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DALL SHEEP

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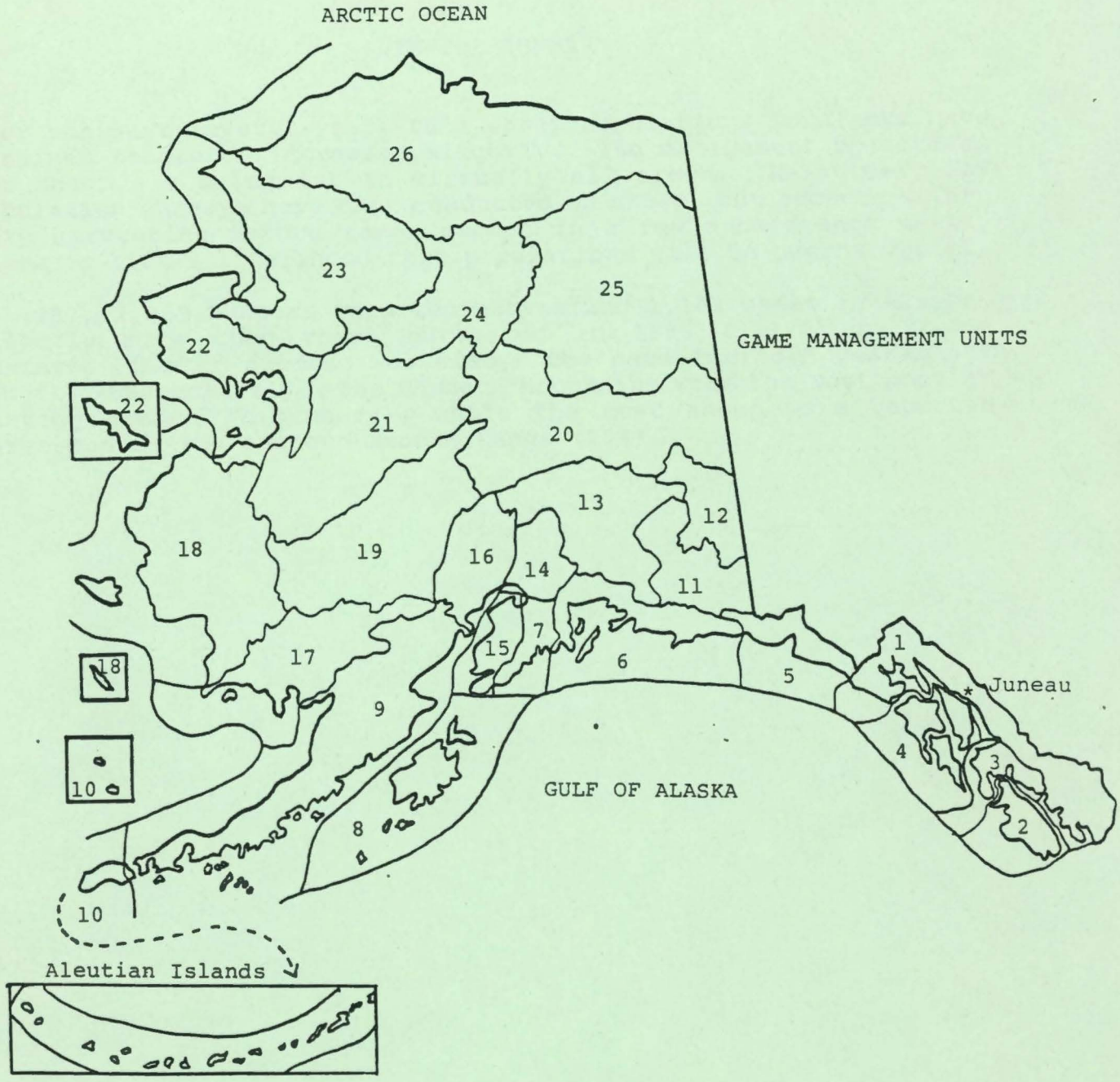
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STATEWIDE SUMMARY

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 1987, 2,869 hunters reported harvesting 1,188 sheep in Alaska, slightly more than those harvested in 1986 (1,122) by 2,666 hunters. Hunter success was almost the same for both years: 42% and 41%, respectively. The Chugach Mountains were the most popular hunting area (577 hunters), while the most sheep were reported harvested in the eastern Brooks Range (274).

Summary of Dall sheep harvest data for 1986-87.

Mountain Range	Units (or portions thereof)	Reported harvest	Number of hunters	Average August horn length
Kenai Mountain	7 and 15	30	189	33.5
Alaska Range west and south of Denali National Park	9, 16, 17, and 19	139	220	35.5
Chugach Mountains	11, 13D, 14A, and 14C	162	577	34.6
Mentasta Nutzotin and northern Wrangell Mountains	12	214	423	33.0
Alaska Range east of the Johnson River (Tok Mgmt. Area)	12, 13, and 20	41	101	36.1
Talkeetna Mountains and Chulitna-Watana Hills	13A, 13E, 14A, and 14B	82	372	--
Delta Controlled Use Area The eastern Alaska Range	20A, 20D, and 13B	33	89	35.6
White Mountains	20B, 20F, 25C, and 25D	2	16	36.8
Tanana Hills	20D and 20E	7	19	32.6
Alaska Range east of Denali National Park	20A	142	354	35.0
Western Brooks Range	23 and 26A	37	60	34.6
The Brooks Range within Gates of the Arctic National Park	24	25	41	--
Eastern Brooks Range	24, 25A, 26B, and 26C	274	408	33.6
	Total of Average	1,188	2,869	34.6

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STUDY AREA

GAME MANAGEMENT UNITS: 7 and 15 (10,000 mi²)

GEOGRAPHICAL DESCRIPTION: Kenai Mountains

BACKGROUND

Reports by the U.S. Fish and Wildlife Service indicate aerial sheep surveys were initiated on the refuge portion of the Kenai Mountains in 1949. These reports, along with Department records after statehood (i.e., 1959), indicate the Kenai Mountains sheep population steadily increased from 1949 to 1968 and then sharply declined until 1977 and 1978, when the lowest counts were recorded. Survey data collected since the late 1970's indicate that the sheep population has been rebuilding from previous low levels. Weather and quantity and quality of habitat significantly impacted the size of the population. Although predation, regulated hunting, and natural and disease-caused mortality have also played a part in controlling the population, they do not significantly affect the population.

POPULATION OBJECTIVES

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

METHODS

Planned regionwide activities for this reporting period included (1) conducting summer aerial sex and age composition surveys, (2) indentifying and documenting critical sheep habitat, and (3) monitoring the harvest. No specific activities were identified for sheep in the Kenai Mountains.

RESULTS AND DISCUSSION

Population Status and Trend

Since 1981 sheep populations have increased in the 3 trend count areas that extend from Skilak River to Fox River (Table 1). Although surveys have not been conducted every year, the only time weather may have had a significant impact on the sheep numbers was in 1984-85. The unseasonably cool and rainy spring and summer of 1985 may have lowered lamb survival. Surveys were not flown in 1985 because of the amount of residual snow in the count areas. Data collected from the 1987 survey and the harvest reports suggest the sheep population is slightly increasing and lightly hunted.

Population Size:

Survey conditions during 1987 were good or excellent in all areas surveyed. In general, count areas were snow free and surveys were

conducted with skilled pilots and experienced Department biologists. Eight of 12 count areas were surveyed during 1987, and 923 sheep were classified. I estimate the Kenai Mountains population at 1,200-1,500 sheep. This estimate includes 200 sheep in the Cooper Landing Closed Area.

Population Composition:

During aerial sex and age composition surveys in 1987, 923 sheep were classified (Table 2). The sample included 43 legal rams, 172 sublegal rams, 534 ewes and yearlings, and 174 lambs. Lambs represented 19% of the total number of sheep observed. The percentage of legal rams sampled increased slightly from 3.9% in 1986 to 4.5% in 1987. The percentage of sublegal rams sampled showed a slight decrease from 19.7% in 1986 to 18.6% in 1987.

Mortality

Season and Bag Limit:

The open seasons for resident and nonresident hunters in Units 7 and 15, except that portion of Unit 7 in the Cooper Landing Closed Area, are 10 August to 20 September. The bag limit is 1 ram with 7/8-curl horn or larger.

Human-induced Mortality:

Thirty rams were harvested during the 1987 season, compared with 25 in 1986 and an average of 23 for the previous 5 years (Table 3). Harvest reports indicate that 189 hunters spent 787 days hunting sheep; their success rate was 16%. Reports also showed that 93% (n = 27, 1 unk) of the harvest occurred prior to 1 September.

Mean horn length of rams killed by hunters was 33.5 inches (range = 28.5 to 40.4 inches). Mean age of these rams was 7.1 years (range = 5 to 13 years). Seven rams in the sample were 8 or more years old.

Hunter Residency and Success. Twenty-six (87%) of the 30 successful hunters during 1987 were Alaskan residents, and four (13%) were nonresidents (Table 4). Unsuccessful hunters were represented by 148 (96%) residents and 6 (4%) nonresidents. From 1984 to 1987, 97% and 3% of all participating hunters were residents and nonresidents, respectively.

Transport Methods. Successful hunters used the following means of transportation during the 1987 season: highway vehicle, 13 (45%); aircraft, 10 (34%); boat, 5 (17%); horse, 1 (3%); and unspecified means, 1 (3%).

Natural Mortality:

Data are 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-caused mortality 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 the south-facing slopes; i.e., the alder-brush zone through the alpine tundra zones. Culbertson et al. (1980) observed sheep use of the burned and adjacent unburned areas; more sheep/area (40%) were observed in the burned area than in the unburned area. Two important food grasses, Trisectum spicatum and Festuca rubra, were found to be more abundant and vigorous in the burn area than in nearby unburned areas. They concluded that in midsummer sheep make equal or more use of the 1974 burn area than the adjacent unburned alpine habitat.

CONCLUSIONS AND RECOMMENDATIONS

Sheep management for the Kenai Mountains will require development of 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 during the same time period. To more accurately assess population changes, the 3 trend areas currently used should be expanded to include 3 additional areas: Bear and Russian Mountains (Area 853) and Sheep Creek (Area 858) as hunting trend areas and the Cooper Landing Closed Area as a nonhunting area. Including areas such as Sheep Creek and Grant Lake (Area 839), which are characterized as on the "edge" of suitable sheep range, may serve as early indicators of weather- or range-related population changes; however, these areas do not support large numbers of sheep. The harvest and survey data suggest that the population objective is being met; therefore, no changes in season or bag limit are recommended.

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Table 1. Results of sex and age composition trend counts in Twin Lakes (855), Indian Creek (856) and Fox River (857) for Subunits 15B and 15C (1981, 1983, and 1987).

Year	Legal	Sublegal	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

[a] Eleven rams were unclassified.

Table 2. Sex and age composition counts conducted in Units 7 and 15, 1983-1987.

Year	Rams			Unclassified ewes and yrlgs.	Lambs	Total sheep	Count time
	Legal	Sublega	Tot.				
1983	33	75	108	331	124	563	--
1984	NO DATA						
1985	NO DATA						
1986	18	100	118	276	105	499	--
1987	43	172	215	534	174	923	14.8 hrs.

Table 3. Annual sheep harvests in Units 7 and 15, 1983-1987.

Year	Males	Females[a]	Total
1983	25	0	25
1984	19	0	19
1985	21	0	21
1986	25	0	25
1987	30	0	30

[a] No open season on females.

Table 4. Hunter residency and success in Units 7 and 15, 1983-1987.

	Successful				Unsuccessful		
Year	Local res.	Nonlocal res.	Nonres.	Total	Resident	Nonres.	Total
1983	NO DATA			25			
1984	7	10	2	19	1573	160	
1985	11	9	1	21	148	3	151
1986	10	12	0	25[a]	132	0	132
1987	15	11	4	30	148	6	159[b]

[a] Three successful hunters failed to report residency.

[b] Five unsuccessful hunters failed to report residency.

STUDY AREA

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

GEOGRAPHICAL DESCRIPTION: The Alaska Range west and south of Denali National Park (ARW).

BACKGROUND

The management plans for Dall sheep (ADF&G 1976, ADF&G files) define the management goals for this species in Alaska. These goals include protection and maintenance, scientific and educational study, and diversified recreational, commercial, and subsistence uses. The federal and state subsistence laws mandate subsistence use as the highest priority of fish and wildlife when harvest is allowable. However, the Alaska Board of Game, acting in compliance with these subsistence laws, has determined that historic human use of Dall sheep rarely meets the present definitions of subsistence use; consequently, recreation (i.e., hunting, observing, photographing) is the predominant use of Dall sheep in Alaska.

The ADF&G revised management plan (ADF&G files) recognizes diversified recreational uses of Dall sheep, including both consumptive and nonconsumptive uses. The consumptive-use objectives for this species include the maximum opportunity to (1) hunt under aesthetically pleasing conditions, and (2) harvest unusually large rams as trophies.

MANAGEMENT OBJECTIVES

To provide the opportunity to harvest Dall rams under aesthetically pleasing conditions.

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

To maintain sustained uncrowded hunting conditions by monitoring hunting activities and assessing hunters' satisfaction with their experiences in the ARW.

To maintain a sustained harvest of more than 100 legal rams per year with a mean horn length and age exceeding 34 inches and 8 years, respectively.

METHODS

No herd management activities were performed in the ARW during this reporting period. Conclusions regarding human use were based on analysis of hunter harvest reports.

RESULTS AND DISCUSSION

Population Status and Trend

Because no systematic aerial or ground survey program has ever been established in the ARW, no reliable information on population trend is available; however, reports from guides in the area indicate that the status of sheep populations during the reporting period is similar to that of past years. Sheep harvests in the western Alaska Range were relatively small and consistent until 1982. Since 1982 harvests have been on an upward trend. The 1987 reported harvest of 139 rams continued this upward trend, representing the highest one on record. This upward harvest trend is probably due to relatively mild winter weather, which has contributed to greater recruitment of adult rams to the huntable population.

Population Size:

No recent sheep surveys have been conducted in the ARW. The most comprehensive sheep survey in the area was conducted in 1974; 2,125 sheep were observed. Following that survey, a 65% correction factor was arbitrarily applied to produce an estimate of approximately 3,200 sheep for the area. In 1978 the size of the population was estimated at 4,000-5,000 sheep (Shepherd 1979). In 1984 and 1985 the number of sheep inhabiting the ARW was thought to be about 4,000 (Pegau 1985, 1986).

Practical experience indicates a ram harvest rate of 3% of a total population is sustainable for Dall sheep in Alaska (Heimer 1980). If we used this year's harvest of 139 rams and apply a harvest rate of 3%, the expected population would be approximately 4,600 sheep. Similarly, Heimer and Watson (1986) calculated the maximum theoretical harvest of full-curl rams at 5%. However, if we use the harvest of 139 rams and apply Heimer and Watson's (1987) theoretical harvest of rams at 5%, then the population would be approximately 2,800 sheep.

If there are 4,000-5,000 sheep in the population, a harvest rate of about 3% should be easily sustainable. If this is the case, present harvest levels may be maintained indefinitely without depleting standing stocks of rams. However, if the population is only 3,000 sheep, the present harvest rate is approaching the theoretical maximum, and it is unlikely that increased harvests will be sustainable without declining horn size and age.

Population Composition:

No sheep surveys have been conducted in the ARW in recent years. Based on 5 aerial counts of various portions of the range from 1972 to 1984, relative lamb production has averaged 38 lambs:100 ewes (range = 25-45). Data gathered on these surveys also indicated a legal ram percentage averaging 10% (range = 9-11%).

Using the 1985 population estimate of 4,000 sheep in the ARW (Pegau 1986) and further assuming that 10% of the population is composed of legal rams (≥7/8 curl), there would potentially be about 400 legal rams available to hunters. If so, the harvest of 139 rams during the 1987 season would constitute an annual harvest of 35% of the available rams, or about 3.5% of the herd; however, these percentages would be more useful if the annual increment to the ram population were known.

If survival in the ARW were similar to that projected from Murie's (1944) data from Denali Park, a population of 4,000 Dall sheep could be expected to produce about 850 lambs annually. When this lamb cohort reaches age 7 years, it should provide an increment of 222 7/8-curl rams, if survival is not greatly different from that in Denali Park. The harvest of 139 rams would come to approximately 62% of the anticipated increment under these conditions. When approached from this perspective, an annual harvest of 139 rams would represent approximately 15% of the available 7/8-curl rams, suggesting a larger population than the calculation based on ram percentages in the survey data. In either case, whether the ram harvest is 35% or 15%, it can be considered light as long as the population of sheep from which it is taken approaches 4,000.

Distribution and Movements:

No surveys were conducted during this reporting period; however, based on incidental observations and analyses of harvest locations reported by hunters, it appears that no significant shifts have occurred in sheep harvest distribution within the ARW. It appears that the bulk of the harvest occurs in the Alaska Range from Denali Park west to Big River. It seems likely that this portion of the ARW contains the best range and the majority of sheep. From Big River south to Lake Clark National Park, sheep habitat may be marginal. Rams from this area are generally small and slow-growing (Heimer and Smith 1975). Also, fewer sheep are harvested from this area.

Mortality

Season and Bag Limit:

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:

In 1987 reported harvest of sheep was 139 rams; 220 hunters participated. This is the highest harvest from the ARW since adoption of the 7/8-curl minimum in 1979. Before that time, when 3/4-curl rams were legal for harvest, the highest harvest on record was 140 rams (Table 1).

Based on harvest ticket returns, the 1987 sheep harvest in the ARW consisted of rams with a mean horn length and age of 35.5 inches (Fig. 1) and 8.9 years (Table 2), respectively. With the exception of 1983, this represents the longest mean horn length on record. As indicated in Table 2, very few sheep harvested in the ARW are less than 6 or greater than 13 years old. Only 1.3% of 390 sheep harvested between 1984 and 1987 were less than 6 years old; only 0.8% were more than 13 years old.

Three sheep were reported harvested from Subunit 9B. This subunit contains marginal sheep habitat, most of which is within the Lake Clark National Park. No sheep were reported harvested from Unit 17 during 1987.

In Unit 16, 22 sheep were reported harvested. Twelve of these rams were taken from the Skwentna River. Other drainages in Unit 16 contributed harvests of two sheep each: Johnson Creek, Kichatna River, and the West Fork Yentna River.

Unit 19 contains vastly more sheep habitat than do any of the other ARW game management units; it accounted for over 82% of the 1987 harvest. The Windy Fork of the Kuskokwim River and Sheep Creek drainages produced a harvest of 29 rams. The Tonzona-Pingston-Dillinger area accounted for an additional 28 rams. Only 9 sheep came from the area between the Big and Telaquana Rivers. The 1987 harvest locations are not significantly different from those of previous years.

Interest in hunting the ARW is slightly below the levels of the late 1970's (Table 1); however, the success rates remain atypically high, resulting in near-record harvests. I suspect that future harvests will continue to climb.

Hunter Residency and Success. Forty-six percent (n = 89) of the hunters in the ARW during 1987 were nonresidents (Table 3). During the previous 20-year period (1967-86), the percentage of nonresidents has averaged 38.2%. Only 9 hunters (5%) were residents of Unit 19.

Many successful exclusive-use guide areas are present in the ARW, and the guides generally cater to nonresidents; thus a nonresident's chances of success are usually higher than unguided resident hunters. This is reflected in the mean difference in success rates by residents and nonresidents. During 1987 success rates were 57% and 90% for residents and nonresidents, respectively, a difference of 33%.

Harvest Chronology. The majority of the harvest occurred during the 1st half of the season (August). During the 5-year period from 1983 to 1987, an average of 70% of the harvest was taken in August. A further breakdown of harvest dates into weekly (or other) periods is meaningless, because harvest chronology is greatly influenced

by weather during the hunting season. When weather systems create poor visibility or severe turbulence in the mountains, air access is restricted.

Transport Methods. Since 1982 airplanes have provided 86% of the primary access to the ARW for sheep hunters. I suspect that an even greater proportion of the hunters gained initial access to the area by airplanes but used additional means (i.e., horses, three-wheeler, or ATV's) to gain further access.

Natural Mortality:

Winters have been moderate over the last 5 years, resulting in less-than-normal mortality. Eagle, brown bear, black bear, and wolf predation undoubtedly occur, but not at a level sufficient to depress the sheep population.

Habitat Assessment and Enhancement:

No quantitative habitat assessment work has been conducted on the ARW sheep ranges. I do not think range-related problems have occurred in the recent past, and it is not likely that range problems will surface in the near future (Heimer 1988). No enhancement of sheep range has been conducted, nor are there plans for such work.

Game Board Actions and Emergency Orders

No Board of Game actions, emergency orders, or regulatory proposals affecting the ARW sheep population have been discussed in recent years.

CONCLUSIONS AND RECOMMENDATIONS

The management objective of providing an aesthetically pleasing hunting opportunity is being attained in the ARW. Productivity, population status, and population trend should be monitored annually. At the very least, contingency plans should be formulated to provide funding for sheep surveys in the event of a severe winter. In some drainages, sheep densities appear quite high, and the occurrence of a severe winter may have drastic effects on those subpopulations.

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Table 1. Numbers of hunters, sheep harvested, and success rates for the Alaska Range west of Denali National Park for the period 1962-87, 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[a]	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

[a] Values estimated although no harvest report reminder letters were sent.

Table 2. Age at death and mean age of sheep harvested from the Alaska Range West from 1984 to 1987.

Harvest year	Age at death (years)												Mean age in years
	4	5	6	7	8	9	10	11	12	13	14	15	
1984	0	1	8	17	23	20	16	9	3	2	0	0	8.7
1985	0	4	4	29	26	14	10	6	6	0	1	0	8.4
1986	0	0	5	16	26	22	13	10	4	2	2	0	8.9
1987	0	0	9	16	29	14	17	7	6	2	0	0	8.9
Total %	0	5	26	78	104	70	56	32	19	6	3	0	
% of total	0	1	7	19	26	18	14	8	5	2	1	0	

Table 3. Reported residence of sheep hunters using the Alaska Range West in 1987.

Residence	Successful	Unsuccessful	Total	% Success
Unit 19	2	7	9	22
Anchorage	41	44	85	48
Other urban	7	8	15	47
Other rural	9	9	18	50
All residents	59	68	127	47
Other states	59	11	70	84
Aliens	18	1	19	95
All nonresidents	77	12	89	87
Unknown	3	1	4	75
Total	139	81	220	63

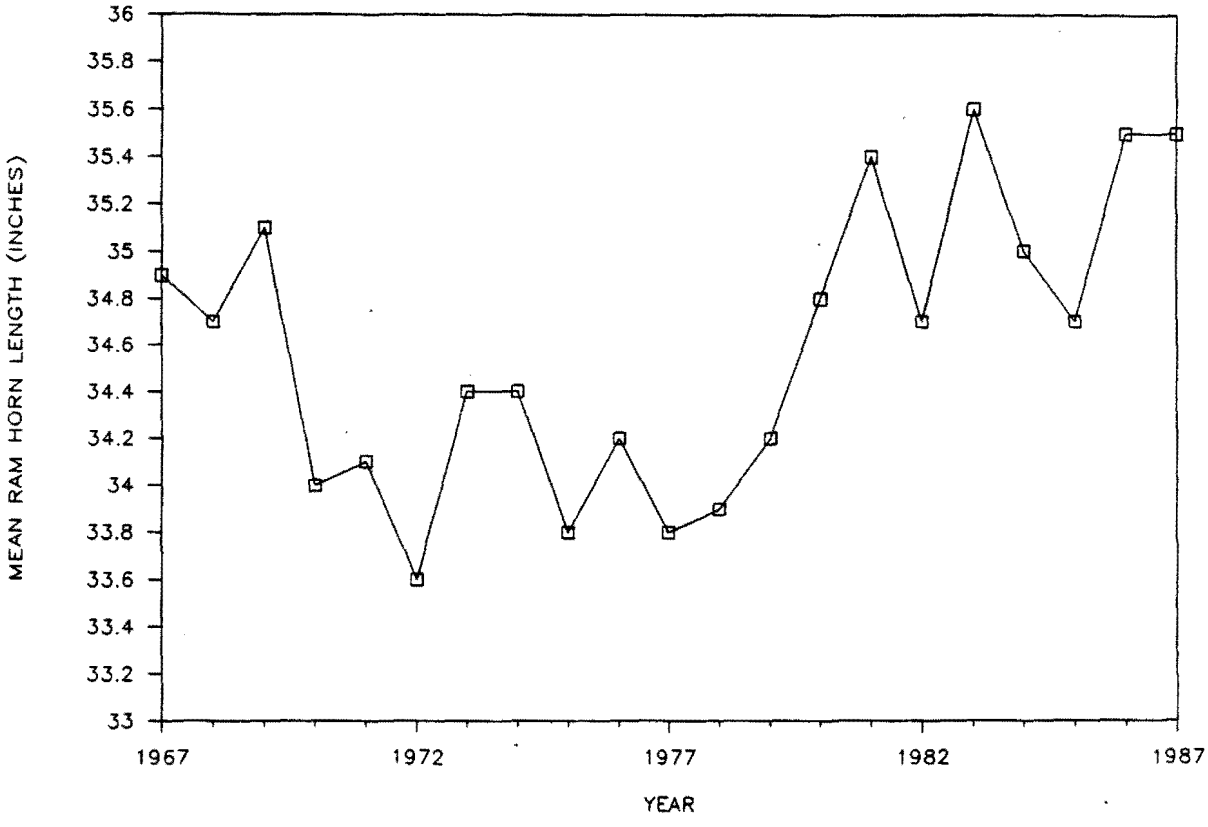

Figure 1. Reported historical ram horn lengths from the Alaska Range west of Denali National Park from 1968 to 1987.

STUDY AREA

GAME MANAGEMENT UNITS: 11, 13D, 14A, 14C (13,200 mi²)

GEOGRAPHICAL DESCRIPTION: Chugach Mountains

BACKGROUND

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

The mean annual harvest from the Chugach Mountains over the past 2 decades was 119 sheep. Hunting pressure has increased during the past 4 years; a record harvest of 162 sheep was reported in 1987. Subunit 13D accounts for approximately one-half of the total harvest.

Hunting is under a general open season. Over 70% of the total harvest occurs in Subunits 14A and 13D. In Subunit 14C participation is limited by drawing permit, and in lightly hunted Unit 11, National Park Service regulations restrict hunting to residents of the area.

POPULATION OBJECTIVES

To maintain a mean average harvest of 120 rams with 7/8-curl horn or larger.

METHODS

Activities scheduled for FY88 included conducting summer aerial sex and age composition surveys; identifying and documenting critical sheep habitat, including winter ranges, mineral licks, and lambing areas; and monitoring the number and sizes of sheep harvested as well as the 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 DISCUSSION

Population Status and Trend

Sheep numbers in the western end of the Chugach Mountains (Subunit 14C) have increased 133% during the past decade. In Subunit 14A numbers of sheep are stable or increasing slightly. Because of the absence of recent extensive 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 past 2 decades.

Population Size:

Aerial survey data indicated that a minimum of 5,000 sheep inhabit the Chugach Mountains; they are distributed as follows: Subunit 14C, 2,200 sheep; Subunit 14A, 750 sheep; Subunit 13D, 1,700-2,000 sheep; and Unit 11, 400 sheep. Studies have shown that experienced observers see 80-90% of all sheep during composition surveys in areas with which they are familiar. The population totals presented above represent figures obtained by biologists over the past 15 years. Since severe winter weather has not caused serious sheep mortality in the Chugach Mountains since 1971, it is safe to assume that the total sheep population is similar to the figures presented.

Population Composition:

Current composition data are only available for Subunit 14C (Table 1). Annual surveys since 1976 have shown a gradual increase in the percentage of legal rams. As a percentage of the total population, lambs and young rams have remained relatively constant. Data for Subunits 13D and 14A were last obtained in 1984 and 1986, 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 assessments 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 summer concentration areas have also been determined from harvest records and discussions with hunters. Although sheep are found throughout the entire 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.

Little is known about precise winter distribution patterns. It is known that sheep most often frequent relatively snow-free, windblown ridges above an elevation of 3,000 feet. Lambing areas are widely scattered and are nearly always 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 is 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 8 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 (14C), hunting is permissible by drawing permit and bow and arrow only; up to 25 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:

Hunting pressure for sheep in the Chugach Mountains has fluctuated substantially over the past 10 years (1978-1987). During this same period, the mean harvest has increased and hunter success has remained relatively constant. An average of 108 sheep were taken annually between 1978 and 1982. From 1983 through 1987, the mean harvest was 132 sheep (Table 5). The record harvest of 158 sheep in 1986 was eclipsed by the 162 sheep harvested in 1987. Larger harvests reflect increased hunting pressure, increased opportunity through additional permits in Subunit 14C, and greater numbers of sheep as a result of several consecutive 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 12 of 293 sheep (4%) during the past 5 years (Tables 6 and 7). In Subunit 13D, nonresidents composed 40% (123 of 311) 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 this portion of the range is entirely within the Wrangell-Saint Elias National Park. Despite this fact, harvest records over the past 5 years indicate that 78% of the total harvest (26 of 34 sheep) are taken by either nonresidents or nonlocal residents (Table 9). More than likely the vast majority of this apparent illegal harvest is a result of inaccurate reporting or coding, because it seems improbable that hunters or guides would voluntarily report obviously illegal sheep harvests to the Department. This matter should be investigated when harvest reports become available this fall. Nonlocal residents composed 45% of all successful sheep hunters in the Chugach Mountains and approximately 55% of unsuccessful hunters. Nonlocal residents most commonly hunt in Subunit 13D, where they account for 53% of the harvest.

Permit Hunts. Permit hunts occur only in the Subunit 14C portion of the Chugach Mountains (Table 10). Permit numbers have increased from 120 to 345 over the past 5 years, primarily as a result of the substantial increase in sheep numbers. One hundred five of the 345 permits issued in 1987 were for archery only. Forty-two participating archers failed to harvest sheep. Of the remaining 240 permittees, 88 did not hunt, 113 hunted unsuccessfully, and 39 were successful.

Harvest Chronology. Thirteen of 39 (33%) sheep harvested in 1987 under permit in Subunit 14C were taken between 10 and 16 August (Table 11). An additional 15% and 31% were harvested during the 2nd and 3rd weeks, respectively. In Subunit 14A during 1987, 53% of the harvest occurred during the 1st week of the season, while the remainder of the harvest was distributed equally throughout the season (Table 12). In Subunit 13D, 42% of the harvest occurred during the 1st week of the season, 20% during the 2nd, and 14% each during the 3rd and 4th weeks (Table 13). The harvest in Unit 11 is too small for comparison.

Transport Methods. In Subunit 14C, approximately 80% of all successful hunters used highway vehicles, while 10% used 3- or 4-wheelers (Table 14). In Subunit 14A, transportation means varied: 33% of all hunters used aircraft, 23% highway vehicles, 19% horses, and 17% boats (Table 15). In Subunit 13D, over 60% of all successful hunters used aircraft (Table 16).

Natural Mortality:

The natural mortality of Dall sheep is seldom documented in the Chugach Mountains; however, 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-age ewes, and young rams are most susceptible to natural mortality.

During the exceptionally mild winters from 1979 through 1986, the population in Subunit 14C annually increased by a figure nearly equal to the previous year's lamb count minus the ram harvest. This indicated minimal winter mortality.

In December 1987, 16 sheep died 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

The winter range has not been evaluated. One theory contends that snow depth and hardness, rather than range quality or quantity, are the major causes of winter mortality. Funding for winter range evaluation during FY88 was unavailable.

Game Board Actions and Emergency Orders

Sheep hunting regulations in Subunits 14A and 13D and Unit 11 have not changed during the past 5 years. A 133% increase in the population in Subunit 14C from 1983 to 1987 has allowed an increase in the number of drawing permits and the addition of 1 registration hunt. In 1983 and 1984, 120 drawing permits were issued. In 1984, 159 hunters participated in a registration hunt. One hundred eighty drawing permits were issued during 1985 and 1986. In 1987, 240 drawing permits and an additional 105 archery-only permits were allocated. No Emergency Orders have been issued during the past 5 years.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Subunit 14C continues to increase at a high rate, and the number of legal rams will probably increase substantially during the next several years. The sheep population in Subunit 14A is stable or increasing slightly. The mean horn size of sheep in Subunit 14A has remained virtually unchanged over the past 5 years, despite a steady increase in the harvest. The status of the Subunit 13D population is uncertain. An increase in the mean horn size from 33.7 inches in 1986 to 34.6 inches in 1987 with only a 10% decline in the harvest may indicate that the population in Subunit 13D contains more sheep and legal rams than previously thought. Little is known about the population in Unit 13, except that harvest levels there have increased 50% or more in recent years.

The harvest objective of 120 rams whose horns are 7/8-curl or longer for the Chugach Mountains was exceeded by 42 sheep in 1987. This may have occurred because the Subunit 13D portion supports considerably more sheep than found during earlier surveys. A thorough survey of all sheep habitat in Subunit 13D east of the Matanuska Glacier is needed to determine the current population level. 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 and to comply with our schedule of activities. Harvest monitoring activities were completed throughout the Chugach Mountains during FY88. Because of budgetary constraints, no critical habitat was documented during the past year. Given the frequency and importance of various land use decision related primarily to mining, efforts to acquire funding for these studies adjacent to or within known sheep habitat should be pursued.

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SUBMITTED BY:

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Table 1. Sheep population status in Subunit 14C, as determined from aerial surveys, 1983-1987.

Year	Legal rams (%)	Young rams (½ to <7/8 curl)	Ewes + ½ curl rams	Lambs (%)	Total
1983	118 (6.9)	292	1,006	289 (17.0)	1,705
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 (17.2)	2,063
1987	162 (7.5)	427	1,228	352 (16.2)	2,169

Table 2. Sheep population status in Subunit 14A, as determined from aerial surveys, 1983-1987.

Year	Legal rams (%)	Young rams (½ to <7/8 curl)	Ewes + ½ curl rams	Lambs (%)	Total
1982	38 (6.8)	65	336	120 (21.4)	559
1983	-- --	--	--	-- --	--
1984	56 (8.0)	117	380	149 (21.2)	702
1985	-- --	--	--	-- --	--
1986	51 (7.5)	153	371	106 (15.6)	681
1987	-- --	--	--	-- --	--

Table 3. Sheep population status in Subunit 13D, as determined from aerial surveys, 1983-1987.

Year	Legal rams (%)	Young rams (½ to <7/8 curl)	Ewes + ½ 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	-- --	--	--	-- --	--

Table 4. Sheep population status in Unit 11, as determined from aerial surveys, 1973.

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

Table 5. Annual sheep harvest by subunit of rams with 7/8-curl horns or larger in the Chugach Mountains, 1983-1987.

	14A[a]	14C	13D	11	Total[b]
1983	18	17	59	6	102
1984	27	41	57	1	128
1985	31	26	49	3	109
1986	31	30	86	9	158
1987	34	39	77	11	162

[a] 1 ewe killed in 1983, 1 in 1984, 6 in 1985.
[b] Total exceeds sum of subunits because sheep harvests reported only by mountain range.

Table 6. Sheep hunter residency and success in Subunit 14A, 1983-1987.

	Successful				Unsuccessful			
Year	Local res.	Nonlocal res.	Non-res.	Total[a]	Local res.	Nonlocal res.	Non-res.	Total
1983	4	9	3	16	22	31	3	56
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

[a] residency not always reported.

Table 7. Sheep hunter residency and success in Subunit 14C, 1983-1987.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Non-res.	Total	Local res.	Nonlocal res.	Non-res.	Total
1983	15	2	0	17	46	9	0	55
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

Table 8. Sheep hunter residency and success in Subunit 13D, 1983-1987.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Non-res.	Total[a]	Local res.	Nonlocal res.	Non-res.	Total
1983	2	34	21	57	11	97	15	123
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

[a] residency not always reported.

Table 9. Sheep hunter residency and success in Subunit 11, 1983-1987.

Year	Successful				Unsuccessful			
	Local res.	Nonlocal res.	Non-res.	Total[a]	Local res.	Nonlocal res.	Non-res.	Total
1983	0	6	1	7	1	4	1	6
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

[a] residency not always reported.

Table 10. Sheep harvest data by permit hunt in Subunit 14C, 1983-1987.

Hunt No.	Year	Permits issued	Did not hunt	Unsuccessful	Successful	Applicants
1130-Goat Pioneer Hunter	1983	26	4	15	7	260
	1984	22	6	13	3	617
	1985	26	0	22	4	92
	1986	24	3	14	6	459
	1987	25	9	9	7	366
1131-Goat Pioneer Hunter	1983	26	16	9	1	113
	1984	22	8	13	1	202
	1985	26	3	16	7	35
	1986	24	10	10	3	155
	1987	25	7	14	4	182
1132-Peters Thunderbird N. Eagle	1983	14	6	6	2	83
	1984	16	6	9	1	281
	1985	18	0	13	5	53
	1986	20	5	7	6	228
1132-Goat Pioneer Hunter	1987	25	9	12	4	112
1133-Peters Thunderbird N. Eagle	1983	14	7	6	1	48
	1984	16	7	9	0	125
	1985	18	2	16	0	37
	1986	20	5	10	3	67
	1987	15	1	9	5	185

Table 10. (cont'd)

Hunt No.	Year	Permits issued	Did not hunt	Unsuccessful	Successful	Applicants
1134-S. Eagle Bird Ship	1983	20	6	12	2	159
	1984	22	7	11	4	383
	1985	16	0	12	4	59
	1986	16	4	7	4	215
1134-N. Eagle Peters Thunderbird	1987	15	3	8	4	79
1135-S. Eagle Bird Ship	1983	20	7	9	4	84
	1984	22	13	9	0	190
	1985	16	2	9	5	34
	1986	16	4	11	1	97
1135-N. Eagle Peters Thunderbird	1987	15	5	10	0	82
1136-All hunt areas	1986	60	15	36	8	335
1139-All hunt areas	1987	60	35	24	1	337
1137-S. Eagle Bird Ship	1987	20	5	10	5	95
1138-S. Eagle Bird Ship	1987	20	6	11	3	70
1140-All hunt areas-archery	1987	80	51	29	0	112
1141-Eklutna	1987	25	12	13	0	80

Table 11. Sheep harvest chronology in Subunit 14C, 1985-1987.

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

Table 12. Sheep harvest chronology in Subunit 14A, 1983-1987.

Year	Week of harvest 8/10-16	8/17-23	8/24-30	8/31-9/6	9/7-13	9/14-20
1983	8	0	5	3	0	4
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

Table 13. Sheep harvest chronology in Subunit 13D, 1983-1987.

Year	Week of harvest 8/10-16	8/17-23	8/24-30	8/31-9/6	9/7-13	9/14-20
1983	35	11	14	13	6	7
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

Table 14. Successful sheep hunter transport methods in Subunit 14C, 1983-1987.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	Highway vehicle
1983	--	--	--	--	--	--	--
1984	2	0	1	1	0	1	27
1985	--	--	--	--	--	--	--
1986	0	1	0	5	0	1	21
1987	1	2	2	3	0	0	28

Table 15. Successful sheep hunter transport methods in Subunit 14A, 1983-1987.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	Highway vehicle
1983	5	2	2	0	0	2	7
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

Table 16. Successful sheep hunter transport methods in Subunit 13D, 1983-1987.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow-machine	ORV	Highway vehicle
1983	48	0	2	0	0	1	6
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

STUDY AREA

GAME MANAGEMENT UNIT: 12 (26,000 mi²)

GEOGRAPHICAL DESCRIPTION: Mentasta, Nutzotin, and Northern Wrangell Mountains

BACKGROUND

The history of Dall sheep in the northern Wrangell Mountains (NWM) dates from the earliest dispersal of modern Dall sheep from the glacial refugium in the Tanana and Yukon uplands following the Wisconsin glaciation. Human use of Dall sheep began as humans colonized these same areas; however, records are scarce. The recorded history of human use of Dall sheep in the northern Wrangell Mountains dates from the turn of the century (Young 1947). In his book, Alaska and Yukon Trophies Won and Lost, Young recounts the travels of Prince Demidoff through the Wrangell Mountains, his hunting exploits in the NWM, and a harrowing float down the White and Yukon Rivers to Dawson. Young's account reveals that Dall sheep were abundant then, and descriptions of the specimens collected indicate sheep horn sizes were similar to those currently being harvested.

Other accounts of Dall sheep use by humans in the northern Wrangell Mountains indicate heavy exploitation by miners and market hunters during the period of active gold production on the Chisana and Nabesna Rivers. Capps (1916) reported harvests of 2,000 sheep from the Chisana area for sale in the gold camps. Sheep were said to be locally depleted when gold production ceased in the early decades of the 20th century.

Active sheep conservation began in 1935 when a harvest limit (2 rams) and a hunting season (20 August-31 December) were established by the Bureau of Biological Survey, which eventually became the U.S. Fish and Wildlife Service (USFWS). The season was progressively shortened, and a 1-ram limit was established in 1945. The 3/4-curl horn limit was established in 1950. The Bureau of Biological Survey also carried out widespread predator control, in an effort to increase Dall sheep abundance in the northern Wrangell Mountains. The 1st aerial survey of Dall sheep in the northern Wrangells took place in 1949; it was conducted by the USFWS (Heimer and Smith 1980).

Wholesale predator control ceased with Alaska statehood, but the harvest of sheep continued to be limited to a fall hunting season for 3/4-curl rams. Under this system, populations were reestablished and the Wrangell Mountains developed a wide-spread reputation as a prime sheep hunting area.Although this reputation was based primarily on hunting activities centered in the southern Wrangell Mountains, Dall Sheep were eventually discovered in the northern Wrangell Mountains by recreational hunters as well. In

1967 ADF&G began systematic compilation of harvest data, using a mandatory reporting system. By the early to mid-1970's, the Wrangell Mountains supported a disproportionate share of the ram harvest in Alaska.

Consequently, when discovery of oil along the arctic coast dictated settlement of the aboriginal land claims by Alaskan Natives and compromises with conservation interests, Dall sheep hunting in the Wrangell Mountains became a national issue (Heimer 1980), because the anticipated creation of vast new national parks was imminent and alpine areas were selected for their undisturbed character and scenic values. Retaining sheep hunting opportunity in the Wrangell Mountains became a high priority for the state of Alaska and ADF&G.

This issue defined an immediate need for biological data on sheep abundance and human use. As a result, a concentrated, multiyear aerial survey program was begun. It continued until the entire Wrangell Mountain Range had been surveyed from fixed-wing aircraft, resulting in a population estimate of about 12,000 Dall sheep for the northern Wrangell Mountains (Heimer and Smith 1980). These data were integral to the successful negotiation of park preserve status for most of the northern Wrangell Mountains.

Still, much Dall sheep habitat in Alaska was withdrawn from hunting, and in 1979 the Board of Game reacted to this decrease in hunting opportunity by raising the legal harvest limit for Dall rams in Alaska from 3/4 to 7/8 of a curl (Heimer 1980). The present full-curl horn size for legal harvest was established by the Board of Game in 1984. Its establishment was stimulated by at least 3 circumstances. First, there had been a fairly long-term demand for a full-curl limit by the advisory committees making recommendations to the Board of Game for this area that reflected local support. Second, the National Park Service (NPS) mandate called for "natural" populations in Wrangell-Saint Elias National Park and "healthy" populations in park preserve. Because harvest of full-curl rams would result in less impact on the sheep resource than harvest of rams at younger ages, the NPS favored this regulation. Third, reported horn sizes indicated that the harvest was already limited to the full-curl level by hunter preference. Also, biological data based on ADF&G's sheep research suggested population and harvest benefits would accompany full-curl hunting (Heimer 1980, Heimer and Watson 1982, Heimer et al. 1984).

Since the mid-1970's, Dall sheep populations in the northern Wrangell Mountains have been managed to provide the maximum opportunity to participate in sheep hunting. This objective is consistent with (1) the abundant sheep populations in the northern Wrangells, (2) the population's ability to produce average but not spectacular trophies (Heimer and Smith 1975), and (3) the persistent public desire to see maximum hunting opportunity preserved there.

The northern Wrangell Mountains continue to be a popular sheep hunting area for both resident and nonresident hunters. In recent

years about 400 sheep hunters have reported harvesting more than 200 full-curl rams each year. Harvests are controlled by restricting the harvest to rams with full-curl or larger horns or rams with both horns broken. Only a hunting license and sheep harvest ticket are required, thereby ensuring maximum opportunity to participate in sheep hunting.

Current ownership of sheep habitat in the northern Wrangell Mountains is complex. Most sheep habitat is held by the NPS in the Wrangell-Saint Elias National Park-Preserve, where hunting is allowed by state regulations under the terms of the Alaska National Interest Lands Conservation Act. Smaller areas are held by the Tetlin National Wildlife Refuge (USFWS), the state of Alaska, and the Tetlin Native Corporation. The majority of the area is open to sport hunting, and all major land and resource management agencies and managers must cooperate to achieve successful Dall sheep management in the northern Wrangell Mountains.

MANAGEMENT OBJECTIVES

To manage a population of approximately 12,000 sheep.

To provide the greatest opportunity to participate in hunting sheep.

METHODS

Population Assessment

The Mentasta Mountains portion of the northern Wrangell Mountains was surveyed during the reporting period. Survey dates were 17 July to 1 August 1988. The surveys were in PA-18 Piper Super Cubs with experienced pilot-observer teams. Flights were made following mountain contours in the 4,000- to 7,000-foot elevation zone where most sheep occur. Those sheep in ram bands were classified as 4/4-, 3/4-, 1/2-, and 1/4-curl and unidentified rams; and those in "ewe" bands were classified as "ewes," lambs, and unidentified ewe-like sheep. All yearling and some 2- and 3-year-old rams were classified as "ewes" when they were traveling with predominantly ewe-lamb bands, because their sex and age could not be reliably determined from aircraft. This known bias causes underestimation of ram and lamb proportions in the population, relative to females.

Harvest Assessment

All sheep hunters are required to complete harvest report cards and submit them to ADF&G. These reports contain information relating to hunting activity; unit and subunit; mountain range; specific location; transportation type; success; horn length, horn base diameter, and whether the ram had broomed horns; and age of the ram harvested. Hunters who failed to return their harvest report card

by 15 October are reminded by mail. Data from harvest reports are used to quantify the harvest and detect trends in hunter pressure and harvest characteristics.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

The sheep population in the NWM area is believed to have stabilized at about 12,000 sheep, following the severe winter of 1982-83 when sheep populations declined by about 10-15% because of the loss of older sheep (Watson and Heimer 1984).

Population Composition:

During this reporting period, the entire Mentasta Mountains were surveyed (Tables 1 and 2). These surveys were jointly funded by ADF&G, NPS, USFWS, and the Tetlin Native Corporation.

Distribution and Movements:

Dall sheep occur throughout the northern Wrangell Mountains, but the greatest densities occur in the Wiki Peak area near the U.S.-Canada border. The extreme northwestern Mentasta Mountains (i.e., north of Buck Creek, south of Tuck Creek, and immediately east of the Tok-Slana Highway) support the fewest sheep. Three large, historically recognized mineral licks in Lost Creek, Sonya Creek, and East Fork Snag Creek concentrate hundreds of sheep during June and July. Other major licks may be present but have not been identified. Smaller mineral licks occur throughout the area. During most winters sheep concentrate on windswept alpine ridges, but snow accumulations occasionally force sheep to brushfields at lower elevations.

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-three hunters reported harvesting 214 full-curl rams in fall 1987; i.e., 51% hunter success rate. This compares to a reported 1986 harvest of 231 rams by 435 hunters.

Hunter Residency and Success. Of the 214 successful hunters in 1987, 128 (60%) were Alaskan residents, 60 (28%) were nonresidents,

and 26 (12%) did not report residency but were assumed to be mostly residents. Only 8 residents of Unit 12 reported hunting sheep; five were successful.

Harvest Chronology. Seventy-eight successful hunters (37%) harvested rams during the 1st week of the 6-week season, while harvests averaged 25 rams per week (range = 19-36) during the remaining 5 weeks of the season.

Transport Methods. Sixty percent (129) of successful sheep hunters used aircraft to access the NWM area; 17% (37) used horses. Fourteen successful hunters used highway vehicles, 11 each used boats and three-wheelers, and three used off-road vehicles; 9 successful hunters did not specify mode of access.

Natural Mortality:

During the course of the Mentasta Mountains aerial survey a golden eagle was seen near a dead lamb on 31 July. An ewe and other sheep in the ewe-lamb band were attempting to approach the dead lamb, but the eagle was sufficiently aggressive to keep them away. Of 15 golden eagles observed during the surveys, nine were observed in the Boyden Hills, where lamb survival to the survey date had been the lowest observed during the survey (21 lambs:100 "ewes"). Two gray wolves were seen on a freshly killed mature ram on 17 July. In 1981, 14 wolf-killed sheep were found in a small area on Platinum Creek. Tracks indicated these sheep were killed by a pack of 12 wolves. I have also found sheep killed by coyotes in the Chisana area. Predation is probably the greatest source of natural mortality operating on this sheep population, but at this time it does not appear to be responsible for measurable population decline.

Habitat Assessment and Enhancement

The NWM has been glaciated and remains quite steep and rugged with excellent escape cover in close proximity to Dryas-dominated feeding areas. Curiously, moderate densities of sheep occur in the Ophir Creek and North Fork of the White River drainages, where escape cover is discontinuous and limited in extent. In the Jacksina Creek drainage sheep feed on high-elevation plateaus and use the cliffs below as escape cover. Human intervention has not affected sheep habitat in the NWM area to any great extent, and the present land ownership pattern is expected to protect most sheep habitat from future development.

Most of the NWM area has been accorded Limited Fire Protection status, which means that wildfires will not receive initial attack except under extraordinary circumstances. This is expected to maintain near-natural levels of disturbance, and no intentional enhancement is necessary.

Game Board Actions and Emergency Orders

Sheep populations in the WMN area are primarily regulated by natural factors. Since 1935 hunting has been restricted to males only. For almost 3 decades harvests were restricted to rams with 3/4-curl or larger horns, rams typically older than 5 years. In the fall of 1979 the minimum legal horn size was increased to 7/8 curl, rams typically older than 6 years. In 1984 the full-curl or larger minimum horn size was adopted, limiting harvest to rams that are generally older than 7 years. Research in the nearby Alaska Range (Heimer and Watson 1986) indicated that sustained yield of Dall sheep populations could be increased by protecting immature males. The mortality of young rams may be reduced by maintaining greater numbers of mature rams for breeding; however, in 1984 concerns were expressed that a full-curl minimum horn size would reduce harvests and hunter success.

Under the 7/8-curl regulation, 440 hunters reported taking 208 rams in 1983. In 1984 initiation of the full-curl regulation coincided with inclement weather during August, and only 134 full-curl rams were taken. Harvests increased to 188 in 1985, 231 in 1986, and finally 214 in 1987. While it is too soon to detect any improvement in population yield, the increased minimum horn size requirement has not resulted in lower harvests than were achieved under the 3/4- and 7/8-curl regulations. This is not surprising, given the relatively low harvest rates in the NWM at present (<2%). Tables 3 and 4 illustrate that the percentage of all rams and rams with 3/4-curl or larger horns in the population has increased in portions of the Mentasta Mountains since the 1980 and 1982 surveys. Mean horn length of harvested rams of about 33 inches has not shown an increasing trend, as a result of the full-curl horn regulation. This is also consistent with the low harvest rate.

CONCLUSIONS AND RECOMMENDATIONS

Both the strategic and population objectives are currently being met by the existing sheep management program in the northern Wrangell Mountains. Theoretically, sustainable maximum harvests from a population of 12,000 sheep could reach an estimated 600 full-curl rams per year. Consequently, no changes in seasons or bag limits are recommended.

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Table 1. Sex and age composition summary of Dall sheep in the Mentasta Mountains, 17 July-1 August 1987.

Location	Rams[a]						"Ewes"[a]	Lambs	Unclass. "ewes"	Time (hrs)	Total sheep
	4/4	3/4	1/2	1/4	Unclass. rams	Total					
W. Mentastas	33	71	44	19		167	365	160		5.0	692
E. Mentastas	29	80	43	31	8	191	279	100	49	5.2	619
Subtotal	62	151	87	50	8	358	644	260	49	10.2	1,311
Boyden Hills	8	30	24	21		83	127	27		2.0	237
Log Cabin/ Meiklejohn	9	8	10	5		32	54	25		2.7	111
Total	79	189	121	76	8	473	825	312	49	14.9	1,659

[a] Yearlings and 2- and 3-year-old rams are classified as "ewes" when not in ram bands and the classification is from aircraft.

Table 2. Sex and age ratios of Dall sheep in the Mentasta Mountains, 17 July-1 August 1987.

Location	Percentage rams/ adult sheep	Rams: 100 ewes[a]	Percentage lambs	Lambs: 100 ewes[a]	Sheep/ hour	Total sheep
W. Mentastas	31	46	23	44	138	692
E. Mentastas	41	68	16	36	119	619
Subtotal	36	56	20	40	129	1,311
Boyden Hills	40	65	11	21	119	237
Tok Cutoff/ Mice Creek	37	59	23	46	41	111
Total Mentastas	36	57	19	38	111	1,659

[a] Yearlings and 2- and 3-year-old rams are classified as "ewes" when not in ram bands and the classification is from aircraft.

Table 3. Sex and age ratios of Dall sheep in the Mentasta Mountains, 1971-87.

Year	Percentage rams/ adult sheep	Percentage ≥3/4 curl rams/ total rams[a]	Rams: 100 ewes[a]	Percentage lambs[a]	Lambs: 100 ewes[a]	Total adults	Total sheep	Time (hrs)
1971	17	89	20	14	25	877	1,104	--
1973	33	57	50	5	8	811	1,002	--
1980	29	38	41	25	47	1,061	1,549	7.5
1987	36	61	56	21	40	1,002	1,310[b]	9.8

[a] Excludes unclassified sheep; 0, 150, 132, and 48 in 1971, 1973, 1980, and 1987, respectively.

[b] Includes 48 unclassified sheep observed in a previously unsurveyed block. This area took 0.3 hrs to survey.

Table 4. Sex and age ratios of Dall sheep in the Boyden Hills, 1982 and 1987.

Year	Percentage rams/ adult sheep	Percentage ≥3/4 curl rams/ total rams	Rams: 100 ewes	Percentage lambs	Lambs: 100 ewes	Total adults	Total sheep	Time (hrs)
1982	51	37	104	7	16	274	296	2.0
1987	40	46	65	11	21	210	237	2.0

STUDY AREA

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

GEOGRAPHICAL DESCRIPTION: Tok Management Area, Alaska Range east of the Johnson River

BACKGROUND

The Tok Management Area (TMA) is the only sheep trophy management area in the state. Its 1974 origin predates the management plans, although the TMA plan was reviewed by the public with the rest of the draft plan in 1976 (ADF&G 1976). The TMA plan was revised and endorsed by the Board of Game in 1980.

The management history of the TMA began well before its creation, when it was being managed for unlimited 3/4-curl ram hunting during the fall season. That is, ram harvests at 3/4 curl were allowed with no limitation on numbers of hunters. At that time, interest in the TMA was relatively low. Hunting pressure increased rapidly in the early 1970's as the area's potential for producing large-horned trophy rams gained recognition.

In response to these rapidly increasing ram harvests, regional and area game biologists, local hunting guides, and the Tok Fish and Game Advisory Committee began exploring alternative management concepts to maintain the trophy production potential of this sheep population. Trophy management of the extreme eastern Alaska Range was based upon the work of Heimer and Smith (1975), which showed that rams in this area had unusually great trophy production potential, compared with sheep populations throughout the state; i.e., the TMA ranked third among the areas studied by them.

The Board of Game adopted the regulatory proposal creating the Tok Management Area in 1974. This initial trophy management program consisted of a full-curl minimum horn size for rams to be harvested, a limit on ram hunting pressure through issuance of drawing (lottery) permits, and mandatory hunt reporting. A conservative annual harvest of ewe sheep regulated by drawing permit was also included in the package. In recognition of the national importance of such a trophy Dall sheep management area and the potential adverse impacts on local hunting guides, 10% of available permits were set aside for nonresident hunters in a separate drawing.

Sixty permits were issued to ram hunters in 1974. They were drawn from a pool of 630 applicants. Only 34 hunters actually hunted, and they reported a surprisingly small harvest of 5 rams, down from the record harvest of 72 rams in 1973. Sixty ewe permits were also issued from a pool of 250 applicants; 27 hunters reported taking 9 ewes. Numbers of ram permits were increased to 120 in 1975. The lottery permit hunt for ewes was replaced by a registration permit hunt in 1980 that was dropped in 1985.

Only slight changes have been made in the management of the TMA since 1975; the basic concepts have remained unchanged. For many years, "alternates" were selected to receive ram drawing permits that could not be used by the original permit lottery winners. As interest in this hunt grew, use of permits increased and harvests began to approach the harvest goal. Furthermore, the logistics and expense of permit issuance to alternate hunters were inefficient and costly. These factors led to abandonment of the "alternate" hunter program in the late 1970's. Also, the initial ram permit stipulation limiting hunters to 1 permit every 4 years was eventually changed to a simple bag limit of 1 full-curl ram by permit every 4 years, with no time limit on eligibility for subsequent permits. This was done to encourage greater selectivity by hunters for more mature rams. Finally, because of intense localized ewe harvests in some accessible locations, certain drainages were closed to ewe hunting in an effort to spread ewe harvests more evenly throughout the TMA.

In 1985 an Alaska court ruled that all Alaskan residents were eligible to participate in subsistence hunting and, if it becomes necessary to restrict hunter numbers, local residents will be given a priority. As a result, hunters residing near the TMA were granted preference in the issuance of permits and the Board of Game suspended the registration permit hunt for ewes.

Under terms of the 1986 Alaska subsistence law, the Board of Game ruled that Dall sheep hunting in the TMA was not a subsistence activity; since 1985 ram hunt permits have been administered just as they had been prior to 1985 with one exception: the quota for nonresident permittees was deleted. It has been difficult for guides in the TMA to secure clients in recent years because of the difficulty and uncertainty in obtaining permits for nonresidents.

Dall sheep in the TMA have done well under 15 years of trophy management. The population, though fluctuating slightly, has remained generally stable and continued to produce large-horned rams each year. Heimer and Watson (1986) documented lamb production and ram survival benefits that accompanied the presence of full-curl rams in the TMA Dall sheep populations.

The TMA sheep hunting experience is highly regarded by sheep hunters throughout Alaska; nearly 1,100 permit applications were received for the 1987 hunt. Throughout the first 15 years of trophy management, horn length of harvested rams has averaged approximately 37 inches. Rams with horn lengths $\geq$40 inches (considered unusually fine trophies) have averaged 8-10% of the harvest each year. This is approximately twice the rate of occurrence of 40-inch rams in the statewide harvest. Rams with horns in the 42- to 45-inch class have been taken with regularity over the years, and 1 ram with 48-inch horns was taken in the TMA. This indicates the true trophy potential of these populations. Excluding the 1974 harvest of only 5 rams, harvests have ranged from 28 to 51 rams annually.

MANAGEMENT OBJECTIVES

Strategic Objective

To provide opportunity to hunt large-horned sheep under aesthetically pleasing conditions.

Population Objectives

To maintain a population of about 2,000 Dall sheep and harvests of 30 to 45 full-curl rams each year.

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

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

To prevent unacceptable increases in hunter concentration and maintain existing aesthetic qualities of TMA sheep hunting.

METHODS

Methods used during this reporting period were limited to harvest data collection and analyses as well as initial work on determining specific management and population objectives.

RESULTS

Population Status and Trend

The sheep population in the TMA was estimated at approximately 2,100 in 1980. This estimate was based on an aerial count of 1,698 sheep and an assumed 80% sightability of sheep (Heimer and Watson 1986) actually present. Field work on sheep population dynamics in the TMA (Heimer and Watson 1986) indicated the TMA population probably grew beyond this level before 1982. As determined by their observations of known-age visually marked sheep, Watson and Heimer (1984) concluded relatively severe conditions during winter 1981-82 caused a decline in the population because of the loss of predominantly older individuals. Composition surveys conducted since that winter, as well as the last aerial census of Heimer and Watson's study area in 1984, indicate yearling recruitment had stabilized the population at 2,000 sheep, about the same size as was estimated in 1980. There have been no extensive aerial surveys of the TMA since 1984 to determine actual population size or trend, and no adult ewe mortality estimates have been made since 1985.

Population Composition:

The population is only minimally affected by the limited harvest of full-curl rams that average 8.5 years of age. Data gathered and presented by Heimer and Watson (1986) suggest that this population

is highly productive, and the number of rams harvested has been less than the number recruited into the full-curl class each year. No sex and age composition data have been gathered since 1985.

Distribution and Movements:

During winter Dall sheep are frequently found at higher elevations on windblown ridges, where forage and escape routes are available. In April and May, Dall sheep are commonly observed at low elevations. Their use of the 1969 Little Tok River burn, immediately west of the Tok Cutoff, was particularly notable. During June and early July, Dall sheep in the TMA concentrate at mineral licks. Major licks have been identified in Sheep, Cathedral, and Clearwater Creeks, but others are probably present. Summer sheep ranges do not have concentrations of sheep to a significant extent.

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, larger or 2 broken horns every 4 regulatory years by drawing permit only; 120 permits are issued each year.

Human-induced Mortality:

Forty-one rams were harvested; of these, four (10%) had horn lengths exceeding 39 inches and three (7%) were over 40 inches. Average horn length was 36.1 inches, slightly below average. The average reported age of rams was 8.6 years (range = 5-13 years).

Hunter Residency and Success. All permittees were residents of Alaska; 39 reported that they did not hunt and 62 reported hunting. Forty-one hunters killed rams (i.e., hunter success of 67%). This success rate is unusually high for resident hunters in the TMA. No follow-up of nonreporting permittees was conducted, so it is likely that success was actually lower. Unsuccessful hunters typically report at a lower level than successful hunters. If all of the permittees who did not report were actually unsuccessful hunters, success would have been 51%, which is also high compared with past years in the TMA.

Permit Hunts. Nearly 1,100 people applied for the 120 TMA permits. Only 101 of the 120 permittees complied with the mandatory reporting requirements. This was an unusually low (85%) response rate for this hunt. The activities of the 19 permittees who did not report are unknown.

Harvest Chronology. Most rams (n = 21, 51%) were taken during the 1st week of the season, 10-16 August. During the 1st week of September, 7 (17%) rams were taken. Harvests ranged from 2 to 4 rams during the other 4 weeks of the hunt.

Transport Methods. Of the 41 successful hunters, 31 (76%) used light aircraft, six (15%) used highway vehicles, two (5%) used three-wheelers, and one each (2%) used a boat and an off-road vehicle.

Natural Mortality:

Most natural mortality of Dall sheep in the TMA is probably the result of predation. Reports and observations of predations on Dall sheep by wolverines, wolves, coyotes, grizzly bears, and golden eagles have been made regularly over the years. Sheep also die in accidental falls and avalanches; however, these losses are thought to be comparatively small. Diseases are not causing the significant mortality that has been reported in other sheep ranges outside Alaska (Onderka and Wishart 1984), even though certain viral antibodies have been identified in this population (Heimer et al. 1982). Dominance-related mortality in young rams (Heimer et al. 1984) should not be a factor because of the limited full-curl hunt in the TMA.

Habitat Assessment and Enhancement

The TMA may be characterized as rugged, glaciated terrain with Dryas spp.-dominated feeding areas at elevations below about 5,000 feet. Mixed bunch-grass and forb communities are also important in summer. In winter, windblown ridges are utilized by TMA sheep who eat more browse and lichens during the winter than other sheep populations, whose winter diets are primarily composed of grasses and sedges (Heimer 1983).The upper Tok River and Rumble Creek drainages are mineralized areas that could be developed in the future. Wildlife values could be jeopardized by development and increased access. Development would certainly compromise the secondary goal of maintaining the opportunity to hunt under aesthetically pleasing conditions.

No wildlife habitat enhancement for sheep is planned for the TMA. Most lands within the TMA will receive limited or modified fire protection, which should ensure the near-natural occurrence of wildfire on low-elevation sheep range in the future.

CONCLUSIONS AND RECOMMENDATIONS

The present Dall sheep population and the existing management program in the TMA appear adequate to meet the management objectives. However, the present population monitoring program, which relies primarily on reported harvest and occasional fixed-wing aircraft surveys, cannot detect changes in population size or composition and may require corrective action to assure objectives are met in the future.

Annual monitoring of lamb production and yearling recruitment by on-ground classification counts and monitoring of population trend must be reestablished, if population status is to be meaningfully

tracked. Mineral lick observations currently offer the best opportunity to gather these data.

The present harvest regime should be continued with 1 slight adjustment. The original allocation procedure of setting aside 10% of the permits for nonresidents should be reinstated. This allocation arrangement was changed when hunting for Dall sheep was defined as a subsistence activity in 1985. Now that the Alaska Board of Game has ruled that Dall sheep hunting in the TMA is not a subsistence activity, a nonresident allocation could be provided. Nonresident hunting is important to maintenance of the TMA program. Successfully maintaining the TMA will require continued support by the local advisory committees. Guides, who have considerable influence on the recommendations of these committees in the Tok area, strongly support nonresident use. Reestablishment of a guaranteed nonresident hunting opportunity would also recognize the national and international significance of the TMA.

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Table 1. Sheep hunting regulations in the eastern Alaska Range from 1926 to 1987.

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	10 Aug-20 Sep; no motorized vehicles or pack animals from 5-25 Aug	1 ram with 3/4 curl
1978	10 Aug-20 Sep; no motorized vehicles 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 7/8 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	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	Date			
	1980	1981	1982	1983
Legal rams:100 ewes (7/8 curl)	5	1	12	14
Sublegal rams:100 ewes	15	5	241	49
Lambs:100 ewes	39	41	6	29
Yearlings:100 ewes	27	45	6	21
Total sheep	274	270	62	232

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 1987.

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

[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 1987, Hunt 1103.

Area	No. hunters	% Hunter success	% Hunters in area	% Total kill
Granite Mountains	6	67	13	18
Ruby to Miller Creek	21	17	14	44
Jarvis Creek drainage	10	80	21	36
Black Rapids area	2	50	5	4
Johnson River	4	100	8	18
Gerstle River	5	40	10	9

Table 5. Location of hunting effort and sheep harvest in the Delta Controlled Use Area during 1987, Hunt 1104.

Area	No. hunters	% Hunter success	% Hunters in area	% Total kill
Granite Mountains	0	0	0	0
Ruby to Miller Creek	2	0	6	0
Jarvis Creek drainage	12	42	36	50
Black Rapids area	1	100	3	10
Johnson River	12	33	36	40
Gerstle River	6	0	18	0

STUDY AREA

GAME MANAGEMENT UNIT: 13A, 13E, 14A, and 14B (15,835 mi²)

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) hunters have always been restricted to mature rams and (2) the Alaska Department of Fish and Game (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

Planned regionwide activities for this reporting period included (1) conducting summer aerial sex and age composition surveys, (2) identifying and documenting critical sheep habitat, and (3) monitoring the harvest. No specific activities were identified for sheep in the TCW.

RESULTS AND DISCUSSION

Population Status and Trend

Because of infrequent sheep surveys in the TCW, the data base needed for interpreting population trends and sheep densities is sparse; however, aerial surveys have been conducted more often in Subunit 14A (i.e., south of the Matanuska River) than in any other area in Units 13 and 14. Sheep numbers there have remained relatively stable; in 1976, 709 sheep were observed, and in 1984 and 1986 the count was 702 and 681 sheep, respectively (Table 1). Surveys from Subunit 14A north of the Matanuska River (TCW) indicate that sheep numbers may have increased. In 1974 observers counted 423 sheep; the numbers increased to 628 in 1981 and 923 in 1986 (Table 1). Because variable survey conditions and, in some cases, survey areas, the counts are probably not comparable. Based on these surveys, the relatively stable harvests, and recent mild winters, I believe sheep numbers in Unit 14 have increased slightly during the last decade.

Population Size:

Past aerial surveys have not covered all of the sheep habitat in the TCW at the same time; most surveys covered less than half of the total area. The highest number of sheep that has ever been observed was 1,249 in 1982, and this survey excluded all portions of Unit 14. Therefore, the 1982 count represents the absolute minimum number of sheep in the Talkeetna Mountains. Population estimates have been derived indirectly by comparing the results on population surveys from 1974 to 1986 of various geographical areas within the TCW. The smallest total number of sheep from all count areas combined is 1,515; the largest combined total is 2,442 sheep (Table 1). It is probably safe to assume that the minimum number of sheep in the TCW is 1,500; however, the population may exceed 2,500 sheep. From 1982 to 1988, the largest number of sheep/subunit counted in any 1 year was as follows: (1) Subunit 14A, 503; (2) Subunit 14B, 371; (3) Subunit 13A, 1,049; and (4) Subunit 13E, 200 (Table 1).

Population Composition:

The most recent population composition data were obtained in 1986 in Subunits 14A and 14B while conducting mountain goat surveys. The population composition in a sample of 923 sheep was as follows: 11 legal rams:100 ewes; 30 sublegal rams:100 ewes; and 30 lambs:100 ewes. Lambs composed 17% of the population (Table 2). Since 1981 only 3 composition surveys have been conducted in Subunits 14A and 14B (Table 2). The resulting data are insufficient to identify trends, but it appears that no major changes in composition have occurred. Legal rams composed 8.4% of the sheep population in 1981 and only 6.4% in 1986, indicating a possible decline. This decline is further supported by the total number of rams declining from 27% in 1983 to 24% in 1986 (Table 3). Although these data indicate that ram numbers have declined, it is also possible that this difference was due to a sampling error.

Mortality

Season and Bag Limit:

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

Human-induced Mortality:

Prior to 1978 hunters were allowed to harvest rams with a 3/4-curl horn or larger; beginning in 1978 hunters were restricted to taking a ram with a 7/8-curl horn or larger. The mean annual harvest from 1980 to 1987 was 86 rams. Annual ram harvests from 1980 to 1983 ranged from 53 to 80; from 1984 to 1986 they increased from 101 to 118 rams. The harvest in 1987 was near the 8-year (1980-87) mean: 82 rams (Table 4). Although the ram harvest increased steadily

during the years 1984 to 1986, the harvest in 1987 was 36 less than that in 1986. The reasons for a harvest decline after several years of steady increases are not known, but it may be related to ram availability. The greatest number of sheep occur in Subunit 13A; the lowest, in Subunit 13E (Table 1). Harvests of rams also followed a similar pattern. The largest number of sheep (39) was killed in Subunit 13A, and the smallest numbers were killed in Subunits 14B and 13E: 13 rams and 14 rams, respectively (Table 4). The harvest in Unit 13 has consistently been higher than that in Unit 14; during most years hunters in Unit 13 killed twice as many rams. During the period 1980 to 1987 the mean harvest in Unit 13 was 58 rams; 30 rams were harvested in Unit 14 (Table 4).

Hunter Residency and Success. From 1983 to 1987 Alaska residents took approximately 70-80% of the annual harvest in the TCW. Hunting in Unit 13 has been dominated by nonlocal resident hunters; in contrast, Unit 14 hunters have been predominantly local residents (Tables 5 and 6). Heaviest hunting pressure has occurred in Subunit 13A. From 1983 to 1987 the annual mean number of hunters in Subunit 13A was 169, followed by Subunit 14A with 69, Subunit 13E with 47, and Subunit 14B with 31. The mean success rate is inversely proportional to the number of hunters; i.e., subunits with the largest number of hunters have had the lowest success. In 1987 the success rate in Subunit 13A was 25%. The success rates for other subunits as follows: Subunit 14A, 28%; Subunit 14B, 34%, and Subunit 13E, 38% (Tables 5 and 6). Two important points are worth noting: (1) the number of hunters has gradually increased in the past 5 years, most notably in Subunit 13A (129 to 208) and (2) in 1987 the average success rate for all subunits dropped from 47% to 25%. The reason for such an abrupt decline is not known, but lower success may have been related to poor weather; possibly, the number of legal rams available to hunters was lower than that of previous years.

Harvest Chronology. In the past 5 years, the chronology of the harvest has been relatively consistent from year to year. Approximately 40% of the sheep were taken in the first 2 weeks of the season, and the remaining 60% were spread over the last 5 weeks (Table 7). The number of sheep killed in the 1st and 2nd weeks varied considerably from year to year. Part of this difference (Table 7) may have been due to variable weather conditions, but the principal reason for that difference is due to the way harvest data are tabulated. The sheep season always starts on a different date each succeeding year; therefore, the number of days in the 1st week will vary. For instance, in 1985, the 1st "week" of the season was only 1 day long. This resulted in a low recorded harvest for that 1st "week" and a higher-than-average harvest for the following week. Data were not available to sort all the harvest data to the exact calendar week; however, this is probably not necessary to identify trends. The "distortion" in the table only occurs in the first 2 weeks, because the 1st week has not always been composed of 7 full days.

Transport Methods. In the past 5 years (1984-88), the most popular transportation method has been aircraft, accounting for 47-58% of the successful hunters (Table 8). Although the number of successful hunters using aircraft for access declined from 57 in 1986 to 36 in 1987, this decline probably occurred because the annual harvest in 1987 was smaller than it had been in previous years. One major change in transportation methods has been the increasing popularity of horses. In 1984 no horses were used by successful hunters; in 1987, 14 successful hunters used them. The 6 methods used to harvest sheep in 1987 and their frequency of use were as follows: aircraft, 47% (36); horse, 18% (14); 3- or 4-wheeler, 14% (11); highway vehicle, 6% (10); ORV, 7% (5); and boat, 1% (1) (Table 8).

Game Board Actions and Emergency Orders

Since statehood, the harvest of rams in the TCW has been restricted to a 3/4-curl or larger horn. 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, and I would not recommend any liberalization at this time because present knowledge of sheep population status and density is limited in the TCW.

In 1982, at the Division'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

Mean annual harvest since 1980 in the TCW is 86 rams; the 1987 harvest was 82 rams. The 1987 harvest met the management population objective of 75 rams annually. This goal, however, was not achieved because of a strong active sheep management program by ADF&G; it occurred passively, largely because a harvest of 75 sheep can be expected to occur in any year with moderate-to-heavy hunting pressure.

Management of sheep in the TCW has a number of real or potential problems that should be addressed:

1. Data on sheep numbers, density, distribution, composition, and general population status is not well understood because data have been collected so infrequently;

2. Long-term plans to conduct sheep surveys or other work on sheep population status currently do not exist, largely because of budgetary constraints; and

3. Hunting pressure has increased substantially in the past 2 years. In 1987 the ram harvest decreased 30% from the previous year, in spite of the fact that the number of hunters

did not decline. This situation suggests that the number of legal rams available for harvest may have declined. This hypothesis is also supported by a 10% decline in hunter success throughout the TCW in 1987.

Dall sheep is a resource held in high esteem by the hunting and nonhunting public alike. Hunters spend thousands of dollars each year for the opportunity to hunt a legal ram. Because sheep are a very high-profile species, a long-term operational plan dedicating manpower and money for sheep management is needed. Funds for sheep surveys have been limited, and these budgetary constraints have precluded timely, ongoing research efforts. If ADF&G is to effectively identify and respond to management problems (i.e., need for current population information), the acquisition of currently updated population information must occur on a planned and recurring basis.

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Table 1. Numbers of sheep in northern Chugach and Talkeetna Mountains subunits as determined from aerial surveys, 1974-1987.

Year	Chugach Mountain	Talkeetna Mountains subunits					
	14A	14A	14B	14 A&B Total	13A	13E (Watana Hills)	Talkeetna Mtns. Total
1974	--	222	201	423	--	76	499
1976	709	--	--	--	--	130	130
1978	--	--	--	--	1,359	152	1,511
1979	--	--	--	--	--	189	189
1980	502	--	--	--	--	174	174
1981	--	336	292	628	--	209	837
1982	559	--	--	--	1,049	200	1,249
1983	--	370	168	538	--	149	687
1984	702	--	--	--	--	--	0
1986	681	552	371	923	--	--	923
1987	No surveys	--	--	--	--	--	--
Lowest count		222	168		1,049	76	1,515
Highest count		552	371		1,359	209	2,491

Table 2. Sheep composition in the Talkeetna Mountains Subunits (14A and 14B) as determined from aerial surveys, 1981-1987.

Year	Legal rams: 100 ewes	Sublegal rams: 100 ewes	Total rams: 100 ewes	Lambs: 100 ewes	% Lambs in herd	Total sheep	Sheep/ survey 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
1987	No survey	--	--	--	--	--	--

Table 3. Sheep population status and composition in Talkeetna Mountains Subunits (14A and 14B) as determined from aerial surveys, 1981-1987.

Year	Legal rams No.	Legal rams (%)	Sublegal rams	Total rams No.	Total rams (%)	Ewes & unidentified	Lambs	Total	Hours of survey 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	--	--	--	--	--	--	--	--

Table 4. Harvest of rams with 7/8-curl or larger horns in the Talkeetna Mountains, by units and subunits, 1980-1987.

Year	Unit/Subunits						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	47	18	68[a]	105
1986	27	22	49	43	26	69	118
1987	16	13	29	39	14	53	82
Mean	19	13	30	42	18	58	86

[a] Includes some rams not identified by subunit.

Table 5. Sheep hunter residency and success in the Talkeetna Mountains, Subunits 13A and 13E, 1983-87.

		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%
	Mean[b]	3	33	8	42	8	130	4	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%
	Mean[b]	1	15	4	18	4	129	0.6	30	47	38%

[a] Total includes some hunters not identified as to residency.

[b] Mean for local and nonlocal residents 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 and 14B, and in all subunits in Talkeetna Mountains combined, 1983-87.

		Successful				Unsuccessful					
Subunit/ Area	Year	Local resident	Nonlocal resident	Nonresident	Total[a]	Local resident	Nonlocal resident	Nonresident	Total[a]	Total hunters	Success rate
14A	1983	9	unk	8	17	46	unk	3	49	66	26%
	1984	10	unk	5	15	47	unk	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	43	8	2	54	70	22%
	Mean[b]	12	14	8	19	42	5	3	50	69	28%
14A	1983	2	unk	3	5	13	unk	1	14	19	26%
	1984	5	unk	4	10	16	unk	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	12	3	4	19	32	41%
	Mean[b]	1	.3	6	14	12	2	4	18	32	34%
TCW[c]	1983	unk	41	17	58	unk	171	10	183	241	24%
	1984	unk	71	26	101	unk	186	5	195	296	34%
	1985	27	82	21	105	60	193	16	209	304	35%
	1986	28	56	29	118	66	171	12	254	372	32%
	1987	19	35	26	82	70	198	18	290	372	22%
	Mean[b]	25	58	24	93	66	188	13	227	317	29%

[a] Total includes some hunters not identified as to residency.

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

c Talkeetna mountains and Chulitna/Watana Hills.

Table 7. Sheep harvest chronology, Talkeetna Mountains, 1983-1987.

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.	(%)	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
Mean	21	(22)	20	(21)	14	(15)	12	(13)	10	(11)	10	(11)	4	(4)	3	(3)	94

Table 8. Successful sheep hunter transport methods, Talkeetna Mountains, 1983-1987.

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	(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
Mean	47	(52)	7	(8)	1	(1)	11	(12)	0	--	9	(10)	15	(17)	90

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

BACKGROUND

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

The historical patterns of hunter participation and harvest in Subunit 20A fall into 3 definable periods (Table 1). From 1968 to 1972, an average of 326 hunters took an average of 121 sheep annually; from 1973 to 1982, an average of 230 hunters took an average of 100 sheep annually; and from 1983 to 1987, an average of 318 hunters took an annual average of 121 sheep. Since before statehood, rams have been harvested under minimum horn curl regulations (1944-50, any ram; 1950-78, 3/4 curl; 1979-83, 7/8 curl; 1984-87, 4/4 curl). The change from 3/4- to 7/8-curl horns 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 greater harvests could be realized if only full-curl rams were taken (Heimer and Watson 1986). Subunit 20A was a suitable area for this test because of past history, good access, high hunter participation, and the management goal of providing the maximum opportunity to hunt Dall sheep.

MANAGEMENT OBJECTIVES

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

To allow full-curl ram harvests up to the limit of the population to produce them.

METHODS

During 1987 composition of ARE sheep populations was estimated from ground surveys. Biologists surveyed the Coal Creek and Moody Creek drainages from 17 to 20 July by classifying sheep encountered while hiking along ridges and drainage bottoms. Sheep were also classified from a fixed observation point as they entered the Dry Creek mineral lick between 15 and 24 June between 0500 and 1200 hours (ADT). In the Coal Creek/Moody Creek survey, each animal was classified once. At the Dry Creek mineral lick, all sheep entering the lick were classified. Therefore, it is likely that during the

10-day observation period, many Dry Creek sheep were classified more than once (Heimer 1973). The cumulative classification over the 10-day period was used to calculate the Dry Creek composition values. The aerial survey attempted in July was not completed because of poor weather.

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. Comprehensive aerial surveys have not been conducted throughout Subunit 20A since 1977. Therefore, population changes have been inferred from changes observed in the Dry Creek study area and extrapolated from the 1977 survey.

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 lower than that reported by Heimer and Watson (1986) for 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), I believe 5,000 sheep is a reasonable current estimate for the ARE.

Population Composition:

Lamb:100 ewe ratios observed in the Coal Creek/Moody Creek surveys (43:100) were lower than that observed at Dry Creek (53:100), but yearling:ewe ratios were similar (22:100 and 23:100, respectively) (Table 2). Yearling survival (70%) in Dry Creek during 1987 was the highest since 82% was recorded in 1975; but because 1986 lamb:ewe ratios were low (33:100), the 1987 absolute yearling recruitment was average.

During July 1987, 51 rams were classified in the Coal Creek/Moody Creek walkabout survey (Table 3). Legal rams (full curl) composed only 4% of the rams observed. However, subsequent reports by hunters and harvest results suggested legal rams were more abundant than indicated by survey data. In the 1984 and 1985 aerial surveys of the Dry Creek study area, legal rams (full-curl) made up 8% and 11%, respectively, of the ram samples.

Distribution and Movements:

Based on the 1977 aerial survey, sheep are distributed throughout mountains of the ARE in Subunit 20A. Summer range densities are highest (approximately 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.

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

Mortality

Season and Bag Limit:

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 or larger horns or both horns broken.

Human-induced Mortality:

During 1987, 354 hunters reported killing 142 full-curl rams in Subunit 20A. The 1986 harvest was 136 rams (Table 4). Both the 1987 and 1986 harvests were well above the mean annual one of 105 rams taken under the 7/8-curl regulation (1979-83). Heimer and Watson (1986) theorized that changing to a full-curl regulation would further increase the number of harvestable sheep, because natural mortality of sublegal rams would decline even further than that observed with the 7/8-curl regulation. However, I think the available data are insufficient to link the higher harvest of 1986 and 1987 to a change in ram age structure that may have resulted from the full-curl regulation.

The simplest explanation for the increased harvest may be increased hunter participation (Table 1). During the period 1979-83, an average of 236 hunters reported annually. During 1986 and 1987, 357 and 354 hunters, respectively, reported hunting sheep in Subunit 20A. Therefore, although reported harvest during 1986 and 1987 averaged 32% higher than during 1979-83, reported hunter numbers averaged 51% higher.

Above-average yearling recruitment in 1980 and 1981 (Table 2) may also have contributed to the high harvest of 1987 and should allow an above-average harvest in 1988. Yearling recruitment since 1981 has been moderate, and unless survival of young rams actually increased, harvest after 1989 may be lower.

After implementation of the full-curl regulation, mean horn size and mean age of harvested rams increased. Mean horn size among rams harvested in 1987 was 35 inches. Mean age of harvested rams as reported by hunters was 8.7 years (Table 5). Forty percent of the rams taken in 1987 had horns greater than 36 inches in length (Table 6).

Hunter Residency and Success. Hunter success increased to 40% during 1987. Under the full-curl regulation, mean annual hunter success has been lower (37%, $\underline{n}$ = 4 years, $\underline{x}$ = 323 hunters) than

under the 7/8-curl regulation (45%, $\underline{n}$ = 5 years, $\underline{x}$ = 235 hunters). Distribution of the harvest among residents and nonresidents is given in Table 7.

Harvest Chronology. Traditionally, the greatest harvest occurs during the 1st 10 days of the sheep season, (i.e., 10-20 August). However, during 1986 and 1987, the harvest was distributed more evenly between the 10-20 August and 21-31 August periods than during the previous 2 years (Table 8).

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 accompanying trail development in the ARE. Those areas contain approximately half of the Dall sheep range in Subunit 20A. Consequently, aircraft and horses are primary methods of transportation (Table 9). Since 1984, average success rates for hunters using aircraft and horse access have been 44% and 57%, respectively, while overall success rates have averaged 37%.

Natural Mortality:

Severe winter weather and predation are the 2 greatest natural mortality factors for Dall sheep. Winter snow depths in Subunit 20A have probably not affected sheep overwintering mortality since the winter of 1981-82.

Predation by wolves may be an increasingly significant source of mortality. During the early 1970's, predation by wolves 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 radiotelemetry 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 accompanied by photos of rams killed by wolves during 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 or sex classes of sheep. The most recent composition data also fail to indicate trends in lamb:100 ewe ratios or yearling survival that suggest 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 sheep in Subunit 20A differed from that of sheep studied in the

Robertson River (Unit 12), there was no 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.

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, which is the population objective. Recent increases in harvest may be related to increasing hunting pressure. The number of available legal rams (full curl) is expected to be higher than average in 1988 and 1989 because of high yearling recruitment in 1980 and 1981. Harvests may decline after 1989 because yearling recruitment rates have dropped since 1981.

I think the greatest information needs for management of Subunit 20A sheep are (1) A total population estimate to assess the assumption of population stability, (2) unbiased estimates of lamb production and yearling recruitment, (3) a determination of ram harvest rates, and (4) an estimate of the impact of wolf predation. I recommend that during the next 5 years these information needs be met by accomplishing the following:

1. An aerial census of Subunit 20A to estimate total sheep population size.

2. Collection of composition data at the Dry Creek mineral lick; analyses of past Dry Creek data should be accomplished in a manner that examines the potential for sampling bias.

4. Estimate the impact of wolf predation on the sheep population by monitoring collared wolf packs in the mountains of Subunit 20A and by monitoring collared sheep in eastern Subunit 20A. Sheep will be radio-collared in eastern Subunit 20A in April 1988.

5. Conduct annual field interviews of hunters and guides during the hunting seasons.

No changes in seasons or bag limits are recommended.

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Table 1. Historic sheep harvests and hunter participation in Subunit 20A, 1968-87.

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	347	38	34.2
1987	142	354	40	35.0

Table 2. Summer sheep composition and estimates of yearling survival from the Dry Creek mineral lick, 1968-87.

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	55
1987	53	23	70

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

Table 3. Summer sheep composition from aerial or ground walkabout surveys Alaska Range East, 1984-87.

Survey	Year	Lambs: 100 "ewes"	Yearlings: 100 "ewes"	Rams: 100 "ewes"	Percent of total rams (n) curl development 1/4	1/2	3/4	7/8	4/4	Total rams	N
Aerial fixed-wing (Dry Creek Study Area)	1984	38[a]	[a]	39	--	--	--	--	8 (22)	291	1,313
Helicopter (Dry Creek Study Area)	1985	28[a]	[a]	40	17 (37)	15 (34)	30 (66)	26 (58)	11 (25)	220	929
Walkabout (Moody Creek Coal Creek)	1987	43	22	60	32 (16)	32 (16)	24 (12)	10 (5)	4 (2)	51	192

[a] In aerial surveys yearlings cannot be accurately distinguished from ewes. Therefore, the "ewe" category for 1984 and 1985 surveys includes yearlings.

Table 4. Distribution of sheep harvest Subunit 20A, 1984-87.

Area	Numeric location code	1984		1985		1986		1987	
		Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters
Rex Dome to Lignite Creek	(0102)	0	3	0	0	0	5	11	13
Healy Creek	(0103)	7	48	7	43	20	64	19	72
Moody Creek	(104)	7	17	2	8	10	24	10	23
Yanert	(105, 106, 107, 108)	13	41	12	51	24	56	19	53
Totatlanika River	(0202)	2	12	2	13	4	21	3	20
Tatlanika River	(0302)	5	10	3	11	3	3	5	13
Wood River West	(0402, 0403)	12	18	0	0	22	37	13	30
Wood River East	(0404)	20	39	12	28	16	30	19	32
Wood River South	(0405)	7	11	7	9	4	6	7	8
Total Wood River[a]	(0400)	43	85	38	63	46	87	45	79
Dry Creek	(0505)	6	11	3	16	7	16	4	13
West Fork Little Delta	(0603, 0604)	6	7	1	3	0	3	2	0
Buchanan Creek	(0602)	1	4	1	3	1	6	6	0
East Fork Little Delta	(0605)	7	10	6	13	10	23	5	14
Total Little Delta[a]	(0601, 0600)	14	29	8	23	15	45	18	32
Delta Creek	(0702)	8	15	3	6	4	15	2	3
McGinnis Glacier	(0802)	0	3	0	2	1	6	1	3
Total 20A	(0000, 0100, 0200, 0300, 0400, 0500, 0600, 0700, 0800)[a]	105	292	102	292	136	357	142	354

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

Table 5. Distribution of harvest among horn length classes and mean age of harvested sheep as reported by hunters, Subunit 20A, 1984-87 (full-curl regulation).

Year	Total Harvest	Horn length in inches							$\bar{x}$ Length	$\bar{x}$ Age
		<30	30.0-31.9	32.0-33.9	34.0-35.9	36.0-37.9	38.0-39.9	≥40		
1984	105	4	14	23	37	22	4	1	$\bar{x}$ = 33.97 SD = 2.59 N = 105	$\bar{x}$ = 7.81 SD = 1.56 N = 103
1985	101	9	14	20	28	20	7	3	$\bar{x}$ = 34.04 SD = 2.93 N = 101	$\bar{x}$ = 8.4 SD = 1.88 N = 99
1986	135	5	15	28	50	30	5	2	$\bar{x}$ = 34.17 SD = 2.44 N = 135	$\bar{x}$ = 8.4 SD = 1.66 N = 124
1987	135	1	9	31	39	43	10	2	$\bar{x}$ = 34.99	$\bar{x}$ = 8.74

Table 6. Percentage distribution of harvest among ram horn size classes in Subunit 20A, 1984-87.

Year	Horn length in inches (%)		
	<34	34-36	>36
1984	35	35	26
1985	43	28	30
1986	36	37	27
1987	30	29	40

Table 7. Dall sheep hunter residency and success, Subunit 20A, 1984-87.

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	190	292
1986	59	31	36	136	141	55	13	221	357
1987	61	19	49	142	100	66	9	212	354

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

Table 8. Sheep harvest chronology in Subunit 20A, 1984-87.

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

Table 9. Subunit 20A successful sheep hunter transport methods, 1984-87 (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

STUDY AREA

GAME MANAGEMENT UNITS: Portions of 20D, 20A, and 13B (1,680 mi²)

GEOGRAPHICAL DESCRIPTION: The Delta Controlled Use Area (DCUA) in the eastern Alaska Range, including the drainages of the Tanana River south of the Alaska Highway from the west bank of the Johnson River to and including the drainages of the Delta River north of Miller Creek.

BACKGROUND

Sheep seasons and legal harvest have become progressively more restrictive in the eastern Alaska Range over time (Table 1), because of the increasing human population and hunting pressures. As this process evolved, hunters began to demand assurance of aesthetically pleasing, high-quality 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 walk-in hunting opportunities free from competition with other types of transportation.

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 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.

The designation of the Delta Management Area as a walk-in only area 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 for available rams. In 1977 hunters killed 78 rams, despite the desired harvest objective of 40 rams (Larson 1979).

In 1978 sheep hunting in the Delta Management Area was restricted by lottery permit. 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 or larger horns. 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 the 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 as a management area.

In 1984 the 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 maintain a population of 1,800 sheep and provide a mean annual harvest of 35 full-curl rams with a mean horn length of more than 36 inches and mean age exceeding 8 years.

To provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means so that virtually all hunters will be satisfied with the quality of their hunt.

METHODS

Human Use Management

Hunters selected in the permit lottery were required to report on their activities. Data contained on these reports were analyzed to determine hunter success, horn size, hunt location, transportation type, and hunter residence.

Herd Inventory and Management

An ongoing serologic study was begun in the DCUA in 1987. 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 maleate (Prom Ace or Acepromazine, Fort Dodge Lab., Fort Dodge, Iowa), blind-folded, and hobbled; 20 milliliters 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: ovine 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. Black neck bands with yellow symbols 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 horn curl: 1/4, 1/2, 3/4, 7/8, or 4/4 curl. Other sheep were classified as ewes, yearlings, or lambs.

RESULTS AND DISCUSSION

Population Status and Trend

No data suitable for determining trends in DCUA sheep populations were gathered in 1987. 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.

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. The population was estimated at 1,500 sheep (Johnson 1982). The population has remained stable at 1,500 sheep since 1980 (Johnson 1986).

Population Composition:

Trends in composition of DCUA sheep are unknown. Insufficient composition data to indicate herd composition were collected at the Granite Creek lick during 1987. The most recent reliable composition data for the DCUA were collected during ground surveys at the Granite Creek lick in 1983 (Table 2). Two hundred thirty-two sheep were classified from 14 to 16 July 1983; however, this sample may have been too small to accurately reflect herd composition. Heimer (1973) suggested a minimum of 500 sheep should be classified during ground surveys at mineral licks to overcome bias that results from factors such as bands of sheep repeatedly visiting the lick. The types of bias resulting from small sample sizes are evident in Table 2.

Mortality

Season and Bag Limit:

The open season for resident and nonresident hunters is from 10 August to 20 September. 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 0001 hours on 26 August. Hunters were not allowed to use motorized vehicles or pack animals to transport themselves, hunting gear, or sheep within 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 33 rams in 1987 (Table 3). This harvest is similar to the mean of 32 sheep harvested each year during the previous 5 years and the mean of 33 sheep harvested each year since the DCUA became a permit hunting area in 1979. Sixty-seven percent of the harvest occurred during hunt No. 1103, and 33% occurred during hunt No. 1104. No reminder letters were sent to hunters who failed to return their permits in 1987.

Regulation changes in legal horn size have not significantly affected the harvest rate. 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 1987, the average harvest was 31 sheep per year (range = 18-40). The low harvest of 18 sheep in 1984 was unusual; it was caused by an early deep snowfall that created poor hunting conditions. If 1984 is omitted from the calculations for mean annual harvest, the full-curl harvest has averaged 35 sheep per year.

Mean horn length for sheep taken during 1987 was 35.6 inches, similar to mean horn length since the full-curl regulation was adopted in 1984 (Table 3). Horn length increased significantly following establishment of the permit hunt in 1979. Mean age for sheep killed in 1987 was 8.3 years.

Hunter Residency and Success. The DCUA was used exclusively by Alaskan residents in 1987. One nonresident received a permit but did not hunt. The DCUA is a popular sheep hunting area for residents throughout the state. Eighty percent of the permits went to Alaska residents who do not live in Subunit 20D.

Sheep hunters in the DCUA had a 38% success rate during 1987. Successful hunters hunted a mean of 4.1 days, compared with 4.6 days for unsuccessful hunters. These values are similar to mean hunting effort during the previous 5 years; i.e., 4.0 days per successful hunter and 4.4 days per unsuccessful hunter.

Permit Hunts. The Department received 489 and 572 applications for hunt Nos. 1103 and 1104, respectively. Of the 75 permits issued for each hunt, 51 and 38 of the permittees participated in hunt Nos. 1103 and 1104, respectively.

Transport Methods. During hunt No. 1103, the walk-in hunt, 98% of the hunters used highway vehicles for access to the DCUA and 2% used aircraft. Highway vehicles were also a popular means of access to the DCUA during hunt No. 1104, accounting for 32% of the hunters. This is probably because much of the DCUA is easily accessible from the Alaska and Richardson Highways. Also, no air taxi operators were operating in Delta Junction during the 1987

hunting season. Other transportation means used in hunt No. 1104 included three-wheelers (30%), aircraft (18%), off-road vehicles (16%), and horses (3%).

Harvest Chronology. Approximately 75% of the harvest occurred during the first 5 days of each hunt (hunt No. 1103 = 76%, hunt No. 1104 = 73%). Approximately 90% of all sheep had been taken by the end of the second 5-day period during each hunt (No. 1103 = 90%, No. 1104 = 91%). Given suitable weather conditions, sheep hunters in the DCUA begin hunting as early as legally possible and kill their sheep early in the season.

Harvest Locations. During hunt No. 1103, the majority of the harvest (68%) was taken in the most accessible portions of the DCUA; i.e., either the Granite Mountains south of the Alaska Highway, the Jarvis Creek drainage or between Ruby Creek and Miller Creek east of the Richardson Highway (Table 4). Hunters in these areas had their highest success rate (80%) in the Jarvis Creek drainage. Hunter effort and the number of sheep killed in the Johnson and Gerstle River drainages were relatively low because of the difficulty of walking into these areas.

Fifty percent of the sheep harvested during the mechanized access hunt were also taken in the Jarvis Creek drainage, although only 36% of the hunters used that area (Table 5). Forty percent of the harvest came from the Johnson River drainage, where another 36% of the hunters hunted. No sheep were reported taken from the Gerstle River drainage.

Natural Mortality:

Only 1 sheep was captured during the serologic study at the Granite Creek lick. The captured sheep was a 10-year-old ewe. Serum from this sheep contained no antibodies to any of the agents tested. In addition to capturing the ewe, field facilities were established near the Granite Creek lick to facilitate future capture operations and classification counts.

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. Because the ram harvest from the DCUA appears to be stable, indicating a stable population, predation is not considered particularly detrimental to sheep populations there.

Weather is probably a chronic limiting, but not acutely depressing, factor for sheep in the DCUA. The DCUA is located at the north end of the 2,443-foot Isabel Pass through the Alaska Range, so winter storms frequently bring high winds and warm temperatures. Therefore, much of the area is either snow-free or has very little snow during much of the winter.

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 regulation proposals by the Board of Game or emergency orders affected the DCUA during 1987.

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 1987 reported harvest was 33 full-curl rams with a mean horn length of 35.6 inches and a mean age of 8.3 years. These data indicate the harvest objective continues to be attained.

By inference from harvest data and hunter comments, the sheep population in the DCUA appears to be stable. 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 8 years. It is also unknown if the human use objective of providing aesthetically pleasing hunting conditions is being achieved. Hunters appear to be satisfied with hunting conditions in the DCUA.

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 sufficient composition data to assess lamb production and yearling recruitment in the Granite Mountains; and (5) quantify hunter impression of the aesthetics of sheep hunting in the DCUA.

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Table 1. Sheep hunting regulations in the eastern Alaska Range from 1926 to 1987.

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	10 Aug-20 Sep; no motorized vehicles or pack animals from 5-25 Aug	1 ram with 3/4 curl
1978	10 Aug-20 Sep; no motorized vehicles 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 7/8 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	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	Date			
	1980	1981	1982	1983
Legal rams:100 ewes (7/8 curl)	5	1	12	14
Sublegal rams:100 ewes	15	5	241	49
Lambs:100 ewes	39	41	6	29
Yearlings:100 ewes	27	45	6	21
Total sheep	274	270	62	232

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 1987.

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

[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 1987, Hunt No. 1103.

Area	No. hunters	% Hunter success	% Hunters in area	% Total kill
Granite Mountains	6	67	13	18
Ruby to Miller Creek	21	17	14	44
Jarvis Creek drainage	10	80	21	36
Black Rapids area	2	50	5	4
Johnson River	4	100	8	18
Gerstle River	5	40	10	9

Table 5. Location of hunting effort and sheep harvest in the Delta Controlled Use Area during 1987, Hunt No. 1104.

Area	No. hunters	% Hunter success	% Hunters in area	% Total kill
Granite Mountains	0	0	0	0
Ruby to Miller Creek	2	0	6	0
Jarvis Creek drainage	12	42	36	50
Black Rapids area	1	100	3	10
Johnson River	12	33	36	40
Gerstle River	6	0	18	0

STUDY AREA

GAME MANAGEMENT UNITS: Portions of 20B, 20F, 25C, and 25D (534mi²)

GEOGRAPHICAL DESCRIPTION: The alpine habitat in the vicinity of Victoria Mountain, Mount Schwatka, Mount Prindle, Lime Peak (also known as Rocky Mountain), Cache Mountain, and the White Mountains

BACKGROUND

Because of small populations and low harvest intensity, Dall sheep in the White Mountains area have received relatively little attention and surveys have been infrequent. However, between 1983 and the present, 11 sheep were radio-collared as part of a cooperative study between the Bureau of Land Management (BLM) and ADF&G. A final report on this study is expected to be completed by the fall of 1988.

Most of the sheep habitat in the White Mountains area lies within the White Mountains National Recreational Area and the Steese National Conservation Area, which were established by the Alaska National Interest Lands Conservation Act in 1980; this area is managed by the Bureau of Land Management (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, which is to provide for the opportunity to hunt them under aesthetically pleasing conditions. Sheep management activities in the White Mountains area were previously reported in the Tanana Hills report series.

MANAGEMENT OBJECTIVES

To maintain a population of at least 250 Dall sheep.

To sustain an annual harvest of at least 4 full-curl rams.

To determine by 1991 whether or not hunters find hunting conditions aesthetically pleasing.

To reevaluate population and human-use management objectives after reviewing the findings of the cooperative study by ADF&G and BLM.

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

Biologists from BLM located these sheep approximately once per month during the winter and at 7- to 10-day intervals from mid-April through mid-November.

The harvest was monitored through harvest ticket report cards. Historical data on the sheep population and its human uses were examined for this report.

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 had reached its highest point in 1970 (i.e., 285 sheep) but had declined by 56% in 1977. The observer in both surveys, believed that this dramatic decline was not an artifact of survey conditions or techniques (T. Smith memo, 26 Aug 1977). The decline was probably caused by the deep snow in the winter of 1970-71 and increased wolf predation caused by the lack of caribou west of the Steese Highway after 1971. Since 1977 the population has been increasing, especially between 1982 and 1986 when it rose to 85% of the "historical high." In 1986 the survey area was more extensive than that in 1982; however, agreement between ground and aerial surveys indicated sightability was higher during 1982.

Population Size:

Based on a 1986 survey, the sheep population in the White Mountains area is currently estimated at 250-300 animals (approximately 0.5-0.6 sheep/mi^2). During the aerial survey from 27 to 29 June 1986, 240 sheep were counted under very good or excellent survey conditions. Also, radiotelemetry studies increased the efficiency of finding sheep (B. Durtsche, pers. commun.). No surveys were conducted in 1987.

Population Composition:

Although composition data were available from ground and aerial surveys, only the latter provided data for the White Mountains area, suggesting that the population fluctuations since 1970 have been primarily in the ewe and lamb segments (Table 1, Fig. 1). Although the lamb component is highly variable in most sheep populations (Heimer and Watson 1986), ram numbers are typically more variable than ewes, particularly in hunted populations. Numbers of rams in the White Mountains area have not varied greatly during the last 17 years, but 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 those with 7/8-curl or larger horn, rather than 3/4-curl rams included in 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 ewes ratios, because the "ewe" category also contains yearlings and young rams.

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 winters on Victoria Mountain, before moving to Mount Schwatka during late May and early June; they return to Victoria Mountain in late fall (Fig. 2). The main travel route used between the 2 areas is through Long and Victoria Creeks and through the unnamed drainage directly south of these creeks (B. Durtsche, pers. commun.). A 1955 report noted use of this well-defined trail (ADF&G files).

Another group winters in the Lime Peak area, moving to either Mount Prindle or the White Mountains for the summer. A portion of this group remain 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).

Sheep in the White Mountains may display different movement patterns than typical sheep populations. Sheep habitats in the Tanana/Yukon Uplands, which include the White Mountains and the eastern Tanana Hills, are unique among Dall sheep habitats of Alaska. This portion of Interior Alaska is less influenced by maritime weather than any other sheep range in the state, and it was not glaciated during the last ice age. As a result of its geologic history, terrain is low in elevation and less precipitous than typical Dall sheep habitat in Alaska.

Because this area was ice-free steppe-tundra during the last ice age it seems likely that the ancestors of present-day Dall sheep were there. As the ice receeded, these ancestral sheep probably colonized their present, typically mountainous habitats; consequently, present-day Dall sheep of the White Mountains may be considered a remnant population.

Dall sheep habitat in the White Mountains is characterized by small disjunct areas of steep, rugged terrain. Although the high rolling hills of the White Mountains provide extensive summer ranges, it appears that sheep numbers there have not achieved high densities

in modern times. This may be a result of disjunct suitable habitats, inadequate escape terrain, and limited winter-feeding opportunities.

The White Mountains are physiographically unique among Alaskan habitats, because their geographic orientation does not assure the reliable "down valley" air flow characteristic of more typical habitats. Typical Dall sheep habitat lies on the "precipitation shadowed" slopes of major mountain masses and is characterized by long, relatively straight drainages that run from a glaciated crest at altitudes of 10,000 feet, through the mountains, foothills, and to the flats below. As cold air is pushed upward and over the crests of those mountain ranges by prevailing air flows, it cools, drops its moisture, and increases in densitity. Consequently, after flowing over the crests, it runs downhill following the long, straight drainages, thus creating the required predictable wind necessary to keep winter ranges consistently snow-free. This cannot occur in the White Mountains because there is no high altitude mountain mass that intersects a predictable air flow pattern. Consequently, winter ranges are more variable in location and size than in more stable sheep habitats. This suggests that the area cannot support the densities of sheep common to other ranges.

We expect sheep in the White Mountains to have differing range and movement ecologies from Dall sheep in more stable habitats. This should be reflected in increased home range size, decreased loyalty to seasonal ranges, and relatively unstable population numbers.

Variability in distribution and movements is being assessed in a study of 11 radio-collared sheep. All 3 ewes collared on Victoria Mountain on 21 April 1983 moved to Mount Schwatka for the winters and back to Victoria Mountain for the summer. All 8 sheep collared in the Lime Peak/Mount Prindle area (i.e., 3 ewes on 21 April 1983 and 2 rams and 3 ewes on 21 April 1985) moved to Lime Peak for the winters. 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 near Lime Peak. Radio-collared sheep were always relocated on the same side of Beaver Creek where they were collared. A final report on the findings from all the species radio-collared in this study is expected to be completed by the BLM in fall 1988 (B. Durstche, pers. commun.).

Mortality

Season and Bag Limit:

The hunting season is from 10 August through 20 September. The bag limit is 1 ram with full-curl or greater horns or with both horns broken. From 1979 through 1986 a 7/8-curl limit was in effect for the White Mountains area. The full-curl regulation in this area was established for 1987 (Table 2).

Human-induced Mortality:

During the last 5 years, annual harvests of rams have been low (2-6 rams), but they have followed no consistent pattern (Table 3). In 1986 the fall harvest represented 29% of the legal rams counted in late June. The harvest of only 2 rams in 1987 may be partly due to the change in the minimum legal horn size from 7/8 curl to full curl; however, it is within the range of variability in harvest size.

Although the sample size was only 2 rams, the ages and horn sizes of rams harvested in 1987 were slightly higher than the 4- or 5-year mean (Table 4). This was expected because of the change in the legal horn size from 7/8 curl to full curl. Ages of harvested rams during the last 4 years (no age data available for 1983) ranged from 6 to 11 years, with a mean of 8.4. The 2 rams harvested in 1987 were 8 and 9 years old. Half of the rams harvested since 1983 have had 1 or 2 broomed horns.

Mean reported horn length in 1987 of 36.8 inches was slightly larger than the 5-year mean of 34.5 inches. Measurements from some broomed horns were included in this analysis. The 5-year-mean horn length of unbroomed horns was almost an inch greater (35.3 inches). Mean horn base circumference was 14.8 inches in 1987, compared with the 5-year mean of 13.7 inches. This is a notably large base circumference for Dall sheep. Only 11% of the top 100 sheep in the Boone and Crockett record book have bases exceeding 15 inches in basal circumference.

Regulation changes in 1984 limited sheep harvest in the Tanana Hills portion, representing about half of the sheep in the Tanana/Yukon Uplands, by lottery permit. This change may have shifted sheep hunting pressure from the Tanana Hills to the White Mountains area. However, the increasing number of sublegal rams in the population suggests that a higher harvest may be sustained in upcoming years.

Hunter Residency and Success. Most sheep hunters in the White Mountains area were nonlocal residents. Of the 86 hunters hunting in the White Mountains area during the last 5 years, only three nonresidents and only five were local residents (Table 5). 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; the 5-year mean is 21%.

During the last 5 years, the annual mean number of days hunted ranged from 6 to 12 days for successful hunters and from 4 to 7 days for unsuccessful hunters (Table 6). If the 2 hunters who had reported unusually long hunts (25 days each) were excluded, the range of hunt length for unsuccessful hunters would be shortened to 4-6 days.

Harvest Chronology: Both sheep harvested in 1987 and 61% of the 18 sheep harvested since 1983 have been taken during the first 11 days

of the season (Table 7). It is not possible to determine whether the timing of the hunt influences the probability of success, because unsuccessful hunters have not been asked to report when they hunted.

Transport Methods. Main access points for wheel planes are a small airstrip on Lime Peak, gravel bars, and several private strips along Beaver Creek; floatplanes can land on several small lakes north of Mount Schwatka and sometimes on Beaver Creek. Ground access is primarily from the Steese Highway, trails, or mining roads.

Despite the scarcity of landing sites, airplanes were the most common means of transportation for successful and unsuccessful sheep hunters. Since 1983 airplanes have provided transportation for 88% of the successful hunters and 32% of the unsuccessful hunters (Table 8). Unsuccessful hunters also commonly used three- or four-wheelers, ORV's, and highway vehicles.

Natural Mortality:

Natural mortality of sheep in the White Mountains area is caused primarily by weather and predation. Deep snow and cold temperatures have been implicated as important causes of sheep mortality in some years (Heimer and Watson 1986); however, weather in the winters of 1986-87 and 1987-88 was relatively mild (i.e. low snowfall) and probably not responsible for much sheep mortality.

Possible predators in the area include wolves, wolverines, grizzly and black bears, golden eagles, and lynx. One collared ewe was killed by wolves during the winter of 1983-84, and golden eagles have been observed on Lime Peak (B. Durtsche, pers. commun.). The degree of predation and abundance of predators are unknown. Sheep in the White Mountains area may be more susceptible to predation than in other areas because (1) they frequently travel through forested areas at low elevations and (2) there is a scarcity of rugged escape terrain in the alpine areas (ADF&G 1976).

Habitat

Assessment:

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 especially 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.

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 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" (ADF&G files). However, in 1982 during an on-ground sheep survey, Ed Crain (pers. commun.) observed 5 rams leaving a cave; he reported the weather as hot and "buggy."

Protection of important sheep habitats is more important to sheep welfare than habitat manipulation, because sheep ranges are usually climax vegetation (ADF&G 1980). Two potential threats to sheep habitat include mineral exploration and development of recreational facilities in the White Mountains National Recreation Area by BLM. These facilities include trails and remote cabins, which may substantially increase human use of the area.

Enhancement:

In an effort to improve moose browse quantity and quality, the BLM burned, approximately 5,000 acres in the upper Bear and Quartz Creeks drainages in June 1987. In addition, a natural fire burned several thousand acres south of Cache Mountain during summer 1987. These burns may also benefit sheep habitat by retarding encroachment of forest upon the alpine areas and establishing an earlier stage of plant succession in the area. The BLM is assessing the feasibility of a prescribed fire in the Birch Creek area during 1988.

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

I believe the population goal of providing for aesthetically pleasing hunting conditions is currently being met. At the present time, 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 development of trails 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.

To effectively pursue the management objective for the White Mountains area, my recommendations for future activities include

(1) estimating population size and general composition with postlambing aerial surveys at least once every 3 years, (2) cooperatively working with BLM and Department of Natural Resources to maintain and protect sheep habitat in the White Mountains area, especially travel routes and mineral licks, (3) defining "aesthetically pleasing hunt conditions" and determining what situations would negate them, (4) monitoring harvest and harvest intensity through harvest ticket reports, and (5) modifying statewide sheep harvest reports to gather data that would show if one or both horns on a ram had been broomed (broken).

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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, 1983-87.

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

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

Table 3. Annual harvest of rams in the White Mountains area, 1983-87.

Year	Subunit	Uniform Coding Unit	Number harvested	Summary by area 1983-87 combined Subunit	UCU	No. harvested
1983	25D	702	3	25C	102	1
1984	25C	102	1	25C	103	4
	25D	702	1	25C	201	3
Total 1984			2			2
1985	20F	000	1	25C	301	2
	25C	103	2	25D	702	7
	25C	201	1	20F	000	1
	25C	301	1			
	25D	702	1			
Total 1985			6			
1986	25C	103	2			
	25C	301	1			
	25D	702	2			
Total 1986			5			
1987	25C	201	2			

Table 4. Horn characteristics of harvested rams from the White Mountains area, 1983-87.

Year	Horn length (in)[a]				Horn base (in)				Age from rings			
	$\bar{x}$	SD	n	Range	$\bar{x}$	SD	n	Range	$\bar{x}$	SD	n	Range
1983-87	34.5	± 2.44	18	28-37.5	13.7	± 1.28	17	11-15.5	8.4	± 1.29	14	6-11[b]
1987	36.8	± 0.75	2	36-37.5	14.8	± 0.25	2	14.5-15	8.5	± 0.50	2	8-9

[a] Includes some broomed horns.

[b] Excludes 1 reported 14-year old with 33.5 x 14-inch horns and unbroomed. This would probably not be a 14-year old. No age data available for 1983.

Table 5. Sheep hunter residency and success for the White Mountains area, 1983-87.

Year	Successful hunters					Unsuccessful hunters					Total hunters	
	Locals[a]	Non-local	Nonres.	Unspec.	Total	Local	Non-local	Nonres.	Unspec.	Total	No.	% success
1983	0	2	1	0	3	0	12	0	0	12[b]	15	20
1984	0	0	2	0	2	0	22	0	1	23[c]	25	8
1985	0	6	0	0	6	2	10	0	1	13[d]	19	32
1986	0	4	0	1	5	1	4	0	1	6	11	45
1987	0	2	0	0	2	2	12	0	0	14	16	12
Total					18					68	86	21

[a] Local = resident of subunit hunted.

[b] One coded as 25Z could have been for Tanana Hills instead.

[c] One coded as 20Z could have been for Tanana Hills instead.

[d] Two coded as 27Z could have been for Tanana Hills instead.

Table 6. Mean number of days hunted for sheep in the White Mountains area, 1983-87.

Year	Successful		Unsuccessful		Total
	No. hunters	Mean no. days	No. hunters	Mean no. days	no. hunters
1983	3	12.3 ~ 3.77	12[a]	5.5 ~ 3.12	15
1984	2	8.0 ~ 0	23[b]	6.9 ~ 6.15	25
1985	6	5.5 ~ 1.50	13[c]	3.6 ~ 1.39	19
1986	5	9.4 ~ 3.32	6	5.3 ~ 2.36	11
1987	2	6.0 ~ 1.00	14	3.6 ~ 1.91	16
1983-87	18	8.1 ~ 3.50	68	5.2 ~ 4.19	86
			(66	4.6 ~ 2.41)[d]	

[a] One coded 25Z may have been for Tanana Hills instead.

[b] One coded 20Z may have been for Tanana Hills instead. Also includes two 25-day hunts.

[c] Two coded 27Z may have been for Tanana Hills instead.

[d] Excludes 2 hunters in 1984 with 25-day hunts.

Table 7. Harvest chronology for sheep in the White Mountains area, 1983-87.

Year	Harvest chronology			
	10-20 Aug	21-31 Aug	1-10 Sept	11-20 Sept
1983	3	0	0	0
1984	2	0	0	0
1985	3	1	1	1
1986	1	2	1	1
1987	2	0	0	0

Table 8. Transport methods for sheep hunters in the White Mountains area, 1983-87.

Year	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Unknown
Successful					
1983	3	0	0	0	0
1984	2	0	0	0	0
1985	5	0	1	0	1
1986	3	0	1	0	1
1987	2	0	0	0	0
Total	15	0	2	0	2
Unsuccessful					
1983	0	0	4	7	1
1984	9	6	3	2	3
1985	4	2	4	3	0
1986	0	2	3	1	0
1987	7	2	2	0	3
Total	20	12	16	13	7

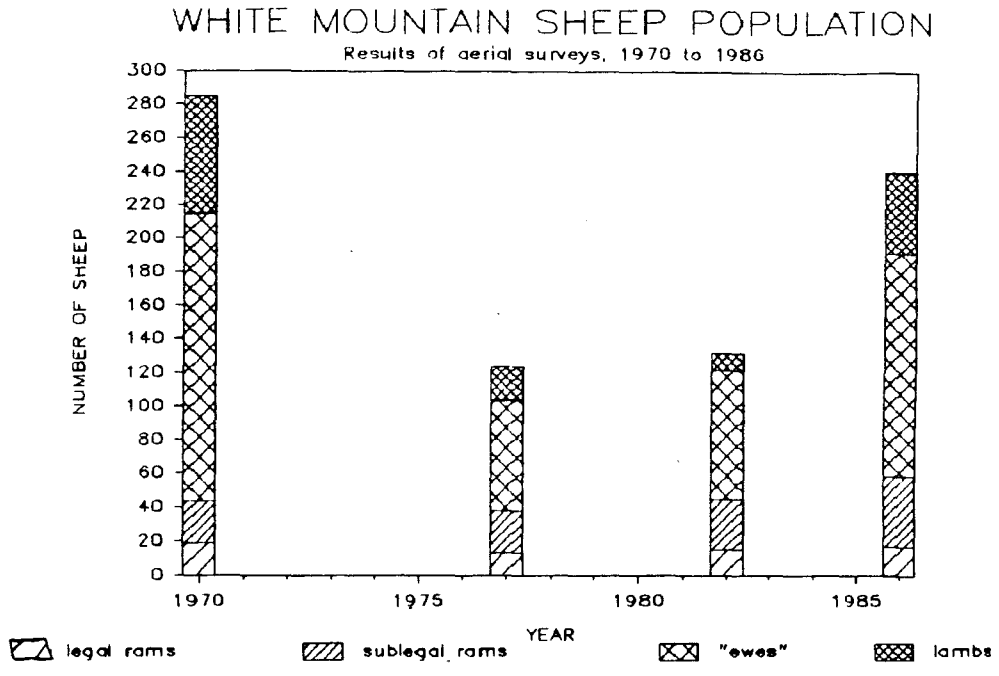

Figure 1. Composition of sheep observed during aerial surveys of the White Mountain area, 1970-1986 (definition of "legal rams" 3/4-curl from 1970-78, 7/8-curl from 1979-85, and 7/8-curl for that portion in Unit 25, and 4/4-curl for that portion in Unit 20 in 1986).

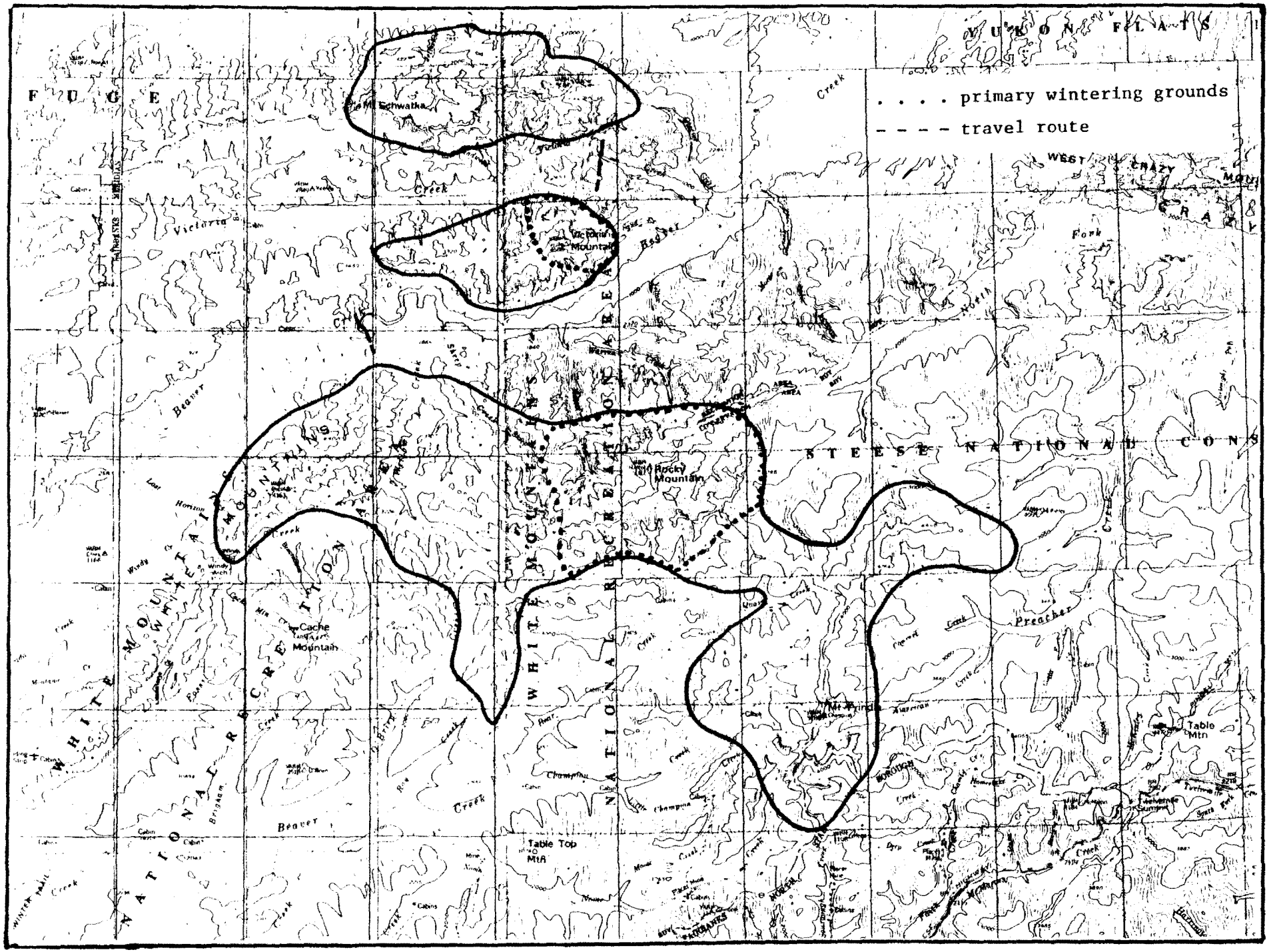

Figure 2. Primary range of sheep in the White Mountains area (1 square = 36 miles^2).

STUDY AREA

GAME MANAGEMENT UNITS: 20D and 20E (1,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Tanana Hills

BACKGROUND

Sheep habitats in the Tanana/Yukon Uplands, which include the eastern Tanana Hills and the White Mountains, are unique among Dall sheep habitats in Alaska. This portion of Interior Alaska is less influenced by maritime weather than any other sheep range in the state, and it was not glaciated during the last ice age. As a result of its geologic history, terrain is low in elevation and less precipitous than typical Dall sheep habitat in Alaska.

Because this area was ice-free during the last ice age, it seems likely that the ancestors of present-day Dall sheep spent that geologic period there when it was steppe-tundra. As the ice receded, these ancestral sheep probably colonized their present, typical mountainous habitats. Consequently, present-day Dall sheep of the Tanana Hills may be considered remnant or relict populations.

Dall sheep habitat in the Tanana Hills is now characterized by small, isolated areas of steep, rugged escape terrains that are similar to typical Dall sheep habitat; these terrain are disjunct and limited in extent, occurring from southern Mount Harper northeast to Glacier Mountain near Eagle. Conversely, the high rolling hills provide extensive summer ranges. Still, it appears that sheep numbers in the Tanana Hills have not achieved high densities in modern times. This may be a result of disjunct "islands" of suitable habitat, inadequate escape terrain, or limited foraging opportunity.

The Tanana Hills are also physiographically unique among sheep habitats, because their geographic orientation does not assure the reliable "down valley" air flow characteristic of more typical habitats. Most Dall sheep habitat lies in the precipitation shadow of major mountain masses and is characterized by long, relatively straight drainages that run from the crest, through the foothills, and to the flats below. As air is pushed up and over the crests of these mountain ranges by prevailing air flows, it cools and increases in density. Consequently, it flows down the long, straight drainages creating the required predictable wind necessary to keep winter ranges consistently snow-free. This cannot occur in the Tanana Hills, because there are no identifiable mountain masses, no long, straight drainages, and no prevailing air flow pattern. Consequently, winter ranges are more variable in location and size than those in more stable sheep habitats. Hence, the Tanana Hills simply cannot support the densities of sheep common to other ranges because of limited escape terrain and unstable

winter range availability.

Dall sheep in the Tanana Hills will have differing range and movement ecology from those occupying more stable habitats. This will be reflected in home range size, loyalty to seasonal ranges, and relatively unstable population numbers. The country is remote and seldom visited and the terrain offers easy walking. The Glacier Mountain Controlled Use Area (Fig. 1) was created in 1971 to provide walk-in only hunting opportunities for sheep hunters. In 1985, 3 permit hunt areas were created to provide aesthetically pleasing conditions by limiting crowding among sheep hunters in the Mount Harper (Hunt No. 1106), Upper Charley River (Hunt No. 1108), and Lower Charley River (Hunt No. 1107) areas. This management program has been successful in maintaining uncrowded hunting conditions; however, hunter success has been low, relative to other areas of Alaska.

MANAGEMENT OBJECTIVES

To provide an opportunity to hunt sheep under aesthetically pleasing conditions.

To maintain low hunter density through limited permit drawings and access restrictions.

To determine the extent, chronology, and causes of adult and lamb sheep mortality by 1993.

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

METHODS

Four permits were issued in each of the 3 permit hunting areas (Nos. 1106, 1107, and 1108). Permit reports are evaluated each year to determine hunter participation, harvests, access means, specific hunt areas, and effort in terms of time spent afield by both successful and unsuccessful hunters. Hunters using the Glacier Mountain Controlled Use Area are required to obtain sheep harvest tickets and to submit harvest reports from which comparable information is obtained.

RESULTS AND DISCUSSION

Population Status and Trend

Population Size:

The last complete survey of sheep habitat in Subunit 20E and northern Subunit 20D was conducted in the summer of 1982; 281 sheep were classified. By applying a 1.3 correction factor, a population estimate of about 365 sheep was derived. The trend of the population since 1982 has not been determined.

Distribution and Movements:

While sheep have been observed throughout most alpine areas in northwestern and northern Subunit 20E, concentration areas exist (Fig. 2). Sheep observed during the 1982 survey were distributed as follows: Mount Harper, n = 87 (31%); Crescent Creek-Charley River, n = 54 (19%); Twin Mountain, n = 18 (6%); Mount Sorenson-Seventymile River, n = 41 (15%); and Glacier Mountain-North Peak, 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

Season and Bag Limit:

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 (Fig. 1). 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:

Two rams were taken by permit hunters. One 9-year-old ram with 36.5-inch-long horns was taken on the north end of Mount Harper (hunt area No. 1106), and one 8-year-old ram having a horn length of 38 inches with 14.5-inch base circumference was taken from the Lower Charley River (hunt area No. 1107). An additional 5 rams were taken in the Glacier Mountain Controlled Use Area. Harvest from the Tanana Hills totaled 7 rams with full-curl horns. Hunters in the permit areas averaged 6 days afield.

Hunter Residency and Success. Twelve permits were issued for the permit areas. One recipient was a local resident, 10 were Alaska residents, and one was a nonresident. Two hunters killed rams, representing a hunter success rate of 25% in the permit areas. No rams were taken in the upper Charley River (hunt area No. 1108).

In the Glacier Mountain Controlled Use Area, 11 hunters reported killing a total of 5 full-curl rams, representing a success rate of 45%. One Fannin color phase ram was taken. Four of the 5 rams were 8 years old, and one was 10 years old. Mean horn length was 32.6 inches; 3 of the 5 rams harvested had broomed (i.e., broken) horns.The overall number of hunters in the Tanana Hills was 19, the total harvest was 7, and the overall hunter success rate was 37%.

Permit Hunt. Of the 12 hunters who received permits, only eight hunted. There were no reports of crowded hunting conditions, and the hunters who were interviewed were pleased with the quality of their hunting experience.

Harvest Chronology. Both rams harvested in the permit areas were taken in the first 3 days of the season. Harvest from the Glacier Mountain Controlled Use Area was spread over the 1st week of the season.

Transport Methods. In the permit areas, all hunters used aircraft transportation to their hunting area. No mechanized transport is allowed in the Glacier Mountain Controlled Use Area. In this area, 3 successful hunters walked from the Taylor Highway, one used horses, and one walked from an airstrip located outside the restricted area.

Natural Mortality:

Most Dall sheep mortality in the Tanana Hills is attributable to natural factors. Predation may be a limiting factor for this population. 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 mountains; 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

Sheep habitat in the Tanana Hills may be thought of as rich in summer food and poor in escape cover; patches of typical sheep habitat are disjunct and limited. Inconsistent winter winds and snowpacks averaging 50 inches per year combine to produce variable winter forage supplies. The limited extent of escape cover makes such habitat critical to the status of this sheep population.

Northern areas are in the Yukon-Charley Rivers National Preserve and will probably be protected from human disturbances. The Mount Harper area, however, has been selected by the State and Native owners, has known mineral potential, and has already been subjected to disturbances 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 intensive 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 nearly natural fire regime throughout this area that should ultimately benefit sheep.

CONCLUSIONS AND RECOMMENDATIONS

This small, widely dispersed, but highly disjunct sheep population is believed to be limited by predation because of limited escape cover. Winter ranges are unpredictable and may be limiting as well. Observed lamb survival has been extremely low in the Tanana Hills, compared with other sheep areas. Little is known about natural mortality factors or rates for adult sheep, but harvests of adult rams have been low.

Our goal of providing opportunities to hunt sheep under aesthetically pleasing conditions is currently being met; no complaints of overcrowding have been received since the drawing-permit hunt was instituted in 1985. Management activities to determine the extent, chronology, and causes of sheep mortality and increasing sheep numbers that have been recommended should be pursued to meet the need for these data by 1993.

We recommend that an aerial sheep survey that is comparable with the 1982 effort be conducted during the summer of 1988 or 1989 to determine population size. On-ground sex and age composition data should be gathered annually. No changes in seasons or bag limits are recommended.

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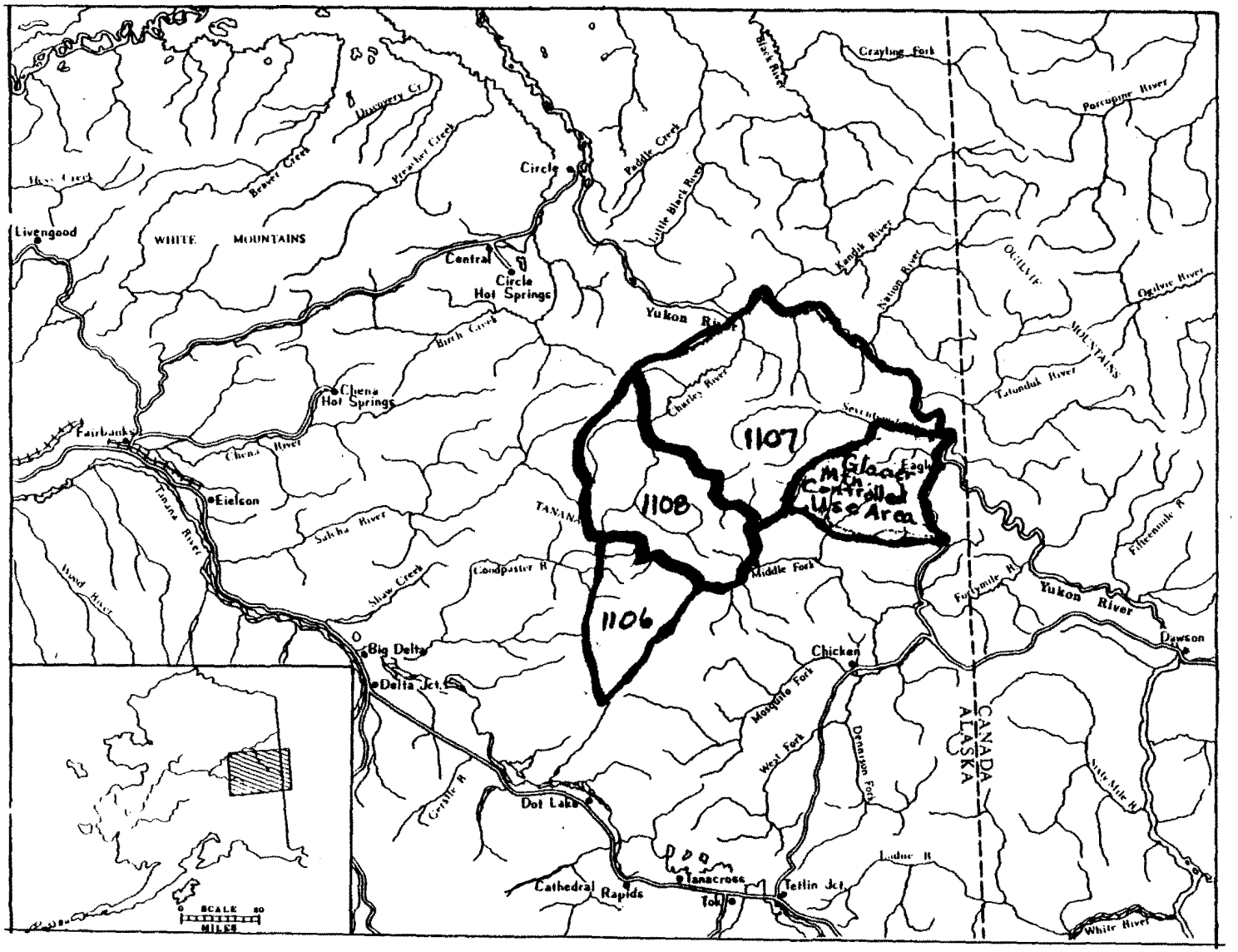

Figure 1. Sheep management areas, Tanana Hills.

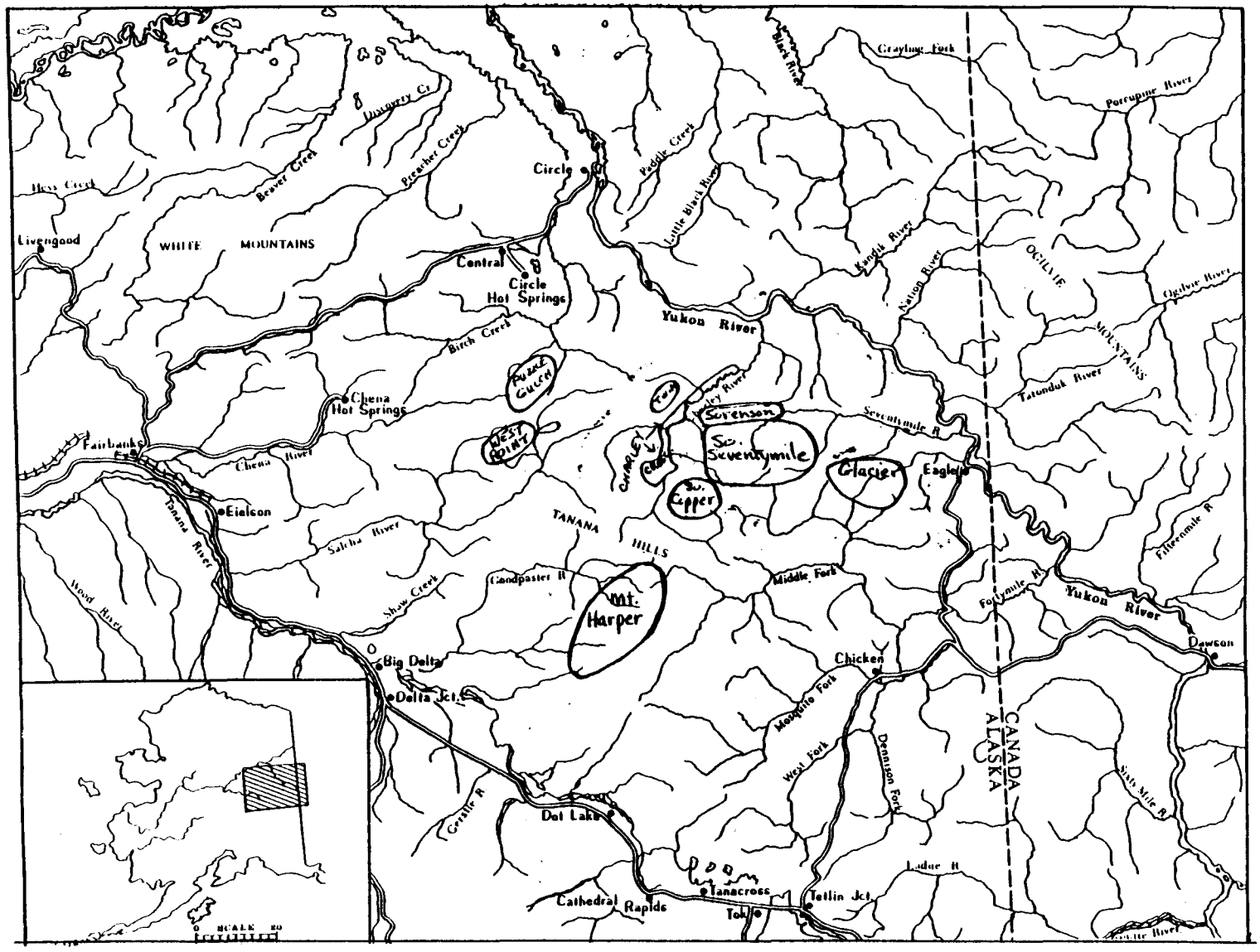

Figure 2. Tanana Hills sheep concentration areas, July 1982.

STUDY AREA

GAME MANAGEMENT UNIT: 23 (43,000 mi²) and 26A (53,200 mi²)

GEOGRAPHICAL DESCRIPTION: Western Brooks Range

BACKGROUND

Dall sheep occur at the northwestern extremity of their range in Unit 23 and Subunit 26A. These sheep populations represent only 2-4% of all sheep in Alaska and are one of the least surveyed or understood in the state. The absence of a boreal zone creates differences in habitat use between sheep in northwestern Alaska and those in more southern regions. Because willows and lichens constitute a larger proportion of the diet of sheep in northwestern Alaska, compared with that in other parts of Alaska and Canada (Ayres 1986), methods for estimating carrying capacity and optimum population size in the literature may not be directly applicable to these populations.

For many years, indigenous people in northwest Alaska hunted sheep opportunistically for subsistence purposes; these harvests have been presumably low. During the last 20 years, sheep in northwest Alaska have been increasingly sought by resident and nonresident recreational hunters as well as local subsistence hunters and harvests have increased.

In response to increased hunting pressure, the Department began monitoring sheep populations more intensively in the early 1980's, particularly in the Baird Mountains where much of the harvest occurs. Because access into these mountains is relatively easy, compared with other sheep ranges in northwest Alaska, staff remain concerned about potential overexploitation of that population. Continued monitoring of the Baird Mountain population is a high priority.

POPULATION OBJECTIVES

To maintain or increase, if feasible, the existing populations of Dall sheep in the Baird and DeLong Mountains; i.e., 800 and 1,100 sheep, respectively.

METHODS

Aerial surveys were conducted in cooperation with National Park Service (NPS) staff in the DeLong Mountains on 22 and 28 June and 11-12 July 1987 and in the Baird Mountains on 13, and 22-23 July. Limited ground counts were also conducted in the Baird and DeLong Mountains in conjunction with the aerial surveys.

Survey areas in the Baird and DeLong Mountains were established using available knowledge of sheep distribution and geographical landmarks easily recognized from the air. These areas ranged in

size from 13 to 43 mi^2 in the DeLong Mountains and from 27 to 115 mi^2 in the Baird Mountains. A Cessna 206 was used to rank survey areas into low-, medium-, or high-density strata prior to conducting the actual surveys. Three PA-18 Supercubs and one Arctic Tern were used to conduct the surveys. A helicopter was used when bands of sheep were determined to be too large to be accurately surveyed using fixed-wing aircraft. Ground counts were conducted in the DeLong Mountains on 8 and 11 July and in the Baird Mountains on 13 July by landing a helicopter near sheep bands and using spotting scopes to classify sheep into appropriate sex and age categories. Including pilots, 11 people were involved in the surveys.

As reported in previous years, harvest information was obtained through the statewide harvest ticket system, a permit registration hunt, and a special reporting system set up for the subsistence hunt. People hunting in the DeLong Mountains during August and September 1987 reported their harvest using 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 Fish and Game office. Individuals hunting sheep during the winter subsistence season used a specifically designated report card.

RESULTS AND DISCUSSION

Population Status and Trend

Sheep populations in both the Baird and DeLong Mountains appear to be stable; however, increased harvest in recent years, particularly in the Baird Mountains, may be cause for concern. Continued monitoring of population trend through harvest data analysis and aerial and ground surveys should remain a high priority.

Population Size:

Five hundred twenty-nine sheep were counted in 1080 mi^2 of the DeLong Mountains during July 1987, resulting in an estimated density of 0.49 sheep/mi^2. Survey personnel spent 37.2 hours counting sheep and the survey intensity ranged from 0.9 to 2.8 minutes/mi^2; however, much potential sheep habitat in the DeLong Mountains was not surveyed. Extrapolations accounting for the number of sheep in unsurveyed areas were necessary to derive an estimate of overall population size. To derive an upper estimate for that portion of the DeLong Mountains that had not been surveyed, the density estimate for the surveyed portion (0.49 sheep/mi^2) was applied to that area (965 mi^2), resulting in an estimate of 473 sheep. It is highly unlikely that sheep densities in the unsurveyed areas exceeded those in the surveyed areas. A density of 0.1 sheep/mi^2 was arbitrarily selected as a low density. Using this value resulted in an estimate of 96 sheep for the unsurveyed area. Adding these two figures to the minimum count of 529 sheep resulted in an extrapolated population estimate of 625 to 1,002 sheep. Singer and Johnson (1984) estimated that 908 sheep

occupied the Delong Mountains in 1983. There are no indications that the size of the sheep population there has changed significantly since 1983, and I believe that it currently numbers between 800 and 900 sheep.

During July 1987, 665 sheep were counted in 600 mi^2 of the Baird Mountains; the density was estimated at 1.11 sheep/mi^2. Twenty-three hours were spent surveying sheep in the Baird Mountains, and survey intensity ranged from 1.4 to 2.0 minutes/mi^2. In 1986, 669 sheep were counted in the same area (Table 1). Because most of the habitat believed to be used by sheep was surveyed in both years, no extrapolations were made to account for additional sheep in unsurveyed areas.

Population Composition:

Sex and age composition was determined from aircraft and additional composition surveys were conducted on the ground (Table 1). Of the 665 sheep counted from aircraft in the Baird Mountains, 143 (21%) were lambs. Similarly, 116 (22%) of the 529 sheep counted from aircraft in the DeLong Mountain were lambs.

Composition data obtained from aerial and ground surveys are not comparable, because it is not possible to reliably distinguish between young rams and ewes from the air. However, data obtained from ground counts in the Baird Mountains can be compared with ground counts made in the DeLong Mountains (Table 2). Despite the differences in sample sizes between the two areas, the sex and age ratios and percentage values are very similar. The only noticeable disparities are the percentages of lambs and legal rams among all rams. The difference of 6% in the percentage of lambs may not be significant; in any given area, 1 band of sheep may be composed predominantly of ewes and lambs (i.e., nursery band), while 1 or 2 miles away very few ewes or lambs may be found in another band. Another possible explanation for the difference is that the DeLong population, which is farther north than the Baird population, would experience more inclement weather and higher lamb mortality.

The lower percentage of legal rams among all rams observed in the Baird Mountain (i.e., 5%, compared with 7% for the DeLong Mountains) may again be an artifact of sampling, reflecting differences in the types of bands surveyed. However, the lower percentage from the Baird Mountains may also reflect differences in hunting pressure between the two areas. Because Baird Mountains afford hunters easier access than the DeLong Mountains, it receives more hunting pressure. Heavier hunting pressure and harvests relative to population size could measurably depress the percentage of legal rams observed.

In July and August 1986 ground surveys were conducted at Kilyaktalik Peaks in the Baird Mountains (Table 3). The ratio of yearlings:ewes was estimated at 37:100, compared with 23 yearlings:100 ewes in 1987 (Table 2). The ratio of 63 lambs:100 ewes observed in 1987 is higher than the 44 lambs:100 ewes observed

in 1986 and the 50 lambs:100 ewes observed in 1985. Because the 1987 estimated ratio of yearlings:ewes was only 23:100, half of the lambs born in 1986 may have died during their 1st year of life. This conclusion should be viewed as tentative, however, because the areas surveyed in 1987 were not identical to those surveyed in 1986. In addition, comparing the percentage of lambs in 1986 with that of yearlings in 1987 may not be completely valid, because survivorship among other cohorts and natality may not have been constant during the 2 years. Data obtained during surveys in 1988 will again be closely analyzed to determine what proportion of the 1987 cohort survived their 1st year.

Distribution and Movements

Surveys conducted in July 1987 indicate that sheep in Unit 23 may move long distances during short periods of time. On one occasion, a major change in density in a sample area was attributed to sheep movements. The sample area, which had originally been placed in the high-density stratum, was later found to contain no sheep. It was determined that in a period of a single day a number of sheep had moved into an adjacent area. Intensive surveys should be initiated immediately after completing stratification flights.

In an exercise to determine between-observer variability, 3 pilot-observer teams were asked to survey a count area in the Poktovik Mountains during a 3-day period. Total sheep counted by each of the 3 teams were 65, 77, and 79, and I believe little movement occurred. Search intensity varied from 102 to 130 minutes. Because of the questionable ability of one team to accurately determine the composition of sheep bands from the air, composition data were only compared between 2 of the 3 teams. Differences were minor; one group counted 54 ewes, the other 57. One group identified no legal rams, while the other identified one. Lamb counts were identical.

In a similar exercise, 2 teams were asked to survey a 37-mi^2 sample area in the DeLong Mountains. Total sheep counted by each team on 2 consecutive days was 31 and 19. One team counted 12 lambs, 15 ewes, 1 sublegal ram, and 3 legal rams, and the other team counted 7 lambs, 9 ewes, zero sublegal rams, and 2 legal rams. I believe that the discrepancy between the 2 data sets resulted from movements of sheep. Although movements undoubtedly occur in Units 23, distance and frequency are presently unclear.

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:

The reported harvest for the 1987 fall season was 37 rams. Nineteen rams were taken from the DeLong Mountains and 18 from the Baird Mountains (Table 4). Forty-eight registration permits were issued for hunting in the Baird Mountains during the fall, compared with 57 issued during the 1986 season (Table 5). Unlike 1986, however, good weather conditions prevailed during August 1987, and a larger proportion of the permittees actually hunted. As a result, the preseason quota of 17 rams was quickly filled and the season was closed by Emergency Order prior to the original 20 September closure. Average reported horn lengths of sheep taken in the Baird and DeLong Mountains were 34.3 inches (SD = 2.8, n = 13) and 34.8 inches (SD = 3.2, n = 19), respectively.

Fourteen sheep were reported taken during the 1986-87 either-sex subsistence season (Table 4). As in past years, most of the reported harvest (12) came from the Baird Mountains. I suspect that more sheep are taken each winter than are reported; however, the magnitude of the unreported harvest is unknown. Because the 1987-88 subsistence hunt is currently in progress, harvest data for that hunt will be presented in next year's survey-inventory progress report.

Hunter Residency and Success. Eighteen of the 48 registration permittees killed sheep in the Baird Mountains during the fall of 1987 (Table 5). Thirteen successful hunters were residents of Alaska who did not reside in Unit 23 and Subunit 26A, and seven of the 13 were from Nome. Only 3 and 2 sheep from the Baird Mountains were killed by local resident and nonresident hunters, respectively. Of the 19 individuals who reported harvesting a sheep in the Delong Mountains, 1 person resided in Unit 23 (Table 6). Nonresidents (13) accounted for most of the harvest.

Harvest Chronology. Although the fall season is 6 weeks long, most of the 1987 harvest occurred during the first week of the season (Table 7). Thirteen out of 17 sheep were taken from the Baird Mountains during the first week of the season.

Transport Methods. All hunters who reported killing sheep during fall 1987 used aircraft for access. Snowmobiles and dog teams were used to access hunting areas during the winter subsistence hunt; use of aircraft was not permitted during this hunt.

Natural Mortality:

Wolf and brown bear are common in Units 23 and 26A; however, the rate of predation on sheep is unknown. During July 1987 a recently deceased lamb was found near the DeLong Mountains; the cause of death could not be determined.

Game Board Actions and Emergency Orders

Prior to 1970, subsistence and sport harvests were low in northwestern Alaska. In 1972 enactment of the Marine Mammals Protection Act caused hunters staging in Kotzebue to hunt polar bear to redirect their efforts towards sheep. Twenty-six sheep were reported taken in that year from Unit 23 (Table 4). Between 1973 and 1978 the reported harvest in Unit 23 increased from 13 to 35 sheep. Beginning in 1979 the state-wide bag limit was changed from 1 ram with 3/4-curl or larger horns to 1 ram with 7/8-curl or larger horns. Possibly as a result of this regulatory change, the reported harvests in 1979 and 1980 dropped to 25 and 16 sheep respectively.

In 1982 the Board of Game created a subsistence registration permit hunt, allowing the harvest of 1 sheep of either sex between 1 August and 30 April. Permit holders were required to reside north and west of the Noatak River. Although a quota of 50 animals was established for this hunt, only 9 sheep were reported taken (Table 4). Beginning with the 1984-85 season, the Board reduced the registration permit quota to 30 sheep but retained the 1 August to 30 April season. For the 1985-86 season, the Board increased the quota to 40 sheep, changed the season to extend from 1 October to 30 April, and opened the hunt to all Alaska residents.

Because aerial surveys conducted in July 1985 indicated that sheep numbers in the Baird Mountains were possibly declining, staff worked cooperatively with the Kotzebue Fish and Game Advisory Committee to design harvest regulations that would limit the harvest of sheep there. We believed that relatively easy access into the Baird Mountains could potentially lead to overexploitation of that sheep population. The DeLong Mountains, on the other hand, were considered more difficult to hunt and the sheep population appeared to be healthy. Therefore, no additional restrictions were proposed for that area.

The Board established an overall harvest quota of 40 sheep in the Baird Mountains for the 1986-87 season. The winter subsistence season will be closed by Emergency Order prior to the 30 April closure when 30 sheep are taken there. Only residents of Unit 23 were allowed to participate in the subsistence hunt, and aircraft use was prohibited. Furthermore, a registration permit hunt was set up for the fall season in the Baird Mountains; the quota was 10 rams. If the number of rams taken from the Baird Mountains during the previous winter is less than 15, the difference will be added to the fall quota of 10 rams. The quota was 21 rams for the fall of 1986 and 17 rams for the fall of 1987. The fall season in

the Baird Mountains will also be closed by Emergency Order if the quota is reached prior to 20 September. An Emergency Order was not necessary for the fall of 1986, but one was issued for the fall of 1987. No additional restrictions were established for the DeLong Mountains. These regulations remained unchanged during 1987-88.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Unit 23 and Subunit 26A appears productive and stable. However, as hunting pressure increases, harvest and survey data must be closely scrutinized to identify trends in the population.

The overall harvest quota should remain at 40 sheep per year for the Baird Mountains. The fall registration permit system, along with a ram harvest quota, should be retained as well. No regulation changes are proposed at this time.

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

Sex-age class	Number, percentages and ratios of sheep	
	1986	1987
Legal rams[a]	47	50
Sublegal rams	98	64
Unclassified rams	0	2
Total rams	145	116
Ewes[b]	416	393
Lambs	105	143
Unidentified	3	13
Total Sheep	669	665
Legal rams:100 ewes	11	13
Sublegal rams:100 ewes	24	16
Total rams:100 ewes	35	29
Lamb:100 ewes	25	36
Lamb % of total	16	21
Legal rams % of all sheep older than lambs	8	10
Legal rams % of all sheep	7	7
Legal rams % of all rams	32	43
Ram % of total sheep	22	17

[a] 7/8-curl or larger.
[b] Ewe classification also includes yearlings of both sexes and rams having 1/4-curl or less horns.

Table 2. Dall sheep composition data obtained from ground surveys in Unit 23, July 1987.

Sex/age class	Area			
	Wulik Peaks[a]	DeLong Mtns.	DeLong (total)	Baird Mtns.
1/4-curl rams	1	3	4	22
1/2-curl rams	4	0	4	22
3/4-curl rams	6	0	6	20
7/8-curl rams	1	2	3	11
4/4-curl rams	1	1	2	4
Total rams	13	6	19	79
Ewes	18	8	26	113
Yearlings	3	4	7	26
Unclassified yearling/ewes	0	10	10	12
Lambs	7	7	14	71
Total sheep	41	35	76	301
Legal rams[b]:100 ewes	11	37	19	13
Sublegal rams:100 ewes	61	37	54	57
Total rams:100 ewes	72	75	73	70
Lambs:100 ewes	39	87	54	63
Yearlings:100 ewes	17	50	27	23
Lamb % of total sheep	17	20	18	24
Yearling % of total sheep	7	11	9	9
Legal rams % of all sheep older than lambs	6	11	8	6
Legal rams % of all sheep	5	9	7	5
Legal rams % of all rams	15	50	26	19
Ram % of total sheep	32	17	25	26

[a] Part of DeLong Mountains.
[b] 7/8 curl or larger.

Table 3. Dall Sheep sex and age composition data obtained from ground surveys at Kilyaktalik Peaks, 30-31 July and 1 August 1986.

Sex/age class	Number, percentages, or ratios of sheep
Total sheep	159
Lamb	31
Yearling	26
Ewe	70
Unclassified ewe/yearling	2
Total rams	30
1/4-curl ram	16
1/2-curl ram	6
3/4-curl ram	4
7/8-curl ram	3
4/4-curl ram	1
Lambs:100 ewes	44
Yearlings:100 ewes	37
Lamb % of total sheep	19
Yearling % of total sheep	16
3/4-curl ram % of total rams	13
7/8-curl ram % of total rams	10
4/4-curl ram % of total rams	3

Table 4. Summary of Dall Sheep harvest statistics (i.e, R = rams, E = ewes, L= lambs, and U = unknown) for Unit 23, 1970-1987.

Year	General hunt (Rams only)			Winter hunt												Total harvest (min)
				Bairds				DeLongs				Unknown				
	Bairds	DeLongs	Unk.	R	E	L	U	R	E	L	U	R	E	L	U	
1970	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	17
1971	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	16
1971[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	--	--	--	--	--	--	--	--	30
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[e]	18	19	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 ongoing.

Table 5. Hunter residency and success in Baird Mountain registration permit hunt, Unit 23, fall of 1987.

Residency of hunter	No. of permits issued	Successful	Unsuccessful	Did not hunt
Local unit resident	20	3	8	9
Nonlocal Alaska resident	22	13	7	2
Nonresident	6	2	1	2
Total	48	18	16	13

Table 6. Hunter residency and success in DeLong Mountains, Unit 23, fall of 1987.

Residency of hunter	Successful	Unsuccessful
Unit 23 resident	1	0
Nonlocal Alaska resident	3	6
Nonresident	13	1
Unknown	2	0
Total	19	7

Table 7. Chronology of sheep harvest in Unit 23, fall 1987.

Week of season	Total harvest	Area	
		Baird Mtns.[a]	DeLong Mtns.
Aug 10-15	21	13	8
Aug 16-22	2	0	2
Aug 23-29	4	2	2
Aug 30-Sept 5	7	2[b]	5
Sept 6-12	0	-	0
Sept 13-20	2	-	2
Unknown	1	1	0

[a] Date of harvest unknown for 1 sheep.
[b] Season closed by Emergency Order.

STUDY AREA

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

GEOGRAPHICAL DESCRIPTION: Eastern Brooks Range

BACKGROUND

Both the Alaska Board of Game and the Alaska National Interest Lands Conservation Act (ANILCA) have recognized subsistence use of Dall sheep as a component of human use in selected areas of the eastern Brooks Range; for the residents of Kaktovik and Arctic Village, it is the highest priority. There are also abundant opportunities for diversified recreational uses. The primary nonconsumptive-use objective in Atigun Canyon is viewing and photography.

With the exception of a period of reported scarcity at the turn of the century (Campbell 1974), Dall sheep have been relatively abundant in the Brooks Range. Aerial surveys and observations of guides, hunters, and biologists over the past 2 decades indicate that populations have remained stable. There are indications that populations in the eastern Brooks Range may be at the highest level ever recorded; i.e., 15,000 Dall sheep.

Human use of Dall sheep in the eastern Brooks Range has increased steadily over the last 20 years, because of increasing human populations and better access to sheep habitats. Subsistence hunting of Dall sheep increased with establishment and growth of a permanent village at Kaktovik in the 1950's. Access from Kaktovik also increased when dependable snow machines replaced dog teams and small aircraft became available as transportation to traditional hunting sites.

Similarly, recreational hunting increased proportionately with increases in the general population of Alaska as well as in technology, primarily in light aircraft, that allowed those who did not live in the Brooks Range to hunt there. Human interest in recreational hunting eventually led to establishment of the Arctic National Wildlife Range in 1959.

When oil was discovered on the Arctic Slope, further increases in human population and technology occurred because of development of the Trans-Alaska Pipeline, which has profoundly affected Dall sheep management in the eastern Brooks Range (Heimer 1978, 1980, 1985). There is now a complex pattern of land ownership and use that influences sheep management in the eastern Brooks Range: (1) Dalton Highway, (2) national park, (3) park preserve, (4) state and federal land, and (5) national wildlife refuge (i.e., formerly the Arctic National Wildlife Range).

Access to sheep populations in eastern Unit 24 and Subunit 26B improved dramatically when the Dalton Highway (i.e., from the Yukon River to Prudhoe Bay) was constructed. Public use was initially prohibited, but commercial users were able to obtain permits to use the highway as early as 1978. Some hunters used it for sheep hunting access during that period. Beginning in 1981, the highway was opened for public use as far north as Dietrich Camp on the south slope of the eastern Brooks Range in eastern Unit 24. Commercial permits are still required for those who use the highway beyond that point. If sheep hunters had been prohibited from traveling beyond the public-use portion of the Dalton Highway, it would be of little use to them. However, some hunters developed a variety of commercial reasons to use the road and thereby circumvent the law. Hunter use of the sheep resources along the Dalton Highway has increased, but the viability of sheep populations has probably not been jeopardized by this use because the harvest is limited to older males.

Several environmental, business, and political concerns attended construction of the Dalton Highway and the pipeline. These concerns resulted in an array of restrictive regulations applying to the Dalton Highway Corridor Management Area (i.e., land lying within 5 miles of either side of the Dalton Highway): hunting is prohibited, except big game and small game may be taken by bow and arrow and no motorized vehicles, except aircraft, boats, and licensed highway vehicles may be used for hunting or transporting hunting equipment or game within the management area. These restrictions have furthered the viewing and photography objectives for the Atigun Canyon. They have also limited harvests within the pipeline corridor while allowing more hunters to use the eastern Brooks Range; however, they have had little impact on aesthetic hunting conditions there.

MANAGEMENT OBJECTIVES

To sustain a population of approximately 13,000 Dall sheep.

To continuously provide the opportunity for subsistence users to harvest up to 50 sheep per year from Subunits 25A and 26C.

To perpetually provide the opportunity to harvest legal rams under aesthetically pleasing hunting conditions.

To maintain a mean horn length exceeding 34 inches and a mean age of more than 8 years among harvested sheep.

To maintain a hunter harvest success of at least 40%.

METHODS

The only surveys completed during the current year were on-ground composition counts in Atigun Gorge in western Subunit 26B. They were conducted by Mike Hansen with the Alaska Cooperative Wildlife Research Unit as part of his doctoral-thesis research. 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 is about 13,000 (Heimer 1985). The total population may have increased since that time. Repeated aerial surveys of the Hulahula River, a densely populated drainage in Subunit 26C, indicated the possibility of an upward trend (Table 1).

While there is an obvious upward trend in the total number of sheep observed, it is important to note that the greater survey efficiency of Super Cub aircraft used after 1976 and failure to classify large groups of sheep in 1979 tend to emphasize the appearance of that upward trend. Also, the time spent searching for sheep in 1986 was more than twice that of any of the other 3 surveys. Although this factor should have contributed to a greater number of sheep observed, the low lamb:100 "ewes" (Heimer and Watson 1986) ratio for 1986 (i.e., 20:100) did not indicate an increase in total sheep. Heimer (1983) attempted to standardize the variability introduced by differing aircraft types, classification procedures, and survey efficiencies during the 1976, 1979, and 1982 surveys and estimated a sheep population of approximately 2,700 in the Hulahula River.

The actual sighting of almost 3,200 sheep in 1986 seemingly guarantees a population of at least that size. If the earlier estimate of 2,700 in 1982 was realistic, the population would have experienced a 19% increase in 4 years. Because the lamb production in 1982 and 1986 was low, recruitment to the population in 1983, 1984, 1985, and 1986 would have to have been spectacular for the apparent population growth rate to have occurred. However, low adult mortality, particularly in the upper age classes, could have coupled with reasonably high recruitment to produce the observed increase; and if this combination produced the increase in population, conditions must have been unusually favorable in terms of weather and predation. Watson and Heimer (1984) have shown that the transient increases in total sheep numbers arising from these conditions are followed by a decline.

The population in the Hulahula River did not decline during the early and mid-1980's. Also, a downward adjustment in total sheep numbers or a stabilization of the upward trend should be expected with changes in conditions (i.e., weather, predation) affecting survival of adults, particularly old sheep.

Population Composition:

Unfortunately, population composition data that would facilitate interpretation of the Hulahula River population trend are not available; however, on-ground classification counts were conducted

in the Atigun Gorge area from 1986 through 1988. The lamb:ewes ratios for 1987 and 1988 were 50:100 and 58:100, respectively. Lamb production among 5 radio-marked ewes was three in 1988.

Distribution and Movements:

The highest densities of sheep are found in Subunit 26B within the Itkillik, Atigun, and Marsh Fork drainages and in Subunit 26C within the Canning, Hulahula, and upper Kongakut Rivers. Densities are lower in eastern Unit 24 and in Subunit 25A. Within Subunit 25A, the most highly populated area is the North Fork Chandalar River.

Very little is known about sheep movements, with the exception of the Atigun River population; M. Hansen (pers. commun.) found that sheep collared within Atigun Gorge generally wintered and lambed north of the gorge, moving south across the Atigun River to higher elevations during summer. The most extreme movements, in terms of elevational change and linear distance, were made by mature rams.

Mortality

Seasons and Bag Limits:

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

Human-induced Mortality:

Harvest of sheep has steadily increased over the past 5 years (Table 2). The most notable increases have occurred in Subunit 26B, where the Dalton Highway allows hunters walking access to 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 the aircraft and maintain base camps at many of these sites.

Harvests over the last 5 years have increased from 22 to 51 sheep in areas adjacent to the Dalton Highway (Table 3). These totals include all harvests from land adjacent to the Dalton Highway in eastern Unit 24 and Subunit 26B. The harvests from those portions of Subunit 26B that are not adjacent to the highway have risen from 16 to 57 animals.

Clearly, restrictions on recreational use of the Dalton Highway have not prevented an increase in the harvest. Enforcement of the highway-use regulations is sporadic, and numerous legal loopholes are available. Only 1 Fish and Wildlife Protection Officer is assigned to the entire eastern Brooks Range. The permit check station at Chandalar Shelf is not continuously manned, and no physical barrier is in place to force travelers to stop. Hunters

can also 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, 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 and have failed to stabilize harvest at pre-1981 levels.

Away from the Dalton Highway, increasing numbers of hunters may be causing crowding around larger and better known aircraft landing sites. Although concentration of hunters at these landing sites probably represents the most extreme case, it illustrates a potential problem that was emphasized by reports of crowding from transporters, guides, and outfitters and concerns of the Arctic National Wildlife Refuge (ANWR) staff. Few complaints were received directly from hunters.

In spite of increasing harvests, the horn sizes and ages of harvested rams show stable trends for the past 5 years. During this time, the mean horn length has averaged more than 34 inches in all areas, except along the Dalton Highway where it fell to 33.2 inches during 1983 and 1984. Horn length averaged 33.6 inches during 1987 (Table 3). Average circumference of the horn base was above 12.4 inches during all years. Mean age was consistently above 8 years of age.

No subsistence harvest of sheep was reported through the established harvest reporting system during the current year; however, a muskoxen hunter who spent several days in Kaktovik estimated that as many as 60 sheep may have been taken by local hunters in the Hulahula River. From 1979 through 1986, this subsistence harvest was regulated by registration permit, and the reported take varied from 12 to 30 animals. Hunters from both Arctic Village and Kaktovik have participated.

Hunter Residency and Success. Most sheep hunters using the eastern Brooks Range were Alaska residents (Table 2). During the reporting period, 30% of those hunters lived outside Alaska; the remaining 70% were Alaska residents, although none lived in the eastern Brooks Range. Similar percentages of nonresident hunters have been reported over the last 5 years. The trend is stable.

During the reporting period, hunter success varied from 56% along the Dalton Highway to 74% in Subunit 26C (Table 4). This pattern has persisted over the past 5 years, and the only aberration has been the unusually high success of 56% along the Dalton Highway. During each of the previous 4 years, success along the highway has ranged from 38% to 40%.

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). During this reporting period, 80% of the harvest occured during this period.

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).

Natural Mortality:

The only natural mortality data available were collected from Atigun Gorge in Subunit 26B (M. Hansen, pers. commun.), where there was 1 natural mortality among the 6 radio-marked sheep; the cause was unknown. Winter weather was relatively warm and mild, causing less-than-normal mortality.

Game Board Actions and Emergency Orders

The only change in regulations over the past 5 years occurred during this reporting period. The subsistence hunt was changed from a registration permit hunt with a quota of 50 sheep to a general hunt with no quotas. No changes were made to the length of the season, timing, or bag limit. Subsistence harvest estimates varied from 12 to 30 animals. While some sheep were undoubtedly taken and not reported, it is unlikely that the total number harvested by subsistence hunters had a significant impact on the population.

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 a 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 rams. The exception is along the Dalton Highway, where horn sizes have averaged slightly lower than the 34 inches specified in the management objectives during the last 5 years.

The smaller horn size reported from along the Dalton Highway is not a major management problem. It is above the legal minimum length, and it could be a result of hunters 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 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 sizes have not occurred consistently. If decreasing horn sizes become a consistent occurrence and other objectives are not being 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. We recommend that the enforcement effort along the highway be increased. This will be difficult for Division of Fish and Wildlife Protection staff, given recent funding cuts; however, both the Bureau of Land Management and U.S. Fish and Wildlife Service have expressed willingness to increase their enforcement efforts on lands under their jurisdiction.

Hunter crowding, both along the Dalton Highway and at aircraft landing areas in Subunits 26B and 26C, is a source of concern. We must determine the density of hunters that is compatible with the management objective of providing aesthetically pleasing sheep hunting. Once this has been determined, specific user concentration objectives should be formulated to serve as a guide for management decision making. We recommend a hunter survey be conducted in cooperation with U.S. Fish and Wildlife Service (USFWS) to find whether crowding is negatively affecting the hunters as greatly as it seems to be affecting guides, outfitters, transporters, and the ANWR staff.

The total lack of harvest reporting by subsistence hunters is also a problem. The either-sex harvest by Kaktovik residents on the Hulahula River and by Arctic Village residents on the East Fork Chandalar River could negatively impact local sheep populations if it increases significantly. We recommend that Native councils in both villages be contacted and invited to participate in workshops to develop solutions that are compatible with local lifestyles.

Collection of additional information on population status and trend is essential. Annual ground composition counts should be conducted in Atigun Gorge and in the Hulahula River in cooperation with USFWS. Also, ADF&G should support USFWS efforts to develop survey methodology by making staff expertise available.

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Table 1. Total sheep observed during aerial surveys of the Hulahula River, Brooks Range, Alaska, 1976-86.

Year	No. Sheep	Survey time (hrs)	Aircraft type
1976	1,746	19.0	Helio Courier
1979	1,982	14.0	Super Cub
1982	2,186	20.8	Super Cub
1986	3,196	36.3	Super Cub

Table 2. Hunter residency and success in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1983-87.

Year	Successful hunters					Unsuccessful hunters				
	Local resident[a]	Nonlocal resident	Non-resident	Un-specified	Total	Local resident[a]	Nonlocal resident	Non-resident	Un-specified	Total
1983	1	81	46	4	132	1	88	17	5	111
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

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

Table 3. Mean horn size and age in the harvest from eastern Unit 24 and Subunits 25A, 26B, and 26C, 1983-87.

Year	Area	Average length	Average base circumference	Average age	Harvest
1983	Subunit 25A	35.9	13.1	9	32
	Subunit 26B (remainder)[a]	35.5	13.1	--	16
	Subunit 26C	34.1	12.9	9	62
	Dalton Highway[b]	33.2	12.4	--	22
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

[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. Hunter success in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1983-87.

Area	Percent success				
	1983	1984	1985	1986	1987
Subunit 25A	49	57	62	56	65
Subunit 26B (remainder)[a]	55	71	64	67	71
Subunit 26C	67	73	76	70	74
Dalton Highway[b]	39	40	38	40	56

[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. Harvest chronology in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1983-85 and 1987.

Year	August					September					October					Unk
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
1983[a]	0	50	25	24	--	10	3	4	4	--	2	0	0	0	0	2
1984	2	20	66	26	28	11	6	3	1	--	0	0	0	0	0	3
1985	0	17	74	43	32	13	9	2	1	--	2	0	0	0	0	2
1987	0	0	110	56	53	20	20	4	4	--	0	0	1	0	0	6

[a] Dalton Highway in Unit 24 not included.

Table 6. Successful hunter transport methods in eastern Unit 24 and Subunits 25A, 26B, and 26C, 1983-87.

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snow machine	ORV	Highway vehicle	Unk
1983	106	8	2	0	0	2	14	0
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

STUDY AREA

GAME MANAGEMENT UNIT: 24 (24,150 mi²)

GEOGRAPHICAL DESCRIPTION: Koyukuk River drainage above Dulbi River (the Brooks Range within Gates of the Arctic National Park)

BACKGROUND

For most game species in Alaska, the subsistence priority law mandates subsistence use as the highest priority when harvesting is allowable. The subsistence priority on both state and federal lands was established during settlement of the Alaska national interest lands debate, following the discovery of oil on Alaska's north slope (Heimer 1982, 1986). Subsistence is the only consumptive human use permitted in the national parks that were created by resolution of the Alaska lands controversy. Gates of the Arctic Park is one of these newly created parks. So, while diversified human recreation is the predominant use of Dall sheep in Alaska, subsistence is the congressionally mandated use in the national parks.

In those portions of Unit 24 that are outside Gates of the Arctic National Park, recreational use is the management goal; ADF&G recognizes both consumptive (e.g., hunting) and nonconsumptive uses (e.g., viewing and photography). Providing the opportunity to hunt Dall sheep under aesthetically pleasing conditions is the present consumptive use objective in those portions of Unit 24 that are outside the park, including the park preserve.

Management of sheep in the area has evolved from no regulations to the present restrictive regulations involving sex, horn size, seasons, and reporting requirements. As regulations evolved, so did differing standards of regulation enforcement. Recreational hunters were forced to comply with the restrictive seasons and bag limit regulations, while the activities of subsistence hunters were ignored. Before creation of the park in 1981, there were no regulatory provisions for subsistence hunting of sheep based on past customary and traditional use criteria.

Prior to 1981 the area was open to recreational hunting and the average harvest was 50 rams each year. During negotiation of the boundaries for Gates of the Arctic Park, the distribution of Dall sheep within the Brooks Range was a major consideration. Consequently, the park includes 99% of the sheep within Unit 24 west of the Dalton Highway.

Recreational sheep hunting within the park is now prohibited, but qualified subsistence hunting is allowed. Recreational hunting in the John and Wild River systems south of the park boundary falls under the general hunting seasons and regulations; i.e., a bag limit of 1 ram having at least 7/8-curl horns. Both rivers have

a harvest of less than 1 or 2 sheep per year, and the hunted population mainly resides within the park. Sheep populations in Unit 24 are assumed to be stable or slowly increasing; the annual harvests total less than 40 sheep per year.

The Dall sheep population throughout the Brooks Range is estimated at 30,000. The Gates of the Arctic National Park population in Units 23, 24, and 26 is estimated at 12,000 sheep (Heimer 1985).

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 harvest of 50 sheep.

To maintain or increase the sheep population in Unit 24.

METHODS

The subsistence harvest was monitored through a registration hunt authorized by the Board of Game. The recreational harvest was monitored using hunter harvest reports. Aerial population estimates were conducted in prior years by the National Park Service (NPS) and ADF&G using fixed-wing aircraft (i.e., Super Cub and Helio Courier) and helicopters. Helicopters were used for both aerial and ground composition surveys.

RESULTS AND DISCUSSION

Population Status and Trend

Human harvest has probably not been a significant source of mortality in recent years. Sheep population sizes increased between 1982 and 1984 in the northcentral park area and between 1974 and 1982 in the central park area and the Noatak drainage (Singer 1984). Wolf predation may be increasing, because the number of trappers allowed to take wolves within the park has decreased.

Population Size:

Extensive surveys were conducted in 1974, 1976, 1982, and 1984 by ADF&G and NPS (Singer 1984). Unit 24 was divided into 18 survey blocks. The blocks were based on mountain systems, so some overlapped into adjacent units; 4,417 sheep were counted in those blocks (Table 1). No recent surveys have been conducted in the area.

Population Composition:

Singer (1984) conducted composition surveys: 15% lambs, 8% yearlings, 51% ewes, 23% rams, and 3% unclassified.

Mortality

Season and Bag Limit:

Only qualified subsistence zone residents (i.e., residents of Anaktuvuk Pass, Bettles/Evansville, Wiseman, Alatna, Allakaket, Ambler, Hughes, Kobuk, Nuiqsut, and Shungnak) are allowed to participate in the subsistence hunt. In those portions of Unit 24 and Subunit 26A within Gates of the Arctic National Park the season is 1 August to 30 April. The bag limit is 3 sheep. Harvest is limited by registration permit and a quota of 50 sheep. In the remainder of Unit 24 the open season for subsistence, resident, and nonresident hunters is 10 August to 20 September. The bag limit is one 7/8-curl ram.

Human-induced Mortality:

From 1982 to 1987 the subsistence harvest within Gates of the Arctic National Park has been between 25 and 30 sheep. Most of these sheep have been rams or adults (Table 2). Approximately 25 sheep are harvested by Anaktuvuk Pass residents and 1 to 5 sheep by residents from the other 9 eligible villages. The harvest has never exceeded the quota of 50 sheep. In the lower John and Wild Rivers, 1 or 2 sheep are taken by recreational hunters each year.

In April 1988 I went to Anaktuvuk Pass and conducted a door-to-door harvest survey of all the people who received registration permits in 1987. Most residents do not set out solely to hunt sheep; rather, they also hunt caribou, fish, or trap. Most people get permits so they can legally take sheep if the opportunity occurs.

Sheep are hunted in Subunit 26A north of the Anaktuvuk River, on Contact Creek west of the community and in the Chandler Lake area. In Unit 24 sheep are taken on the John River and its tributaries (i.e., Kollutarak, Ekokpuk, and Inukpasugruk Creeks). Occasionally during the trapping season, 1 or 2 unreported sheep may be taken and used for trapping bait.

There is some concern among resource managers because harvests by Anaktuvuk Pass residents are concentrated along travel corridors. While it may be true that any sheep that are found along river bottoms will be killed, present-day hunting techniques using mechanical transport and short hunting stalks generally preclude taking sheep more than 1 mile off the corridor. Under these conditions, the subsistence harvest does not appear to threaten the sheep populations.

There are 6 survey blocks in Units 24 and 26. These areas supply 99% of the sheep harvested by Anaktuvuk Pass residents. Singer (1984) found 2,693 sheep in these blocks. The annual harvest of 30 sheep represents a harvest rate of 1.1%. If confined primarily to rams, this harvest should be well below the sustainable rate.

In addition to the Anaktuvuk Pass survey, I sent harvest survey letters to permit holders in Wiseman and Bettles/Evansville. Bettles residents use the permits to document subsistence activities within the park, but very few of the people actually hunted sheep. In Wiseman, only full-curl rams are taken by residents, who walk into the park in the fall. Residents of Allakaket and Alatna have an interest in hunting sheep, but Alatna River conditions seldom allow boat access to the sheep hunting areas. Only 2 sheep have been taken in the past 5 years; one of those was harvested in the John River area. Ambler, Kobuk, and Shungnak residents all hunt within Unit 23 and were not contacted by me. Residents of Hughes and Nuiqsut are in the designated subsistence zone; however, access to sheep hunting areas is virtually impossible without using aircraft, which is prohibited by the NPS.

Hunter Residency and Success. All hunters reside in the designated subsistence zone villages. Most live in Anaktuvuk Pass.

Harvest Chronology. Hunting occurs when sheep are in the best condition (i.e., August to December). Although residents prefer to have the season open until April to provide emergency food in case they have snow-machine trouble, sheep are too thin to be actively hunted as food after December.

Permit Hunts. Because of confusion within the Department, no specific responsibility for management of the registration permit hunt was assigned; thus the issuance, collection, and analysis of permits have not occurred systematically since creation of the hunt in 1982. Because there are no Department personnel living in or near the park, the registration permits are issued by vendors and agents. I contacted all Department personnel who may have had access to the harvest data. I tried to summarize it (Table 2), but unfortunately, most of the permits and overlays have been lost.

Transport Methods. Residents of Anaktuvuk Pass used Argos, a type of ATV, until snowfall. After snowfall, snow machines were used for transportation. Because NPS regulations severely restrict the use of all-terrain vehicles, many of the better sheep hunting areas are not accessible before snowfall.

Natural Mortality:

Wolves are the main predator on sheep within the park (R. Stephenson, ADF&G biologist, pers. commun.). The area has approximately 130 wolves in 10-12 packs. There is currently a joint NPS-ADF&G study on wolf that should help calculate predation

rates. Also, there were less caribou than normal in the Brooks Range near Anaktuvuk Pass during the winter of 1987-88. During late October 1988 sheep were forced to lower elevations by shoulder-high snows. In the Tinayguk River area, I observed a wolverine feeding on a half-curl ram that it had apparently killed.

Game Board Actions and Emergency Orders

Prior to the 1981 hunting season, the sheep season was from 10 August to 20 September; the bag limit was one 3/4-curl ram until 1979, when it was changed to one 7/8-curl ram. After Gates of the Arctic National Park was created in 1980, the residents of Anaktuvuk Pass asked for a special season to recognize subsistence hunting of sheep. The Game Board then established the registration permit hunt and a harvest quota of 50 sheep for residents of the park. That regulation was in effect until the 1984-85 regulatory year, when the hunt was extended to include residents of all the villages in the designated subsistence zone.

CONCLUSIONS AND RECOMMENDATIONS

The primary NPS objective for Gates of the Arctic National Park is to provide for the recreational use of sheep through observation and photography. The Alaska National Interest Lands Conservation Act recognizes subsistence hunting of Dall sheep as well. The subsistence sheep hunt provides a maximum harvest of 50 sheep annually for qualified subsistence hunters. Elsewhere in the unit the objective is to provide hunting for sheep under aesthetically pleasing conditions. Based on sustainable harvest rates of 1.5-2.5% elsewhere in Interior Alaska, the estimated annual harvest of 30 sheep from the park is well below the sustainable harvest.

To ensure that future harvest information is accurate and current, I plan to change the registration harvest report card to a questionnaire letter. This letter will be sent to all permit holders. Since the whole registration permit process is expensive and the current harvest does not warrant the in-season monitoring of a permit, I recommend that the current system be changed to a less-expensive system instituted in cooperation with NPS.

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Table 1. Dall sheep counts in Unit 24, Gates of the Arctic National Park (Singer 1984).

Count unit	Mountain	Year	No. sheep
1	Nunamiut	1982	462
2	MacVicar	1982	216
5	Ursus-Cairn	1982	204
6	Kollutuk	1982	501
7	Sillyasheen	1982	169
8	St. Louis	1982	255
9b	Grey	1982	201
10	Frigid Craigs	1974	202
11	Ipnek	1974	118
12	Emma Dome	1974	130
13	Jesse	1983	507
14	Foggytop	1974	126
15	Doonerak	1983	349
16	Redstar	1982	534
19	Dalimaloak	1983	229
20	Nahtuk	1983	63
21	Arrigetch	1983	0
123	Survey Pass	1983	151

Table 2. Gates of the Arctic National Park sheep harvest and hunter residency, 1982-87.

Activity	1982	1983	1984	1985	1986	1987
Permits issued	49	No data	41	16	16	41
Permits returned	15	--	6	5	4	2
Successful hunters	14	--	2	1	1	12[a]
Permits issued by village:						
Anaktuvuk	49	No data	26	1	5	30
Bettles	0	--	10	6	9	5
Allakaket	0	--	2	2	0	1
Wiseman	0	--	3	4	2	5
Sex composition:						
males	18	--	4	2	1	22
females	7	--	--	--	--	3
lambs	1	--	--	--	--	--
Totals	26	?	4	2	1	25

[a] Number of sheep taken are based on verbal survey, not returned permits.

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