4	10/5-10/10
1985	--	--	11	6	4	5	--	--	--
1986	--	--	12	6	3	3	7	0	0
1987	13	6	12	4	3	1	0	0	0
1988	12	5	2	6	8	2	3	6	2

Table 12. Sheep harvest chronology in Subunit 14A, 1984-1988.

	Week of harvest					
Year	8/10-16	8/17-23	8/24-30	8/31-9/6	9/7-13	9/14-20
1984	11	1	7	1	3	3
1985	8	3	4	3	3	3
1986	11	5	4	5	3	3
1987	18	2	3	4	3	4
1988	7	6	4	1	7	2

Table 13. Sheep harvest chronology in Subunit 13D, 1984-1988.

Year	8/10-16	8/17-23	8/24-30	8/31-9/6	9/7-13	9/14-20
1984	24	11	10	5	4	6
1985	20	9	4	11	8	0
1986	29	23	16	9	9	8
1987	31	15	10	10	4	3
1988	29	19	9	5	6	4

Table 14. Successful sheep hunter transport methods in Subunit 14C, 1984-1988.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	highway vehicle
1984	2	0	1	1	0	1	27
1985[a]	--	--	--	--	--	--	--
1986	0	1	0	5	0	1	21
1987	1	2	2	3	0	0	28
1988	0	0	4	5	0	0	37

Table 15. Successful sheep hunter transport methods in Subunit 14A, 1984-1988.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	highway vehicle
1984	11	0	5	4	0	3	16
1985	16	0	7	3	0	3	12
1986	20	6	4	3	0	3	20
1987	16	9	8	3	0	1	11
1988	12	3	1	4	0	1	5

Table 16. Successful sheep hunter transport methods in Subunit 13D, 1984-1988.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	highway vehicle
1984	38	5	3	0	0	0	14
1985	24	7	4	1	0	0	13
1986	52	14	8	4	0	1	14
1987	44	9	4	4	0	0	15
1988	51	5	5	0	0	2	7

STUDY AREA

GAME MANAGEMENT UNIT: Portions of 12 (26,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Mentasta, Nutzotin, and Northern Wrangell Mountains

BACKGROUND

The sheep population in the northern Wrangell, Mentasta, and Nutzotin (WMN) Mountains exist in typically rugged, glaciated habitats at relatively high densities. These populations are stable and productive, and the primary management goal for Unit 12 is to protect, maintain, and enhance them and their habitat in concert with other components of the ecosystem. The secondary goal is to provide for diversified human recreational use of sheep in the WMN Mountains (Kelleyhouse and Heimer 1989).

The WMN Mountain sheep populations produce rams with horns of below-average size, compared with other sheep populations in Alaska (Heimer and Smith 1975). The relative abundance of sheep and production of rams with slightly less-than-average-sized horns suggest that conservative harvest for maximum trophy production would be an unsuitable management strategy for consumptive use in Unit 12 (Kelleyhouse and Heimer 1989). Consequently, the strategic consumptive use goal for Unit 12 is to provide the greatest opportunity to participate in hunting sheep. No restrictions beyond limiting harvest to full-curl rams during the fall hunting season and requiring hunting licenses and harvest tickets are applied in Unit 12. The evolution of these restrictions was presented in last year's report (Kelleyhouse and Heimer 1989).

MANAGEMENT OBJECTIVES

To manage for maintenance of a population of approximately 12,000 sheep.

To provide the greatest opportunity to participate in hunting sheep.

METHODS

Methods applied during this reporting period were limited to harvest data collection and analysis (Kelleyhouse and Heimer 1989).

RESULTS AND DISCUSSION

Population Size:

There is no reason to suspect population size has changed significantly from last year, because there were no unusual weather events nor changes in natural predation or hunting management. Dall sheep populations tend toward stability under these conditions (Heimer 1988).

Population Composition:

Population composition varies from year to year, depending on lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting management (Heimer 1988). Weather was not unusual, there were no discernible changes in natural predation, and hunting management in Unit 12 is designed to minimize the effects on production, recruitment, and survival through limiting harvest to full-curl rams.

Distribution and Movements:

There are no data which suggest distribution and movements are different than reported by Kelleyhouse and Heimer (1989).

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters is 10 August to 20 September. The bag limit is 1 ram with full-curl horn or larger or with both horns broken.

Human-induced Mortality:

Four hundred twenty-seven hunters reported harvesting 222 full-curl rams from the WMN Mountains, representing a hunter success rate of 52% during the fall 1988 hunting season (Table 1). Mean horn length was 34.3 inches, slightly greater than the mean length of 33.7 inches for 1979-83, when legal rams were defined as 7/8 curl (Table 1). Ten rams (4.5%) had horns lengths >39 inches, and only 4 (1.8%) had horns $\geq$40 inches. In contrast, the Tok Management Area, which is suitable for trophy management, produced a ram harvest with 19% of the rams having horns longer than 39 inches. This demonstrates the appropriateness of the "maximum opportunity" objective for consumptive use in Unit 12. The mean reported age of harvested rams was 8.7 years (n = 214). Mean age for this reporting period was 1.5 years greater than the mean of 7.2 years during the period of 7/8-curl management.

Hunter success, average horn length, and age of harvested rams do not appear to have changed significantly since establishment of the full-curl regulation in 1984. Hence, change to the full-curl

horn requirement did not result in declines in the harvests. Total ram harvests in the last 3 years have been the highest ever recorded, exceeded only by 1981 when the harvest reached the all-time high of 267 rams (Table 1).

Hunter Residency and Success. Eighty-five nonresidents constituted 20% of the total hunters using the WMN Mountains during the fall 1988 season. They enjoyed an 86% success rate. In contrast, 298 resident hunters had a harvest success rate of 49%. Overall hunter success in Unit 12 was 51%, which is typical for sheep hunters in the northern WMN. Only 8 residents of Unit 12 reported hunting sheep in the WMN Mountains.

Harvest Chronology. Most sheep were taken early in the hunting season. Eighty-seven rams (40% of the harvest) were taken during the 1st week of the season, and 50 rams (23% of the total) were taken during the 2nd week. During the remaining 4 weeks of the season 13 to 25 rams (6-11% of the harvest) were harvested. This harvest chronology is typical for the WMN Mountains.

Transport Methods. Of the 210 successful hunters who reported their transportation methods, 130 (62%) used aircraft, 40 (19%) used horses, 24 (11%) used highway vehicles, nine (4%) used boats, and seven (3%) used three- or four-wheelers. Of all aircraft-transported hunters (n = 187), 70% were successful. Hunters using horseback access (n = 57) were also 70% successful. The 15 hunters who used boats or rafts for transportation were 60% successful, and 68 hunters using highway vehicles had a success rate of 35%. The 30 hunters using three- or four-wheelers were 23% successful, and the 4 hunters who used off-road vehicles did not harvest any rams. Twelve hunters did not specify a means of access.

Natural Mortality:

There are no data which suggest changes in natural mortality from those reported by Kelleyhouse and Heimer (1989).

Habitat

Habitat and habitat management concerns remain unchanged from last year (Kelleyhouse and Heimer 1989).

Game Board Actions and Emergency Orders

There were no changes in regulations during the report period.

CONCLUSIONS AND RECOMMENDATIONS

The goals and objectives for management of Dall sheep in Unit 12 are currently being met. There are no immediate threats to the stability of sheep populations or their habitats, and these populations are providing more harvest opportunity than is being

utilized by hunters during the open season. The maximum sustainable harvest is projected to be more than twice the current level of ram harvest. Hence, the goal of providing maximum opportunities to participate in sheep hunting is being achieved at this time. Additional sheep harvesting opportunities could be provided by allowing the taking of ewe sheep; however, it may not be socially acceptable and would require substantially more population monitoring to assure attainment of the primary management goal of protecting, maintaining, and enhancing these sheep populations.

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Table 1. Number of hunters, rams harvested, and success rates for Unit 12 for the period 1979-88.

Year	Number of hunters	Ram harvest	% Success	$\bar{x}$ horn size
1979[a]	294	175	60	
1980[a]	262	136	44	
1981[a]	399	228	57	$\bar{x}$ 33.7[a]
1982[a]	431	227	53	
1983[a]	435	205	47	
1984[bc]	399	155	39	34.0
1985[b]	459	216	47	33.6
1986[b]	499	258	52	33.6
1987[b]	435	231	51	34.0
1988[b]	427	222	52	34.3

[a] 7/8-curl legal rams 1979-84.
[b] Full-curl legal rams.
[c] Unusually bad weather during early hunting season.

STUDY AREA

GAME MANAGEMENT UNITS: Portions of 12, 13, and 20 (1,500 mi^2)

GEOGRAPHICAL DESCRIPTION: Tok Management Area

BACKGROUND

The Tok Management Area (TMA) was created in 1974 to provide opportunities for sheep hunters to harvest large-horned, trophy Dall sheep rams. This objective is the primary consumptive use aspect of a management goal to provide for diversified human recreational use in this area (Kelleyhouse 1989). The TMA is known for production of fast-growing, large-horned rams (Heimer and Smith 1975).

Hunter management in the TMA was designed to limit harvest by controlling hunter numbers through a limited entry drawing-permit system. This system keeps annual harvests low enough to allow some rams to attain their maximum potential horn size. Harvests are also restricted to rams with at least full-curl horns. This system has been successful, and the primary human-use objective (ADF&G 1976) of providing an opportunity to take large rams is currently being achieved.

A secondary management objective of providing the opportunity to hunt sheep under aesthetically pleasing conditions is also being attained by maintaining low hunter density, high legal ram abundance, the presence of large trophy rams, the abundance of other wildlife, maintenance of varied opportunities for access to the area, and other high-quality hunting experience components, which are assured through the limited-entry drawing-permit system for hunting. A more complete history of management in the TMA is available in Kelleyhouse (1989).

MANAGEMENT OBJECTIVES

To maintain a population capable of producing submaximal ram harvests of 30-45 rams each year.

To maintain a mean horn length of 36-37 inches among harvested rams as well as a mean age of 8-9 years.

To maintain the average percentage of rams with 40-inch or greater horns in the harvest at 7-10%.

To prevent unacceptable increases in hunter concentration and maintain the existing aesthetically pleasing qualities associated with sheep hunting in the TMA.

METHODS

Methods used during this reporting period were limited to collecting and analyzing harvest data, refining specific management and population objectives, and gathering data on population composition. During the period 29 June-1 July, a trained, experienced volunteer, Sue Entsminger, walked to the Sheep Creek mineral lick and classified sheep in the following categories: lambs; yearling males and females; ewes; and 1/4-, 1/2-, 3/4-, and full-curl rams (Heimer and Watson 1986).

RESULTS AND DISCUSSION

Population Status and Trend

Under normally prevailing environmental conditions in Interior Alaska, recruitment and mortality are roughly balanced, and sheep populations are generally stable (Heimer 1988). There were no indications of disturbance of this reported equilibrium, so the population is assumed to be approximately stable at about 2,000 sheep (Kelleyhouse 1989).

Population Composition:

Population composition varies from year to year as a function of lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting management (Heimer 1988). The notable variable this past year was winter weather, which was considered mild because of low snow accumulation. This should have favored lamb production and survival of last year's lambs to yearling age (Heimer 1988).

One hundred thirty-six sheep were classified at the Sheep Creek mineral lick in late June and early July 1988. Nine yearling rams, one 1/4-curl, two 1/2-curl, and one 3/4-curl rams were seen. An additional 11 yearling ewes, 18 ewes without lambs, and 47 ewes with lambs were classified. This admittedly small sample suggests a lamb:100 ewe ratio of 72:100. There were also 31 yearlings:100 ewes, which is slightly higher than normal for yearling recruitment among these populations. The mean yearling recruitment has been 27 yearlings:100 ewes since 1974 (Heimer and Watson 1986).

Distribution and Movements:

Heimer (1988) summarized movement data typical of Dall sheep, and Heimer and Watson (1986) reported on movements and distribution of ewes in the TMA. Although no further data on distribution and movements were collected during this reporting period, there is no reason to suspect distribution and movements were different than those reported previously.

Mortality

Seasons and Bag Limits:

The open season is 10 August to 20 September. The bag limit is 1 ram every 4 regulatory years by drawing permit only. Rams must have full-curl horns or larger or with both horns broken. One hundred twenty permits are issued each year.

Human-induced Mortality:

Permittees reported harvesting 52 rams; ten of these rams (19%) had horns measuring greater than 39 inches, and six (12%) had horns measuring above 40 inches. The average horn length of these rams was 36.6 inches (range = 23.5 to 43.8 inches). The average reported age of rams harvested was 8.8 years (range = 6 to 14 years). These values are typical with respect to past years (Kelleyhouse 1989, Table 1) and continue to meet the harvest management objectives.

Hunter Residency and Success. Resident Alaskans received 116 (97%) of the permits; nonresidents received four (3%) of the 120 permits. Three of the nonresidents were successful (75% harvest rate), and 49 of the 81 residents were successful (60% success rate). The overall success rate was 61%, the highest ever recorded. It cannot be explained by a preponderance of guided hunters (who often have a mean harvest success of 60-80%). The most reasonable explanation is that experienced sheep hunters drew the permits this year, they had unusually favorable weather for hunting, and they found many suitable rams readily available for harvest. Also, air taxi operators serving the area have continually pioneered new landing areas, making more rams available without hiking heroic distances. This may also contribute to the trend for increasing harvest success in the TMA (Table 1).

Complaints concerning the difficulty local guides have in securing nonresident clients persisted (Kelleyhouse 1989). As reported earlier, only 4 nonresident hunters received permits in 1988.

Permit Hunts. There were 1,495 applicants for the 120 available permits. This was an increase of 36% above last year, lowering the probability of an individual being selected from 1 chance in 11 to 1 chance in 12. Of the 120 permits distributed, 85 permit holders hunted (71%) (Table 2). In three of the past 5 years permit utilization has been 70% or greater. If permit utilization continues at this high rate and harvest success continues to be high, it may be necessary to reduce the number of permits issued to continue attaining the management objectives.

Transportation Methods. Hunters who reported using aircraft (n = 41) were 78% successful, and those walking in from their highway

vehicle (n = 30) were 50% successful. Hunters using off-road vehicles and horses (n = 10) were 50% successful.

Natural Mortality:

There are no data which suggest changes in natural mortality from those reported by Kelleyhouse (1989).

Habitat

Habitat and habitat management concerns remain unchanged from last year (Kelleyhouse 1989).

CONCLUSIONS AND RECOMMENDATIONS

The sheep populations of the TMA continue to provide unique opportunities for hunters to seek large-horned rams under aesthetically pleasing conditions. The continuing popularity of the trophy management program in the TMA suggests development of similar opportunities in other suitable areas would be well received by the public. At the present time, only 5% of the huntable sheep in Alaska are managed specifically for trophy hunting (Heimer 1985). Sheep in the Chugach Mountains have trophy potential exceeding that of TMA sheep (Heimer and Smith 1975). This trophy potential could be realized with appropriate management.

It may be desirable to provide greater opportunity for nonresidents to hunt sheep in the TMA. This would recognize the national and international significance of this area, the only Dall sheep trophy management area in the United States. Continued national and international recognition of this area's sheep should benefit these populations over the long term.

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Table 1. Harvest of Dall sheep rams in the Tok Management Area, 1984-88.

Year	Total harvest	Total hunters	% Success	Horn length				Mean age(yrs)
				Average	≥39"	(%)	≥40" (%)	
1984	28	66	42	36.6	4	(14)	0 (0)	--
1985	38	84	45	No data collected				
1986	41	89	46	36.9	7	(17)	4 (10)	--
1987[a]	41	62	66	36.1	4	(10)	3 (7)	8.6
1988	52	85	61	36.6	10	(19)	6 (12)	8.8
$\bar{x}$	40	77	52	36.6	6	(15)	3 (8)	8.7

[a] Reporting incomplete because no reminder letter was sent to nonreporting permittees. See Kelleyhouse (1989).

Table 2. Permit utilization by successful applicants in the Tok Management Area 1984-88.

Year	Permits issued	Permits utilized	% Utilization
1984	120	66	55
1985	120	84	70
1886	120	89	74
1987	120	62	52
1988	120	85	71

STUDY AREA

GAME MANAGEMENT UNIT: 13A, 13E, 14A, and 14B (15,835 mi^2)

GEOGRAPHICAL DESCRIPTION: Talkeetna Mountains and Chulitna-Watana Hills

BACKGROUND

Aerial surveys and other biological investigations of Dall sheep populations in the Talkeetna Mountains and Chulitna-Watana Hills (TCW) have been sporadic since statehood, because (1) biological effects of harvests restricted to mature rams have not been considered significant and (2) the ADF&G has had insufficient funding and manpower to conduct extensive surveys. Although data are sparse, sheep numbers during the past 10 years appear to have remained relatively stable or increased slightly.

POPULATION OBJECTIVES

To maintain a population of sheep that will sustain a mean annual harvest of 75 rams.

METHODS

The harvest was monitored by compiling statistics from harvest reports submitted by hunters and comparing this data with information from previous years. No other specific activities were identified for sheep in the TCW.

RESULTS AND DISCUSSION

Population Status and Trend

Because sheep surveys in the TCW have been infrequent, the data base to interpret population trends and sheep density is sparse. Surveys from Subunit 14A north of the Matanuska River (TCW) indicate that sheep numbers may have increased. In 1974 observers counted 423 sheep; the number increased to 628 in 1981 and 923 in 1986, but it decreased to 866 in 1988 (Table 1). Because of variation in count conditions and, in some cases, count areas, all counts are not directly comparable; however, the data suggest an increasing number of sheep. Aerial surveys in Subunit 14A south of the Matanuska River (a portion of the Chugach Mountains, immediately adjacent to and similar to the Talkeetna Mountains) indicate that sheep numbers there have remained relatively stable or increased slightly: in 1976, 709 sheep were observed; in 1980 and 1982 only a respective 502 and 559 sheep were observed; and in 1984 and 1986 the counts indicated increases of 702 and 681, respectively (Table 1).

Based on aerial surveys in Unit 14, relatively stable but low harvest of rams, and recent mild winters, I believe sheep numbers in the Talkeetna Mountains have increased slightly during the last decade.

Population Size:

Past aerial surveys have not covered all of the sheep habitat in the TCW in the same year; most surveys covered less than half of the total area. The highest number of sheep that have ever been observed in any one year was 1,249 in 1982, and this count did not include any portion of Unit 14. Population estimates in the TCW have been derived indirectly by comparing the results on all population surveys from 1974 to 1988. The smallest total number of sheep from all count areas combined is 1,515; the largest combined total is 2,520 (Table 1). From 1982 to September 1988, the largest number of sheep counted in any 1 year by subunit was as follows: (1) Subunit 14A, 581; (2) Subunit 14B, 371; (3) Subunit 13A, 1,049; and Subunit 13E, 209 (Table 1). Counts from these subunits total 2,210 sheep. It is probably safe to assume that the minimum number of sheep in the TCW is 1,500; however, the available data suggest a population of closer to 2,500 sheep.

Population Composition:

The most recent sheep composition data were obtained in 1988, while conducting mountain goat surveys in Subunits 14A and 14B. The population composition in a sample of 866 sheep follows: 5 legal rams:100 ewes, 36 sublegal rams:100 ewes, and 33 lambs:100 ewes. Lambs composed 19% of the population (Table 2). Since 1981 only 4 composition surveys have been conducted in Subunits 14A and 14B (Table 2). Although the data are sparse, 3 relatively consistent trends are apparent: (1) lamb production has varied little ranging from 30-38 lambs:100 ewes; (2) the ratio of sublegal rams to ewes has ranged between 29-36:100, and (3) the ratio of legal rams to ewes appears to have declined from 15:100 to 5:100. Legal rams composed 8.4% of the sheep population in 1981, declined to 6.4% in 1986, and then declined to 2.7% in 1988 (Table 3). It is possible that sampling error could account for some decline in the ratio of legal rams, especially in areas where hunting pressure has substantially increased (i.e., rams are more wary/solitary and harder to spot from the air); however, it's unlikely that the decline in legal rams can be attributed solely to sampling error. Numbers of sheep observed in 1986 and 1988 were relatively similar (923 and 866, respectively), yet the number of legal rams observed in 1988 declined from 59 to 24. I believe the composition data are fairly accurate and a substantial decline in the number of legal rams has occurred during the past 8 years.

Mortality

Season and Bag Limit:

The open season for subsistence, resident, and nonresident hunters in Subunits 13A, 13E, 14A, and 14B is 10 August to 20 September; the bag limit is 1 ram with 7/8-curl horn or larger.

Human-induced Mortality:

Beginning in the early 1980's, the annual harvest of rams began to steadily increase. From 1980 to 1983 harvests ranged from 53 to 96 ($\bar{x}$ = 72). Then during the 3-year period from 1984 to 1986, harvests increased substantially, ranging from 101 to 118 (mean = 108). In 1987, the harvest unexpectedly declined to 82 rams (Table 4). The cause of the abrupt decline is not known, but availability of legal rams and poor weather may have been factors. In 1988 hunters harvested 105 rams, an increase of 23 rams over the previous year. The 1988 harvest was comparable in magnitude to the high harvests between 1984 and 1986. The principal factor responsible for the relatively high harvest of rams in the past 5 years has been a substantial increase in the number of hunters.

Aerial surveys have indicated that the greatest number of sheep occur in Subunit 13A; the least, in Subunit 13E (Table 1). Hunter harvests show a similar pattern. Of the 105 rams killed, 62 were taken in Subunit 13A, and only 21 were taken in Subunit 13E. Despite the low harvest in Subunit 13E, the combined harvest in Unit 13 has consistently been larger than that for Unit 14; in most years the ram harvest in Unit 13 has been nearly twice as large as those in Unit 14. However, the harvest in Unit 14 has been increasing in recent years. During the early 1980's the mean harvest in Unit 14 was 25 rams, but over the past 3 years the mean harvest has increased to 40 rams. In contrast, the harvest in Unit 13 has continued to average close to 60 rams annually. In 1988 hunters took 62 rams in Unit 13 compared with 43 rams in Unit 14 (Table 4).

Hunter Residency and Success. During the period 1983 to 1988 approximately 70-80% of the annual harvest in the TCW has been by Alaska residents; however, the nonresident harvest during this period was gradually increased. In 1983 nonresidents took 17 rams; in 1988 nonresidents took 40 rams, the most ever, accounting for 38% of the total harvest (Table 6).

The proportion of local versus nonlocal Alaska residents who have hunted in Unit 13 has been considerably different from the proportion that has hunted in Unit 14. Unit 13 hunters have been predominately nonlocal residents (73% nonlocal, compared with 5% local). In contrast, Unit 14 hunters have been predominantly local residents, accounting for 53% of the harvest, compared with 5% for nonlocal residents (Tables 5 & 6).

In comparing subunits, the heaviest hunting pressure has occurred in Subunit 13A. From 1983 to 1988 the annual mean number of hunters in Subunit 13A was 169, followed by Subunit 14A with 68, Subunit 13E with 48, and Subunit 14B with 32. The mean success rate has been inversely proportional to the number of hunters; subunits with the fewest hunters have had the highest success and those with the most hunters have had the lowest sucess. The highest success rate in 1988 was 45% in Subunit 14B. The success rates for other subunits in descending order were Subunit 13E, 40%; Subunit 14A, 34%; and Subunit 13A, 24% (Tables 5 & 6). Two important points are worth noting: (1) the number of hunters has gradually increased in the past 6 years, most notably in Subunits 13A (129 to 208) and 14B (19 to 40) and (2) in any year in which the number of hunters increased (i.e., either within the subunit or the TCW as a whole), the success rate almost always dropped. These data suggest that hunters are taking most of the legal rams as they become available in the population, and few places remain where sheep have not been hunted.

Harvest Chronology. Over the past 7 years the chronology of harvest has been from year to year. Approximately 40% of the sheep were taken in the first 2 weeks, and the remaining 60% were spread over the last 5 weeks. (Table 7).

Transport Methods. In the past 7 years the most popular transportation method has been aircraft, accounting for 47-58% of the successful hunters (Table 8). The number of successful hunters who used an aircraft declined from 57 in 1986 to 36 in 1987, but this decline reflects a smaller 1987 harvest, not reduced success of hunters using aircraft.

Use of other transport methods has also remained relatively constant, except for the use of horses. In 1984 no hunters used horses to take a sheep, while in 1988, 17 successful hunters reported using this method.

Game Board Actions and Emergency Orders

Since statehood, the harvest of rams in the TCW has been restricted to a 3/4curl horn or larger. In 1978 the Board of Game amended the regulations in most areas of the state, requiring legal rams to have a horn of 7/8 curl or larger. This is the present regulation throughout the TCW.

In 1982, at the Department's request, the Board of Game established a drawing-permit hunt for ewe sheep in Subunit 14A. Ten drawing permits were issued annually through 1985. Because of complications with the state subsistence law, the board terminated this hunt in 1986.

CONCLUSIONS AND RECOMMENDATIONS

The mean annual harvest in the TCW since 1980 is 89 rams; the 1988 harvest was 105 rams. The harvests from 1984 to 1988 have met the management population objective of providing at least 75 rams annually. This objective, however, was exceeded largely because enough legal rams were available to provide well in excess of 75 rams and the hunting pressure has increased significantly over the decade.

There are problems that are affecting or may affect the management of sheep in the TCW that should be addressed. General sheep population status, including numbers, density, distribution, and composition, is not well understood because data have been collected so infrequently. Subunit 13A has received the heaviest hunting pressure of all of the 4 subunits in the TCW, accounting for 40-50% of the annual harvest, yet comprehensive aerial surveys have been conducted only twice in this subunit in the past 11 years. Although nearly twice as many aerial surveys have been conducted in Subunits 14A and 14B, data on the status of sheep population are still insufficient to make well-informed management recommendations. Long-term plans to conduct sheep surveys or other work on sheep population status currently do not exist, largely because of budgetary constraints. Hunting pressure has increased substantially since 1983 (i.e., from 241 hunters to 333 in 1988). In 1987 the ram harvest decreased 30% from the previous year, in spite of the fact that the number of hunters did not decline. In 1988 the number of hunters declined slightly while the harvest increased, but hunters still complained of crowded conditions and difficulty in finding legal rams. Limited resource data make it difficult to satisfactorily answer the public's questions concerning the lack of legal rams and to determine what management actions should be recommended.

Dall sheep are highly regarded by the hunting and nonhunting public alike. Some hunters spend thousands of dollars each year for the opportunity to hunt a legal ram. Because there is such strong interest in sheep, a long-term operational plan dedicating manpower and money for sheep management is needed. Unfortunately, the outlook for regular funding of sheep surveys is not good, and years may pass between surveys. If the Department is to effectively identify and respond to management problems, the acquisition of current population information must take place on a planned, recurring basis. Use of current harvest data and outdated population information may be an acceptable alternative, if funding is unavailable and harvest is restricted to mature rams. However, this management scenario is not the preferred alternative, because there is a risk of not detecting a major change in sheep population status and/or making a decision on sketchy data that may result in an inappropriate management action.

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Table 1. Sheep population status by subunits in the Talkeetna Mountains and west/central Chugach Mountains as determined from aerial surveys, 1974-1988.

	Talkeetna Mountains Subunits						
Year	14A	14B	14 A&B	13A	13E[a]	Talkeetna Mts. Totals	Chugach Mts. Subunits 14A
1974	222	201	423	--	76	499	--
1976	--	--	--	--	130	130	709
1978	--	--	--	1,359	152	1,511	--
1979	--	--	--	--	189	189	--
1980	--	--	--	--	174	174	502
1981	336	292	628	--	209	837	--
1982	--	--	--	1,049	200	1,249	559
1983	370	168	538	--	149	687	--
1984	--	--	--	--	--	0	702
1986	552	371	923	--	--	923	681
1987	--	--	--	--	--	--	--
1988	581	285	866	--	--	866	--
Lowest	count	222	168	1,049	76	1,515	
Highest	count	581	371	1,359	209	2,520	

[a] Including Watana Hills and Chulitna Mountains.

Table 2. Sheep composition in the Talkeetna Mountains Subunits 14A and 14B, as determined from aerial surveys, 1981-1988.

Year	Legal Rams/ 100 Ewes & Unidentified	Sublegal Rams/ 100 Ewes & Unidentified	Total Rams/ 100 Ewes & Unidentified	Lambs/ 100 Ewes & Unidentified	% Lambs in herd	Total sheep	Sheep/ hour
1981	15	29	44	38	21	628	27
1982	No survey	--	--	--	--	--	--
1983	14	33	46	23	14	538	28
1984	No survey	--	--	--	--	--	--
1985	No survey	--	--	--	--	--	--
1986	11	30	41	30	17	923	40.0
1987	No survey	--	--	--	--	--	--
1988	5	36	41	33	19	866	44.2

Table 3. Sheep population status and composition in Talkeetna Mountains Subunits, 14A and 14B, as determined from aerial surveys, 1981-1988.

Year	Legal rams No.	Legal rams (%)	Sublegal rams	Total rams No.	Total rams (%)	Ewes & unidentified	Lambs	Total	Hours/ count time
1981	53	(8)	99	152	(24)	344	132	628	23.6
1982	No survey	--	--	--	--	--	--	--	--
1983	43	(8)	103	146	(27)	317	75	538	19.4
1984	No survey	--	--	--	--	--	--	--	--
1985	No survey	--	--	--	--	--	--	--	--
1986	59	(6)	161	220	(24)	543	160	923	40.0
1987	No survey	--	--	--	--	--	--	--	--
1988	24	(3)	178	202	(23)	501	163	866	19.6

Table 4. Harvest of rams with 7/8 curl or larger horns in the Talkeetna Mountains, by unit and subunit, 1980-1988.

Year	Unit/Subunit						Total
	14A	14B	14	13A	13E	13	
1980	unk	unk	21	unk	unk	59	80
1981	unk	unk	34	unk	unk	62	96
1982	unk	unk	20	unk	unk	43	53
1983	17	5	22	29	7	36	58
1984	15	10	25	52	23	76[a]	101
1985	20	16	37[a]	47	18	68[a]	105
1986	27	22	49	43	26	69	118
1987	16	13	29	39	14	53	82
1988	23	20	43	41	21	62	105
Mean	20	14	31	41	18	59	89

[a] Includes rams not identified to subunit.

Table 5. Sheep hunter residency and success in the Talkeetna Mountains, Subunits 13A and 13E, 1983-88.

		Successful				Unsuccessful					
Subunit	Year	Local resident	Nonlocal resident	Nonresident	Total[a]	Local resident	Nonlocal resident	Nonresident	Total[a]	Total hunters	Success rate
13A	1983	unk	27	2	29	unk	93	5	100	129	22%
	1984	unk	37	12	52	unk	96	2	100	152	34%
	1985	3	36	7	47	7	106	4	117	164	29%
	1986	2	34	5	43	5	136	2	146	189	23%
	1987	-	27	11	39	10	147	9	169	208	19%
	1988	1	25	12	41	3	109	8	129	170	24%
	Mean[a]	2	31	8	42	6	115	5	127	169	25%
13E	1983	unk	3	4	7	unk	18	0	18	25	28%
	1984	unk	18	5	23	unk	20	0	22	45	51%
	1985	1	16	1	18	2	24	0	26	44	41%
	1986	1	19	6	26	5	29	2	37	63	41%
	1987	0	8	5	14	4	38	1	43	57	25%
	1988	0	14	6	21	3	26	.5	32	53	40%
	Mean[b]	1	13	5	18	4	24	.6	30	48	38%

[a] Total includes some identified hunters.

[b] Mean for local and nonlocal was calculated only on 1985 through 1987 data because harvest data for local residents were not available prior to 1985.

Table 6. Sheep hunter residency and success in the Talkeetna Mountains, Subunits 14A, 14B, 13A, and 13E combined, 1983-88.

		Successful				Unsuccessful					
Subunit	Year	Local[a] resident	Nonlocal[a] resident	Nonresident	Total[b]	Local[a] resident	Nonlocal[a] resident	Nonresident	Total[b]	Total hunters	Success rate
14A	1983	9	0	8	17	46	0	3	49	66	26%
	1984	10	0	5	15	47	0	2	49	64	23%
	1985	12	0	7	20	38	1	3	42	62	32%
	1986	12	2	12	27	44	5	3	52	79	34%
	1987	12	0	4	16	44	8	2	55	71	22%
	1988	9	2	12	23	38	3	1	44	67	34%
	Mean[c]	11	1	8	20	43	4	3	49	68	29%
14B	1983	2	0	3	5	13	0	1	14	19	26%
	1984	5	0	4	10	16	0	1	18	28	36%
	1985	11	0	5	16	12	2	6	20	36	44%
	1986	13	1	6	22	12	0	4	17	39	56%
	1987	7	0	6	13	13	3	4	20	33	39%
	1988	15	2	10	20	11	0	8	20	40	50%
	Mean[c]	7	.6	6	14	13	1	4	18	32	34%
TCW	1983	unk	41	17	58	0	171	10	183	241	24%
	1984	unk	71	26	101	0	186	5	195	296	34%
	1985	27	82	21	105	60	133	16	209	304	35%
	1986	28	56	29	118	66	105	12	254	372	32%
	1987	19	35	26	82	70	128	18	290	372	22%
	1988	16	43	40	105	55	139	19	228	333	31%
	Mean[c]	23	55	27	95	63	186	13	227	320	30%

[a] Local residents are hunters residing in the subunits. Specific (local or nonlocal) residency of hunters was not determined prior to 1985. Data shown as local resident for 1983 and 1984 includes all residents.

[b] Total includes some hunters of unknown residency.

[c] Mean for local and nonlocal was calculated only for 1985 through 1988 because harvest data for local residents were not available prior to 1985.

Table 7. Sheep harvest chronology, Talkeetna Mountains, 1983-1988.

Year	8/10-8/15		8/16-8/22		8/23-8/29		8/30-9/5		9/6-9/12		9/13-9/19		9/20-9/26		Unk		Total
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
1983	16	(27)	6	(10)	10	(17)	14	(24)	7	(12)	2	(4)	2	(4)	1	(1)	58
1984	15	(15)	32	(31)	13	(13)	12	(12)	13	(13)	9	(9)	3	(3)	4	(4)	101
1985	8	(8)	24	(23)	16	(15)	15	(14)	12	(11)	18	(17)	10	(10)	2	(2)	105
1986	39	(33)	20	(17)	16	(14)	9	(7)	14	(12)	15	(12)	2	(2)	3	(3)	118
1987	26	(32)	20	(24)	16	(20)	8	(10)	3	(4)	5	(6)	1	(1)	3	(3)	82
1988	23	(22)	25	(24)	7	(7)	14	(13)	14	(13)	10	(10)	10	(10)	2	(2)	105
Mean	21	(22)	21	(21)	13	(15)	12	(13)	10	(11)	10	(11)	5	(4)	3	(3)	95

Table 8. Successful sheep hunter transport methods, Talkeetna Mountains, 1983-1988.

Year	Airplane		Horse		Boat		3-or 4-wheeler		Snowmachine		ORV		Vehicle		Total
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
1983	30	(52)	4	(7)	0	-	1[a]	(2)	0	-	14	(24)	9	(15)	58
1984	57	(58)	0	-	0	-	11	(11)	0	-	10	(11)	19	(20)	97
1985	54	(55)	1	(1)	1	(1)	16	(16)	0	-	6	(6)	20	(21)	98
1986	57	(51)	9	(8)	1	(1)	18	(16)	0	-	9	(8)	16	(16)	111
1987	36	(47)	14	(18)	1	(1)	11	(14)	0	-	5	(7)	10	(13)	77
1988	46	(46)	17	(17)	4	(4)	16	(16)	0	-	6	(6)	10	(10)	99
Mean	47	(52)	8	(9)	1	(1)	12	(13)	0	-	8	(9)	14	(15)	90

[a] Prior to 1984, 3 or 4-wheelers were included in the ORV category.

STUDY AREA

GAME MANAGEMENT UNIT: 13B, 20A, portions of 20D (1,680 mi^2)

GEOGRAPHICAL DESCRIPTION: Delta Controlled Use Area (DCUA)

BACKGROUND

Sheep seasons and legal harvest have become progressively more restrictive in the eastern Alaska Range over time (Table 1). This was necessary as human populations increased and Dall sheep conservation required more active management. As this process evolved, hunters began to demand assurance of certain types of hunting experiences. The DCUA, which was formerly known as the Delta Management Area, was the 1st attempt to meet these demands. The Delta Management Area was established prior to the hunting season in 1971 to provide sheep hunters with high-quality walk-in hunting opportunities free from competition with other transportation types.

In the Delta Management Area, the use of motorized vehicles and pack animals for transporting hunters, hunting gear, or game was initially prohibited for the 1st portion of the 10 August-20 September hunting season. After 25 August the transportation restrictions were lifted and mechanized and pack animal access was permitted. The bag limit was 1 ram with 3/4-curl or larger horns.

Designation of the Delta Management Area as a walk-in only area successfully provided hunting opportunities but failed to reduce harvest to the desired level or provide high-quality hunting experiences. Rams were still being subjected to heavy hunting pressure, resulting in excessive harvest, reduced horn size, and a great deal of hunter competition. In 1977 hunters killed 78 rams, even though the desired harvest objective was 40 rams (Larson 1979).

In an effort to achieve the harvest and aesthetic quality objectives, sheep hunting in the Delta Management Area was restricted by lottery permit in 1978. Sixty permits were issued for a 10-25 August walk-in season, and 60 permits were issued for a 26 August-20 September open-access season. The bag limit was 1 ram with 3/4-curl horns or larger. As expected, the permit hunt reduced the hunting pressure and harvest. Harvest was reduced from 78 rams in 1977 to 31 rams in 1978, but the average horn size decreased to an all-time low of 31.2 inches (Larson 1980).

In 1979 minimum horn size for legal sheep in all of Unit 20 was increased from 3/4 to 7/8 curl. The 7/8-curl regulation did not affect the number of rams harvested in the Delta Management Area, but average horn size increased from 31.2 inches in 1978 to 34.6 inches in 1979 (Larson 1979).

In 1981 the Delta Management Area was renamed the Delta Controlled Use Area to more accurately reflect its classification as a controlled use area rather than a management area. In 1984 minimum horn size for legal sheep in Unit 20 was raised from 7/8 curl to full curl. The season and bag limit in the DCUA have not changed since 1984, excepting 1985 when Tier II subsistence regulations were adopted for the DCUA.

MANAGEMENT OBJECTIVES

To manage a population of approximately 1,800 sheep, providing mean annual harvests of 35 full-curl rams, horn lengths of more than 36 inches, and age exceeding 8 years.

To provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means.

METHODS

Human Use Management

Hunters selected in the permit lottery were required to report on their activities. Data contained on the permit reports were analyzed to determine success, residence, hunter effort, ram horn size, harvest location, and transportation type. Hunters were also asked to complete a questionnaire about their hunt. The questionnaires were mailed to all hunters and hunters were asked when, how many days, and where they hunted. They were also asked how many people were in their party, how many other parties were encountered, and how many people were in each. Hunters reported how many sheep were seen, their composition, if any sheep had neckbands or ear tags, their location, and neckband or ear tag number. Finally, hunters were asked if they were satisfied with the quality of their hunt and if they have any suggestions for improvements.

Herd Inventory and Management

A serologic survey begun in 1987 was continued during the period 1988-89. The objective of this survey is to determine the occurrence of microbial disease agents in DCUA sheep. Sheep were captured with a rocket net at the Granite Creek mineral lick (Heimer et al. 1980). Captured sheep were given injections of acepromazine, blind-folded, and hobbled. Twenty ml of blood were collected from each sheep, and serum was collected using techniques described in Heimer et al. (1982). Serum was tested for antibody titers to the following diseases: bovine progressive pneumonia, contagious ecthyma, epizootic hemorrhagic disease, bluetongue, Q-fever, infectious bovine rhinotracheitis, bovine viral diarrhea, parainfluenza III, and respiratory syncytial virus. Morphological data collected from each sheep

included hind foot length, girth, contour length, and tongue color. Each sheep was inspected for lumpy jaw. Reproductive status was determined for ewes. Horn length was measured on rams. Colored and numbered plastic ear tags were placed in the ears of all sheep. Numbered neck bands were placed on all ewes.

Composition surveys were conducted from the ground at the Granite Creek mineral lick in conjunction with serologic investigations. Sheep that visited the lick were classified with the aid of binoculars or a spotting scope based on the criteria described by Heimer (1973). Rams were classified based on 1/4-, 1/2-, 3/4-, 7/8-, or 4/4-curl horns. Other sheep were classified as ewes, yearlings, or lambs.

An aerial survey was conducted in the Black Rapids Glacier area from a PA-18 Piper Super Cub aircraft. Ram horn curl was classified as 1/2, 3/4, 7/8, or 4/4. All sheep not classified as rams or lambs were classified as "ewes." This classification includes yearling and 2-year-old rams (often referred to as 1/4-curl rams) as well as all ewes regardless of age and reproductive status.

RESULTS AND DISCUSSION

Population Status and Trend

No data suitable for determining trends in DCUA sheep populations were gathered during the reporting period; however, the ram harvest appears to be stable based on trends in hunter success, days hunted per sheep, and mean horn length of harvested rams. These parameters are discussed in detail below.

Population Size:

The last population estimate for the DCUA was based on aerial surveys flown from 23 July to 4 August 1980. Nine hours were spent searching the DCUA from the Johnson River to the Delta River. The DCUA west of the Delta River was not surveyed. A population estimate of 1,500 sheep was derived (Johnson 1982). The population has remained stable at 1,500 sheep since 1980 (Johnson 1986).

An aerial survey was conducted along the north side of Black Rapids Glacier during this reporting period. The survey covered 26 mi^2, lasted 2 hours 35 minutes, and 161 sheep were classified as follows: 93 "ewes," 23 lambs, 8 4/4-curl rams, 12 7/8-curl rams, 13 3/4-curl rams, and 12 1/2-curl rams.

Population Composition:

Recent trends in composition of DCUA sheep are unknown. Because only 24 sheep were classified at the Granite Creek lick during June 1989, there are insufficient data to calculate herd

composition. Heimer (1973) suggested a minimum of 500 sheep should be classified during ground surveys at mineral licks to overcome bias resulting from factors such as bands of sheep repeatedly visiting the lick. The most recent composition data are presented in Table 2.

Distribution and Movements:

No surveys were conducted to evaluate sheep distribution and movements. Two hunters reported seeing collared sheep during the hunting season. One collared ewe was seen in Granite Creek, and two were seen southwest of Granite Creek.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters is from 10 August to 20 Septembe. The season is divided between 2 drawing permit hunts (i.e., Nos. 1103 and 1104). For permit hunt No. 1103, the season is open from 0001 hours on 10 August until 001 hours on 26 August. Hunters were not allowed to use motorized vehicles or pack animals to transport themselves, hunting gear, or sheep withing the DCUA during this period. Normal travel continued on the Richardson Highway and through recognized airports lying within the DCUA boundaries. For permit hunt No. 1104, the season is open from 26 August through 20 September; there are no access restrictions. The bag limit is 1 full-curl ram by drawing permit only. Seventy-five permits each are issued for hunt Nos. 1103 and 1104.

Human-induced Mortality:

Hunters reported a harvest of 42 rams during 1988, compared with 33 rams in 1987 (Table 3). This harvest exceeded the mean of 31 sheep for 1983-1987 and is the highest harvest since permit hunting was initiated in the DCUA (1978). Thirteen sheep (31% of the DCUA harvest) were killed during hunt No. 1103, and 29 sheep (69% of the DCUA harvest) were taken during hunt No. 1104. Two reminder letters were sent to hunters during 1988, and 97% of the hunters responded. Reminder letters may have contributed to the increased reported harvest during 1988; however, most successful hunters mailed in their hunt reports without reminder letters. No reminder letters were sent to hunters during 1987; therefore, the reported harvest of 33 sheep may have been low that year.

Regulatory changes in legal horn size have not caused a decrease in the harvest and appear to be associated with an increase. Under the 7/8-curl regulation from 1979 to 1983, the average harvest was 34 sheep per year (range = 30-41). With the full-curl regulation from 1984 to 1988, the average harvest was 33 sheep per year (range = 18-42). The low harvest of 18 sheep in 1984 was unusual, resulting from early deep snowfall that created poor hunting conditions. If 1984 is omitted from the calculation

of the mean annual harvest, the full-curl harvest has averaged 37 sheep per year, increasing under full-curl regulations. The implementation of 7/8-curl and full-curl regulations appears to be responsible for an increase in available legal rams for hunters, although this cannot be unequivocally proven with this data set.

Mean horn length for sheep taken during 1988 was 36.0 inches, compared with 35.6 inches in 1987. Mean horn length has increased since full-curl regulations were adopted in 1984 (Table 3). Mean age for sheep killed in 1988 was 8.9 years old, compared with 8.3 years in 1987.

During hunt No. 1103, hunters were more evenly distributed within the DCUA than in 1987. The Johnson River, Ruby Creek to Miller Creek, Granite Mountains, Jarvis Creek, and Black Rapids areas each had from 13% to 19% of the hunting effort (Table 4). The harvest was also fairly evenly distributed among the Granite Mountains, Jarvis Creek, and Black Rapids. The most significant change in harvest occurred in the area from Ruby Creek to Miller Creek; 44% percent of the harvest came from this area during 1987; however, 7 hunters failed to kill a sheep there in 1988. Hunters had the highest success rates (50%) in the Granite Mountains and Little Gerstle River.

Most hunters participating in hunt No. 1104 hunted in the Johnson River, Jarvis Creek, and the Ruby Creek to Miller Creek area (Table 5). Hunter success was highest in the Granite Mountains and Gerstle River area (100%). Thirty-eight percent of the harvest in this hunt was taken in the Johnson River area.

Hunter Residency and Success. Alaskan residents received 97% of the DCUA permits during 1988 (Table 6); local residents received 19%. Two nonresidents received permits (1%), along with 3 hunters of unknown residency.

Sheep hunters in the DCUA had an overall success rate of 40% during 1988, compared with a 38% during 1987 (Table 3). Hunters had a 27% success rate during hunt No. 1103 and a 50% success rate during hunt No. 1104. Successful hunters hunted a mean of 4.5 days during hunt No. 1103 and 4.3 days during hunt No. 1104. Unsuccessful hunters hunted a mean of 4.7 and 5.7 days during hunt Nos. 1103 and 1104, respectively. Overall, successful hunters spent a mean of 4.4 days hunting, and unsuccessful hunters a mean of 5.1 days

Permit Hunts. During 1988 ADF&G received 475 and 557 applications for hunt Nos. 1103 and 1104, compared with 489 and 572 during 1987, respectively. Of the 75 permits issued for each hunt, 48 and 58 permittees participated in hunt Nos. 1103 and 1104, respectively.

Transport Methods. During hunt No. 1103, the restricted access hunt, 79% of the hunters used highway vehicles for access,

compared with 88% during 1987 (Table 7). The decrease in highway vehicle use was replaced by increased use of aircraft (i.e., hunters land outside the DCUA and walk in). Ten percent of the hunters used aircraft for access to the area during 1988, compared with only 6% during 1987.

Aircraft were the most common means of transportation into the DCUA during hunt No. 1104 and were used by 38% of hunters (Table 8). Highway vehicles were also a popular means of access (31% of the hunters), because much of the DCUA is easily accessible from the Alaska and Richardson Highways.

Harvest Chronology. Fifty-four percent of the harvest occurred during the first 4 days of hunt No. 1103; 38% occurred during the next 7 days. Seventeen percent of the hunt No. 1104 harvest occurred during the first 2 days of the hunt, and 62% occurred during the next 7 days. Given suitable weather conditions, sheep hunters in the DCUA begin hunting as early as legally possible, killing their sheep early in the season.

Natural Mortality:

Nineteen sheep were captured for the serologic study at the Granite Creek lick in June 1989. This brings the total captured and tested to 33. Results from the serological survey have not been completely analyzed; they will be presented in a later report. Early results suggest the Granite Mountains sheep are free from domestic animal pathogens, so introduced diseases are not a factor at this time.

Predation rates on sheep in the DCUA are unknown. Wolves, grizzly bears, black bears, and golden eagles all occur in the area and undoubtedly prey on sheep; however, predation is not considered to be limiting population at this time.

Climate is a chronically limiting, but infrequently depressing, factor for sheep in the DCUA. The DCUA is located at the north end of the 2,443-foot Isabel Pass in the Alaska Range, so winter storms frequently bring high winds and warm temperatures. Therefore, much of the area is either snow-free or has little snow during much of the winter, providing suitable stable winter range for Dall sheep.

Habitat:

Sheep habitat appears to be sufficient to support the population at its current level, although no habitat assessment surveys have been conducted. The 2 greatest threats to sheep habitat in the DCUA are mining activities and military exercises on state land. Both of these activities should be monitored closely.

Game Board Actions and Emergency Orders

No regulations by the Board of Game or emergency orders affected the DCUA during this reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The harvest objective for the DCUA calls for a harvest of 35 full-curl rams with a mean horn length exceeding 36 inches and mean age greater than 8 years. The 1988 reported harvest was 42 full-curl rams with a mean horn length of 36.0 inches and a mean age of 8.9 years. These data indicate the harvest objective continues to be attained.

Hunter comments suggest the DCUA sheep population is stable. This is consistent with the present working hypothesis of Dall sheep proposed by Heimer (1988). However, it is not known whether the population objective of 1,800 sheep is being met. The 1980 estimate of 1,500 sheep in the DCUA is below that objective, but no population estimates have been made in the last 9 years.

Results of the DCUA questionnaire indicate that hunters during both hunt Nos. 1103 and 1104 were satisfied with current DCUA regulations. Eighteen questionnaires were received from hunters in each hunt.

Of the 18 respondents from hunt No. 1103, 17 (94%) were "satisfied with the quality of their hunt." The one "no" response was from a hunter who thought walk-in access was too difficult. During hunt No. 1103, most hunting parties (65%) saw no other hunting parties, 20% saw one other party, and 15% saw two other parties. The following comments were received from hunt No. 1103 hunters: (1) Hunt number 1103 should have the same length season as hunt No. 1104 = 3; (2) complained about military activity in the area = 2; (3) the DCUA should be walk-in only = 1; (4) fewer permits should be issued for the DCUA = 1; and (5) full-curl regulations should be adopted for all of Alaska = 1.

Of the 18 respondents from hunt No. 1104, 17 (94%) were "satisfied with the quality of their hunt." The one "no" respondent thought there was too much ATV activity. He hunted in the Little Gerstle River, where a miner was cutting a trail to a mineral claim. Hunters during hunt No. 1104 saw more people during their hunt than those in hunt No. 1103. Thirty-seven percent of the parties saw no other hunters, 11% saw one other party, 26% saw two other parties, 5% saw three other parties, and 21% saw four or more parties. The following comments were received from hunters during hunt 1104: (1) Keep the hunt as is and/or maintain quality, six; (2) full-curl regulations have helped, one; (3) make the area walk-in only, one; (4) complained about military activity, one; and (5) saw too many other hunters

(saw 2 other parties) and saw too much of Fish and Wildlife Protection, one.

The management objective of providing aesthetically pleasing hunting conditions is also being met; 94% of hunters responding to questionnaires indicated they were satisfied with the quality of their hunts. Therefore, no changes in the hunts are recommended. The following work objectives are recommended for next year: (1) Continue the present seasons and bag limits for DCUA permit hunts; (2) conduct an aerial sheep census of the entire DCUA and estimate the population size; (3) continue the Granite Creek lick capture operation and serologic survey of DCUA sheep; (4) collect a sufficient composition data sample to assess lamb production and yearling recruitment in the Granite Mountains; and (5) quantify hunter impression of the aesthetics quality of sheep hunting in the DCUA through hunter questionnaires.

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Table 1. Dall sheep hunting regulations in the eastern Alaska Range from 1926 to 1988.

Year	Season	Bag limit
1926-37	20 Aug-31 Dec	2 rams
1938-39	20 Aug-30 Nov	2 rams
1940-41	20 Aug-15 Nov	2 rams
1942	No open season	0
1943	1-30 Sep	1 ram
1944	Unknown	Unknown
1945	20 Aug-5 Sep	1 ram
1946-50	20-31 Aug	1 ram
1951-53	20-31 Aug	1 ram with 3/4 curl
1954-59	20 Aug-10 Sep	1 ram with 3/4 curl
1960-70	10 Aug-20 Sep	1 ram with 3/4 curl
1971-77	1- Aug-20 Sep; no motorized vehicle or pack animals from 5-25 Aug	1 ram with 3/4 curl
1978	10 Aug-20 Sep; no motorized vehicle or pack animals from 5-25 Aug	1 ram with 3/4 curl by permit only; 60 permits per season
1979-81	10 Aug-20 Sep; no motorized vehicles or pack animals from 5-25 Aug	1 ram with 7/8 curl by permit only; 60 permits per season
1982-83	10 Aug-20 Sep; no motorized vehicles or pack animals from 5-25 Aug	1 ram with full curl by permit only; 75 permits per season
1984	10 Aug-20 Sep; no motorized vehicles or pack animals from 5-25 Aug	1 ram with full curl by permit only; 75 permits per season
1985	20 Aug-27 Sep	1 ram with full curl; 150 permits to Tier II residents
1986	20 Aug-20 Sep; no motorized vehicles or pack animals from 20-25 Aug	1 ram with full curl by permit only; 75 permits per season
1987-88	10 Aug-20 Sep; no motorized vehicles or pack animals from 5-25 Aug	1 ram with full curl by permit only; 75 permits per season

Table 2. Dall sheep composition data collected from 1980 to 1983 at the Granite Creek mineral lick in the Delta Controlled Use Area.

Ratios	1980	1981	1982	1983	1988
Legal rams:100 ewes[a]	5	1	12	14	17
Sublegal rams:100 ewes	15	5	241	49	57
Lambs:100 ewes	39	41	6	29	17
Yearlings:100 ewes	27	45	6	21	91
Total sheep	274	270	62	232	65

[a] A legal ram was 7/8 curl in 1980-83 and 3/4 curl in 1988.

Table 3. Annual reported harvest of Dall sheep, number of hunters, hunter success, and mean horn length in the Delta Controlled Use Area from 1976 to 1988.

Year	Hunter kill	Number hunters	% Hunter success	Mean horn length (in)
1976	54	202	27	31.3
1977	78	240	33	31.3
1978	31	85	36	31.2
1979	39	71	55	34.6
1980	30	78	38	34.5
1981	30	80	38	35.2
1982	41	85	48	34.7
1983	30	81	37	34.8
1984	18	71	25	35.8
1985	40	95	42	--[a]
1986	32	98	33	35.1
1987	33	89	38	35.6
1988	42	106	40	36.0

[a] No horn length data gathered from Tier II subsistence hunt.

Table 4. Location of hunting effort and sheep harvest in the Delta Controlled Use Area during 1988, hunt 1103[a].

Area	No. hunters	% Hunter success	Harvest
Granite Mountains	8 (17)	50	4 (31)
Ruby to Miller Creek	7 (15)	0	0 (0)
Jarvis Creek drainage	9 (19)	33	3 (23)
Black Rapids area	9 (19)	33	3 (23)
Johnson River	6 (13)	17	1 (8)
Gerstle River	5 (10)	20	1 (8)
Little Gerstle River	2 (4)	50	1 (8)
Unknown	2 (4)	0	0

[a] Values in parentheses are percentages.

Table 5. Location of hunting effort and sheep harvest in the Delta Controlled Use Area during 1988, hunt 1104[a].

Area	No hunters	% Hunter success	Harvest
Granite Mountains	2 (3)	100	2 (7)
Ruby to Miller Creek	11 (19)	45	5 (17)
Jarvis Creek drainage	11 (19)	18	2 (7)
Black Rapids area	6 (10)	33	2 (7)
Johnson River	15 (26)	73	11 (38)
Gerstle River	6 (10)	100	6 (21)
Little Gerstle River	3 (5)	0	0 (0)
Unknown	4 (7)	25	1 (3)

[a] Values in parentheses are percentages.

Table 6. Residency of hunters receiving Delta Controlled Use Area sheep permits for hunts 1103 and 1104, 1987 and 1988[a].

Year	Local residents	Nonlocal residents	Nonresidents	Unknown
1987	29 (19)	120 (80)	1 (1)	0 (0)
1988	28 (19)	117 (78)	2 (1)	3 (2)

[a] Values in parentheses are percentages.

Table 7. Number of hunters using different transportation means in the Delta Controlled Use Area during hunt 1103, 1987 and 1988[a].

Year	Airplane	Horse	Boat	3- or 4-Wheeler	ORV[b]	Highway vehicle	Unknown
1987	3 (6)	0 (0)	0 (0)	0 (0)	0 (0)	46 (88)	3(6)
1988	5 (10)	0 (0)	2 (4)	0 (0)	1 (2)	38 (79)	2(4)

[a] Values in parentheses are percent of hunters.
[b] Off-road vehicles other than 3- or 4-wheelers.

Table 8. Number of hunters using different transportation means in the Delta Controlled Use Area during hunt 1104, 1987 and 1988[a].

Year	Airplane	Horse	Boat	3- or 4-Wheeler	ORV[b]	Highway vehicle	Unknown
1987	7 (18)	1 (3)	0 (0)	11 (30)	6 (16)	12 (32)	0 (0)
1988	22 (38)	0 (0)	2 (3)	7 (12)	8 (14)	18 (31)	1 (2)

[a] Values in parentheses are percent of hunters.
[b] Off-road vehicles other than 3- or 4-wheelers.

STUDY AREA

GAME MANAGEMENT UNIT: 20A (6,753 mi^2)

GEOGRAPHICAL DESCRIPTION: Alaska Range east of Denali National Park, excluding the Tok Management Area and the Delta Controlled Use Area (ARE)

BACKGROUND

A history of Dall sheep management goal development in the Alaska Range east of Denali Park (ARE) was McNay (1989). The current goals center on protection of sheep populations to provide maximum opportunity for human recreational use.

Dall sheep numbers in the ARE were probably stable in the 1960's, declining between 1970 and 1975 (Heimer and Watson 1986). From 1976 to 1980 sheep numbers increased concurrently with ADF&G wolf reduction programs, as did caribou and moose. Since 1980 there has been no apparent trend in sheep numbers.

Since before statehood, rams have been harvested under minimum horn curl regulations (i.e., 1944-49, any ram; 1950-78, 3/4 curl; 1979-83, 7/8 curl; 1984-88, 4/4 curl). The change from 3/4 to 7/8 curl occurred as an indirect result of congressional passage of the Alaska Native Claims Settlement Act (Heimer 1980). The change in legal horn size from 7/8 curl to full curl was made to test a hypothesis that harvesting full-curl rams would yield greater harvests (Heimer and Watson 1986). Subunit 20A was suitable for that test because of good access and high hunter participation.

I have divided historical hunter participation and harvests in Subunit 20A into 3 periods (Table 1). For the periods 1968 to 1972, 1973 to 1982, and 1983 to 1988, annual averages of 326, 230, and 318 hunters harvested 121, 100, and 121 sheep, respectively, although an upward trend in hunters and harvests has been evident since 1985.

POPULATION OBJECTIVES

To maintain a Dall sheep population of approximately 5,000 sheep.

To maintain naturally regulated ewe and subadult ram segments of the population.

METHODS

Composition of Dall sheep in Subunit 20A was estimated from observations made at the Dry Creek sheep lick between 16 and 22 June 1988. All sheep entering the lick were classified, and visits by marked individuals were recorded. Cumulative classification over the 10-day period was used to calculate the Dry Creek composition values.

RESULTS AND DISCUSSION

Population Status and Trend

Dall sheep numbers declined in the early 1970's, increased in the late 1970's, and have shown no detectable trend since 1980. Because comprehensive aerial surveys have not been conducted throughout Subunit 20A since 1977, population changes throughout the ARE have been inferred from changes observed in the Dry Creek study area.

Population Size:

During 1977, 3,576 sheep were counted in the ARE at a low survey intensity of approximately 1.3 min/mi^2. Sightability was unknown, but Heimer and Watson (1986) believe it was lower than that for surveys in the Dry Creek study area, where survey intensities were more than twice as high. Based on an assumed sightability of 70-80%, incomplete coverage of some sheep habitat, and population growth since 1977 (Heimer 1984), there are an estimated 5,000 sheep in the ARE.

Population Composition:

During 77.7 hours of observation between 16 and 22 June 1988, biologists Robin Beasley and Jack Winters (ADF&G) classified 1,020 sheep entering the Dry Creek lick. Thirty-seven previously marked ewes each visited the lick an average of 2.2 times during this observation period. There was no detectable difference between the mean visitation rate of marked ewes with lambs ($\underline{x}$ = 2.3) and marked ewes without lambs ($\underline{x}$ = 2.1).

Based on the 1,020 cumulative sightings, lamb:ewe and yearling:ewe ratios were 41:100 and 29:100, respectively. Only 7 rams that were 7/8 curl or larger visited the lick. Ram:ewe ratios were not calculated from the Dry Creek lick observations during 1988, because temporal distribution of lick use by rams does not coincide with that by ewes. The daily observation schedule and timing of the observation period in 1988 did not accommodate these temporal differences.

The lamb:ewe ratio of 41:100 observed during 1988 was below the previous 5-year mean of 48:100 (Table 2). The 1988 yearling:ewe ratio (29:100) was higher than the previous 5-year mean (21:100).

Among the observed marked ewes, lamb:ewe ratios were 54:100. Compared with the cumulative sample (41:100), the higher lamb:ewe ratio among marked ewes may be related to the age structure of the marked ewe sample that did not contain any 2- or 3-year-old ewes but was composed of ewes in their prime reproductive years.

Distribution and Movements:

Based on the 1977 aerial survey, sheep are distributed throughout mountains of the ARE. Summer range densities are highest (approx. 4-5 sheep/mi^2) in the area between the Wood River and West Fork of the Little Delta River. Densities decrease to both the east and west of this core area. In the 1977 survey no sheep were found on the northfacing slopes between McGinnis Creek and Trident Glacier. In a 1988 survey of the same area, no sheep were sighted, even though survey intensity was greater.

Small numbers of sheep are frequently sighted in the foothills of the Alaska Range. Specifically, sheep are often seen on Jumbo Dome, Molybdenum Ridge, Needle Rock, and along the Totatlanika River gorge. Sheep are also occasionally reported from Rex Dome.

Mortality

Seasons and Bag Limits:

The open season for resident and nonresident hunters in Subunit 20A is from 10 August through 20 September. The bag limit is 1 ram with full-curl, larger, or 2 broken horns.

Human-induced Mortality:

During 1988, 404 hunters reported killing 154 full-curl rams in Subunit 20A. The 1987 and 1988 harvests were 142 and 136 rams, respectively (Table 3). The harvest trend over the last 4 years has been upward. Under the 7/8-curl regulation (1979-83) the mean harvest was 105 rams.
Heimer and Watson (1986) theorized that changing to a full-curl regulation would increase the number of harvestable sheep because natural mortality of sublegal rams would decline and lamb production would increase. However, I think the available data are insufficient to definitely link the higher harvest of 1987 and 1988 to changes in ram age structure that resulted from the full-curl regulation. An alternate explanation for the increased harvest could be increased hunter participation (Table 1). During the periods 1979 to 1983 and 1986 to 1988, respective averages of 236 and 372 hunters reported annually; therefore, although reported harvests during 1986-88 averaged 37% higher than those for 1979-83, hunters averaged 58% higher. Increased harvests probably resulted from both increased hunting effort and ram abundance.

Above-average yearling recruitment in 1980 and 1981 (Table 2) probably contributed to the high harvest for the period 1986 to

1988. These 1980 and 1981 yearling cohorts may continue to provide harvestable rams during 1989; however, yearling recruitment since 1981 has been moderate, and unless survival of young rams increased substantially following the full-curl regulation, harvests after 1989 may be lower.

Since implementation of the full-curl regulation, mean horn size and mean age of harvested rams have also increased. Mean horn size among rams harvested in 1988 was 34.7 inches. Mean age of harvested rams as reported by hunters was 8.8 years (Table 4). Thirty-nine percent of the rams taken in 1987 had horns greater than 36 inches in length.

Hunter Residency and Success. Hunter success was 38% during 1988. Under the full-curl regulation (1984-88), mean annual hunter success has been lower (37% success, $\underline{n}$ = 5 years, $\underline{x}$ = 338 hunters) than under the 7/8-curl regulation (1979-83); i.e., 45% success, $\underline{n}$ = 5 years, $\underline{x}$ = 235 hunters. I do not believe these data necessarily imply that decreased hunter success is a function of the more restrictive full-curl regulation. There is a negative correlation between hunter success and hunter numbers ($r = -0.57$, $\underline{P} \leq 0.01$, $\underline{n} = 21$), suggesting changes in hunting success may be affected by the number of hunters. Distribution of the harvest among residents and nonresidents for the last 5 years is given in Table 5. To hunt Dall sheep in the Alaska, nonresidents must be accompanied by a guide or resident relative.

Harvest Chronology. Traditionally, the greatest harvest occurs during the 1st 10 days of the sheep season (10-20) August (Table 6). During 1988, 50% of the harvest was taken between 10 and 20 August. Only 9% of the harvest was taken during the last 10 days of the season (10-20 September).

Transport Methods. Ground motorized vehicle access for big game hunting is prohibited in the Wood River and Yanert Controlled Use Areas to protect habitat from the erosion that accompanies trail development in the ARE. These areas contain approximately half of the Dall sheep range in Subunit 20A. Consequently, aircraft and horses are primary methods of transport (Table 7). Since 1984, average success rates for hunters using aircraft and horse access have been 46% and 57%, respectively, while overall success rates have averaged 38%.

Natural Mortality:

Severe winter weather and predation appear to be the most important natural mortality factors for Dall sheep (Heimer and Watson 1986, Murie 1944). Winter snow depths in Subunit 20A have probably not affected overwinter mortality in an unusual way since the winter of 1981-82.

Predation by wolves may be an increasingly significant source of mortality; during the early 1970's, it was probably a significant factor in the decline in sheep numbers (Heimer and Stephenson

1982). Following wolf control efforts in the mid-1970's the sheep population in Subunit 20A increased. Wolf radio-telemetry studies conducted in the Alaska Range portion of Subunit 20A during 1986-88 indicated wolf numbers have recovered from the control efforts of the late 1970's. During 1987 I received 2 hunter reports and photos of rams killed by wolves in September. Biologists have also seen wolves stalking sheep, and several radio-collared wolf packs are known to occupy sheep ranges. Davis et al. (1987) presented evidence of increasing wolf predation on caribou in Subunit 20A beginning in 1984; wolves may also be having a greater impact on sheep. It is also possible that increased caribou and moose populations lowered wolf predation on sheep as these more preferred prey species increased. Heimer and Watson (1986) found no evidence that wolf predation is selective for certain age/sex classes of sheep. The most recent composition data also fail to indicate trends in lamb:ewe ratios or yearling survival, suggesting selective predation.

Habitat Assessment

From 1975 to 1981 Heimer (1983) investigated the hypothesis that the difference in quality among sheep populations resulted from differences in range quality. He found that although the diet of Subunit 20A sheep differed from that of sheep studied in the Robertson River drainage, there were no net differences in energy storage or utilization between the 2 populations. No data relating forage availability to utilization have been collected for sheep in Subunit 20A. Human disturbance of sheep habitat, including disturbance of travel routes and mineral licks, by mining or road development is probably the greatest potential threat to habitat. Coordination with Habitat Division to minimize such development will be a primary consideration in sheep management in Subunit 20A.

Game Board Actions and Emergency Orders

Since the changes from 7/8 curl to 4/4 curl in 1984, the Game Board has taken no action regarding sheep in Subunit 20A.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Subunit 20A appears stable at approximately 5,000 sheep. Recent increases in harvest may be related to hunting pressure and ram abundance. The number of available legal rams (full-curl) is expected to be higher than average in 1989, because of high yearling recruitment in 1980 and 1981. Harvest may decline after 1989, because yearling recruitment rates were lower after 1981.

Information needs for the next 5 years are given in the Appendix. These needs will determine management activities in the ARE. Under each "need", 2 or more options for management activities

are listed. Each option, in concept, could provide the required information; however, budget constraints and differing opinions among biologists on the applicability of each option will require additional discussion before a work plan is developed. That work plan will be developed during the next reporting period. Information needs pertain not only monitoring the general "health" of the sheep population, but also recognizing the continuing effort to evaluate the effectiveness of our full-curl management program in meeting our stated management objectives. No changes in seasons or bag limits are recommended.

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Table 1. Historic sheep harvests and hunter participation, Subunit 20A, 1968-88.

Year	Reported harvest	Total hunters	Percent success	Mean horn length (inches)
1968	138	366	38	33.1
1969	97	262	37	32.9
1970	119	269	44	33.6
1971	133	376	35	33.8
1972	120	359	33	32.5
1973	78	246	32	31.3
1974	101	232	43	31.8
1975	97	217	45	32.3
1976	112	248	45	32.3
1977	116	233	50	32.3
1978	98	248	40	31.8
1979	86	226	38	33.4
1980	88	214	41	34.9
1981	116	252	46	34.9
1982	112	189	59	34.0
1983	121	297	41	33.7
1984	105	292	36	34.0
1985	102	292	35	34.0
1986	136	357	38	34.2
1987	142	354	40	35.0
1988	154	404	38	34.2

Table 2. Summer sheep composition and estimates of survival to yearling age from the Dry Creek mineral lick, 1968-88.

Year	Lambs: 100 ewes	Yearlings: 100 ewes	Percent[a] estimated survival
1968	63	13	
1969	64	31	49
1970	55	31	48
1971	50	51	93
1972	15	16	32
1973	38	11	73
1974	28	25	66
1975	28	23	82
1976	36	16	57
1977	58	17	47
1978	41	25	43
1979	65	19	46
1980	67	36	55
1981	60	43	64
1982	31	25	41
1983	57	7	23
1984	57	25	44
1985	40	28	55
1986	33	22	49
1987	53	23	70
1988	41	29	55

[a] Ratio of yearlings:100 ewes in year x to lamb:100 ewe ratios in year x - 1.

Table 3. Distribution of sheep harvest, Subunit 20A, 1984-88.

Area	Uniform Location Code	1984		1985		1986		1987		1988	
		Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters
Rex Dome	(0102)	0	3	0	0	0	5	11	13	4	10
Healy Creek	(0103)	7	48	7	43	20	64	19	72	11	56
Moody Creek	(104)	7	17	2	8	10	24	10	23	13	32
Yanert	(105-109)	13	41	12	51	24	56	19	53	27	73
Totatlanika River	(0202)	2	12	2	13	4	21	3	20	7	24
Tatlanika River	(0302)	5	10	3	11	3	3	5	13	3	12
Wood River West	(0402, 0403)	12	18	0	0	22	37	13	30	25	43
Wood River East	(0404)	20	39	12	28	16	30	19	32	26	48
Wood River South	(0405)	7	11	7	9	4	6	7	8	2	3
Total Wood River[a]	(0400)	43	85	38	63	46	87	45	79	54	104
Dry Creek	(0505, 0507)	6	11	3	16	7	16	4	13	10	19
W. Fork Little Delta	(0603, 0604)	6	7	1	3	0	3	2	0	1	1
Buchanan Creek	(0602)	1	4	1	3	1	6	6	0	2	4
E. Fork Little Delta	(0605)	7	10	6	13	10	23	5	14	9	15
Total Little Delta[a]	(0601, 0600)	14	29	8	23	15	45	18	32	15	30
Delta Creek	(0702)	8	15	3	6	4	15	2	3	4	8
McGinnis Glacier	(0802)	0	3	0	2	1	6	1	3	1	2
Unknown 20A		0		24		2		5		5	34
Total Subunit 20A		105	292	102	292	136	357	142	354	154	404

[a] Includes harvest for which no specified area was given.

Table 4. Percent distribution of harvest among horn length categories and mean age of harvested sheep as reported by hunters, Subunit 20A, 1984-88 (full-curl regulation).

Year	Percent of total harvest by horn length category (inches)							$\bar{x}$ Length	$\bar{x}$ Age	% Reported broomed
	<30	30.0-31.9	32.0-33.9	34.0-35.9	36.0-37.9	38.0-39.9	≥40			
1984	4	13	22	35	21	4	1	$\bar{x}$ = 33.97 S = 2.59 N = 105	$\bar{x}$ = 7.81 S = 1.56 N = 103	--
1985	9	14	20	27	20	7	3	$\bar{x}$ = 34.04 S = 2.93 N = 101	$\bar{x}$ = 8.4 S = 1.88 N = 99	--
1986	4	11	21	37	22	4	1	$\bar{x}$ = 34.17 S = 2.44 N = 135	$\bar{x}$ = 8.4 S = 1.66 N = 124	--
1987	1	7	23	29	32	7	1	$\bar{x}$ = 34.99 S = 2.27 N = 135	$\bar{x}$ = 8.74 S = 1.46 N = 133	38
1988	1	8	22	30	29	9	1	$\bar{x}$ = 34.71 S = 2.36 N = 149	$\bar{x}$ = 8.8 S = 1.44 N = 152	32

Table 5. Dall sheep hunter residency and success, Subunit 20A, 1984-88.

Year	Successful				Nonsuccessful				Total hunters
	Unit res.	Other AK res.	Non-res.	Total[a]	Unit res.	Other AK res.	Non-Res.	Total[a]	
1984	--	78	27	105	---	177	7	187	292
1985	44	21	36	102	143	34	10	90	292
1986	59	31	36	136	141	55	13	221	357
1987	61	19	49	142	100	66	9	212	354
1988	43	29	45	154	125	50	3	250	404

[a] Includes hunters for which no residency was given.

Table 6. Sheep harvest chronology in Subunit 20A, 1984-88.

Year	Percent of total harvest			
	10-20 Aug	21-31 Aug	1-10 Sep	11-20 Sep
1984	56	18	13	13
1985	52	23	15	9
1986	38	29	25	8
1987	49	29	13	10
1988	50	26	15	9

Table 7. Subunit 20A successful sheep hunter transport methods, 1984-88 (S = successful, NS = nonsuccessful).

Year	Airplane		Horse		Boat		3-, 4-wheeler		ORV		Highway vehicle		Total	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
1984	68	83	19	20	0	4	0	18	6	17	9	37	102	179
1985	54	74	26	24	1	2	1	10	3	17	11	48	96	175
1985	61	90	37	24	0	1	2	15	7	14	20	55	127	199
1987	65	65	40	21	0	2	3	27	6	13	17	61	131	189
1988	88	87	28	25	0	3	2	19	7	26	17	75	142	235

APPENDIX

INFORMATION NEEDS AND MANAGEMENT ACTIVITY OPTIONS

Need: 1. A reliable index to, or estimate of, population size.

Options:
a. Total aerial census or stratified random survey of sheep habitat in Subunit 20A to estimate total population size.

b. Total aerial survey of key areas to provide an index to total population trends.

c. Ground-based observations at mineral licks to provide an index to total population trend.

Need: 2. Unbiased estimates of lamb production and yearling recruitment.

Options:
a. Aerial survey by helicopter in delineated composition count areas.

b. Ground-based observation from mineral licks during the post-lambing period.

Need: 3. Age/sex specific natural mortality rates.

Options:
a. Radio-telemetry studies of a sample of different sex/age classes of sheep.

b. Ground-based observations at mineral licks documenting the annual return rate of previously marked sheep to traditionally used mineral licks.

Need: 4. Knowledge of the harvest rate among available legal rams each year and the age composition of that harvest.

Options:
a. Ear tag marking and return from hunters of a sample of legal rams.

b. Estimation of total legal ram abundance derived from a total population estimate and aerial composition values.

c. Age composition can be taken from harvest reports or from field checks. Field checks could also provide an improved estimate of harvest.

Need: 5. An estimate of the impact of predation on Dall sheep.

Options: a. Radio-telemetry study of sheep.

b. Wolf/prey study of radio-collared wolf packs where wolf home ranges overlap sheep habitat.

c. Coyote predation assessment.

STUDY AREA

GAME MANAGEMENT UNIT: Portions of 20B, 20F, 25C, and 25D (534 mi^2)

GEOGRAPHICAL DESCRIPTION: White Mountains

BACKGROUND

Because of small populations and low harvest intensity, sheep in the White Mountains area have received relatively little attention and surveys have been infrequent. However, between 1983 and the present, 11 sheep have been radio-collared and monitored as part of a cooperative study between the Bureau of Land Management (BLM) and ADF&G.

Most of the sheep habitat in the White Mountains area lies within the White Mountains National Recreational Area (WMNRA) and the Steese National Conservation Area (SNCA), which were established by the Alaska National Interest Lands Conservation Act in 1980 and are managed by BLM. Increases in public use as a result of development of trails, roads, public use shelters, and mineral exploration and development may conflict with the existing management goal for sheep to provide for the opportunity to hunt sheep under aesthetically pleasing conditions.

MANAGEMENT OBJECTIVES

To maintain a population of at least 250 Dall sheep.

To provide for the annual harvest of full-curl rams.

To establish guidelines by 1990 for protection of sheep habitat in the White Mountains in cooperation with other land management agencies and potentially affected interest groups.

To determine by 1991 if the management goal of providing aesthetic hunting conditions is consistent with current public interest.

METHODS

No aerial or ground surveys were conducted to estimate population size and composition during this reporting period; however, distribution and habitat use of 6 radio-collared sheep were monitored as part of a cooperative study by BLM and ADF&G. BLM biologists located these sheep approximately once per month during winter and at 7- to 10-day intervals from mid-April through mid-November.

Harvests were monitored through harvest ticket report cards. Only data from hunters in the White Mountains area were examined for this report. Beasley (1989) also included information from several hunters who hunted in other areas of Subunit 20F.

RESULTS AND DISCUSSION

Population Status and Trend

Previous surveys indicate that the size of the sheep population has fluctuated widely during the last 17 years. Aerial surveys were conducted in 1970, 1977, 1982, and 1986 (Table 1). According to these surveys, the population was highest in 1970 (285 sheep counted) but had declined 56% by 1977. The observer in both surveys, Tim Smith (ADF&G biologist), believed that this dramatic decline was real and not an artifact of survey conditions or techniques (T. Smith memo, 26 Aug 1977, ADF&G files). He stated that important factors contributing to this decline were probably deep snow during the winter of 1970-71 and increased wolf predation related to lack of caribou west of the Steese Highway after 1971. Since 1977 the number of sheep observed during surveys has been increasing, especially between 1982 and 1986 when the population rose to 85% of the "historical high" of 1970. In 1986 the area searched during the survey was more extensive than in 1982; however, agreement between ground and aerial surveys indicated sightability was high during the 1982 survey. Some of the fluctuations in numbers of sheep observed during surveys may be a function of differences in area covered, survey intensity, and sheep sightability, rather than actual changes in population size.

Population Size:

Based on a 1986 aerial survey, the sheep population in the White Mountains area is approximately 250-300. During this survey (27-29 Jun 1986), 240 sheep were counted under very good to excellent survey conditions. Although some sheep were probably not seen because poor sightability in portions of their range caused by rock outcrops and trees, the extensive time spent surveying (14.6 hours) should have minimized the number of sheep missed. Locating the radio-collared sheep in the area increased the efficiency of surveying this population (B. Durtsche, pers. commun.). No population surveys were conducted in 1987 or 1988.

Population Composition:

Composition data were available from ground surveys, radio-tracking flights, and aerial surveys; however, only the latter provided data for sheep throughout the White Mountains area. These aerial surveys suggested that the recorded population fluctuations since 1970 have been primarily in the ewe and lamb segments of the population (Table 1, Fig. 1). Numbers of rams in the White Mountains area have not varied greatly during the last

17 years; rather, they have been increasing slowly since 1977. Although the increase in the number of "legal" rams has been negligible since 1970, the number of rams with 7/8-curl or larger horns has probably increased; "legal" rams in the 1982 and 1986 surveys only included rams with 7/8-curl or larger horns rather than 3/4-curl horns in the 1970 and 1977 surveys. The number of sublegal rams increased by 40% between 1982 and 1986. The 1986 survey data suggested the population was moderately productive (37 lambs:100 "ewes") and increasing. Aerial classification counts underestimate lamb:100 adult ewe ratios, because the "ewe" category contains yearlings and young rams as well as ewes. Because sightability of sheep in this area can be low, some of the apparent changes in composition may be a result of groups of certain age classes being missed during the survey.

Distribution and Movements:

Sheep in the White Mountains area occur in small, widely scattered groups throughout approximately 534 mi^2 of alpine habitat in the vicinity of Mount Victoria, Mount Schwatka, Mount Prindle, Lime Peak, Cache Mountain, and the White Mountains. This area is geographically isolated from other sheep populations (ADF&G 1976).

Distribution and movements of sheep within this area can be divided into several groups. One group resides in the vicinity of Mount Schwatka and Victoria Mountain (Fig. 2). Some sheep make seasonal movements between the 2 areas. The main travel route is through Long Creek, Victoria Creek, and the unnamed drainage directly south (B. Durtsche, pers. commun.).

Another group winters in the Lime Peak area, then moves to either Mount Prindle or the White Mountains for the summer. Part of this group remains on Lime Peak during both winter and summer; in some years, snow may be deep enough to hinder movements and feeding activity, resulting in the change of wintering areas (Jennings 1985). Wayne Heimer (ADF&G biologist) believes that sheep in the White Mountains may display different movement patterns than typical sheep populations because of climate and topography (Beasley 1989).

The distribution and movements of sheep in the White Mountains is being assessed in a study of 11 radio-collared sheep. All 3 ewes collared on Victoria Mountain (21 Apr 1983) moved to Mount Schwatka for the winter and back to Victoria Mountain in summer. All 8 sheep collared in the Lime Peak/Mount Prindle area (i.e., 3 ewes on 21 Apr 1983, 2 rams and 3 ewes on 21 Apr 1985) were on Lime Peak during the winter; however, during the summer the 3 ewes collared in 1983 were on Lime Peak or Mount Prindle and the 5 sheep collared in 1985 were on or west of Lime Peak. Radio-collared sheep were always relocated on the same side of Beaver Creek that they were collared. A report on the findings from all the species radio-collared in this study is expected to be completed by the BLM in fall 1989 (T. W. Hobgood, pers. commun.).

Mortality

Seasons and Bag Limits:

The open season is from 10 August to 20 September. The bag limit is 1 ram with full-curl, greater, or 2 broken horns (Table 2).

Human-induced Mortality:

Only 1 ram was reported harvested from the White Mountains area in 1988. During the last 5 years annual harvests of rams have only been 1 to 5 rams (Table 3). In 1986 the harvest represented 29% of the legal rams counted during an aerial survey in late June.

The mean horn size of sheep harvested since 1983 is 35.3 inches long for unbroomed horns (range = 32-37.5 inches, n = 9) with 13.8-inch bases (range = 12.0-15.5 inches, n = 17). The minimum legal horn size was 7/8-curl during part of this period. The 13-year-old ram harvested in 1988 was the oldest ram taken since at least 1984. Mean age of rams harvested since 1984 is 9 years (range = 6-13, n = 15). Nine of the 18 rams harvested since 1983 have had a broomed horn(s).

Before 1984 the entire Tanana/Yukon uplands supported unlimited hunter participation during the open season; however, regulatory changes in 1984 limited sheep harvest in the Tanana Hills portion (i.e., about half of the sheep in the Tanana/Yukon Uplands) by lottery permit. This may have shifted some sheep hunting pressure from the Tanana Hills to the White Mountains area, resulting in the large harvests of 1985 and 1986. This trend did not continue in 1987 and 1988.

Hunter Residency and Success. In 1988, 7 of 8 hunters with known residency were from the Fairbanks or North Pole areas and 1 hunter was from Rampart. Of the 79 hunters hunting in the White Mountains area during the last 5 years, only two were nonresidents (Table 4).

Hunter success is influenced by many factors, including hunt location, hunter efforts, and hunting skills. Hunter success ratios have varied widely during the last 5 years (range = 7-50%), with a 5-year mean of 19%.

During the last 5 years, the White Mountains area has provided 425 days of sheep hunting for 79 hunters. The annual mean number of days hunted ranged from 2 to 9 days for successful hunters and from 4 to 7 days for unsuccessful hunters (Table 5).

Harvest Chronology. Most of the 15 sheep harvested since 1984 were taken during the first 11 days of the season (Table 6). It is not possible to determine whether the timing of the hunt

influences the probability of success, because unsuccessful hunters are not asked to report when they hunted.

Transport Methods. Main access points for planes are a small airstrip on Lime Peak, gravel bars, and several private strips along Beaver Creek; float-planes can land on several small lakes north of Mount Schwatka and sometimes on Beaver Creek. Ground access is primarily from the Steese Highway on trails or mining roads. In 1988 BLM established ORV restrictions throughout the WMNRA and SNCA. Most of the sheep range in the White Mountains area is closed to the use of ORV's; however ORV's weighing <1,500 pounds are allowed in most of the area between the Steese Highway and Mount Prindle, providing good access to sheep habitat.

Despite the scarcity of landing sites, airplanes were the most common means of transportation for successful and unsuccessful sheep hunters. From 1984 to 1988 airplanes provided transportation for 87% of the 15 successful hunters but only 34% of the 64 unsuccessful hunters (Table 7). Unsuccessful hunters also commonly used three- or four-wheelers, ORV's, and highway vehicles.

In 1988, 5 hunters reported using aircraft; however 1 hunter said 8 sheep hunters were on Lime Peak (only accessible by air) prior to 17 August. The degree of unreported harvest and effort is unknown. We also received a report of a hunter flying a four-wheeler into Lime Peak, which is closed to four-wheelers by BLM regulation (R. Goodwin, pers. commun.).

Natural Mortality:

Natural mortality of sheep in the White Mountains area is probably caused by weather and predation. Deep snow has been implicated as an important cause of sheep mortality in some years (Heimer and Watson 1986). Weather in the winters of 1986-87 and 1987-88 was relatively mild (i.e., low snowfall) and probably was not directly responsible for much sheep mortality. The 1988-89 winter weather conditions in Fairbanks (R. Bost, National Weather Service, pers. commun.) are summarized as follows: fall temperatures were higher and snowfall was greater than normal, December was warm and dry, and January was very cold (8-12°F below normal), lacking the thermal inversions that usually keep temperatures warmer at higher elevations. Hence, temperatures in the mountains were estimated to be 20°F colder than normal. Temperatures and snowfall were above average in February and below average in March. The maximum snow depth measured during the winter was 28 inches, which is several inches above normal.

Little is known about predation rates and predator populations in the White Mountains area. Since 1984 sealing documents show an annual harvest in Subunit 25C of 1-10 wolves, 3-5 wolverines, 2-3 grizzlies, and 3-29 lynx. McNay (1989) estimated that 87 wolves reside in Subunit 25C. One collared ewe was killed by wolves in the winter of 1983-84, and golden eagles have been seen on Lime

Peak (B. Durtsche, pers. commun.). In Denali National Park, a University of Alaska Fairbanks graduate student studying lambing behavior found 2 entire lamb carcasses in 1 golden eagle nest in the spring of 1988 (J. Rachelow, pers. commun.). Sheep in the White Mountains area frequently travel through forested areas because of scattered, low-elevation sheep habitats and the scarcity of rugged escape terrain in the alpine areas (ADF&G 1976). Although these forested areas may provide some escape cover from eagles, traveling through these areas probably increases Dall sheep susceptibility to predation by terrestrial predators. The risk of sheep traveling away from escape terrain was illustrated in November 1988, when a pack of 5 wolves killed 13 rams in Unit 11. These rams had crossed a flat 1- or 2-mile drainage bottom and begun to ascend but had not reached escape cover (R. Tobey, pers. commun.).

Habitat Assessment and Enhancement:

Important features of sheep habitat include summer range, winter range, travel routes between the 2 ranges, mineral licks, lambing areas, and escape terrain. Protection of these features is important to the long-term welfare of sheep in the White Mountains area because the relatively low-elevation, discontinuous alpine areas offer limited sheep habitat and few alternatives. Mineral licks have been identified at Mount Schwatka (Jefferson Creek), Lime Peak (Mascot Creek), Mount Prindle (Convert Creek), along Beaver Creek, and possibly at Victoria Mountain (B. Durtsche, pers. commun.).

Caves have been used by sheep in the White Mountains area for many years, perhaps for relief from hot weather. In 1950 L. E. Powell (ADF&G files) wrote that "A cave on the eastern slope of the White Mountains had considerable sheep sign in it. The entrance was approximately 25′ high and 14′ wide. A water hole 25′ inside the cave was inaccessible to sheep because it was sunken in shear walls below ground level. The floor of the cave was covered with an inch of old sheep droppings. No prominent or recently used trails were found in the immediate area." In 1982, 5 rams were seen leaving a cave during a "hot and buggy day" (E. Crain, pers. commun.).

Protection of important sheep habitats is probably more important to sheep welfare than habitat manipulation, because sheep ranges are usually climax vegetation (ADF&G 1980). Three potential threats to sheep habitat include mineral exploration, BLM's development of recreational facilities in the WMNRA and SNCA, and forest succession encroaching on sheep range in the absence of a natural fire regime. BLM's facilities include trails and remote cabins that are intended to substantially increase human use of the area. A proposed 18-mile Nome Creek Road, designed to increase recreational opportunity, would link the Steese Highway with 2 new campgrounds and several trailheads.

In an effort to improve moose browse quantity and quality, the BLM burned, by prescribed fire, approximately 5,000 acres in the upper Bear and Quartz Creeks drainages in June 1987. In addition, a natural fire burned 35,000 acres south of Cache Mountain during the summer of 1987. In 1988 the "Livengood" fire burned approximately 517,000 acres, and another fire burned the area north of the White Mountains. These burns may benefit sheep habitat by retarding encroachment of forest upon the alpine areas and establishing an earlier stage of plant succession in the area.

Game Board Actions and Emergency Orders

Effective July 1987, the minimum legal horn size was changed from 7/8 to full curl in Unit 25 (except 25A), which made horn size regulations consistent throughout the White Mountains area, the Tanana Hills, and the rest of Unit 20.

CONCLUSIONS AND RECOMMENDATIONS

The population goal of providing for aesthetically pleasing hunt conditions is currently being met. Human use of sheep in the White Mountains area is relatively low, and it is unnecessary to limit the number or distribution of hunters. However, to maintain aesthetically pleasing conditions, activities such as increased human use, development of trails, access, and cabins, use of ORV's, and mineral exploration should be monitored and discouraged as necessary. Nonconsumptive use of sheep, such as viewing, will probably increase during the next few years as the BLM promotes recreational use of the area.

Our management objectives for at least 250 sheep in the population and for the harvest of full-curl rams are also being met. To further pursue our management goals and objectives, my recommendations for future activities include determining the appropriate method for monitoring population size and composition trends (by 1992); working cooperatively with Habitat Division, BLM, and Department of Natural Resources to maintain and protect sheep habitat in the White Mountains area, especially travel routes and mineral licks; surveying public attitudes through questionnaires or public forums by 1991 to determine if our management goal of providing aesthetic hunting conditions is consistent with their interest; monitoring harvest and harvest intensity through harvest ticket reports; and modifying statewide sheep harvest reports to record whether one or both horns on a ram had been broomed (broken).

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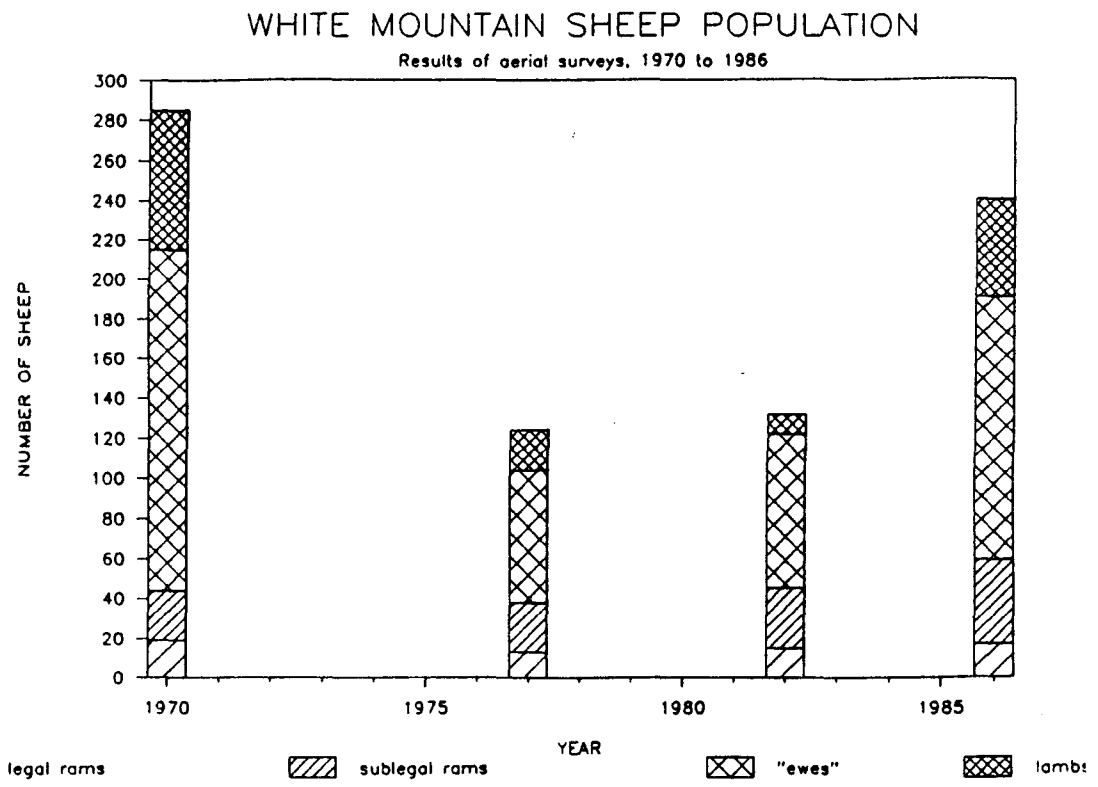

Figure 1. Composition of sheep observed during aerial surveys of the White Mountains area, 1970-86 (definition of "legal ram" was 3/4-curl from 1970 to 1978, 7/8-curl from 1979 to 1985, and 7/8-curl for that portion in Unit 25, and 4/4-curl for that portion in Unit 20 in 1986).

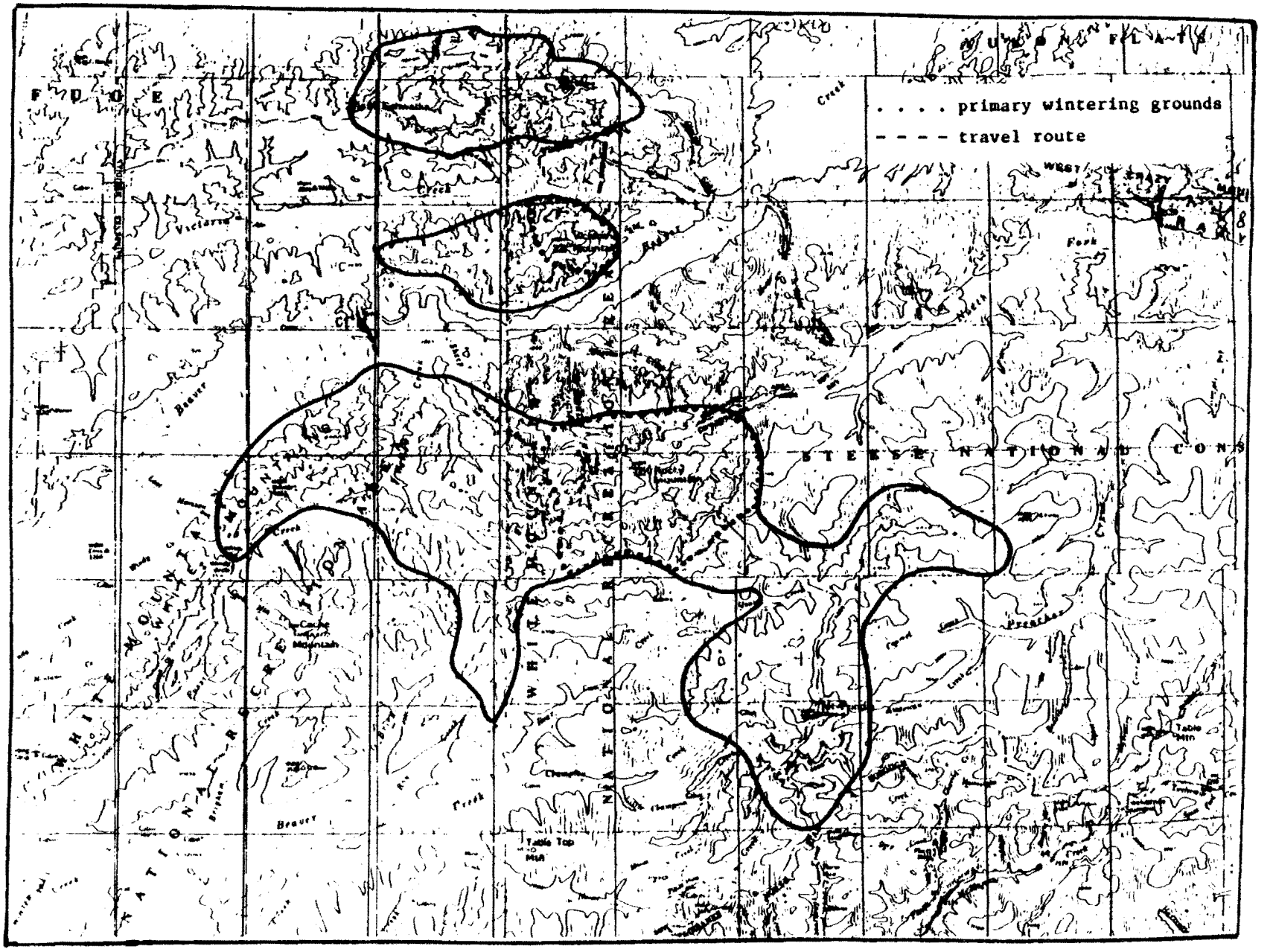

Figure 2. Primary range of sheep in the White Mountains area (1 square = 36 miles^2).

Table 1. Composition of sheep counted during aerial surveys in the White Mountains area, 1970-86.

Date	Rams			Ewes[b]	Lambs	Nonlambs	Total sheep	Count time (hrs)
	Legal[a]	Sublegal	Total					
28 Aug 1970	19	25	44	171	70	215	285	5.9
5-8 Aug 1977	13	25	38	66	20	104	124	6.5
29 Jun-3 Jul 1982	15	30	45	77	10	122	132	9.6
17-29 Jun 1986	17	42	59	132	49	191	240	14.6

[a] "Legal" rams = 3/4-curl in 1970 and 1977, 7/8-curl in 1982 and 1986.

[b] "Ewes" includes unidentified young rams and yearlings of both sexes.

Table 2. Sheep seasons and bag limits in the White Mountains, 1983-88.

Year	Season	Bag limit	Legal horn size[a]	
			Portion in Unit 20	Portion in Unit 25
1983	10 Aug-20 Sep	1 ram with:	7/8-curl horn or larger	7/8-curl horn or larger
1984 1985 1986	10 Aug-20 Sep	1 ram with:	Full-curl horn or larger	7/8-curl horn or larger
1987 1988	10 Aug-20 Sep	1 ram with:	Full-curl horn or larger	Full-curl horn or larger

[a] Full-curl and 7/8-curl restrictions also allow harvest of rams with both horns broken.

Table 3. Characteristics of sheep harvested in the White Mountains area, 1983-88.

Year	Horn			Days hunted
	Age (yrs)	Broomed?	Length (in)	Base (in)	
1983[a]	--	N	36	12	15
	--	N	37.5	14	15
	--	Y	35	12.5	7
1984	11	Y	34	15	8
	7	Y	35.5	13	8
1985	7	N	34.25	14	8
	8	Y	32.5	15.5	7
	6	N	32	13	5
	8	N	37.25	15.25	4
	14	N	33.5	14	5
1986	8	Y	28	15	15
	10	N	37.5	14	6
	8	Y	35	--	6
	9	Y	35	13	10
	10	N	32	11	10
1987	9	Y	36	15	7
	8	N	37.5	14.5	5
1988	13	Y	34.5	14	2

[a] Age data not available.

Table 4. Sheep hunter residency[a] and success for the White Mountains area, 1984-88.

Year	Successful hunters				Unsuccessful hunters				Total hunters	
	Res.	Nonres.	Unspec.	Total	Res.	Nonres.	Unspec.	Total	No.	% Success
1984	0	2	0	2	21	0	1	22[b]	24	8
1985	5	0	0	5[c]	12	0	0	12[d]	17	29
1986	4	0	1	5	4	0	1	5	10	50
1987	2	0	0	2	11	0	0	11[c]	13	15
1988	1	0	0	1	8	0	6	14[c]	15	7
Total	12	2	1	15	56	0	8	64	79	19

[a] Resident of Alaska.

[b] Includes 1 coded as unspecified locations in Unit 20 that could have been from Tanana Hills.

[c] Does not include 1 hunter in Subunit 20F.

[d] Includes 2 coded as 27Z that could have been from Tanana Hills.

Table 5. Mean number of days hunted for sheep in the White Mountains area, 1984-88.

Year	Successful		Unsuccessful		Total
	No. hunters	Mean no. days	No. hunters	Mean no. days	no. hunters
1984	2	8 ± 0	22[a]	7 ± 6.3	24
1985	5[b]	6 ± 1.6	12[c]	4 ± 1.4	17
1986	5	9 ± 3.7	5	6 ± 2.6	10
1987	2	6 ± 1.0	11[b]	4 ± 2.1	13
1988	1	2 + 0	14[b]	4 ± 2.0	15
1984-88	15	7 ± 3.1	64	5 ± 4.2	79

[a] Includes 1 coded 20Z that could have been from Tanana Hills. Also includes 2, 25-day hunts.

[b] Does not include 1 hunter from Subunit 20F.

[c] Includes 2 coded 27Z that could have been from Tanana Hills.

Table 6. Harvest chronology for sheep in the White Mountains area, 1984-88.

Year	Harvest chronology			
	10-20 Aug	21-31 Aug	1-10 Sep	11-20 Sep
1984	2	0	0	0
1985	3	1	1	0
1986	1	2	1	1
1987	2	0	0	0
1988	0	1	0	0
1984-88	8	4	2	1

Table 7. Transport methods for sheep hunters in the White Mountains area, 1984-88.

Year	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other/ unknown
Successful					
1984	2	0	0	0	0
1985[a]	5	0	0	0	0
1986	3	0	1	0	1
1987	2	0	0	0	0
1988	1	0	0	0	0
Total	13	0	1	0	1
Unsuccessful					
1984[b]	8	6	3	2	3
1985[c]	4	1	4	3	0
1986	0	1	3	1	0
1987[a]	6	2	1	0	2
1988[a]	4	1	3	2	4
Total	22	11	14	8	9

[a] Does not include 1 hunter from Subunit 20F.

[b] Includes 1 coded as 20Z that could have been from Tanana Hills.

[c] Includes 1 coded as 27Z that could have been from Tanana Hills.

STUDY AREA

GAME MANAGEMENT UNIT: Portions of 20D and 20E (1,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Tanana Hills

BACKGROUND

Dall sheep populations inhabiting the Tanana Hills may be characterized as low density and disjunct and are at low densities because of the physical geography of the Tanana Hills, which is atypical Dall sheep habitat that support sheep populations with large, discontinuous home ranges (Kelleyhouse and Heimer 1989). Because the Tanana Hills were not glaciated during the most recent glacial advance and there has been little uplift, they are at a fairly low elevation and have a rolling rather than a rugged physiography (i.e., there is a limited amount of escape terrain, making sheep more vulnerable to predation). In an effort to maintain sheep habitats in the Tanana Hills, where forest succession occurs to the top of most hills, the ADF&G continues to support wildfire management plans that should increase the extent of this marginal sheep habitat over time.

MANAGEMENT OBJECTIVES

To maintain the current aesthetically pleasing hunting conditions.

To perpetuate this remnant sheep population and increase sheep numbers from an estimated 350 to 700 by the year 2000.

METHODS

The currently high aesthetic qualities of hunting sheep in the Tanana Hills exist because of limited hunter participation and consumptive use of this small sheep resource. Sheep may be hunted without permit in the Glacier Mountain Controlled Use Area southwest of Eagle and west of the Taylor Highway, but the use of motorized vehicles is prohibited. In the remainder of the area, sheep may be hunted only under terms of limited drawing permits. Four permits are issued for each of 3 hunt areas. Harvest is restricted to full-curl rams only.

Increasing this remnant sheep populations will be accomplished by continued support of wild and prescribed fire, which will renew Dall sheep habitats in the area.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

The last complete survey of sheep habitat was conducted in the summer of 1982; 282 sheep were classified. Application of a 1.3 correction factor resulted in a population estimate of 365 sheep.

Distribution and Movements:

While sheep have been observed throughout most alpine areas in northwestern and northern Subunit 20E, concetraion areas exist. Sheep observed during the 1982 survey were distributed as follows: Mount Harper, $\underline{n}$ = 87 (31%); Crescent Creek-Charley River, $\underline{n}$ = 54 (19%); Twin Mountain, $\underline{n}$ = 18 (6%); Mount Sorenson-Seventymile River, $\underline{n}$ = 41 (15%); and Glacier Mountain-North Peak, $\underline{n}$ = 81 (29%).

No clear seasonal movement patterns are known to exist, but sheep have been observed often in low-lying and timbered areas between normal concentration areas. While mineral licks, which tend to concentrate sheep during June probably exist, no major ones have yet been identified.

Mortality

Seasons and Bag Limits:

The open season for resident and nonresident hunters in Subunits 20D and 20E is 10 August to 20 September; the bag limit is 1 ram with full-curl or longer horns. Lottery permits (4 each) were issued for hunt area Nos. 1106, 1107, and 1108. Hunters using the Glacier Mountain Controlled Use Area may not use motorized vehicles from 5 August through 20 September, but participation is not limited by a lottery-permit requirement.

Human-induced Mortality:

Hunters reported taking 3 rams in the Glacier Mountain Controlled Use Area. The mean horn length of these rams averaged 34.1 inches (range = 32.0 to 35.25). Five hunters harvested a total of 3 rams (60% success rate) in the permit area. Two hunters were successful and 2 were unsuccessful in the Mount Harper hunt area (No. 1106). Both rams taken were 10 years old. One ram had 38-inch horns and the other had horns that were 35.25 inches. One hunter participated in hunt No. 1107 (Mount Sorenson area) and took a 10-year-old ram with 34-inch horns. Weather conditions during the hunting period were good.

Hunter Residency and Success. Twelve hunters participated in the harvest of 3 rams (25% success rate) in the Glacier Mountain Controlled Use Area. Of the 6 hunters who actually participated

in the permit hunts, three harvested rams (50% success rate). Two of 4 hunters were successful on Mount Harper, 1 hunter was successful on Mount Sorenson, and 1 hunter was unsuccessful in the Seventymile River area (hunt No. 1108).

The overall number of hunters in the Tanana Hills was 18, and the harvest was 6 rams, (33% success rate). This success rate is typical for the Tanana Hills.

Permit Hunt. Of the 12 permits that were issued, 6 people actually hunted, for a permit utilization rate of 50%.

Harvest Chronology. In the Glacier Mountain Controlled Use Area, 2 rams were taken during the 1st week of the season. One was harvested during the 2nd week.

Transportation Methods. In the permit areas, which are remote, all hunters traveled to the area using aircraft. In the Glacier Mountain Controlled Use Area, all successful hunters reported walking into the area from highway vehicles. In past years, hunting by horseback has been common among successful hunters. Mechanized transportation is prohibited for sheep hunting in this area.

Natural Mortality:

Most Dall sheep mortality in the Tanana Hills is attributable to natural factors. Predation by golden eagles, wolves, and grizzly bears is known to occur, and the scarcity of escape cover may enhance predator effectiveness. Wolverines are also quite numerous in the area and have been known to kill sheep elsewhere. Sheep in this area are believed by some hunters to have evolved a smaller body size, perhaps as a result of restricted areas of escape cover.

During the aerial survey of Mount Harper in July 1982, most rams were found on the west side of the mountain; ewes and lambs, on the east. Only 2 golden eagles were observed on the west side, but between 10 and 15 eagles were encountered on the east side with the ewes and lambs. Lamb production measured on 9 July 1982 was only 21 lambs:100 ewes; only 8 lambs were seen among the 87 sheep observed on Mount Harper.

Habitat Assessment

Kelleyhouse and Heimer (1989) detailed an explanatory hypothesis of habitat limitation based on physical geography of the Tanana Hills. While it is unlikely that summer range is limiting in extent or quality, it seems probable that winter range availability may limit population growth. Inconsistent winter winds and snowpacks averaging 50 inches per year combine to produce variable winter foraging conditions.

Northern areas in the Yukon-Charley Rivers National Preserve will probably be protected from human disturbance. Mount Harper has known mineral potential, and has already been subjected to disturbance by companies with mining claims there. Any full-scale development of the area must entail sufficient measures to minimize disturbance of sheep or destruction of sheep escape cover or winter range in the area.

Over 30 years of wildfire suppression has caused lower elevation winter ranges and travel routes to become cloaked in spruce forest. The implementation of the Alaska Interagency Fire Management Plan-Fortymile Area is expected to result in a near-natural fire regime throughout this area. When this occurs, sheep should ultimately benefit. Still, the available habitat supported more sheep in the recent past than it does now. Consequently, expansion of sheep ranges by instituting a planned fire regime appears unlikely to offer an immediate increase in sheep populations in this area, without a corresponding effort to reduce predation on sheep.

CONCLUSIONS AND RECOMMENDATIONS

The 1st objective of maintaining the existing, aesthetically pleasing hunting conditions was met during the 1988 hunting season through continued use of transportation restrictions and limited permit drawings. No progress was made toward meeting the objective of maintaining and enhancing the sheep populations of the Tanana Hills.

Because of practical considerations, last year's 2nd objective of determining the causes and chronology of sheep mortality in the Tanana Hills was dropped. This objective was based on the premise that demonstration of population-limiting or population-depressing predation rates could provide the necessary justification for active predator reduction to benefit sheep. However, a practical evaluation of the socio-political climate suggested that while gathering these biological data is possible, the availability of these data is unlikely to contribute substantially to the goal of increasing sheep abundance in the Tanana Hills.

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STUDY AREA

GAME MANAGEMENT UNIT: 23 (43,000 mi^2) and 26A (53,200 mi^2)

GEOGRAPHICAL DESCRIPTION: Western Brooks Range

BACKGROUND

Dall sheep have long been a part of northwest Alaska's indemic fauna. For centuries, indigenous people in northwest Alaska have hunted sheep opportunistically, and early harvests are believed to have been low. In recent years, interest in hunting sheep in northwest Alaska has resulted in increased hunting effort and harvests by resident and nonresident recreational hunters as well as local subsistence hunters.

Because sheep populations in Unit 23 and Subunit 26A are at the northwestern margin of their range in Alaska, they are probably not as robust and productive as populations found in more climatically moderate ranges to the south. Department staff have therefore considered population and harvest monitoring of sheep a high priority. In the Baird Mountains where hunting access is relatively easy, staff remain particularly concerned about potential overexploitation of sheep populations and have committed substantial personnel and fiscal resources to annually monitor that population.

POPULATION OBJECTIVES

To regularly conduct aerial and ground surveys in the Baird and DeLong Mountain ranges, monitor annual hunting mortality, and develop meaningful management guidelines.

METHODS

Aerial surveys were conducted in cooperation with National Park Service (NPS) staff in the Baird Mountains on 13-14 July 1988. Two PA-18 Supercubs and 1 Arctic Tern were used to conduct surveys in 15 discrete sample units ranging in size from 17 to 115 mi^2. All but one of these sample units were established in 1986, and all but three have since been surveyed annually. Ground composition counts were conducted at 9 locations in the Baird Mountains on 11 July. Including pilots, 7 people were involved in the aerial surveys and three in the ground counts.

As reported previously, harvest information was obtained through the statewide harvest ticket system, a permit registration hunt, and a special reporting system established for the subsistence hunt. People reported their harvests in the DeLong Mountains during August and September 1988 with the statewide report card, while people hunting in the Baird Mountains during the same

period used a registration permit report card obtained from the Kotzebue ADF&G office. Individuals hunting sheep during the winter subsistence season reported their harvests using a report card specific for that hunt.

RESULTS AND DISCUSSION

Population Status and Trend

No surveys were conducted in that portion of the DeLong Mountains in Unit 23 and Subunit 26A during 1988. The most recent information for that area was collected during June and July 1987 (Larsen 1989). Although current survey data are lacking, harvest data and staff observations indicate that the size of the DeLong Mountain population probably has remained stable.

Survey data collected in the Baird Mountains during 1988 indicated that the population has apparently remained stable in size, although signs of increase are evident. The overall number of rams in the population appears to be slightly higher than that observed in 1987, but the number of rams with 7/8-curl horns or larger (i.e., legal for harvest during the fall hunt) appears to have decreased (Table 1). Lamb counts have steadily increased between 1986 and 1988.

Population Size:

Eight hundred fourteen sheep were counted in 540 mi^2 of the Baird Mountains during July 1988, resulting in a density estimate of 1.5 sheep/mi^2 (Table 2). Survey personnel spent 20.4 hours surveying sheep in this area, and the survey intensity ranged from 1.3 to 3.0 minutes/mi^2. Survey data obtained from this 540-mi^2 area are directly comparable to data collected in the same area during 1986 and 1987. Six hundred seventy sheep were counted in the area in 1986 and 665 were observed in 1987 (Table 1).

A survey was also conducted in an additional 104mi^2 portion of the Baird Mountains during a 3-hour period in 1988, and an additional 97 sheep were counted (Table 2). The data from the new survey area are included in Table 2, but they were not used in evaluating population changes in the Bairds. Including the 97 sheep counted in the new survey area with the 814 counted in the preexisting survey areas yields a minimum population size of 911 sheep.

Population Composition:

With the exception of legal rams (i.e., $\geq$ 7/8-curl horn), counts determined from aerial surveys for all sex and age groups were higher in 1988 than in 1987 (Table 1). Productivity and recruitment appear to have steadily increased; lamb counts increased from 105 in 1986 to 187 in 1988, and lamb:ewe ratios

increased from 25:100 to 42:100 during the same time period. The significance of the decreased number of legal rams observed is uncertain. Conflicting opinions exist among sheep biologists regarding the effect of eliminating all 7/8-curl or larger rams from the population through hunting. Heimer and Watson (1986) suggested that removal of older aged rams from sheep populations disrupts ram age structure and results in reduced survival of the young rams that remain. Singer et al. (1986) proposed that removal of older rams results in greater rut participation by young rams, but this participation results in depressed survivorship only in those cases where removal of large-horned rams included all 7/8-curl and most 3/4-curl rams. Hoefs et al. (1984) found that an annual harvest of 60% to 70% of the $\geq$7/8curl rams in the Kluane area of southwest Yukon Territory resulted in increased fecundity and population growth. Regardless of the varied opinions, with a fall minimum of 44 legal rams in the Baird Mountains, the ram segment of the population is considered healthy and in no imminent danger from excessive harvest.

The sex and age composition of 224 sheep in the Baird Mountains was determined from the ground on 11 July (Table 3). The 1988 ratio of 59 lambs:100 ewes is only slightly lower than the 1987 ratio of 63:100 obtained at the Kilyaktalik Peaks in the Baird Mountains (Larsen 1989). The number of yearlings:100 ewes observed in 1988 was 35, compared with 23:100 in 1987. Comparing the 1987 lamb:ewe ratio of 63:100 with the 1988 yearling:ewe ratio of 35:100 suggests that 55% of the lambs born in 1987 survived their 1st year of life. This is similar to the 52% lamb survival estimated for 1986-87 (Larsen 1989). Because the areas surveyed on the ground during 1986, 1987, and 1988 were not identical, these survival rates may not be comparable. Additionally, comparing lamb:ewe ratios in 1987 with yearlings:ewe ratios in 1988 may not be completely valid, because survivorship among other cohorts may not have been constant.

Distribution and Movements:

Sheep in northwest Alaska have been known to move long distances in as little as a few days (Larsen 1989). No noticeable shifts in sheep distribution from areas where they have traditionally been found were observed during the 1988 surveys in the Baird Mountains.

Mortality

Seasons and Bag Limits:

The open season for subsistence hunters in Unit 23 is from 1 October to 30 April. The season will be closed in that portion south and east of the Noatak River, excluding Gates of the Arctic National Park (GANP), when 30 sheep have been taken. The bag limit is 1 sheep. The open season for all hunters in Unit 23 is 10 August to 20 September. The bag limit is 1 ram with 7/8-curl or larger horn. A registration permit is required in that

portion south and east of the Noatak River, excluding GANP. The open season for all hunters in those portions of Subunit 26A within GANP is from 1 August to 30 April. The bag limit is 3 sheep by registration permit; 50 sheep may be taken. The open season for all hunters in the remainder of Subunit 26A is 10 August to 20 September. The bag limit is 1 ram with 7/8-curl or larger horn.

Human-induced Mortality:

For the second consecutive year, the fall 1988 harvest of rams from Unit 23 was 37. Seventeen rams were taken from the Baird Mountains, and 20 were from the DeLong Mountains in Unit 23. An additional 12 rams were reported harvested from the DeLongs and the Western Brooks range in Subunit 26A (Table 4). Fifty-five registration permits were issued for hunting in the Baird Mountains during the fall of 1988, compared with 48 during 1987 and 57 during 1986. The average reported horn length of sheep taken in the Bairds is 32.3 inches (SD = 3.5, N = 17), and their average age is 8.4 years (SD = 1.8, N = 16). The average reported horn length of sheep taken in the DeLongs is 32.9 inches (SD = 2.8, N = 20) and their average age is 8.9 years (SD = 1.6, N = 20).

Eleven sheep were reported taken during the 1987-88 either-sex subsistence season in Unit 23 (Table 4). As reported in past years, most of the reported harvest (9 sheep) came from the Baird Mountains. Because the 1988-89 subsistence hunt is currently in progress, harvest data for that hunt will be presented in the next annual survey-inventory progress report (i.e., 1989-90).

Hunter Residency and Success. Seventeen of the 55 registration permittees killed sheep in the Baird Mountains during the fall of 1988 (Table 5). Seven successful hunters were residents of Alaska who did not reside in Unit 23. Four sheep were killed by local residents of Unit 23, and four were taken by nonresident hunters.

Nonresidents accounted for 13 of the 20 sheep harvested from the DeLong Mountains, and three were harvested by nonlocal Alaska residents (Table 6). Local residents of the unit did not report taking any sheep from the DeLongs during the fall.

Harvest Chronology. Eleven of the 17 sheep taken in the Baird Mountains were killed during the first 2 weeks of the 6-week season (Table 7). In the DeLongs, the harvest was distributed throughout the season.

Transport Methods. All hunters who reported killing sheep during the fall of 1988 used aircraft for access (Table 8). Snowmachines were used by hunters during the winter subsistence hunt.

CONCLUSIONS AND RECOMMENDATIONS

No surveys were conducted in that portion of the DeLong Mountains in Unit 23 and Subunit 26A during 1988; however, survey data obtained during 1987 indicated that the DeLong sheep population is probably healthy and stable in size. Aerial surveys should be conducted in the DeLong Mountains at least once every 3 years; it should again be conducted in 1990.

July 1988 surveys in the Baird Mountains accounted for higher numbers of lambs, ewes, and rams than were observed in 1987. However, the number of legal rams ($\geq$ 7/8-curl horn) counted during 1988 was lower than that observed in 1987.

The overall harvest quota of 40 sheep from the Baird Mountains should be retained along with the fall registration permit system with its harvest quota of 10 rams. Because the winter harvest quota of 30 sheep from the Baird Mountains is not sex-specific, the number of ewes harvested could potentially exceed the maximum allowable harvest of 3% recommended by Heimer (1982). However, given the low number of ewes reported harvested during the winter hunts and the observed increase in numbers of ewes and lambs, no regulatory changes are necessary at this time.

ACKNOWLEDGEMENTS

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Table 1. Dall sheep sex and age composition data obtained from aerial surveys of the Baird Mountains, GMU 23, 22-23, July 1986, 13, July 1987,and 13-14, July 1988.

Sex/age class	Number/percent/ratios of sheep 1986	1987	1988
Legal rams[a]	47	50	35
Sublegal rams[b]	98	64	101
Unclassified rams	0	15	1
TOTAL RAMS	145	129	137
Ewes[c]	416	393	484
Lambs	105	143	187
Unidentified	4	0	6
TOTAL SHEEP	670	665	814
Legal rams/100 ewes	11	13	7
Sublegal rams/100 ewes	24	16	21
TOTAL RAMS/100 EWES	35	33	28
Lambs/100 ewes	25	36	39
Lamb % of total	16	22	23
Legal rams % of all sheep older than lambs	8	10	6
Legal rams % of all sheep	7	8	4
Legal rams % of all rams	32	39	26
Ram % of total sheep	22	19	17

[a] 7/8-curl or larger.
[b] Greater than 1/4-curl but less than 7/8-curl horn size.
[c] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 2. Dall sheep sex and age data collected during aerial surveys in the Baird Mountains, 13-14 July, 1988.

Sample unit	Area mi^2	Survey time (min)	Survey effort (min/mi^2)	Total sheep	Lambs	Ewes[a]	Unclass.	Rams 1/2 curl	Rams 3/4 curl	Rams 7/8 curl	Rams Full curl	Rams Unclass.
A	115.3	252	2.2	210	53	141	2	8	2	4	0	0
B	35.1	105	3.0	27	7	18	0	2	0	0	0	0
C	27.3	72	2.6	13	2	9	0	1	0	0	1	0
D	46.0	132	2.9	61	7	24	1 7	20	1	1	0	
E	47.4	90	1.9	184	35	81	1	25	17	13	12	0
F	43.5	96	2.2	0	0	0	0	0	0	0	0	0
G	48.5	114	2.3	13	1	5	0	4	2	0	1	0
H	41.9	120	2.90	161	48	109	1	1	1	1	0	0
I	45.6	114	2.5	33	9	22	0	0	2	0	0	0
J1	52.2	42	1.3	3	1	2	0	0	0	0	0	0
J2		25[c]		0	0	0	0	0	0	0	0	0
K	60.6[b]	60	1.6[d]	109	24	73	1	3	6	1	0	1
TOTAL	563.4	1222	2.3	814	187	484	6	51	50	20	15	1
J3	17.4	24	1.4	40	14	26	0	0	0	0	0	0
O	48.0	54	1.1	0	0	0	0	0	0	0	0	0
P	38.7	102	2.6	57	10	25	0	6	7	0	9	0
TOTAL	104.1	180	1.7	97	24	51	0	6	7	0	9	0

[a] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.
[b] Only the western 36.7 mi^2 of Unit K were surveyed during 1988.
[c] Survey time estimated; actual time not reported.
[d] Calculated based on 36.7 mi^2 surveyed.

Table 3. Dall sheep sex and age composition counts conducted on the ground in the Baird Mountains, 11 July, 1988.

Sex/age class	Number/percent/ratios of sheep
Total sheep	224
Lambs	55
Yearlings	33
Ewes	93
Unclassified ewe/yearling	9
Total rams	34
1/4-curl rams	19
1/2-curl rams	6
3/4-curl rams	4
7/8-curl rams	4
4/4-curl rams	1
Lambs/100 ewes	59
Yearlings/100 ewes	35
Legal rams/100 ewes	5
Sublegal rams/100 ewes	31
Total rams/100 ewes	37
Lamb % of total sheep	25
Yearling % of total sheep	15
Ram % of total sheep	15
3/4 curl ram % of total rams	12
7/8 curl ram % of total rams	12
4/4 curl ram % of total rams	3

Table 4. Summary of Dall Sheep harvest statistics for GMU 23, 1970-88. R=rams, E=ewes, L=lambs, and U=unknown.

Year	General hunt (Rams only)			Winter hunt												Total harvest
				Bairds				DeLongs				Unknown				
	Bairds	DeLongs	Unk	R	E	L	U	R	E	L	U	R	E	L	U	
1970	---	---	17	-	-	-	-	-	-	-	-	-	-	-	-	17
1971	---	---	16	-	-	-	-	-	-	-	-	-	-	-	-	16
1972[a]	---	---	26	-	-	-	-	-	-	-	-	-	-	-	-	26
1973	---	---	13	-	-	-	-	-	-	-	-	-	-	-	-	13
1974	---	---	19	-	-	-	-	-	-	-	-	-	-	-	-	19
1975	---	---	17	-	-	-	-	-	-	-	-	-	-	-	-	17
1976	---	---	22	-	-	-	-	-	-	-	-	-	-	-	-	22
1977	---	---	34	-	-	-	-	-	-	-	-	-	-	-	-	34
1978[b]	---	---	35	-	-	-	-	-	-	-	-	-	-	-	-	35
1979	---	---	25	-	-	-	-	-	-	-	-	-	-	-	-	25
1980[c]	---	---	16	-	-	-	-	-	-	-	-	-	-	-	-	16
1981	3	10	--	-	-	-	-	-	-	-	-	-	-	-	-	13
1982[d]	10	11	--	2	2	-	5	-	-	-	-	-	-	-	-	10
1983	12	8	--	-	-	-	-	-	-	-	-	-	-	-	-	20
1984	8	8	3	2	2	-	-	-	-	-	-	-	-	-	-	23
1985	28	8	1	10	7	0	3	-	-	-	1	-	-	-	-	58
1986	9	14	0	8	4	0	0	-	2	-	-	-	-	-	-	37
1987	18	19	0	3	6	0	0	1	1	-	-	-	-	-	-	48
1988[e]	17	20	0													

[a] Marine Mammals Protection Act.
[b] Carter's Monument withdrawal (Dec. 1978); and 7/8 curl regulation.
[c] Alaska National Interest Lands Conservation Act (ANILCA) (Dec. 1980).
[d] Subsistence permit regulation.
[e] Winter hunt is on-going.

Table 5. Hunter residency and success in Baird Mountain registration permit hunt, Unit 23, fall 1988.

Residency of hunter	No. of permits issued	Successful	Unsuccessful	Did not hunt
Local unit resident	26	4	3	19
Non-local Alaska resident	23[a]	7	12	5
Nonresident	6[a]	4	3	0
Unknown	0	2[b]	0	0
Total	55	17	18	24

[a] One unsuccessful hunter obtained a harvest ticket but not a registration permit.
[b] Hunters obtained harvest tickets but not registration permits.

Table 6. Hunter residency and success in DeLong Mountains, GMU 23, fall 1988.

Residency of hunter	Successful	Unsuccessful
Unit 23 resident	0	3
Non-local Alaska resident	3	7
Nonresident	13	5
Unknown	4	0
Total	20	15

Table 7. Chronology of sheep harvest in GMU 23, fall 1988.

Week of season	Total harvest	Area	
		Baird Mtns.	DeLong Mtns.
Aug 10-15	8	7	1
Aug 16-22	9	4	5
Aug 23-29	3	0	3
Aug 30-Sep 5	7	2	5
Sep 6-12	7	2	5
Sep 13-20	3	2	1

Table 8. Method of transportation used by sheep hunters in the Baird and DeLong Mountains of Unit 23, August - September 1988.

Type of transporation	Bairds		DeLongs	
	successful	unsuccessful	successful	unsuccessful
Aircraft	17	16	20	11
Boat	0	1	0	4
Unknown	0	1	0	0
Total	17	18	20	15

STUDY AREA

GAME MANAGEMENT UNIT: 24 (24,150 mi^2)

GEOGRAPHICAL DESCRIPTION: Brooks Range within Gates of the Arctic National Park

BACKGROUND

Dall sheep in Gates of the Arctic National Park (GAAR) are managed somewhat differently than in most areas of Alaska. The state and federal subsistence priority laws mandate subsistence use as the highest priority consumptive use when harvest is allowable; however, the Alaska Board of Game, acting in compliance with these subsistence laws, has found historic human use of Dall sheep rarely meets the present definitions of subsistence use. Consumptive use by local residents of GAAR and the defined subsistence zone for this park is one of these rare exceptions.

In GAAR, subsistence is the only consumptive human use permitted (Osborne 1989). As a result, one ADF&G management goal for Dall sheep in GAAR is to provide opportunity for human subsistence use. Still, this goal is secondary to the primary goal of protection, maintenance, and enhancement of the sheep population and its habitat in concert with other components of the ecosystem. Another secondary ADF&G management goal for Dall sheep is to provide the opportunity to view and photograph sheep. Attainment of this observation/photography goal is being pursued by the National Park Service.

Within Unit 24, distribution of Dall sheep is limited to suitable habitats in the Brooks Range. Management goals for sheep that occur in the John and Wild River drainages south of the park center on diversified human recreation (Osborne 1989). Sheep inhabiting Unit 24 east of GAAR are covered in the Eastern Brooks Range report.

MANAGEMENT OBJECTIVES

To provide an opportunity for subsistence uses of Dall sheep in Gates of the Arctic National Park and recreational use outside the park.

To provide the opportunity to hunt Dall sheep under aesthetically pleasing conditions in the remainder of Unit 24.

To maintain an annual subsistence harvest of 50 sheep in the GAAR and a general harvest of at least 5 rams in the Wild and John River drainages.

To maintain or increase the sheep population in Unit 24.

METHODS

Subsistence harvest during this reporting period was monitored through a registration permit hunt authorized by the Board of Game after input from the National Park Service and the ADF&G Division of Subsistence.

RESULTS AND DISCUSSION

Population Status and Trend

Human harvests have not been a significant source of mortality throughout Unit 24, and sheep populations in the area vary according to weather and predation (Heimer 1988). However, subsistence hunting (because of its localized nature and harvest of females) may be having localized effects on affected populations (Heimer 1988).

Population Size:

There is no reason to suspect populations are measurably different than reported last year (Osborne 1989). Under typical environmental conditions, Dall sheep populations tend toward stability (Heimer 1988). No unusual conditions were reported last year.

Population Composition:

Population composition varies from year to year depending on lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting management (Heimer 1988). The weather was not unusual, there were no discernible changes in natural predation, and hunting management was unchanged from last year.

Mortality

Season and Bag Limit:

In those portions of Unit 24 and Subunit 26A within Gates of the Arctic National Park, the subsistence hunting season is 1 August-30 April. The individual bag limit is 3 sheep, and total harvest is limited by quota to 50 sheep. Only qualified subsistence residents of Anaktuvuk Pass, Bettles/Evansville, Wiseman, Alatna, Allakaket, Ambler, Hughes, Kobuk, Nuiqsut, and Shungnak are allowed to participate in the subsistence hunt.

In the remainder of Unit 24, the recreational hunting season lasts from 10 August to 20 September and the bag limit is 1 7/8-curl or larger ram per hunter. The current National Park Service policy allows recreational hunting on private lands (inholdings) within the park with permission of the landowner.

Human-induced Mortality:

The subsistence harvest in 1988 was 18 sheep. The annual harvest since 1982 has been between 18 and 30 sheep. Most of these sheep have been adults, and rams are preferred (Table 1). Harvest from the lower John and Wild Rivers (4 rams) was higher than normal in 1988; harvest from this area is usually 1 or 2 rams.

Hunter Residency and Success. Residents of Anaktuvuk Pass have taken about 25 sheep per year during the subsistence hunt. Residents of the other villages in the ANILCA-designated subsistence zone usually take between 1 and 5 sheep each year. This year Anaktuvuk residents took 12 sheep. Other residents of the subsistence zone took six. Success rates are not particularly relevant in this subsistence hunt because of community hunting and sharing traditions (Osborne 1989); however, the harvest was taken by 9 hunters. Ten hunters harvested a total of 4 rams in the lower John and Wild River drainages for a 40% success rate.

Harvest Chronology. Sheep hunting and harvest occurred primarily before December, because the residents think sheep taken after rut are less desirable as food (Osborne 1989).

Permit Hunts. Thirty-two permits were issued, and 24 of these were returned (Table 1). The number of permit hunters who actually hunted in 1988 is not known.

Transportation Methods. There are no data suggesting transportation methods used in 1988 were different than in the recent past. Osborne (1989) provided a recent historical perspective on transportation methods.

Natural Mortality:

There are no data which suggest changes in natural mortality from those reported by Osborne (1989).

Habitat

Habitat and habitat management concerns remain unchanged from last year (Osborne 1989).

CONCLUSIONS AND RECOMMENDATIONS

The primary ADF&G management goal of protection, maintenance, and enhancement is presently being achieved throughout most of the sheep habitat in Gates of the Arctic National Park. Most of the park is used sparingly by viewers and photographers and rarely by subsistence hunters. The secondary goal of providing for subsistence uses of Dall sheep is apparently being achieved. There has been no long-term decline in the number of sheep taken by subsistence residents, and no obvious declines in sheep

populations subjected to harvest by humans have been reported. However, no systematic sheep population monitoring program exists in Unit 24, so subtle declines in local populations are not expected to be noticed if they do occur. Joint efforts to establish population monitoring programs for the subsistence-impacted populations should be undertaken cooperatively by the National Park Service and ADF&G.

To ensure that future subsistence harvest information is more accurate and current, the registration harvest report should be replaced by a questionnaire letter sent to all permit holders during February each year. I plan to work with the National Park Service and the local residents to effect this change in 1989.

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Table 1. Gates of the Arctic National Park sheep harvest and hunter residency, 1982-88.

	1982	1983[a]	1984	1985	1986	1987	1988
Permits issued	49	--	41	16	16	41	32
Permits returned	15	--	6	5	4	2	24
Successful hunters	14	--	2	1	1	12[b]	9
Permits issued by village							
Anaktuvuk	49	--	26	1	5	30	23
Bettles	0	--	10	6	9	5	3
Allakaket	0	--	2	2	0	1	0
Wiseman	0	--	3	4	2	5	5
Ambler	0	--	0	0	0	0	1
Sex of harvest							
Males	18	--	4	2	1	22	15
Females	7	--	-	-	-	3	3
Lambs	1	--	-	-	-	-	0
Total sheep harvest	26	--	4	2	1	25	18

[a] No data available.

[b] Number of sheep taken are based on oral survey not returned permits.

STUDY AREA

GAME MANAGEMENT UNIT: 24 (eastern portion), 25A, 26B, and 26C (49,600 mi^2)

GEOGRAPHICAL DESCRIPTION: Eastern Brooks Range

BACKGROUND

Dall sheep are found across most of the eastern Brooks Range; the highest densities occurred on the north side of the range. Limited surveys and observations over the past 18 years indicated a stable population until the early 1980's when higher numbers were seen in some areas. However, no reliable population trend data are available. There may be as many as 15,000 sheep in this area.

With the exception of a period of reported Dall sheep scarcity at the turn of the century (Campbell 1974), sheep in the eastern Brooks Range have been relatively abundant with respect to the human use they have sustained. Sheep are hunted for food near the villages of Kaktovik and Arctic Village. Sheep also provide a diversity of recreational uses, such as sport hunting, viewing, and photography.

Human use of sheep in the area has increased steadily over the last 20 years. The establishment of Gates of the Arctic National Park in 1980 eliminated sport hunting over a large portion of sheep range, and hunting pressure rose in adjacent areas. The opening of the Dalton Highway for commercial use, including guiding and outfitting, to Prudhoe Bay in 1978 and to general public use as far north as Dietrich in 1981 allowed hunters better access to sheep. The growing human population in the state and the public's affinity for the Arctic National Wildlife Refuge are also contributing factors to rising human use of sheep.

Current management goals for sheep in the eastern Brooks Range are to: (1) protect, maintain, and enhance the sheep population and its habitat in concert with other components of the ecosystem; (2) provide for continued subsistence use of sheep by rural Alaskan residents who have customarily and traditionally used the population; (3) provide an opportunity to hunt sheep under aesthetically pleasing conditions; and (4) provide an opportunity to view and photograph sheep. The history of sheep management and goal development was presented by Nowlin and Heimer (1989). The following objectives should allow these goals to be met.

MANAGEMENT OBJECTIVES

To select trend indicator areas for determination of herd size, composition, productivity, and population trends by 1991.

To develop subsistence harvest assessment techniques by 1991.

To maintain the opportunity to harvest rams with a mean horn length exceeding 34 inches and a mean age of more than 8 years under aesthetically pleasing conditions. The theoretically sustainable ram harvest probably exceeds 500 rams per year.

To maintain an annual hunter harvest success of at least 40% among recreational hunters.

To determine hunter attitudes regarding the aesthetic quality of sheep hunting in the eastern Brooks Range by 1991.

To identify suitable sites for viewing and photographing sheep and cooperate with other agencies in promoting those sites by 1992.

METHODS

The only surveys completed during the reporting period were ground composition counts in Atigun Gorge in western Subunit 26B. They were done through the Alaska Cooperative Wildlife Research Unit as part of a doctoral thesis (M. Hansen, pers. commun.).

During the period 1-6 August and on 27 September 1988, ADF&G and USFWS biologists captured and radio-collared 10 ewes and 2 rams in the area of the Atigun and Sagavanirktok Rivers. These sheep were radio-tracked in early October 1988 and in April 1989. This work was part of a continuing cooperative project between the ADF&G and the USFWS to develop a population trend area in the Atigun-Dalton Highway area. Data on harvest, hunter effort, horn size, and transportation were gathered from mandatory hunter harvest reports.

RESULTS AND DISCUSSION

Population Status and Trend

The most recent population estimate for Dall sheep in the eastern Brooks Range was about 13,000 in 1985 (Heimer 1985). The total population may have changed since that time, but no trend data are available; however, composition data collected in recent years from Atigun Gorge suggest adequate production and recruitment to maintain population stability or allow some growth in that area.

Population Composition:

Ground surveys conducted in Atigun Gorge from 1986 through 1988 indicated lamb production was fair in 1986 and good during 1987 and 1988. Yearling recruitment was fair during 1987 and unusually high in 1988 (Table 1). Lamb production among 5 radio-collared ewes was also good during 1988 (60 lambs:100 ewes).

Distribution and Movements:

There are no data which suggest distribution and movements are different than reported by Nowlin and Heimer (1989).

Mortality

Seasons and Bag Limits:

In Subunits 25A and 26C the subsistence hunting season are from 10 October to 30 April. The bag limit is 3 sheep. For recreational hunters, the bag limit is one 7/8-curl or larger ram. The recreational hunting season is 10 August-20 September.

Human-induced Mortality:

Harvest of sheep declined slightly in 1988 after 5 years of steady increase, but it was still the second-highest harvest during that period (Table 2). The only area which showed a continually increasing harvest in 1988 was Subunit 25A.

Subunits 26B and 26C and the Dalton Highway area all showed declines (Table 3). Despite the downward shift in overall harvest, interest in sheep hunting is high and probably still growing in the Brooks Range.

Most of the harvest in the eastern Brooks Range occurred in the following drainages: (1) Subunit 25A, Middle and East Forks of the Chandalar River, Junjik River, and Sheenjek River; (2) Subunit 26B (not including that portion along the Dalton Highway), west side of the Canning River; and (3) Subunit 26C, east side of the Canning River, Hulahula River, between the Akutoktak and Niguanak Rivers, Aichilik River, and Kongakut River and along the Dalton Highway, Middle Fork Koyukuk River, Itkillik River, and Sagavanirktok River.

Harvest along the Dalton Highway continues to interest hunters and concern managers. The Dalton Highway allows hunters access sheep habitat directly adjacent to the road. Hunters can also gain access to sheep over a much broader area using aircraft that depart from staging points along the highway at Coldfoot, Galbraith Lake, Happy Valley, and Deadhorse. Guides and outfitters operate most of these aircraft and maintain base camps at many of these sites.

Restrictions on recreational use of the Dalton Highway have not prevented an increase in hunters and harvests. Enforcement of the highway use regulations has been sporadic, and numerous legal loopholes exists. Only 1 Fish and Wildlife Protection Officer has been assigned to the entire eastern Brooks Range. The permit check station at Chandalar Shelf has not been continuously manned, and no physical barrier was in place to force travelers to stop. Hunters can be issued highway permits by simply filing

mining claims located north of Chandalar Shelf; they can also fly on regularly scheduled commercial jets to Deadhorse and rent vehicles to travel the road or meet guides and outfitters who will transport them to staging points.

Similarly, restrictions on hunting methods that were implemented with establishment of the Dalton Highway Management Area have been only partially effective in limiting harvest. Hunting is prohibited within 5 miles of the road, except by bow and arrow. Also within the Dalton Highway corridor, no motorized vehicles, except aircraft, boats, and licensed highway vehicles, may be used to transport game or hunters.

Away from the Dalton Highway, the numbers of hunters may be causing crowding around larger and better known aircraft landing sites. Concentration of hunters there represents the most extreme case, but it illustrates a potential problem.

Despite increasing harvests, horn size and age of harvested rams show stable trends for the past 5 years (Table 3). During this time mean horn length has averaged more than 34 inches in all areas, which includes the Dalton Highway where the previous 5-year average was less than 34 inches. Average circumference of the horn base was above 12.4 inches during all years. Mean age was consistently above 8 years.

Subsistence hunters from Kaktovik harvested 20-30 sheep in 1988 (S. Pedersen, pers. commun., ADF&G) hunters from Arctic Village took less than 10 sheep, according to the village Chief, Trimble Gilbert. From 1979 through 1986 the subsistence harvest was regulated by registration permit, varying from 12 to 30 sheep. Hunters from both Arctic Village and Kaktovik participated. Subsistence harvests are rarely reported, however, and more accurate data must be gathered to assess potential impacts to the sheep populations and determine how well subsistence needs are being met.

Hunter Residency and Success. Most sheep hunters using the eastern Brooks Range were Alaska residents (Table 2). During the reporting period, 30% of those reporting residence lived outside Alaska; the remaining 70% were Alaska residents. Only one of the Alaska residents lived in the eastern Brooks Range. Similar percentages of nonresident users have been reported over the last 5 years. The trend is stable, except for the increased number of hunters who did not specify residence.

Hunter success varied from 43% along the Dalton Highway to 73% in Subunit 25A during 1988 (Table 4). The atypically high success rate of 56% along the Dalton Highway in 1987 was lower in 1988 as were the percentages for the other units, except Subunit 25A which showed a substantial increase.

Harvest Chronology. Most sheep are harvested during mid- to late August because weather in the Brooks Range during that time is

generally better than later in the season. For each of the past 5 years, harvests during that period have ranged from 75% to 85% of the total (Table 5); 82% of the harvest taken was during this reporting period. Only 1 subsistence hunter from Wiseman reported taking a sheep in November.

Transport Methods. Airplanes are the primary method of transport for most hunters. Over the past 5 years, 78% to 90% of successful hunters have used aircraft (Table 6). This year was typical.

CONCLUSIONS AND RECOMMENDATIONS

Management goals and objectives for sheep populations in the eastern Brooks Range are being achieved in most areas. The population is able to provide for an increase in high-quality sport hunting opportunity as well as an adequate subsistence harvest. Recreational harvest data show generally high success rates, large horn sizes, and predominance of older-age rams.

The smaller horn size reported from the Dalton Highway area is not a major management problem; it is above the legal minimum length and could be a result of hunters in this area being less selective for large rams than other hunters in the eastern Brooks Range. Very few of these hunters have the advantage of guides to assist them, and they are at least somewhat constrained by restrictions on the use of motorized vehicles and firearms within 5 miles of the highway. Archery hunters may be satisfied with a minimally legal ram, rather than seeking out a larger ram. Also, smaller average horn size has not occurred consistently. If decreasing horn size becomes a consistent occurrence and other objectives are not met, remedial action will be necessary.

Failure to enforce the existing regulations and statutes in the Dalton Highway Management Area is a significant management problem. I recommend that the enforcement effort along the road be increased. This will be difficult for Division of Fish and Wildlife Protection, given recent funding cuts; however, the Bureau of Land Management and USFWS have expressed willingness to increase their efforts in their jurisdictions.

Hunter crowding is a concern along the Dalton Highway and at aircraft landing areas in Subunits 26B and 26C. I recommend further definition of the meaning of the "aesthetic conditions" objective. I also recommend a hunter survey be conducted jointly with USFWS to find whether crowding has been negatively affecting the hunters.

Harvest reporting by subsistence hunters must be improved. Although the either-sex harvests by Kaktovik residents on the Hulahula River and by Arctic Village residents on the East Fork Chandalar River are low and appear stable, they could negatively impact local sheep populations if these are significant increases. To obtain better subsistence information, ADF&G will

institute a hunter registration system in FY 1990 that will provide a list of hunters to be contacted by questionnaire or interview after the season.

The collection of additional information on population status and trend is essential. Annual ground composition counts should be conducted in cooperation with USFWS in Atigun Gorge, Hulahula River, and other select drainages. In addition, there is a need to apply existing population trend and survey methodology for sheep, particularly in areas with heavy human use. I recommend ADF&G and USFWS enter into a cooperative agreement by spring 1990 to meet the above needs.

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Table 1. Dall sheep composition counts in Atigun Gorge, Subunit 26B, 1986-88.[a]

Year	Lambs:100 "ewe-like" sheep[b]	Lambs:100 ewes	Yearlings: 100 Females	n
1986	24	--	--	254
1987	33	50	22	396
1988	35	58	39	375

[a] Data source: Michael C. Hansen, Alaska Cooperative Wildlife Research Unit, University of Alaska, Fairbanks.

[b] Includes adult ewes as well as yearlings and 2-year-olds of both sexes.

Table 2. Dall sheep hunter residency and success in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1984-88.

	Successful hunters					Unsuccessful hunters				
Year	Local resident[a]	Nonlocal resident	Non-resident	Un-specified	Total	Local resident[a]	Nonlocal resident	Non-resident	Un-specified	Total
1984	0	89	69	8	166	1	90	10	3	104
1985	2	109	80	4	195	1	98	13	5	117
1986	0	126	79	9	214	2	120	14	7	143
1987	0	156	104	14	274	0	116	10	8	134
1988	1	109	99	35	244	0	107	18	17	142

[a] Local resident is a resident of eastern Unit 24 or Subunits 25A, 26B, or 26C.

Table 3. Mean Dall ram horn size and age of the harvest from eastern Unit 24 and Subunits 25A, 26B, and 26C, 1984-88.

Year	Area	Average length	Average base circumference	Average age	Harvest n
1984	Subunit 25A	34.9	12.8	9	34
	Subunit 26B (remainder)[a]	35.3	12.6	9	25
	Subunit 26C	34.3	12.6	9	85
	Dalton Highway[b]	33.2	12.9	9	25
1985	Subunit 25A	35.3	13.1	9	46
	Subunit 26B (remainder)[a]	34.4	13.3	8	34
	Subunit 26C	34.9	13.0	9	90
	Dalton Highway[b]	34.1	13.4	8	25
1986	Subunit 25A	36.5	13.1	11	48
	Subunit 26B (remainder)[a]	35.4	13.0	9	51
	Subunit 26C	34.8	13.9	10	86
	Dalton Highway[b]	34.1	13.2	8	29
1987	Subunit 25A	34.6	13.7	9	49
	Subunit 26B (remainder)[a]	35.3	13.2	9	57
	Subunit 26C	34.6	12.8	9	117
	Dalton Highway[b]	33.6	13.0	9	51
1988	Subunit 25A	35.6	13.0	9	64
	Subunit 26B (remainder)[a]	34.9	12.9	9	42
	Subunit 26C	34.8	13.1	10	102
	Dalton Highway[b]	35.3	13.2	9	32

[a] Those portions of Subunit 26B not adjacent to the Dalton Highway.

[b] Includes all harvest reported from eastern Unit 24 and from areas adjacent to the Dalton Highway in Subunit 26B.

Table 4. Dall sheep hunter success in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1984-88.

Area	Percent success				
	1984	1985	1986	1987	1988
Subunit 25A	57	62	56	65	73
Subunit 26B (remainder)[a]	71	64	67	71	60
Subunit 26C	73	76	70	74	69
Dalton Highway[b]	40	38	40	56	43

[a] Those portions of Subunit 26B not adjacent to the Dalton Highway.

[b] Includes all hunters reporting from eastern Unit 24 and from areas adjacent to the Dalton Highway in Subunit 26B.

Table 5. Dall sheep harvest chronology in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1984, 1985, 1987, and 1988.

	August					September				October					November				
Year/Week	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	4	Unk
1984	2	20	66	26	28	11	6	3	1	0	0	0	0	0	0	0	0	0	3
1985	0	17	74	43	32	13	9	2	1	2	0	0	0	0	0	0	0	0	2
1987	0	0	110	56	53	20	20	4	4	0	0	1	0	0	0	0	0	0	6
1988	1	83	61	42	15	17	7	2	2	0	0	0	0	0	0	0	0	1	7

Table 6. Successful Dall sheep hunter transport methods in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1984-88.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	Highway vehicle	Unk
1984	139	5	3	1	0	0	15	6
1985	161	7	2	2	0	1	11	11
1986	192	7	1	3	0	0	5	6
1987	214	5	2	0	0	0	15	14
1988	205	8	3	0	0	0	15	9

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