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DALL SHEEP

Mary V. Hicks, Editor

Grants W-24-4, W-24-5, and W-27-1
Study 6.0
December 1999

STATE OF ALASKA
Tony Knowles, Governor

DEPARTMENT OF FISH AND GAME
Frank Rue, Commissioner

DIVISION OF WILDLIFE CONSERVATION
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LOCATION

GAME MANAGEMENT UNIT: 7 And 15 (8,397 mi^2)

GEOGRAPHICAL DESCRIPTION: Kenai Mountains

BACKGROUND

U.S. Fish and Wildlife Service (USFWS) reports indicate aerial sheep surveys were initiated on the Refuge portion of the Kenai Mountains in 1949. Records after statehood (ADF&G and FWS files) show the Kenai Mountains sheep population steadily increased from 1949 to 1968, before sharply declining until 1977 and 1978, when the lowest counts were recorded.

Since the late 1970s the sheep population has been rebuilding from its previous low levels; the controlling factors were effects of weather and habitat. Although not significant factors, predation, regulated hunting, natural and disease-related mortalities have also controlled the size of the sheep population in the Kenai Mountains.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

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

METHODS

Biologists used a Piper PA-18, flown at 200–400 ft elevation (AGL), to count, sex, and age sheep during the summer in selected count areas of the Kenai Mountains sheep habitat. In addition, 3 trend areas (855, 856, and 857) are counted on a yearly basis when possible. Surveys were generally conducted during early morning or late evening hours to avoid increasing midday sun glare and turbulence. Sheep were classified into categories of lambs, sublegal rams (7/8-curl or less), legal rams (full-curl or larger) and unidentified sheep. The unidentified sheep category was comprised primarily of ewes and a low number of yearling and 2-year-old rams. In addition to counting selected count areas and Round Mountain, 3 count areas from Skilak Glacier to Fox River were designated in 1987 to be used as areas to assess trend of the sheep population.

In addition to standard surveys, a census of all known sheep range was conducted during the summer of 1992. This census was designed to evaluate 3 different survey methods to determine which method provided the highest level of precision, safest flying conditions, and was most economic (Loranger and Spraker 1994). This project was a cooperative effort between the U.S. Fish and Wildlife Service and the department.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We counted 1508 sheep in the summer of 1992, the first complete Kenai Mountains survey since 1968. Assuming an observation rate of 85 percent, the 1992 summer population size was

between 1508 and 1774 animals. This estimate included 135 sheep in the Unit 7 Cooper Landing Closed Area. This population has not reached the size found in 1968 (2200 to 2500); however, it has increased steadily, following the sharp population decline during the early 1970s due to overpopulation and severe winters.

Population Size

Between the years 1993 and 1997, a mean of 698 sheep or 47 percent of the minimum population (1500) were classified annually (Table 1).

In 1996–1997 sheep surveys were completed in 5 of 12 count areas, including Round Mountain, and 547 sheep were classified (Table 1). Surveys were not completed in the trend areas (Table 2). In 1997–98 sheep surveys were completed in 4 count areas, including Round Mountain, and 784 sheep were classified. The three trend areas were counted in 1997–1998, resulting in the classification of 644 sheep. The Round Mountain trend count area (Table 3) was counted from 1993 to 1997. Results of these counts indicated a declining count from 1993 followed by a 36 percent increase in 1997. The increase in 1997 may have resulted from a shift in sheep distribution rather than an actual increase in population size.

Population Composition

Aerial surveys from 1995–1996 to 1997–1998 resulted in 558, 547 and 784 sheep classified, respectively (Table 1). The 1997–1998 data was the highest count during this reporting period. We classified 784 sheep, comprised of 20 (3%) legal rams (full-curl or larger), 127 (16%) sublegal rams, 151 (19%) lambs, and 486 (62%) ewes, yearlings, and 2-year-old rams.

Distribution and Movements

Sheep were throughout the central portion of the Kenai Mountains, north of Sheep Creek in Unit 15 and north of Snow River in Unit 7. The highest density of sheep was on Round Mountain in Subunit 15A.

The count area containing the highest number of sheep (523) was between Killey Glacier and Tustumena Glacier. This area has traditionally supported the highest number of animals due to its size and available habitat. Sheep were not found along the coast of Unit 7 or the southern coast of Unit 15.

Seasonal movement data are not available for sheep in the Kenai Mountains.

MORTALITY

Harvest

Season and Bag Limit. The sheep season for resident, subsistence, and nonresident hunters was 10 August through 20 September, and the bag limit was 1 ram with full-curl horn or larger. Beginning in 1993, a drawing permit hunt was authorized for that portion of Subunit 15A south of Dike Creek and east of Fuller Lake trail (Round Mt.). We issued 20 permits for ewe sheep from August 10 to September 20.

Board of Game Actions and Emergency Orders. In 1996 the Board of Game approved a proposal from the Cooper Landing Advisory Committee to extend the ewe hunt area to include the portion of Round Mountain in Unit 7. No emergency orders were issued during this reporting period.

Hunter Harvest. The harvest remained relatively stable between 1995 (37) and 1996 (39) then declined in 1997 to 25 rams (Table 4). The suspected reason for this decline is low lamb production and survival in the early 1990s, resulting in fewer legal rams in the population. However, the hunting effort also declined in 1997 compared to the 2 previous years. The 3-year harvest resulted in a mean harvest of 34 rams.

Mean horn length of harvested rams remained relatively stable during this reporting period, ranging between 35.1 and 35.2 (Table 4). Horn size ranged from 30.5 to 41.0 inches, and mean age of harvested rams was 8.3 years old from 1995 to 1997.

Between 1995 and 1997 a mean of 16 of the 20 permit holders for the Round Mountain ewe hunted and averaged 7 ewes per year (Table 5). Hunter success ranged between 33 and 56 percent.

Hunting effort remained stable (mean = 267) between 1993 and 1996 then decreased by approximately 20 percent in 1997 (Table 6). Hunter success has ranged between 12 and 14 percent over the past 5 years with no apparent trend.

Hunter Residency and Success. Ninety-five (94%) of the 101 successful hunters reporting residency from 1995 to 1997 were Alaska residents and 6 (6%) were nonresidents (Table 6). Three successful hunters failed to report residency. Unsuccessful hunters comprised 631 (98%) residents, 11 (2%) nonresidents, and 13 of unknown residency.

Harvest Chronology. Chronology of harvest followed similar patterns over the past 3 years (Table 7). Most of the harvest occurred during the first 2 weeks of the season followed by a surge during the last week.

Transport Methods. From 1995–1997 successful hunters used aircraft (33%), boats (33%), and highway vehicles (29%). ATVs and horses were used by less than 5 percent of the successful hunters (Table 8).

HABITAT

Assessment

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 from the 2500 ft to 3500 ft altitude on the south-facing slopes from the alder-brush zone through the alpine-tundra zone. Culbertson recorded 40% more sheep observations per acre in the burned versus the adjacent unburned area. Two grasses important to sheep, *Trisetum spicatum* and *Festuca rubra*, were more abundant and vigorous in burned areas when compared to nearby unburned areas.

CONCLUSIONS AND RECOMMENDATIONS

A primary objective of the sheep management program for the Kenai Mountains should be to maintain a population database that accurately reflects changes in sex and age composition, relative abundance, and changes among areas during the same period. The Cooper Landing Closed Area should be counted annually to sample an unhunted area. Areas that border suitable sheep range, Mills Creek (Area 834) and Snow River (Area 844), should be included in surveys to serve as early indicators of weather or range-related population changes.

Trend area counts in 1992 (689) and 1993 (632), compared to those in 1997 (640), indicate that the population has remained stable at an estimated size of 1500 to 1775 animals. The reported harvest in the past 5 years met the management objective of maintaining a population capable of sustaining an annual harvest of 25 rams. Horn length of harvested rams decreased slightly during the years 1993 and 1994 from 35.6 inches to 35.1 inches in 1995 to 1997. Compared with the mean horn length during the last 5 years of the 7/8 curl regulation (1984 to 1988), the mean horn length has increased from 32.7 to 35.5 inches (1993 to 1997) under full-curl regulations. Horn length ranged from 30.5 to 41.0 inches, and mean age of harvested rams was 8.3 years old from 1995 to 1997. The full-curl regulation has also added approximately 1 year to the mean age of a harvested ram, compared to the 7/8 regulations.

The small population of sheep inhabiting the Round Mountain area slowly declined from 1992 to 1996 then increased in 1997. The suspected reason for this increase was a shift in range by sheep inhabiting range just north of Round Mountain. Because the management objective is to maintain between 80 and 90 sheep in order to protect the remaining habitat, the season allowing the harvest of ewes should continue until the desired density is reached.

The high number of hunters and low hunter success is a factor of the increasing local human population and a high demand for sheep hunting. To address this issue, we should sample public opinion to determine acceptable options for future management. Limiting hunter participation, by issuing permits to maintain acceptable levels of hunter density, is more readily accepted by sheep hunters because sheep are not generally considered a meat animal. Sheep hunters are also much less tolerant of high hunter densities, generally acceptable to moose or caribou hunters.

Passage of full-curl regulations has reduced our need for intensive management programs for sheep populations on healthy range. With the reduced trend in intensive sheep management, at least 2 problems will occur. In the short-term, hunting opportunities will be missed. Over the long-term, population management needs will be realized too late to be easily corrected, and populations will be controlled by habitat quality rather than by management. Sheep in the Kenai Mountains have recently gone through one recorded decline driven by overutilization of range, and we are currently documenting another rebuilding of the population's size.

To avoid the high sheep densities recorded in the late 1960s, which were followed by a sharp decline, we need to maintain our monitoring efforts and achieve the following objectives by 1999–2000: (1) delineate winter range, (2) complete a range evaluation to provide an estimate of allowable density, (3) in areas where we suspect habitat may be limited, reduce the population by harvesting ewes and (4) set an upper limit for sheep numbers well below the level reached in the late 1960s. By establishing an upper population limit of 1800 to 2000 animals, we would

maintain current objectives for hunting opportunities and harvest and allow time for continued habitat evaluations.

No change in season or bag limit is recommended.

LITERATURE CITED

CULBERTSON, J.L., ET AL. 1980. Round Mt. fire effects and sheep range survey 1980. Seward District Chugach National Forest. USDA Forest Service Report.

LORANGER, A. AND T. H. SPRAKER. 1994. Estimation of Dall's sheep and goat populations on and adjacent to the Kenai National Wildlife Refuge. Technical Report Project No. FWS 14-16-0007-91-7762

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Table 1 Kenai Mountains, Units 7 and 15 summer aerial sheep composition counts and estimated population size, 1993–97

Regulatory year	Rams				Ewes	Sheep/ Lambs(%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full-curl(%)	3/4 to full-curl[a]	1/2 to 3/4-curl	<1/2-curl					
1993/94	24(3)	150	--	--	472	96(13)	--	742	1500–1775
1994/95	17(2)	194	--	--	529	121(14)	--	861	1500–1775
1995/96	18(3)	113	--	--	337	90(16)	--	558	1500–1775
1996/97	6(1)	92	--	--	338	111(20)	--	547	1500–1775
1997/98	20(3)	127	--	--	486	151(19)	--	784	1500–1775

[a] Sublegal rams 7/8 curl or smaller.

Table 2 Kenai Mountains, Units 7 and 15 trend count areas (855, 856, and 857), 1993–97

Regulatory year	Rams			Ewes	Lambs	Total sheep
	Full-curl	7/8 or smaller	Total rams			
1993/94	20	135	155	394	83	632
1994/95[a]	11	108	119	296	54	469
1995/96[b]	5	33	38	28	3	69
1996/97	No Count Data Available For These Trend Areas					
1997/98	22	103	125	396	123	644

[a] Only counted area 856.
[b] Only counted area 857.

Table 3 Round Mountain, Subunit 15A summer aerial sheep composition counts and estimated population size, 1993–97

Regulatory year	Rams				Ewes	Lambs	Sheep/ hour	Total Sheep observed	Estimated population size
	Full-curl(%)	3/4 to full-curl[a]	1/2 to 3/4 curl	<1/2 curl					
1993/94	5(4)	17	--	--	86	18	--	126	143
1994/95	3(3)	10	--	--	79	27	--	119	134
1995/96	2(2)	10	--	--	77	18	--	107	119
1996/97	0(0)	15	--	--	65	26	--	106	119
1997/98	2(2)	20	--	--	90	32	--	144	160

[a] Includes all rams less than full-curl.

Table 4 Kenai Mountains, Units 7 and 15 general sheep harvest, 1993–1997

Regulatory year	Rams	x Horn Length (in)	% ≥ 40 in	Ewes	Total
1993/94	33	35.6	0	0	33
1994/95	32	35.5	0	0	32
1995/96	37	35.1	5	0	37
1996/97	39	35.2	3	0	39
1997/98	25	35.1	0	0	25

Table 5 Round Mountain, Subunit 15A drawing permit ewe sheep hunt, 1993–97

Regulatory year	Number of Permits Issued	Number of Hunters	Number of Ewes	Percent Successful	Season Length
1993/94[a]	20	15	8	53	Aug. 10–Sep. 20
1994/95	20	13	5	39	Aug. 10–Sep. 20
1995/96	20	18	6	33	Aug. 10–Sep. 20
1996/97	20	16	9	56	Aug. 10–Sep. 20
1997/98	20	15	6	40	Aug. 10–Sep. 20

[a] Permit ewe hunt started in 1993.

Table 6 Kenai Mountains, Units 7 and 15 general sheep hunter[a], residency and success, 1993–97

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1993/94	21	6	5	33(12)	120	110	4	235(88)	268
1994/95	21	9	1	32(12)	88	127	6	239(88)	271
1995/96	25	8	4	37(14)	92	123	5	222(86)	259
1996/97	20	18	1	39(14)	91	133	5	231(86)	270
1997/98	15	6	1	25(12)	85	94	1	189(88)	214

[a] Excludes hunters in permit hunts.
[b] Residents of Units 7 and 15.

Table 7 Kenai Mountains, Units 7 and 15 general sheep harvest chronology percent by harvest period, 1993–97

Regulatory year	Harvest Periods 8/10-8/16	8/17-8/23	8/24-8/30	8/31-9/6	9/7-9/13	9/14-9/20	*n*
1993/94	66	13	9	0	0	13	3
1994/95	41	22	9	9	3	16	32
1995/96	67	8	0	8	3	14	37
1996/97	50	13	11	11	13	3	39
1997/98	52	16	8	20	0	4	25

Table 8 Kenai Mountains, Units 7 and 15 general sheep harvest percent by transport method, 1993–97

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1993/94	36	3	36	0	0	0	18	7	33
1994/95	25	0	38	0	0	0	38	0	32
1995/96	50	3	28	0	0	0	19	0	37
1996/97	28	0	42	3	0	0	28	0	39
1997/98	20	4	28	0	0	0	40	8	25

LOCATION

GAME MANAGEMENT UNIT: 9B, 16B, 17B, 19B and C (4600 mi^2)

GEOGRAPHIC DESCRIPTION: Alaska Range west and south of Denali National Park and Preserve

BACKGROUND

Dall sheep in the Alaska Range West (ARW) are in greater numbers on the northwestern side of the range than on the southeastern side, probably due to less snow accumulation on the northwestern side. Aerial surveys were conducted during the 1960s, 1970s, and 1980s. ADF&G staff believed the population was stable during the late 1970s and early to mid-1980s, estimating 4000–5000 sheep (Shepherd 1979; Pegau 1986). However, making comparisons between survey years to identify trends in population size has been difficult due to differences in survey intensity, methods, and coverage (Whitten 1997; Masteller et al., ADF&G unpublished 1997 sheep survey report, Palmer, Alaska, USA). Most of the effort was concentrated in the northwestern portion of the range, and since 1994 a more systematic approach has been applied to improve comparability between surveys (Shepherd, 1979; Pegau 1986). Some aerial surveys were conducted in the southeastern portion of the range, with the most recent one in 1996 (Didrickson 1971; Didrickson and Taylor 1979; Singer 1981; Masteller et al., ADF&G unpublished 1997 sheep survey report, Palmer, Alaska, USA; Denali National Park & Preserve unpublished sheep report). Currently, the sheep population in the ARW seems stable. The ARW is a popular sheep hunting area for both resident and nonresident hunters.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Provide opportunity to harvest Dall rams under aesthetically pleasing conditions.

MANAGEMENT OBJECTIVES

- Manage to maintain the existing Dall sheep populations at recorded levels of abundance and productivity.

- Manage for sustained uncrowded hunting conditions by monitoring hunter participation and location and assessing hunter satisfaction with hunting experiences in the ARW.

- Manage for a sustained harvest of more than 100 legal rams per year with a mean horn length of more than 34 inches and a mean age exceeding 8 years.

METHODS

POPULATION SIZE AND COMPOSITION

Population size was not determined, but densities were calculated for some regions based on combined data from individual count areas. To determine sex and age composition, we conducted aerial surveys in count areas on the north side of the Alaska Range from the headwaters of the Swift Fork of the Kuskokwim River south to Lake Clark National Park. These count areas were in Units 19B and 19C. They were selected based on their capability to sustain moderate to high sheep harvests. Surveys were conducted with a PA-18 Super Cub by flying contours in sheep habitat (usually above treeline) with both pilot and observer spotting, enumerating, and classifying sheep. Sheep were classified into 5 categories: full-curl rams, <full-curl rams, ewe-likes (include adult ewes, yearling rams, and ewes), lambs, and unknown. The airplane was flown at 70–80 mph at 100–300 feet above the ground. Surveys were completed during 18 July–1 August. A calm, high overcast day with no glare off the rocks and little shadows was considered excellent conditions for a survey. Six count areas (479 mi^2) were flown in 1994, and 7 (515 mi^2) were flown in 1995. No surveys were conducted in 1996 due to poor weather for flying. Eleven count areas (794 mi^2) were flown in 1997, and 4 (307 mi^2) were flown in 1998. Not all of the same count areas were flown each year. Data from all count areas were combined annually to obtain an overall estimate of sex and age composition and to calculate densities. In addition, a count area was established in Sheep Creek East (between Sheep Creek and the South Fork and Post Rivers) to serve as an indicator of trend for composition in the northwest portion of the range. The objective for the Sheep Creek East count area was to survey the same area with the same survey intensity each year. A moderate harvest occurs annually in the count area.

Sheep composition surveys were conducted in the southeastern portion of ARW by staff from ADF&G Region II in cooperation with the National Park Service (Masteller et al., ADF&G unpublished 1997 sheep survey report, Palmer, Alaska, USA). The region surveyed was west of the Kahiltna and Muldrow Glaciers to Mystic Pass, and south of Shellabarger Pass to Kenibuna/Chakachamna Lakes. The survey region was in Units 16B, 19C, and 20C. Twelve count areas were completed using the method described previously.

HARVEST

Harvest and hunting pressure were monitored using harvest reports submitted by hunters. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year (RY = 1 July–30 June). We used a *t*-test to compare harvest data from different years, and differences were considered significant at the $\alpha = 0.05$ level.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

ADF&G staff estimated 4000–5000 sheep in ARW in 1978 (Shepherd 1979) and 4000 in 1985 (Pegau 1986). Although no censuses were completed during the 1990s, some count areas

were surveyed and densities were estimated. Densities in count areas in the northwestern portion of the ARW were based on combined data from individual count areas and were 1.28–2.23 sheep/mi^2 for 1994, 1995, 1997, and 1998 (Table 1). Densities in the Sheep Creek East count area were 2.58–3.29 sheep/mi^2 for 1995, 1997, 1998 (Table 1). Although densities appeared to be lower in 1998 than in 1997, data from more years are needed to determine a population trend in this count area. Densities for the southeastern portion of the ARW were not estimated.

It was not possible to estimate the sheep population or determine recent sheep population trends in the ARW with statistical bounds because different count areas were selected each year, and count areas were not selected randomly. However, densities were consistently >1 sheep/mi^2, productivity was good except in the Sheep Creek East count area (lamb:ewe-like ratio >30:100; Table 1), and harvest was relatively stable. Therefore, we believe the sheep population was stable.

Population Composition

The proportion of full-curl rams in the northwestern portion of the ARW was 6.8–10.2% during 1994–1998 (Table 1). Whitten (1997) determined that a healthy, unhunted population of sheep included 6% full-curl rams. Therefore, this portion of the ARW population was capable of sustaining the harvest that occurred during the years when surveys were completed (1994–1998). Percent rams were 20.4–32.2%. Percent lambs were 15.7–20.4%. The observed lamb:ewe-like ratios were 38:100 in 1994, 33:100 in 1995, 28:100 in 1997, and 30:100 in 1998. A ratio of 30–40:100 generally indicates a stable population (Whitten 1997). Both the percent lambs and the lamb:ewe-like ratio have declined slightly since 1994; however, due to differences in survey intensity and count areas, it was difficult to draw inferences.

In the Sheep Creek East count area, full-curl rams constituted 4.0–9.3% of the population during 1995–1998 (Table 1). Although percent full-curl rams was low in 1997 (4%), it was higher the following year (8.9%), indicating this count area was capable of sustaining the harvest that occurred and that percent full-curl rams in 1997 was underestimated. Some annual variability in composition is expected simply as a function of missing 1 or more "ram" or "ewe" groups. Effects of this are most severe when examining only 1 count area with a relatively low sample size (<300). Percent total rams were 19.8–36.9%. Percent lambs were 9.8–14.6%. The lamb:ewe-like ratios were 15–22:100. The lamb:ewe-like ratio was <30:100, but this may be due to the absence of preferred habitat for lamb:ewe groups within the Sheep Creek East count area.

In the southeastern portion of the ARW, 6% of the sheep observed during surveys were full-curl rams, 21% were rams, and 22% were lambs (Table 1). The lamb:ewe ratio was 39:100. Data from surveys in 1996 were compared with surveys conducted on the south side in 1970 and 1977. Sheep numbers were greater in at least some of the areas on the south side in 1996 (Masteller et al., ADF&G unpublished 1997 sheep survey report, Palmer, Alaska, USA). Sheep composition data underestimates the true lamb:ewe and ram:ewe ratio because ewe-like sheep include yearling ewes and young rams in addition to adult ewes. In addition, trends in

sex and age composition based on these data should be viewed with caution because distribution of ram groups and ewe/lamb groups may vary from year to year (Whitten 1997).

Distribution and Movements

We did not study movements during this reporting period. However, incidental observations and analyses of kill locations reported by hunters indicated sheep distribution was generally the same as in previous years.

MORTALITY

Harvest

Season and Bag Limit. The open season in the ARW was 10 August–20 September with a bag limit of 1 ram with full curl or larger or broomed horns. The full-curl regulation has been in effect since RY 1989–1990. Before 1989–1990, horn size requirement was a 7/8-curl minimum and prior to RY 1979–1980 it was 3/4 curl or larger.

Hunter Harvest. Reported harvest of sheep probably approximated the actual harvest because little illegal or unreported take was likely. The 5-year mean harvest (± 1s) was 141 ± 10 during RY 1993–1994 through 1997–1998, which was not significantly different from the mean harvest of 138 ± 9.2 during the 5 years prior to RY 1993–1994 ($P = 0.68$; Table 2). The harvest of 132 sheep in RY 1997–1998 was lower than during the previous 2 years, when approximately 150 rams were taken annually; however, this was not unusual as harvest for the past 11 years fluctuated from 126 to 157. This fluctuation in harvest was probably the result of poor weather for flying and hunting.

Mean horn length during RY 1993–1994 through 1997–1998 was 35.3–36.4 inches, and remained ≥36 inches during this reporting period (Table 2). Mean age during these 5 regulatory years was 8.9–9.5 years and remained ≥9 years during this reporting period. Mean horn length and age are largely influenced by the full-curl regulation because most full curl rams are at least 6–8 years old or older and usually have a horn length ≥34" (Whitten, pers commun). A few ≥40" rams have been harvested every year since 1987.

Permit Hunts. A federal subsistence hunt has occurred in Unit 9B since fall 1995. Approximately 2–6 sheep were harvested annually during RY 1995–1996 through 1997–1998. See federal regulations for more details on seasons and bag limits.

Hunter Residency and Success. Approximately 50% of sheep hunters using the ARW during RY 1993–1994 through 1997–1998 were nonresidents (Table 3). Their success rates were higher than resident hunters because they usually were accompanied by licensed guides. The mean success rate was 39% ± 5.4% for resident hunters and 60% ± 4.5% for nonresident hunters during RY 1993–1994 through 1997–1998. These were not significantly different from the previous 5 regulatory years ($\bar{x}$ ± 1s = 43% ± 11.8% for residents, $P = 0.49$; 61% ± 4.2% for nonresidents; $P = 0.74$). Resident success dropped from 42% in RY 1995–1996 and 1996–1997 to 29% in RY 1997–1998. This was the lowest level recorded during the last 11 years. The number of resident hunters also declined in RY 1997–1998. This probably was

caused by warm and rainy weather. Resident hunters often choose not to go hunting in this kind of weather, whereas nonresident hunters tend to hunt regardless of weather. Also, sheep tend to stay at higher elevation when there is little snow, which reduces hunter effort and success, particularly among unguided hunters. Overall hunter success rates were at least 50% since 1977, which is considered high (Ken Whitten, pers commun).

The mean number of hunters was not significantly different ($P = 0.14$) between the periods RY 1993–1994 through 1997–1998 ($\bar{x} \pm 1s = 260 \pm 9.2$) and RY 1988–1989 through 1992–1993 ($\bar{x} \pm 1s = 241 \pm 22.0$). There was no significant change in the proportion of resident and nonresident hunters during this period.

Harvest Chronology. Chronology of the sheep harvest in the ARW was often influenced by weather conditions. During this reporting period (RY 1995–1996 through 1997–1998), over half the harvest occurred during the first 2 weeks of the 6-week season, when weather was less likely to restrict access (Table 4).

Transport Methods. Aircraft were used by 83% of sheep hunters during this reporting period (RY 1995–1996 through 1997–1998). There are no occupied villages or roads within or adjacent to sheep habitat and most rivers are not suitable for boat travel. Other means of access were used in a small percentage of sheep hunts (Table 5).

Other Mortality

Winter weather was moderate in this portion of the Alaska Range during the last 5 years. Wolves, golden eagles, and coyotes exist in the area and are known to prey on Dall sheep (Heimer and Stephenson 1982; Scotton 1997), but the effects of predation were unknown.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

The unregulated guide/outfitter industry in the ARW grew in recent years, and crowded hunting conditions reduced the quality of the sheep hunting experience in several of the most accessible drainages.

CONCLUSIONS AND RECOMMENDATIONS

Aerial surveys indicated the sheep population remained relatively stable during this reporting period (RY 1995–1996 through 1997–1998). Productivity was good (>30:100 lamb:ewe-likes) in most areas and densities were >1 sheep per mi^2 in the areas surveyed. Harvest remained stable with an average annual take of 144 rams during this reporting period. Harvest has not changed significantly during the past 10 years.

We met our goal of providing an aesthetically pleasing hunting opportunity in some areas in the ARW. Reports of crowded conditions have been increasing in the most accessible areas. This goal should be examined more thoroughly. However, the conditions that hunters find "aesthetically pleasing" need to be determined. The objective of maintaining Dall sheep populations at "recorded" levels of abundance and productivity is an unrealistic objective because we do not have accurate historical data to compare with current data. Thus, I

recommend eliminating this objective. I also recommend eliminating the objective of sustaining a harvest of more than 100 legal rams per year with a mean horn length of more than 34 inches and a mean age exceeding 8 years. The full-curl regulation almost guarantees meeting the horn length and age objective and limits harvest to a conservative level. I recommend the following management goals and objectives be implemented for the next reporting period. There has been no public review of these recommendations.

REVISED MANAGEMENT GOALS AND OBJECTIVES

Management Goals

1 Provide a sustained opportunity to harvest Dall sheep rams from a naturally regulated population.

2 Provide an opportunity to harvest Dall sheep rams under aesthetically pleasing conditions.

3 Provide an opportunity to view and photograph Dall sheep.

Management Objectives

1 Maintain a full-curl harvest strategy (Goals 1 and 3).

2 Determine the conditions hunters consider to be aesthetically pleasing (Goal 2).

LITERATURE CITED

DIDRICKSON JC. 1971. Dall sheep, Game Management Unit 16. Page 91 *in* DE McKnight, editor. Annual report of survey-inventory activities, Part II. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-17-3. Jobs 3, 4, 6, 7, 8, 9, 12, 14, 15 and 17. Juneau.

———, AND KP TAYLOR. 1979. Dall sheep, Game Management Unit 16. Pages 38–39 in RA Hinman, editor. Annual report of survey-inventory activities, Part IV. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-17-10. Jobs 6, 7, 10 and 22. Juneau.

HEIMER WE AND RO STEPHENSON. 1982. Responses of Dall sheep populations to wolf control in interior Alaska. Proceedings of sixth biennial symposium North American wild sheep and goat council. 3:320–329.

PEGAU RE. 1986. Unit 19 sheep survey and inventory progress report. Pages 5–6 *in* RA Hinman, editor. Annual report of survey-inventory activities. Volume XVI. Part II. Sheep. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-22-4. Juneau.

SCOTTON BD. 1997. Estimating rates and causes of neonatal lamb mortality of Dall sheep in the Central Alaska Range. Alaska Department of Fish and Game. Federal Aid in

Wildlife Restoration. Research Final Report. Grants W-24-4 and W-24-5. Study 6.12. Juneau.

SHEPHERD PEK. 1979. Unit 19 sheep survey-inventory progress report. Page 102 *in* RA Hinman, editor. Annual report of survey-inventory activities. Volume X. Part II. Sheep. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-17-11. Juneau.

WHITTEN KR. 1997. Estimating population and composition of Dall sheep in Alaska: assessment of previously used methods and experimental implementation of new techniques. Federal Aid in Wildlife Restoration. Research Final Report. Grants W-24-3, W-24-4, and W-24-5. Study 6.11. Juneau.

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Table 1 Alaska Range West sheep composition counts, 1994–1998

Date	Area (mi^2)	Survey intensity (min/mi^2)	Rams			Ewe-likes[a] (%)	Lambs (%)	Unk (%)	Total sheep	Density (sheep/mi^2)
			Full curl (%)	<Full curl (%)	Total (%)					
Northwest portion										
28 Jul 1994	479	1.76	72 (8.7)	141 (17.1)	213 (25.8)	443 (53.6)	169 (20.4)	2 (0.2)	827	1.73
18 and 19 Jul 1995	515	2.13	85 (7.4)	149 (13.0)	234 (20.4)	676 (58.9)	226 (19.7)	11 (0.9)	1147	2.23
29 Jul 1997[b]	794	1.56	118 (10.2)	196 (16.9)	314 (27.1)	659 (56.9)	186 (16.0)	0 (0.0)	1159	1.28
1 Aug 1998	307	2.06	30 (6.8)	112 (25.4)	142 (32.3)	229 (52.0)	69 (15.7)	0 (0.0)	440	1.43
Sheep Creek East										
18 and 19 Jul 1995	83	2.28	22 (9.3)	41 (17.4)	63 (26.7)	150 (63.5)	23 (9.8)	0 (0.0)	236	2.85
28 Jul 1997	83	2.17	11 (4.0)	43 (15.7)	54 (19.8)	179 (65.6)	40 (14.6)	0 (0.0)	273	3.29
1 Aug 1998	83	3.08	19 (8.9)	60 (28.0)	79 (36.9)	112 (52.3)	23 (10.7)	0 (0.0)	214	2.58
Southeast portion										
30 Jun–11 Jul 1996	–[c]	–[c]	114 (6.0)	259 (14.0)	373 (21.0)	1012 (57.0)	396 (22.0)	5 (0.3)	1786	–[c]

[a] Ewe-likes includes adult ewes, all yearlings, and young rams not distinguishable from ewes.
[b] Added new count areas not previously surveyed.
[c] Not available

Table 2 Alaska Range West sheep harvest, horn length, and age, regulatory years 1987–1988 through 1997–1998

Regulatory year	Rams harvested	$\bar{x}$ horn length (inches)	% ≥40"	$\bar{x}$ Age[a]
1987–1988	139	35.5	5.7	
1988–1989	157	35.9	6.5	
1989–1990	141	35.8	5.0	
1990–1991	151	36.1	7.8	
1991–1992	139	36.0	5.8	
1992–1993	126	35.4	7.9	
1993–1994	142	35.8	8.5	9.1
1994–1995	131	35.3	1.5	8.9
1995–1996	151	36.4	7.5	9.0
1996–1997	150	36.4	10.7	9.5
1997–1998	130	36.0	6.1	9.5

[a] Hunters estimate age of harvested ram.

Table 3 Alaska Range West sheep hunter residency and success, regulatory years 1987–1988 through 1997–1998

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Total[b]	(%)	Local resident[a]	Nonlocal resident	Nonresident	Total[b]	(%)	
1987–1988	4	58	77	139	(63)	11	58	12	81	(37)	220
1988–1989	2	70	85	157	(71)	0	47	18	65	(29)	222
1989–1990	4	57	80	141	(59)	5	64	29	98	(41)	239
1990–1991	0	49	102	151	(55)	9	70	44	123	(45)	274
1991–1992	1	53	80	134	(54)	1	81	34	116	(46)	250
1992–1993	1	45	73	126	(57)	4	67	24	97	(43)	223
1993–1994	1	58	81	142	(55)	2	73	44	118	(45)	260
1994–1995	4	50	76	131	(52)	1	75	44	123	(49)	251
1995–1996	4	60	87	151	(56)	4	73	40	118	(45)	269
1996–1997	3	55	87	150	(56)	2	69	45	119	(44)	269
1997–1998	4	34	88	130	(52)	3	68	39	120	(48)	250

[a] Local residents reside in Units 9, 16, 17, or 19.

[b] Total column exceeds summary of residency columns because it includes unknown residency.

Table 4 Alaska Range West sheep harvest chronology percent by time period, regulatory years 1987–1988 through 1997–1998

Regulatory year	Harvest periods						Unk	*n*
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20		
1987–1988	30	20	20	8	4	14	3	139
1988–1989	36	17	16	7	15	9	1	157
1989–1990	37	22	17	7	7	9	1	141
1990–1991	46	12	10	14	9	8	2	151
1991–1992	42	9	16	14	6	12	1	139
1992–1993	34	13	26	9	13	3	2	126
1993–1994	46	12	12	11	10	4	4	142
1994–1995	42	17	8	16	7	4	7	131
1995–1996	44	11	12	7	11	9	6	151
1996–1997	47	17	14	11	5	2	3	150
1997–1998	39	18	18	11	6	6	1	130

Table 5 Alaska Range West sheep harvest percent by transport method, regulatory years 1987–1988 through 1997–1998

Regulatory year	Percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1987–1988	81	5	1	<1	0	3	<1	8	
1988–1989	79	7	1	4	0	1	2	5	
1989–1990	83	6	2	3	0	3	<1	3	141
1990–1991	86	6	2	2	0	0	<1	4	151
1991–1992	79	5	2	5	0	1	<1	8	134
1992–1993	83	9	0	4	0	4	0	0	126
1993–1994	83	8	1	4	0	3	0	<1	142
1994–1995	75	11	4	6	0	1	0	<1	131
1995–1996	83	7	3	2	0	1	2	0	151
1996–1997	83	11	<1	<1	0	4	0	1	150
1997–1998	83	10	1	1	0	3	0	<1	130

LOCATION

GAME MANAGEMENT UNIT: 11 (13,300 mi^2) South Wrangell Mountains

GEOGRAPHIC DESCRIPTION: Chitina Valley and the eastern half of the Copper River Basin

BACKGROUND

Dall sheep inhabit most alpine and subalpine areas of the Wrangell Mountains and have a long history of being hunted for sport and subsistence purposes in Unit 11. The Wrangell Mountains are famous for trophy-sized rams. Little information is available on the number of sheep harvested before 1962 because harvest data were not collected. Since 1962 harvest reports have provided managers with numbers and locations of harvests.

In late 1978 the Wrangell Mountains, including all of Unit 11, were designated as a National Monument. During the 1979 hunting season, only subsistence hunting by local rural residents was allowed under National Monument regulations.

Wrangell-St. Elias National Park and Preserve was established by the Alaska National Interest Lands and Conservation Act (ANILCA) in 1980. Harvest of sheep in the portion designated as Park was limited to subsistence hunting by rural residents of designated communities within Units 11, 13, and 12. Sport hunting for sheep in the Preserve areas was open to residents and nonresidents. Effective 1 July 1990, all Alaska residents were considered subsistence hunters under state law. However, subsistence hunting in the Park was still limited to local residents under federal regulations.

Estimates of historical sheep numbers in the Wrangell Mountains are unavailable. Sheep surveys flown during the late 1950s and 1960s are generally not comparable because survey intensity and specific areas counted are unknown. Specific count areas and techniques for aerial surveys were established in 1973 when sex and age composition surveys were flown over large portions of the Wrangell and Chugach Mountains. Additional surveys to census sheep and to determine sex and age composition have continued to date.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

To maintain a sheep population that will sustain an annual harvest of 60 rams.

METHODS

Aerial surveys were conducted during most years to determine sex and age composition and population trends of sheep in selected count areas within Unit 11. Hunters are required to submit a posthunt harvest ticket report. Harvest report cards provide us with information on the location, timing, and magnitude of harvest.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Survey data for selected sheep trend count areas surveyed during this reporting period in Unit 11 are presented in Table 1.

The most recent surveys included Count Areas 11 and 12, located between the Dadina and Kuskalana Rivers; CA 14, the Crystalline Hills; and CA 22, Hawkins Glacier. In CA 11 the lowest sheep count occurred in 1998 with 184 animals observed. There has been some variability in annual counts, but the trend indicates a long steady decline in CA 11. Count area 12 (adjacent to CA 11) has had comparatively stable numbers of sheep, ranging between 449–602 sheep since 1981. Count area 14, Crystalline Hills, has declined markedly since 1980 when 209 sheep were observed. Only 76 sheep were found during the 1996 count in CA 14. Sheep abundance in CA 22 has remained very stable; between 246 and 305 sheep have been counted each year a survey was conducted.

Historical information on the size of the Unit 11 sheep population is limited. Maximum ADF&G Super Cub counts from the established count areas indicated a minimum of 4000 sheep inhabited the Wrangell Mountains from Mount Drum, southeast to the Canada border. An extrapolated population estimate of 5071 (± 137) was obtained for this portion of the Wrangell Mountains in Unit 11 by the NPS during 1992 (Strickland et al. 1993).

The National Park Service (NPS) conducted sheep surveys in Wrangell-St. Elias National Park and Preserve during 1990 and 1991 (McDonald et al. 1990; 1991). NPS estimated 25,972 sheep ± 6233 (95% CI) in 1990, and 27,972 sheep ± 6448 (95% CI) in 1991. Areas counted in the NPS surveys included the northern Wrangell Mountains (Unit 12) and the eastern Chugach Mountains. In 1992 Strickland et al. revised the NPS estimate to 17,455 ± 3883 sheep in the Wrangell Mtns.

Population Composition

The percentage of lambs in the population during 1998 ranged between 14% and 17% in Count Areas 11, 12 and 22. Count Area 14 was not surveyed in 1998. Abundance of ewes in CA's 11 and 12 decreased by 45% and 30%, respectively, since the last surveys were conducted. The number of rams counted during aerial surveys declined in CA's 11, 12 and 22 in recent years (Table 1); this reduction in the number of rams is probably a reflection of the poor recruitment/production of lambs in the early 1990s.

Distribution and Movement

Information on movements of sheep inhabiting Unit 11 is limited. Studies of sheep have not been conducted in this area. Field observations indicate sheep move to wind-blown, snow-free areas in the winter and to areas of new growth in the spring.

MORTALITY

Harvest:

Seasons and Bag Limit. The open season for resident and nonresident sheep hunters was 10 August through 20 September, and the bag limit was 1 sheep for resident (subsistence) hunters and 1 ram with full-curl horn or larger for nonresident hunters. Guides were required for nonresident sheep hunters.

Board of Game Actions and Emergency Orders. Before 1978 the bag limit was 1 ram with 3/4-curl or larger horns. Beginning in 1978 the minimum horn size was increased to 7/8-curl or larger. In 1989 the bag limit was changed to 1 sheep (any size or sex) for subsistence hunters and 1 ram with full-curl or larger horns for sport hunters. Subsistence hunters for the state were defined as any Alaska resident. No emergency orders restricting the take or season on sheep in this portion of Unit 11 were issued during this reporting period.

Hunter Harvest. The reported sheep harvest varied from 111 to 143 animals during 1993–1997 (Table 2). The number of ewes killed during this period is also presented in Table 2. Ewe harvests have decreased during the past 5 years after peaking in 1992 with a reported kill of 36. During 1997 there were 72 rams taken with reported horn sizes large enough to consider them mature. Between 1993 and 1997 the number of rams taken that could fall into the mature ram category averaged 84 a year (range = 80–106). The number of rams with especially small horns or estimated age <6 years has averaged 18 per year (range = 12–27), indicating immature rams were taken for subsistence.

Harvest reporting requirements provided horn measurements of sheep harvested from Unit 11 (Table 3). Average horn size data from specific areas in the unit were compared year-to-year and within the unit. Table 3 details average horn size in the harvest by harvest location. The Eastern Region includes the area from the Nizina River to the Canada border. The Middle Region includes the area from the Dadina River to west of the Nizina River. The Western Region includes that area of the northern and western Wrangells from Jack Creek to the Dadina River.

Average horn size varied annually from within each of the regions. Historically, sheep horn size has decreased from east to west and north. Contributing factors are suspected to include favorable habitat, weather conditions, and genetic influence. The world record sheep came from the Eastern Region of the Wrangells, an area that produces a number of large sheep every year.

Hunter Residency and Success. The number of reported sheep hunters in Unit 11 is presented in Table 4. Between 1993 and 1997 the number of sheep hunters averaged 316 per year. Hunting effort during this period increased by 53% over the prior 5-year period from 1986–89 when an average of 238 hunters (range 220–258) reported hunting in the Wrangell Mountains. During this period the overall hunter success rate varied annually from 31 to 45%.

Local residents averaged 24 sheep a year (range = 22–28) during the reporting period, while nonlocal residents averaged 66 (range = 53–83) and nonresidents 27 (range = 19–37). During this 5-year period, locals averaged 21% of the yearly harvest, nonlocals 56%, and nonresidents 23%. In comparison, local residents averaged 31 sheep a year (range = 22–42) during the 1990–1994

period while nonlocal residents averaged 79 (range = 59–98) and nonresidents 30 (range = 22–41). The most successful group of sheep hunters were nonresidents, having an average success rate of 70% compared to 34% average success rate for locals and 32% for nonlocal hunters. The requirement for nonresidents to hire a guide probably explains their high success rate.

The average number of days hunted annually by successful hunters ranged from 4.5 to 5.3 days and averaged 4.9 days between 1993 and 1997 (Table 5). The average number of days hunted annually reported by unsuccessful sheep hunters for the same period ranged from 4.3 to 5.3 days and averaged 5.0 days.

Harvest Chronology. Table 6 presents harvest chronology data for sheep taken in Unit 11. During much of this reporting period, the first 3 weeks of the sheep season had the highest harvest.

Transportation Methods. Aircraft were the primary mode of transportation for successful sheep hunters in Unit 11 (Table 7). The percentage of successful hunters using aircraft increased during the last few years.

Other Mortality

Studies of natural mortality of sheep in the area have not been conducted in recent years. Sources of natural mortality common to sheep populations include accidents and starvation during periods of deep snow and icing. Wolf predation has also been observed in portions of Unit 11. Reports by trappers and local residents suggested wolf predation may be an important mortality factor; however, predation rates have not been determined. Coyotes and Golden Eagles are also known to prey on lambs in other game management units (Scotton 1998).

HABITAT

Assessment

Studies of sheep habitat assessment or carrying capacity have not been conducted in the Wrangell Mountains.

CONCLUSION AND RECOMMENDATIONS

Historically, the Dall sheep in the Wrangell Mountains were considered abundant and the population seemed productive. Population estimates, however, were difficult to obtain because of the expense and logistical problems with conducting surveys throughout the Wrangell Mountains. Early population estimates were based on surveys conducted over a period of years. The current population estimates of between 17,000 and 27,000 sheep obtained by the NPS represent the best total count figures available to date for the entire Wrangell Mountains. The northern portion of the Wrangell Mountains is in Unit 12. A population estimate of 5071 (±137) was obtained for the portion of the Wrangell Mountains in Unit 11 by the NPS during 1992 (Strickland et al. 1993).

Annual sheep surveys have been difficult to maintain in Unit 11 due to budget constraints. Surveys have been conducted in years when funding was available but unfortunately yearly continuity was lost, especially from 1990–1992. In the future, an emphasis should be placed on

maintaining annual counts of at least 3 count areas to provide yearly production and survival estimates for lambs in various regions of the Wrangells.

Population trends are difficult to determine from trend counts when they are completed infrequently and when only 1 small area is counted with any degree of consistency. Even though there are limited data, we can conclude sheep numbers have declined in the western portion of Unit 11 extending from Long Glacier to at least the slopes of Mt. Drum. Additional trend count data from CA's 22 and 12 do not suggest that sheep numbers declined as dramatically unitwide. However, local fluctuations have occurred as evidenced by a large decline in the Crystalline Hills. The decline in the Crystalline Hills could be partially due to movement of sheep from that isolated group of mountains, but without funding to survey the contiguous mountains to the north we simply do not know for sure.

Available composition data indicate a period of reduced lamb production and survival along the slopes of Mt. Drum and extending eastward at least to the Kennicott Glacier. The 1993 survey data from the Hawkins Glacier indicate lamb production and/or survival was higher in the eastern portion of Unit 11. Snow survey records for the Copper River Basin show a period of severe winters with deep snow conditions from 1990–1995. Severe winter conditions and increased predation could decrease lamb production or survival. Unfortunately, sheep survey data are not available for 1990–92 when the winters were the worst. Recent winters have been more moderate.

The number of large or mature rams harvested in Unit 11 peaked in 1991, then declined. Ewe harvests increased from the initial opening of the season in 1990 until 1992, then declined. Ewe and small ram harvests have been stable during the last few years. The decline in the ram harvest is probably a result of fewer numbers of full-curl rams present in the population and available for hunters. Poor production or survival of lambs in the 1990s likely contributed to this lack of rams. Despite a decline in the harvest, the opportunity still exists to take large, mature rams.

The number of sheep hunters going afield in Unit 11 during this reporting period was similar to the previous reporting period. One factor limiting nonresident participation is that a guide is required to hunt sheep. Nonlocal Alaskan residents harvested over half the sheep taken, followed by local residents, then nonresidents.

The impact of wolf predation on overall sheep numbers is unknown. Incidences of surplus killing of sheep by wolves have been documented in Unit 11. Reported incidental observations of wolf predation on sheep in Unit 11 are relatively common. Since the Mentasta Caribou herd has declined, availability of alternate prey for predators may be limited, and wolves may have become more reliant on resident sheep populations for food. Research is needed to determine the exact level and influence wolves and other predators such as coyotes and Golden eagles have on sheep abundance.

At this time, no changes in season dates or bag limits are recommended. The department should, however, continue to monitor harvests of mature and immature rams and ewes. Also, we need to emphasize maintaining composition trend counts, especially since there is a ewe harvest. The current subsistence harvest of ewes and small rams is currently low and widely dispersed,

although more hunting pressure occurs in areas accessible by transportation means other than aircraft. To date, I find no evidence that a low level ewe and small ram harvests have affected sheep abundance in Unit 11.

LITERATURE CITED

McDONALD, L. L., D. STRICKLAND, D. TAYLOR, J. KERN, AND K. JENKINS. 1990. Estimation of Dall sheep numbers in the Wrangell-St. Elias National Park, National Park Service, Alaska Region, Anchorage, AK. 26pp.

———. 1991. Estimation of Dall sheep numbers in the Wrangell-St. Elias National Park, National Park Service, Alaska Region, Anchorage, AK. 26pp.

SCOTTON, B. D. 1998. Timing and causes of Dall sheep lamb mortality in the Central Alaska Range. M.S Thesis, University of Montana, Missoula. 44pp.

STRICKLAND, D., L.L. McDONALD, J. KERN, AND K. JENKINS. 1992. Estimation of Dall sheep numbers in the Wrangell-St. Elias National Park, National Park Service, Alaska Region, Anchorage, AK. 30pp.

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Table 1 Unit 11 summer aerial sheep composition counts and estimated population size, 1970–98

Regulatory Year	Full Curl	(%)	¾ Curl[c]	½-3/4 Curl	< ½ Curl	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep observed	Estimated population size
COUNT AREA 11 – DADINA											
1981	24	4%	48	--	--	359	126	23%	168.8	557	557
1983	12	3%	59	--	--	283	60	14%	118.3	414	414
1986	52	9%	71	--	--	330	106	19%	192.8	559	414
1989	28	8%	24	--	--	231	78	22%	109.4	361	361
1993	25	9%	36	--	--	172	35	13%	76.6	268	268
1994	18	6%	21	--	--	197	85	26%	84.5	321	321
1995	9	3%	18	--	--	237	83	24%	102.0	347	347
1996	8	3%	31	--	--	169	46	39%	79.4	254	254
1997	8	3%	41	--	--	198	50	17%	110	297	297
1998	7	4%	42	--	--	109	26	14%	55.8	184	184
COUNT AREA 12 – LONG GLACIER TO KUSKULANA											
1973	51	12%	--	--	--	---	47	11%	---	410	410
1981	26	5%	52	--	--	359	129	23%	---	566	566
1982	60	12%	49	--	--	341	64	12%	111.7	514	514
1983	65	13%	67	--	--	290	68	14%	122.5	490	514
1993	36	6%	67	--	--	426	39	7%	145.6	568	568
1996	37	6%	113	--	--	346	105	17%	88.5	602	602
1998	36	8%	96	--	--	242	75	17%	89.8	449	449

Table 1 Continued

Regulatory Year	Full Curl	(%)	3/4 Curl[c]	1/2-3/4 Curl	< ½ Curl	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep observed	Estimated Population size
COUNT AREA 14 – CRYSTALLINE HILLS											
1980	2	1%	5	--	--	142	60	29%	90.9	209	209
1993	13	10%	8	--	--	85	18	15%	103.3	124	124
1994	5	6%	12	--	--	56	6	8%	79.0	79	79
1996	5		14	--	--	44	13	17%	76.0	76	76
COUNT AREA 22 – HAWKINS GLACIER											
1970	35	14%	13	--	--	131	61	25%	--	246	246
1981	27	11%	28	--	--	143	51	20%	71.1	249	249
1984	33	14%	34	--	--	125	43	18%	94.0	235	235
1993	20	7%	31	--	--	190	63	21%	86.9	304	304
1994	14	5%	15	7	7	191	32	12%	n/a	266	266
1998	21	7%	11	12	1	213	47	15%	n/a	305	305

[a]Legal rams included under "Full-curl" column, Sublegal rams included under "3/4 curl" column. Prior to 1989, 7/8ths curl horn or larger were legal. After 1989, full-curl horn or larger were legal for sport hunting, and for subsistence hunting, any ram was legal.
[b]Includes yearlings of both sexes and rams of ¼ curl or less.
[c]Includes all rams ¾-curl or less.

Table 2 Unit 11 Wrangell Mountains sheep harvest, 1993–97

Regulatory Year	Rams[a]	Average Horn Length (in)[b]	%≥ 40 in	Ewes	Total[c] Sheep
1993/94	122	36.1	9	21	143
1994/95	96	35.8	10	18	114
1995/96	92	36.0	16	19	111
1996/97	126	36.0	5	15	141
1997/98	99	35.8	13	14	113

[a] Prior to 1989, rams with 7/8-curl horns or larger were legal for sport hunting. Beginning in 1989, rams with full-curl horns or larger were legal for sport hunting and any sheep was legal for subsistence hunting.

[b] Average of only "legal " rams.

[c] Includes sheep not classified as to sex.

Table 3 Unit 11 Wrangell Mountains harvest numbers for adult rams and average horn lengths, 1993–97

	1993/94		1994/95		1995/96		1996/97		1997/98	
Region	*n*	Average Horn Length	*n*	Average horn length	*n*	Average Horn Length	*n*	Average horn length	*n*	Average horn length
Eastern	40	37.5	36	36.8	34	36.3	55	36.8	37	37.1
Middle	35	35.1	29	35.2	28	36.6	29	36.1	18	36.0
Western	10	32.1	15	34.2	14	33.7	18	35.1	10	33.9
Unknown	1	39.0	0	--	1	33.0	4	36.3	7	37.5
Total	86	36.0	80	35.8	77	35.9	106	36.3	72	36.4

[a] Includes only those rams for which horn length was reported on harvest.

Table 4 Unit 11 Wrangell Mountains sheep hunter residency and success, regulatory years 1993–97 through 1997–98

Regulatory Year	Successful					Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Non-resident	Total[b]	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total[b]	
1993/94	22	83	27	143	(39)	50	158	10	228	371
1994/95	22	64	26	114	(31)	43	195	12	255	369
1995/96	28	57	26	111	(38)	50	117	9	180	291
1996/97	26	72	37	141	(45)	42	124	15	174	315
1997/98	24	53	19	100	(40)	47	98	13	152	252

[a]Includes residents of Unit 11, eastern Unit 13, and southwestern Unit 12.
[b]Includes unspecified residency.

Table 5 Unit 11 Wrangell Mountains sheep hunting effort[a], 1993–97

Regulatory year	Successful hunters			Unsuccessful hunters			Total hunters		
	No. hunters	Total days	Average days	No. hunters	Total days	Average days	No. hunters	Total days	Average days
1993/94	143	645	4.5	228	978	4.3	371	1714	4.6
1994/95	111	580	5.2	252	1,213	4.8	363	1793	4.9
1995/96	111	499	4.5	180	927	5.2	291	1426	4.9
1996/97	140	699	5.0	167	888	5.3	307	1587	5.2
1997/98	100	526	5.3	148	781	5.3	248	1307	5.3

[a]Includes only those hunters reporting numbers of days hunted on their report.

Table 6 Unit 11 Wrangell Mountains sheep harvest chronology percent by harvest periods, 1993–97[a]

Regulatory year	Harvest periods							
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	n[a]
1993/94	21	32	10	11	12	9	5	142
1994/95	25	25	10	10	16	7	7	104
1995/96	26	21	15	12	12	10	5	111
1996/97	7	37	12	6	23	8	6	132
1997/98	36	6	21	18	9	9	0	96

[a]Includes only reports with date of kill.

Table 7 Unit 11 Wrangell Mountains sheep harvest percent by transport method, 1993–97

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3-or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	n
1993/94	38	2	8	15	0	4	32	1	143
1994/95	35	12	10	21	0	4	18	0	114
1995/96	43	7	9	16	0	3	20	2	111
1996/97	50	6	4	17	0	3	18	1	141
1997/98	54	4	5	17	0	2	17	1	100

LOCATION

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

GEOGRAPHIC DESCRIPTION: Chugach Mountains

BACKGROUND

Large numbers of miners, railroad workers, and market hunters probably decimated Dall sheep populations in accessible areas between Turnagain Arm and the Knik River beginning around 1900. During a thorough aerial survey of 29,000 mi^2 of potential sheep range in 1949, biologists discovered that the number of sheep in Alaska had declined to approximately one-quarter of that estimated 9 years earlier (Scott et al. 1950). Sheep populations in the Chugach, Talkeetna, and Kenai Mountains were estimated at 600, 300, and 350 animals, respectively. The statewide population decline was attributed primarily to several severe winters, but in accessible areas illegal hunting was also a major factor.

Systematic aerial surveys have been conducted sporadically in the Chugach Mountains since 1949. In 1951, 477 sheep were estimated between Turnagain Arm and the Knik River (now Unit 14C) and 185 between the Knik River and Matanuska Glacier (now Unit 14A and a portion of 13D). Current sheep populations in Unit 14C are nearly 5 times higher than in 1951.

Sport hunting was not considered to have had much influence on sheep populations in the Territory. However, the annual harvest reported to the U.S. Fish and Wildlife Service was 3–4 times higher in the mid-1940s, compared to a decade earlier, increasing from about 200/yr to 600/yr (Scott et al. 1950). Beginning in 1942, the bag limit was reduced from 2 or 3 rams in various areas to 1 ram. Hunting pressure was heaviest near human settlements, and accessible ranges near Anchorage were closed to sheep hunting about this time to protect sheep that otherwise might have been hunted out (Scott et al. 1950). The sheep hunting season was reopened in 1961, except for the Rainbow Closed Area, which extended along Turnagain Arm from Potter to Girdwood.

In 1968 the sheep habitat bounded by the Knik River, Turnagain Arm, Lake George, and the Twentymile River was established as the West Chugach Controlled Use Area. No motorized vehicles, other than boats and airplanes, were allowed for hunting or transporting game in this area during the sheep hunting season. In 1971 much of this area was incorporated in the Chugach State Park, which continued to allow sheep hunting in most of the park but prohibited all motorized access, except along the north side of Eklutna Lake. The bag limit for 3/4-curl rams was restricted to 7/8-curl rams in 1979. This regulation remained in effect for 10 years. Because of increasing demand for sheep hunting in Unit 14C, a drawing permit was instituted beginning in 1982 to maintain the number of large rams and uncrowded hunting conditions.

As the number of sheep increased through the 1980s, managers became concerned about exceeding the carrying capacity of the range. Sheep populations appear to be regulated primarily by deep snow and ice cover. However, if overabundant sheep deplete vegetation on winter

ranges, subsequent severe snow and ice conditions could have an even greater effect. Consequently, the bag limit was changed to "any sheep" in 1989 to better control the population through ewe harvests. This regulation remained in effect through 1995. Beginning in 1996 the bag limit for non-archery drawing permits became either full-curl ram/ewe or ewe-only.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

Maintain a minimum harvest of 120 full-curl or larger rams.

METHODS

Activities accomplished for 1996–1997 included summer aerial sex and age composition surveys; identification and documentation of critical sheep habitat, mineral licks, and lambing areas; and monitoring the number and horn size of harvested sheep as well as harvest location. Aerial sex and age composition surveys were completed in Unit 14C in 1996 and 1997. The most recent, although partial, surveys in Unit 14A and Unit 13D were flown in 1995 and 1997.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

An estimated 6000–7000 sheep inhabit the Chugach Mountains, including about 400 in Unit 11. An estimated 1000–1200 and 2500 sheep inhabit Units 14A and 14C, respectively (Tables 1 and 2). It is difficult to estimate the Unit 13D population based on partial aerial surveys in 1993, 1994, and 1997 (Table 3). Assuming, however, a Dall sheep population can sustain an annual harvest of full-curl rams that is 3% of the total population, Unit 13D may have as many as 2000–3000 sheep.

Sheep numbers in the western Chugach Mountains (Unit 14C) have remained relatively stable (2200–2600 sheep) since 1987 (Table 2). The Unit 14A population is believed to have increased slightly, while the total number of sheep observed increased over 50% in count areas repeated between 1992 and 1995. The status of the sheep population in Unit 13D is uncertain because no extensive aerial surveys have been conducted (Table 3). However, considering recent severe winters and data from limited surveys, numbers of sheep have probably declined 15–20% since the late 1980s in most of the Unit 13D portion of the range.

Population Composition

Since 1994 the percentage of full-curl and larger rams in Unit 14C has ranged from 4–6%. The percentage of lambs has ranged from 13–22%, probably reflecting winter conditions. Numbers of ewes and yearling rams remain high, slightly over one-half of the total population.

The number of full-curl rams in Units 13D and 14A appeared to be about 6–11% of total sheep observed. Lambs comprised 8–17% of the total population in both units.

Distribution and Movements

Sheep distribution and movements during the summer months have been documented by aerial surveys. Major late summer concentration areas have also been determined from harvest records and discussions with hunters. Although sheep were throughout the mountain range below the 7500 ft elevation, concentrations vary greatly among drainages. In Unit 14C the Eagle River and Eklutna-Goat Creek drainages supported the largest numbers of sheep. In Unit 14A moderate numbers of sheep frequented the upper reaches of Coal, Carbon, Carpenter, Wolverine, Metal, and Friday creeks. In Unit 13D, sheep were most abundant between the Nelchina and the Klutina Glaciers.

Little is known about winter distribution patterns except that most sheep frequent relatively snow-free areas and windblown ridges above the 3000 ft elevation. Lambing areas are widely scattered and are usually located near precipitous terrain with a southern exposure. Major rutting areas are unknown.

Infrequent ground-based observations in the Unit 14A portion of the range indicate 2 important sites of winter and lambing range. Wolf Point in the Knik River drainage between Friday Creek and Falls Creek appears to provide important winter habitat and lambing range. As high as 10% of the subpopulation have been observed in winter and early spring using this wind-blown cliff complex. Sheep have been observed grazing in the sedge meadow in the valley floor adjacent to the cliff. The second important location is the cliff complex above Mud Lake southeast of McRoberts Creek. During spring lambing over 100 sheep have been observed feeding and resting. This site is recovering from a 20–30-year-old burn and provides abundant early spring feed and escape cover. Recent road improvement by the Mat-Su Borough brings highway and recreational vehicles very near the base of this cliff complex, providing excellent sheep viewing opportunities. However, an informal shooting range is also developing at the site. While disturbance by firearm discharge may have some impact, temptation for the shooters is high with a number of sheep visible at low elevation behind the target area.

MORTALITY

Harvest

Seasons and Bag Limits. In Units 13D and 14A the season was from 10 August to 20 September. The bag limit was 1 ram with full-curl horn or larger.

In Unit 14C, the Eklutna Lake Management Area, the season was from the day after Labor Day to 30 September. The bag limit was 1 sheep by drawing permit only and by bow and arrow only.

In the remainder of Unit 14C the season was 10 August to 31 October, and the bag limit was either 1 full-curl ram or ewe or 1 ewe by drawing permit only. A late season (1–10 October) archery-only hunt had a bag limit of 1 sheep by drawing permit only.

Board of Game Actions and Emergency Orders. In the spring of 1989, the Board of Game passed a regulation requiring all sheep taken in the Chugach Mountains have horns full-curl or larger, except in Unit 14C where the bag limit was changed to "any sheep" under a drawing permit. The

rationale, supported by the department, for the full-curl regulation was to increase the number of large rams and improve productivity.

The "any sheep" bag limit in Unit 14C was intended to stabilize growth of the large population. The sheep population remained large, however, because many sheep hunters were looking for large rams and were unwilling to shoot ewes. Hunters who were interested in harvesting a sheep only for its meat were unlikely to apply for a permit because of the low odds of being selected (2–4%). Few ewes were harvested under the "any sheep" regulation. Unable to find a large ram, some permittees settled for young rams. From 1990–1994, hunters in Unit 14C shot 67 rams with horns less than 7/8-curl; i.e., 20% of all rams harvested. Taking young rams reduced the future number of large rams, without helping to control the population.

Therefore, the board established 2 kinds of drawing permits for Unit 14C, beginning in 1996. Up to 250 permits allow a hunter to take 1 full-curl ram or 1 ewe. A bag limit of 1 ewe only for up to an additional 150 permits was also established. This should ultimately increase the number of rams with full-curl or larger horns in the population and allow greater opportunity to control population growth.

In 1996 the Legislature amended Alaska Statute 16.05.343 that allows nonprofit organizations to raffle or auction state hunting permits to provide money for wildlife research and management. The Alaska Chapter of the Foundation for North American Wild Sheep (FNAWS) applied for a Dall sheep drawing permit in Unit 14C that was auctioned at the FNAWS national meeting in 1997. The winning bid was $200,000, and the permittee chose not to shoot a sheep. About 20% of the bid was divided among the national and local chapters of FNAWS; the remainder $160,000 has been donated to sheep research in Alaska.

Hunter Harvest. The mean annual harvest for 1996 and 1997 was 152 sheep, compared to 184 sheep in 1994–95 (Tables 4-9). The lower harvest was the result of lower success rates in Units 13D and 14C. The number of sheep hunters throughout the Chugach Mountains in 1996 and 1997 was 618 and 589, respectively. Illegal harvest is unknown.

Permit Hunts. From 1991–1993, 240 drawing permits and 105 archery-only drawing permits were issued in Unit 14C (Table 6). Fewer non-archery drawing permits were issued in 1994 (190) and 1995 (211). However, by 1996 the number of non-archery drawing permits was slightly higher than during 1991–1993. Success rates from 1993 to 1995 were 30–36%. Success rates dropped considerably in 1996 and 1997, probably because some ram permits were replaced with ewe-only permits, and hunters were less motivated. Since 1993, harvests have ranged from 66 to 82 sheep (Table 6).

Hunter Residency and Success. In Units 14A and 14C, nonresident hunters have taken 63 of 485 sheep (13%) during the past 5 years (Tables 7 and 8). In Unit 13D, nonresidents composed 48% (171 of 354) of all successful sheep hunters over the past 5 years (Table 9). Most sheep hunters in Units 14A and 14C were residents of Unit 14; whereas, only 2–3% of Unit 13D sheep hunters were residents of Unit 13.

Harvest Chronology. Harvest chronology for the nonpermit hunts was influenced by weather patterns and fluctuated slightly from year to year (Table 10). Typically, 30–50% of the harvest occurs during the first week of the season; 10–20% of the sheep are taken during each of the second and third weeks of the season.

Transport Methods. Methods of transport used by sheep hunters differed widely in the units, because of motorized access restrictions in Chugach State Park and proximity of roads. In Unit 13D most of the successful hunters used aircraft, 13–18% used highway vehicles and 5–15% used horses (Table 11). In Unit 14A the largest proportion of successful hunters used aircraft, and the proportion using aircraft increased in 1996 and 1997 (Table 12). Transport methods in Unit 14C have not changed substantially during the past 5 years. Approximately two-thirds of all successful hunters used highway vehicles in Unit 14C (Table 13).

Other Mortality

Dall sheep natural mortality is seldom documented in the Chugach Mountains. However, in areas where annual counts occur and the population remains stable from year to year, natural mortality, including predation, is almost equal to the lamb increment minus hunting mortality. Lambs, yearlings, and old rams are most susceptible to natural mortality. Levels of predation by wolves, coyotes, bears, wolverines, and golden eagles are unknown.

In the last decade, the sheep population has been affected by a series of harsh winters. During the severe winters of 1989–90 and 1992–93, roughly 450 and 500 sheep died in Unit 14C, respectively. These were the largest winter mortalities on record. Apparently the Unit 13D population declined 15–20% as a result of severe winter weather in 1989–90 and 1990–91, and subsequent harsh winters have apparently delayed recovery.

HABITAT

Assessment

Techniques for evaluating sheep winter range in Alaska have not been developed. Snow depth and hardness, rather than range quality or quantity, may be the primary determinants of winter mortality. In 1998 the FNAWS began funding a research project (University of Alaska, Anchorage) to conduct an assessment of sheep winter range in Chugach State Park.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Unit 14C was stable at 2200–2600 during the mid-1990s. Winter mortality among lambs and old ewes on crowded winter range may prevent the population from increasing further. Numbers of full-curl or greater rams decreased for several years as smaller cohorts of young rams reached maturity. However, the new full-curl and ewe permits should allow numbers of large rams to increase slightly, winter weather permitting.

The status of the Unit 13D population is uncertain, but the Unit 14A population increased slightly.

The harvest objective of a minimum of 120 full-curl or larger rams for the Chugach Mountains was exceeded in 1996 (127), but not in 1997 (115). In addition to full-curl rams, 61 sheep, including 10 rams with 7/8-curl or less horns and 51 ewes, were taken in Unit 14C in 1996 and 1997. The objectives of the ewe-only permits in Unit 14C were to (1) increase harvest of ewes; (2) decrease harvest of young rams, and (3) maintain harvest of full-curl rams, after an interim period of lower than usual harvests. The take of full-curl rams is still low in Unit 14C, but the number of ewes harvested is twice that of 1994 and 1995 (26 total), and the number of young rams harvested in 1996 and 1997 (10 total) is considerably less than the 68 harvested in 1994 and 1995.

A thorough survey of all sheep habitat in the Chugach Mountains is needed to determine the overall population level. Depending on how many sheep are found in Units 13D and 14A, it may be appropriate to increase the harvest objective.

LITERATURE CITED

SCOTT, R. F., E. F. CHATELAIN, AND W. A. ELKINS. 1950. The status of the Dall sheep and caribou in Alaska. North American Wildlife Conference 15:612–626.

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Table 1 Chugach Mountains, Unit 14A sheep composition counts and estimated population size, 1992–1997

Regulatory year	Rams		Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal					
1992/93	25(3)	160	503	176(20)	72	867	900–1000
1993/94[c]	--	--	--	--	--	--	--
1994/95[c]	--	--	--	--	--	--	--
1995/96[d]	15 (10)	27	77	24 (17)	31	143	1000–1200
1996/97[c]	--	--	--	--	--	--	--
1997/98[c]	--	--	--	--	--	--	--

[a] Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed.

[b] Includes yearlings of both sexes and rams of 1/4-curl or less.

[c] No survey.

[d] Count areas A, B, and portion of C only; data collected during mountain goat survey (during 1992 the same area produced 5 legal rams, 22 sublegal rams, 38 ewes, and 16 lambs for a total of 81 sheep.)

Table 2 Chugach Mountains, Unit 14C aerial sheep composition counts and estimated population size, 1993–1997

Regulatory year	Rams		Ewes[a]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
	≥ 7/8 curl (%)	1/2 to 3/4-curl					
1993/94	203 (10)	360	1,200	259 (13)	--	2,022	2,200
1994/95	298 (13)	337	1,291	329 (15)	--	2,255	2,500
1995/96[b]	--	--	--	--	--	--	2,500
1996/97	228 (9)	381	1,262	538 (22)	--	2,430	2,600
1997/98	253 (11)	403	1,243	326 (15)	--	2,286[c]	2,500

[a] Includes yearlings of both sexes and rams of 1/4-curl or less.
[b] No survey due to inclement weather.
[c] Total includes 61 unclassified sheep.

Table 3 Chugach Mountains, Unit 13D sheep composition counts and estimated population size, 1993–1997

Regulatory year	Rams		Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal					
1993/94[c]	7 (6)[d]	6	--	13 (11)[d]	21	159[e]	--
1994/95[f]	20 (11)	51	95	14 (8)	180	180	--
1995/96[g]	--	--	--	--	--	--	--
1996/97[h]	--	--	--	--	--	--	--
1997/98	106 (9)	170	728	178 (15)	--	1,182	2,000-3,000

[a] Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed.
[b] Includes yearlings of both sexes and rams of 1/4-curl or less.
[c] Tonsina Controlled Use Area (count areas 11, 12, and 13).
[d] Percent of classified sheep only.
[e] Minimum count, due to inclement weather conditions and poor visibility; most sheep were not classified.
[f] Count area 5.
[g] No survey.
[h] Count areas 1-5, 7 and Tonsina Controlled Use Area (count areas 11–13).

Table 4 Chugach Mountains, Unit 13D sheep harvest, 1993–1997

Regulatory year	Rams	Average horn length (in)	% ≥ 40 in	Ewes	Total sheep
1993/94	62	37.1	11	1	62
1994/95	86	36.7	7	2	88
1995/96	80	37.4	18	1	81
1996/97	60	37.4	20	0	60
1997/98	54	37.7	9	0	54

Table 5 Chugach Mountains, Unit 14A sheep harvest, 1993–1997

Regulatory year	Rams	Average horn length (in)	% ≥ 40 in	Ewes	Total sheep
1993/94	25	34.9	8	0	25
1994/95	29	36.1	14	0	29
1995/96	19	37.1	21	0	19
1996/97	28	36.4	11	0	28
1997/98	23	37.3	22	0	23

Table 6 Chugach Mountains, Unit 14C sheep harvest data by permit hunt, 1993–1997

Hunt area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Rams	Horn length (inches)[a]	% rams ≥ 40 in.	Ewes (%)	Unk	Total harvest
DS124-129[b]	1993/94[c]	111	26	61	39	24	35.4	8	8 (25)	0	32
Northeast,	1994/95	42	29	47	53	18	38.2	28	0 (0)	0	18
East Eklutna	1995/96	54	30	58	42	16	37.4	19	0 (0)	0	16
	1996/97	74	31	57	43	16	38.7	31	6 (27)	0	22
	1997/98	71	32	73	27	10	37.3	10	3 (23)	0	13
DS130-135[d]	1993/94[e]	33	30	74	26	5	36.3	0	1 (17)	0	6
Northwest,	1994/95	72	19	57	43	17	29.1	6	6 (26)	2	25
Upper	1995/96	90	21	58	42	25	30.6	0	5 (17)	0	30
Eagle River	1996/97	86	26	78	22	8	37.9	13	6 (43)	0	14
	1997/98	86	28	61	39	13	35.6	0	11 (46)	0	24
DS136-138[f]	1993/94	69	26	63	37	17	35.1	0	2 (11)	0	19
Southwest	1994/95	48	21	55	45	17	32.1	6	0 (0)	0	17
	1995/96	39	21	39	61	14	33.8	0	5 (26)	0	19
	1996/97	44	27	53	47	7	36.3	0	8 (53)	0	15
	1997/98	53	17	68	32	10	37.0	10	4 (29)	0	14
DS139[g]	1993/94	27	30	74	26	4	37.2	0	1 (20)	0	5
West	1994/95	28	18	87	13	3	30.6	0	0 (0)	0	3
(late season	1995/96	28	18	78	22	3	33.7	33	2 (40)	0	5
--rifle)	1996/97	70	37	73	27	6	34.3	0	0 (0)	0	12
	1997/98	70	41	83	17	4	35.0	0	3 (43)	0	7

Table 6 Continued

Hunt area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Rams	Horn length (inches)[a]	% rams ≥ 40 in.	Ewes (%)	Unk	Total harvest
DS140	1993/94	80	42	87	13	1	31.0	0	5 (83)	0	6
West	1994/95	80	29	93	7	3	31.3	0	1 (25)	0	4
(late season	1995/96	80	36	82	18	6	29.3	0	3 (33)	0	9
--archery)	1996/97	80	28	90	10	3	28.4	0	3 (50)	0	6
	1997/98	80	31	94	6	3	35.8	0	0 (0)	0	3
DS141	1993/94	25	20	75	25	2	--	0	3 (60)	0	5
West Eklutna	1994/95	25	28	94	6	0	--	--	1(100)	0	1
(archery)	1995/96	25	36	81	19	2	10.0	0	1 (33)	0	3
	1996/97	25	24	84	16	2	28.6	0	1 (33)	0	3
	1997/98	25	28	72	28	5	35.5	0	0 (0)	0	5
Total all	1993/94	345	30	70	30	53	35.4	4	20 (27)	0	73
hunt areas	1994/95	295	24	70	30	58	33.0	12	8 (12)	2	68
	1995/96	316	27	64	36	66	32.3	6	16 (20)	0	82
	1996/97	379	29	73	27	42	36.3	14	30 (42)	0	72
	1997/98	385	30	75	25	45	36.3	4	21 (32)	0	66

[a] Mean length of longest horn on rams with 7/8-curl or larger horns.
[b] Beginning in 1996/97, hunt area includes ewe-only hunts (DS 121–122).
[c] Includes Peters and Thunderbird creek drainages.
[d] Beginning in 1996/97, hunt area includes ewe-only hunts (DS 111–112).
[e] Upper Eagle River only.
[f] Beginning in 1996/97, hunt area includes ewe-only hunts (DS 117–118).
[g] Beginning in 1996/97, hunt area includes ewe-only hunts (DS 119–120).

Table 7 Chugach Mountains, Unit 14A sheep hunter[a] residency and success, regulatory years 1993–1997 through 1997–98

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Total hunters
1993/94	22	0	3	25 (22)	82	5	1	91 (78)	116
1994/95	23	0	6	29 (26)	78	3	1	82 (74)	111
1995/96	16	1	2	19 (15)	97	6	3	107 (85)	126
1996/97	21	1	6	28 (21)	93	5	2	105 (79)	133
1997/98	14	1	8	23 (21)	82	0	3	89 (79)	112

[a] Excludes hunters in permit hunts.
[b] Local means residents of Unit 14.
[c] Total may exceed sum because some hunters fail to report residency.

Table 8 Chugach Mountains, Unit 14C sheep hunter[a] residency and success, 1993–1997

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Total hunters
1993/94	63	3	4	73 (30)	149	15	2	168 (70)	241
1994/95	50	7	10	68 (30)	141	13	1	156 (70)	224
1995/96	60	15	7	82 (36)	127	14	6	148 (64)	230
1996/97	51	9	7	72 (27)	170	21	0	196 (73)	268
1997/98	47	8	10	66 (24)	180	21	4	205 (76)	271

[a] Excludes hunters in permit hunts.
[b] Local means residents of Unit 14.
[c] Total may exceed sum because some hunters fail to report residency.

Table 9 Chugach Mountains, Unit 13D sheep hunter[a] residency and success, 1993–1997

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Total hunters
1993/94	2	38	19	62 (34)	13	85	17	118 (66)	180
1994/95	3	39	40	88 (36)	14	120	20	159 (64)	247
1995/96	2	27	51	81 (37)	10	108	18	137 (63)	218
1996/97	0	29	30	69 (28)	7	122	22	157 (72)	217
1997/98	3	18	31	54 (26)	13	107	28	152 (74)	206

[a] Excludes hunters in permit hunts.
[b] Local means residents of Unit 13.
[c] Total may exceed sum because some hunters fail to report residency.

Table 10 Chugach Mountains, Units 13D and 14A sheep harvest chronology percent by harvest period, 1993–1997

	Harvest periods						
Regulatory year	8/10 - 8/16	8/17 - 8/23	8/24 - 8/30	8/31 - 9/6	9/7 - 9/13	9/14 - 9/20	*n*
1993/94	42	11	15	9	12	12	93
1994/95	52	12	13	8	10	5	112
1995/96	32	17	17	13	10	10	99
1996/97	44	12	14	13	9	9	87
1997/98	39	15	12	16	11	8	75

Table 11 Chugach Mountains, Unit 13D sheep harvest percent by transport method, 1993–1997

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1993/94	65	5	5	6	0	0	18	2	62
1994/95	64	9	9	0	0	3	13	2	88
1995/96	67	5	7	6	0	0	14	1	81
1996/97	52	13	3	3	0	2	25	2	60
1997/98	48	15	11	7	0	2	17	0	54

Table 12 Chugach Mountains, Unit 14A sheep harvest percent by transport method, 1993–1997

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1993/94	28	10	10	17	0	3	28	3	29
1994/95	35	3	17	21	0	3	17	3	29
1995/96	53	16	5	5	0	0	21	0	19
1996/97	50	4	14	7	0	4	21	0	28
1997/98	57	4	4	22	0	0	13	0	23

Table 13 Chugach Mountains, Unit 14C sheep harvest percent by transport method, 1993–1997

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1993/94	11	0	3	12	0	3	69	3	73
1994/95	6	3	1	15	0	1	72	1	68
1995/96	5	0	6	11	0	0	72	6	82
1996/97	10	0	13	2	0	0	70	5	67
1997/98	6	0	6	14	0	2	66	6	65

LOCATION

GAME MANAGEMENT UNIT: Portions of 12 (10,000 mi^2)

GEOGRAPHIC DESCRIPTION: Mentasta, Nutzotin, and northern Wrangell Mountains

BACKGROUND

The Dall sheep population in the northern Wrangell, Mentasta, and Nutzotin Mountains (WMN) traditionally lives at relatively high densities in rugged, glaciated habitats. The WMN Mountains sheep population produces rams with horns that are smaller than average, compared to other sheep populations in Alaska (Heimer and Smith 1975). The relative abundance of sheep and production of rams with relatively small horns indicates that conservative harvest for maximum trophy production would be an unsuitable management strategy for consumptive use in this area (Kelleyhouse and Heimer 1989). Consequently, the management objective for Unit 12 is to provide the greatest opportunity to participate in hunting sheep. No restrictions beyond limiting harvest to full-curl rams during the fall hunting season and requiring hunting licenses and harvest tickets are applied in Unit 12 (excluding the Tok Management Area). The evolution of these restrictions was presented in Kelleyhouse and Heimer (1989).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the sheep population and its habitat in concert with other components of the ecosystem.

- Provide for diversified human recreational use of sheep in the WMN Mountains.

MANAGEMENT OBJECTIVES

- Provide the greatest level of sustainable annual opportunity to participate in hunting Dall sheep

- Provide the greatest level of sustainable annual harvest of Dall sheep.

RELATED MANAGEMENT ACTIVITY

Monitor harvest through hunter contacts and harvest reports.

METHODS

We monitored harvest through harvest report cards. We collected data on harvest success, hunt area, hunter residence and effort, transportation type used to access the hunt area, and animal horn size and age. Annual numbers of hunters and numbers of rams harvested were compared using *t*-tests. Harvest data were summarized by regulatory year (RY = 1 July–30 June); therefore, it covers portions of 2 calendar years.

Population composition was estimated by aerial survey in the Wrangell-St Elias Preserve along the Nabesna and Chisana Rivers in July 1998 (2 different surveys) and in the Mentasta Mountain area in July 1997. Piper Super Cubs were used to conduct the 3 surveys. We classified sheep as rams, ewes, or lambs based on horn size and body conformation. Ewes included young rams that could not be distinguished from ewes. Rams were also classified as either legal (full-curl or both horns broomed) or sublegal.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Kelleyhouse and Heimer (1990) reported the Unit 12 sheep population increased between the late 1970s and mid-1980s and then stabilized about 1988. The population declined during the early 1990s due to adverse weather and possibly predation. Heimer (1988) hypothesized that Dall sheep populations tend toward stability in average prevailing climate conditions. During the late 1970s until the mid 1980s, weather conditions were primarily mild, but between 1990 and 1992 unfavorable summers (drought) and winters (deep snow and ice) prevailed. Lamb recruitment was low during this period, and the number of legal and sublegal rams declined (Table 1). Investigators, local long-term residents, and guides also believed the number of ewes declined. Based on wolf surveys and incidental sightings, predator numbers were relatively high, especially coyotes. Local residents observed coyotes killing lambs and older sheep. Climate conditions improved during 1994 and 1995 and incidental sightings made during caribou surveys indicated that lamb production improved to above 25 lambs/100 ewes. Population recovery continued through 1998 (Tables 1 and 2).

Population Composition

Composition data are not directly comparable between years because different areas were sampled each year (Tables 1 and 2). Factors that were consistent between areas were low lamb survival (9–19/100 ewes) during 1990–1993 and improved lamb survival during 1997 and 1998. No adult mortality data were collected in this area during 1990–1993, but based on our observations of radiocollared sheep, mortality was high in the adjacent Tok Management Area.

Weather, natural predation, and harvest management directly influence annual population composition (Heimer 1988). The changes in population composition in the WMN Mountains were probably due more to unfavorable weather and, secondarily, to predation rather than to harvest. Unfavorable weather conditions prevailed during summers 1990–1993 (drought), spring 1992 (deep snow and persistent ice conditions), and fall 1992 (very deep snow conditions). These conditions were severe enough that pregnancy rates were lower and early mortality higher in a sympatric caribou herd (ADF&G, unpublished data) in 1993. Herd condition was lower and the effects of predation higher during this period. During 1995–1997 weather conditions were favorable with below average snowfall and average to high rainfall. Judging by the physical condition, pregnancy rates, and calf survival found in the adjacent caribou herd, we believe this period was favorable for population growth.

Harvest had little impact on population composition. Hunter numbers declined between RY 1992–1993 and 1997–1998. Moreover, RY 1996–1997 and 1997–1998 harvests were the second and fourth lowest on record, and hunter success rates between RY 1992–1993 and 1994–1995 were the second, third, and fourth lowest recorded since 1972–1973 (Table 3). Composition survey data indicated that lamb recruitment was sufficiently poor to be the primary cause of reduced ram numbers. However, harvest probably reduced legal ram numbers in the eastern Mentasta Mountain (Table 2).

Distribution and Movements

There are no data that indicate distribution and movements were different than reported by Kelleyhouse and Heimer (1989).

MORTALITY

Harvest

Season and Bag Limit. The open season for residents and nonresidents was 10 August–20 September. The bag limit was 1 ram with full-curl horn or larger or with both horns broomed.

Board of Game Actions and Emergency Orders. The Board of Game took no actions and no emergency orders were issued during this reporting period.

Hunter Harvest. During the report period, 252–362 hunters ($\bar{x}$ = 315) reported taking 129–179 sheep ($\bar{x}$ = 157). The number of hunters and number of sheep harvested were below the previous 5-year means of 434 and 205, respectively (Table 4). Overall, harvest has declined since 1992, and hunter participation has declined since 1994. Winter 1992–1993 was severe and it was possible that many legal rams died. We know many older sheep died during this winter in the adjacent Tok Management Area.

Mean horn length was 34.6 inches, compared to the 5-year mean of 34.4 inches. Between 1.6 and 4.1% of the rams taken had horns >40 inches (3%). The mean reported age of harvested rams was 8.9 years. The previous 4-year average was 8.6 years. In contrast, in the Tok Management Area just north of the WMN Mountains, the percentage of the harvested rams >40 inches normally exceeds 10%, and the average annual age of harvested rams ranges between 8.9 and 10 years.

Hunter Residency and Success. During the report period, the average success rate was 50% (Table 3). Nonresident success rates (74–85%) were much higher than resident success rates (36–40%). One reason for the higher rates among nonresidents is that most of them were guided. During the report period, nonresidents composed 29% of the sheep hunters and were responsible for taking 45–47% of the annual harvest. Nonresident participation each year remained relatively constant. The decline in the number of sheep hunters since RY 1994–1995 was due to fewer local and other state residents (28 and 39% decline, respectively).

Historically, most harvest has occurred in the Little Tok River drainage, Boyden Hills-Upper Nabesna River, Mesa Lake, and Wiki Peak areas. During the report period hunters using all of

these areas, except the Boyden Hills-Upper Nabesna River area, experienced high success rates (55–85%). Our survey data mirrors hunter success closely; we found the greatest concentration of legal rams in these areas, except for the Boyden Hills-Upper Nabesna River area. Much of this area is accessible from the Nabesna Road and, consequently, is the most hunted area in Unit 12. During the 1997 survey, no legal rams were observed in the area most accessible from the road or the associated trails. During 1997, 25 hunters took only 3 rams (12%) in this area. Access into the remainder of this area is primarily by boat or airplane. Success rates in the more remote areas of Boyden Hills-Nabesna River were comparable to the remainder of the unit.

Harvest Chronology. Traditionally, in the WMN Mountains most sheep were taken early in the hunting season (Table 5). During the report period, 39–42% ($\bar{x}$ = 40%) of the harvest was taken during the first week of the season which was comparable to most years. Since almost half of the sheep were harvested by nonresidents who were mostly guided, harvest did not taper off as dramatically compared to most other areas in the state. Guides booked clients throughout the season, but most of the state residents hunted the first 10 days of the season.

Transport Methods. Airplanes and horses were the primary modes of transportation for successful sheep hunters (Table 6). During the report period, hunters using these methods took 77–79% of the harvest. Most of the guided hunters (>90%) used horses. Success rates for hunters using aircraft and horses ranged between 56–62% and 68–81%, respectively. Although many hunters used 4-wheelers or highway vehicles, their success was lower.

Other Mortality

We did no studies during this report period to determine changes in the rate or type of natural mortality from what was reported by Kelleyhouse and Heimer (1989).

HABITAT

Assessment

The WMN Mountains are glaciated and offer steep, rugged terrain with excellent escape cover near feeding areas dominated by *Dryas* spp. Human development has not substantially affected sheep habitat, and the present landownership pattern is expected to protect most habitat in the future.

CONCLUSIONS AND RECOMMENDATIONS

Management goals and objectives for Dall sheep in Unit 12 were met. Unit 12 continues to be the most hunted unit in the state for sheep, but the number of hunters has declined during the past 3 regulatory years, probably due to declining success. Declining harvests in the WMN Mountains during the report period were probably due to poor lamb recruitment and high adult mortality during the early 1990s. Harvest success was the lowest along the Nabesna Road, but because this area is readily accessible by hunters using highway vehicles or 4-wheelers, it continues to be intensively hunted. Unitwide harvest is expected to be low until 2001. Lamb recruitment has improved since 1994, and higher legal ram numbers are expected after year 2001.

The management goals and objectives need to be changed to better reflect current management and what is actually achievable. I recommend changing the management goal as follows: maintain a Dall sheep population and its habitat in concert with other components of the ecosystem. The management objectives would become: provide the greatest level of sustainable annual opportunity to participate in hunting Dall sheep; provide the greatest sustainable annual harvest of Dall sheep; and provide the opportunity to view and photograph Dall sheep under natural conditions. The local advisory committee supports these changes.

LITERATURE CITED

HEIMER WE. 1988. Toward a working hypothesis for mountain sheep management. Proceedings of the biennial symposium northern wild sheep and goat council. 6:39–46.

———, AND AC SMITH III. 1975. Dall ram horn growth and population quality and their significance to Dall sheep management in Alaska. Alaska Department of Fish and Game. Technical Bulletin 5. Juneau.

KELLEYHOUSE DG AND WE HEIMER. 1989. Mentasta, Nutzotin, and Northern Wrangell Mountains survey-inventory report. Pages 29–38 *in* SO Morgan, editor. Annual report of survey-inventory activities. Volume XIX. Sheep. Part II. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-21-3. Juneau.

———, AND ———. 1990. Mentasta, Nutzotin, and Northern Wrangell Mountains survey-inventory report. Pages 31–35 *in* SO Morgan, editor. Annual report of survey-inventory activities. Volume XX. Sheep. Part II. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-2. Juneau.

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Table 1 Unit 12 Dall sheep aerial composition counts within Wrangell-St Elias National Preserve, 1991–1998

Sex/age class	1991	1992	1993	1998 (East)	1998 (West)
Legal rams[a]	--	31	111	22	34
Sublegal rams[b]	--	140	544	110	117
Unclassified rams	--	30	0	0	0
Total rams	174	201	655	132	151
Ewes[c]	416	440	1323	373	470
Lambs	75	83	120	113	152
Unidentified	57	0	0	0	0
Total other sheep	548	523	1443	486	622
Total sheep	722	724	2098	618	773
Legal rams:100 ewes	--	7.1	8.4	5.9	7.2
Sublegal rams:100 ewes	--	31.8	41.1	29.5	24.9
Total rams:100 ewes	41.8	45.7	49.5	35.4	32.1
Lambs:100 ewes	18.0	18.9	8.9	30.3	32.3
Lambs % of total	10.4	11.5	5.7	18.3	19.7

[a] Full curl or larger.
[b] Greater than 1/4 curl but less than full curl.
[c] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 2 Unit 12 Dall sheep aerial composition counts in the Mentasta Mountains, 1971–1997

Sex/age class	1971[a]	1973[a]	1980[a]	1997[a,b]	1997[c,d]
Legal rams	78	141	112	70	47
Sublegal rams[e]	10	106	185	97	246
Unclassified rams	22	19	10	0	0
Total rams	110	266	307	167	293
Ewes[f]	555	537	754	692	811
Lambs	137	41	356	196	222
Unidentified	0	150	132	0	0
Total other sheep	548	728	1242	888	1033
Total sheep	1014	994	1549	1094	1326
Legal rams:100 ewes	14.1	26.3	14.9	10.1	5.8
Sublegal rams:100 ewes	--	19.7	24.5	14.0	30.3
Total rams:100 ewes	19.8	49.5	40.7	24.1	36.1
Lambs:100 ewes	24.7	7.6	47.2	28.3	27.4
Lambs % of total	13.5	4.1	23.0	17.9	16.7

[a] Legal size ram is ≥3/4 curl.
[b] Subset of total area surveyed in 1997 to be consistent with counts conducted during 1971–1980.
[c] Counts reflect sheep observed in entire 1997 survey area.
[d] Legal ram is ≥4/4 curl.
[e] Greater than 1/4 curl but less than legal size.
[f] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 3 Unit 12 sheep hunter residency and success, regulatory years 1990–1991 through 1997–1998

Regulatory year	Successful					Unsuccessful					Total hunters[b]
	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	
1990–1991	12	129	83	224	(52)	28	159	16	203	(48)	427
1991–1992	17	159	92	268	(55)	23	173	19	215	(45)	483
1992–1993	10	83	81	177	(43)	17	194	14	230	(57)	407
1993–1994	4	104	62	173	(39)	24	222	23	274	(61)	447
1994–1995	8	93	62	163	(44)	14	177	18	209	(56)	372
1995–1996	15	78	85	179	(49)	35	133	15	183	(51)	362
1996–1997	8	77	77	164	(50)	15	133	16	166	(50)	330
1997–1998	6	64	58	129	(51)	13	90	20	123	(49)	252

[a]Resident of Unit 12.
[b]Total hunters excludes hunters who did not report residency.

Table 4 Unit 12 sheep harvest, regulatory years 1990–1991 through 1997–1998

Regulatory year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Total sheep[a]	Hunters
1990–1991	237	34.4	--	237	448
1991–1992	272	34.3	8.7	272	491
1992–1993	177	34.5	8.6	177	407
1993–1994	169	34.5	8.5	173	447
1994–1995	159	34.2	8.5	167	376
1995–1996	174	34.2	8.7	179	362
1996–1997	164	34.7	8.8	164	330
1997–1998	129	35.0	9.2	129	252

[a] Total sheep includes illegal ewe harvest and unknown sex.

Table 5 Unit 12 sheep harvest chronology percent by time period, regulatory years 1990–1991 through 1997–1998

Regulatory year	Harvest dates						
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	*n*
1990–1991	43	20	12	10	7	7	230
1991–1992	40	21	8	13	12	5	267
1992–1993	34	20	19	14	5	8	172
1993–1994	41	15	16	15	11	3	167
1994–1995	40	13	19	16	5	7	164
1995–1996	39	18	13	14	11	5	175
1996–1997	42	11	17	15	11	5	158
1997–1998	40	16	12	17	5	10	126

Table 6 Unit 12 sheep harvest percent by transport method, regulatory years 1990–1991 through 1997–1998

Regulatory year	Percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1990–1991	53	21	2	9	0	2	16	1	266
1991–1992	56	22	4	5	0	2	9	3	272
1992–1993	62	27	1	2	0	2	6	1	177
1993–1994	62	24	2	5	0	1	5	2	173
1994–1995	59	20	6	9	0	0	5	1	167
1995–1996	50	27	4	10	0	1	8	1	179
1996–1997	53	26	3	7	0	3	8	0	164
1997–1998	55	23	4	5	0	0	12	1	129

LOCATION

GAME MANAGEMENT UNIT: Portions of 12, 13, and 20 (1500 mi^2)

GEOGRAPHIC DESCRIPTION: Tok Management Area

BACKGROUND

The Tok Management Area (TMA) was created in 1974 to provide Dall sheep hunters additional opportunity to harvest large-horned, trophy rams (ADF&G 1976). This objective is the primary consumptive use aspect of a management goal to provide for diversified human recreational use in this area (Kelleyhouse 1989). The TMA is known for production of fast-growing, large-horned rams (Heimer and Smith 1975).

Sheep harvest in the TMA is managed by controlling hunter numbers through a drawing permit system. This system was designed to keep annual harvests low enough to allow some rams to attain their maximum potential horn size. Harvests are also restricted to rams with at least full-curl horns. This system was successful during the 1970s and 1980s, achieving the primary human-use objective of providing an opportunity to take large rams.

The goal of providing the opportunity to hunt sheep under aesthetically pleasing conditions is also part of this drawing permit system. Maintaining low hunter density created an abundance of legal rams, including large trophy rams. It also allowed for the maintenance of varied opportunities for access to the area and for other components of a high-quality hunting experience. A more complete history of management in the TMA is available in Kelleyhouse (1989).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Provide for diversified recreational uses of wildlife.
- Provide for the opportunity to be selective in hunting.
- Provide an opportunity to hunt under aesthetically pleasing conditions.

MANAGEMENT OBJECTIVES

- Maintain a population capable of allowing hunters to be selective in harvesting 30–45 rams each year.
- Maintain a mean horn length of 36–37 inches among harvested rams and a mean age of 8–9 years.
- Maintain an average of 7–10% rams with 40-inch or greater horns in the harvest.

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

METHODS

I monitored harvest using the drawing permit report cards. Data on harvest success, harvest location, hunter distribution, hunter residence and effort, transportation type, and horn size and age were collected to determine if the harvest goals and objectives were met. Harvest data were summarized by regulatory year (RY = 1 July–30 June).

Periodically, population composition and productivity are estimated in the TMA using aerial or ground survey techniques. The next composition survey is scheduled for summer 1999.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We did not complete any population assessment surveys during this report period. Heimer (1988) hypothesized that under normal environmental conditions, sheep populations in Interior Alaska are generally stable. Sheep population declines are primarily caused by deep snow or ice cover. Winter severity (snowfall) in the TMA was mild to average from the late 1980s until 1992. Age structure data collected at the Sheep Creek mineral lick indicated that during this period the adult mortality rate was very low and lamb survival was high. In 1989 the TMA sheep population was estimated at 2000 animals (Kelleyhouse 1989).

Between 1990 and 1993, winters were unfavorable in terms of total snowfall and the number of snow-present days; however, 1992 was the most severe, with the least number of snow-free days in the past 20 years. Data collected at the Sheep Creek mineral lick and during aerial surveys indicated poor lamb recruitment during 1992 and 1993, accompanied by a large die-off of older sheep. Lamb recruitment was also thought to have been low during 1993 based on incidental observations made by area staff. The TMA sheep population probably declined by 10–20%, based on the number of sheep observed/hour in a 1994 aerial survey.

Since 1994, weather conditions have been favorable throughout Interior Alaska. Lamb survival in adjacent areas indicated the sheep population decline ended in 1994 and has subsequently been increasing. However, the number of legal rams is expected to be relatively low until 2001 because of poor lamb recruitment during the early 1990s.

Population Composition

We conducted the last population composition survey in 1994. The lamb and ram:100 ewe-like ratios determined by aerial survey were 24 and 74:100, respectively (Table 1). Full-curl rams composed 30% of the total ram population. Based on a combination of aerial and ground survey data, lamb:ewe ratios ranged from 38 to 49:100 and the percentage of full-curl rams was 35%. The number of legal rams was low in 1994, indicating that mortality of adult sheep had been high in 1992.

Distribution and Movements

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. During this report period we collected no additional data on distribution and movements.

MORTALITY

Harvest

Season and Bag Limit. The season was 10 August to 20 September with a bag limit of 1 full-curl ram every 4 regulatory years. In addition, a drawing permit was required. Rams had to have at least 1 full-curl horn or both horns broken. Up to 120 permits could have been issued per year.

Board of Game Actions and Emergency Orders. The Board of Game did not change seasons or bag limits for sheep in the TMA during the report period. The board considered a proposal requesting additional opportunity for bow hunters by creating a separate registration permit hunt and allowing a longer season. The board rejected the proposal because the change would have conflicted with the current harvest goals and objectives.

Hunter Harvest. During the report period, the average annual harvest was 52 full-curl rams in the TMA. The previous 5-year mean was 42 rams (Table 2). Hunter participation averaged 82%, compared to 76% between RY 1990–1991 and RY 1994–1995. Harvest is expected to decline during the next few years because of reduced recruitment during 1990 and 1993. However, improved survival of rams ≥8 years old due to mild winters during the past 3 years may offset the effects of reduced recruitment. Participation is expected to remain high because of the popularity and reputation of this hunt. The objectives of increased opportunity for large-horned rams (>40") and uncrowded hunting conditions may not be met because of high harvests and high participation rates.

Hunting pressure and harvest were highest in the Tok River and East Fork of the Robertson River drainages. Since RY 1994–1995, 34–51% of the hunters have used these 2 drainages, taking 39–73% of the harvest.

Mean horn length during the report period was 36.6 inches compared to the previous 5-year mean of 37.0 inches (Table 3). The number of harvested rams with horn length ≥40 inches was 3–8 and averaged 9.7% of the annual harvest. The previous 5-year mean was 14.2%. The decline may be due to the high harvest in 1995, which could have reduced the number of legal rams. The average reported age of rams harvested was 9.1, similar to the 5-year mean of 9.0. Mean horn length, age of harvested rams, and the percentage of harvested rams ≥40 inches met the minimum harvest management objectives.

Hunter Residency and Success. During the report period, 2304–2469 applicants applied for 120 permits (4.8–5.2% chance of being drawn). This represented a 7% annual increase in the number of applicants compared to the early 1990s. Alaska residents took 90% of the harvested rams between RY 1995–1996 and RY 1997–1998 (Table 4). On average, only 5 nonresidents per year were drawn and participated. The overall success rate in RY 1995–1996 was the highest recorded since RY 1990–1991. One possible factor for greater success was that

successful hunters in RY 1995–1996 expended greater effort and were in the field an average of 6 days, almost a full day longer than the past 5-year average. Since RY 1990–1991, the mean annual success rate has been 49%, substantially below the mean annual success rate between RY 1987–1988 and RY 1991–1992 (58%). The sheep population in the TMA was much higher during the late 1980s compared to the mid-1990s.

Harvest Chronology. In the past, the greatest harvest usually occurred during the first 10 days of the sheep season (10–20 Aug). Between RY 1995–1996 and RY 1997–1998, 41–48% of the harvest occurred during this period. Recently, there has been an increasing trend for sheep hunters to go to the field later (20 Aug–10 Sep) throughout Unit 12. During the past 3 years, 44–48% of the harvest occurred during this 21-day period. I believe this change in harvest chronology is a result of more sheep hunters becoming aware that competition among hunters is lower and that large-horned sheep (>40 inches) become more vulnerable to harvest later in the season. During the past 4 years, 40–50% of the rams with horn length >39 inches were taken after 20 August. Commonly, during this middle portion of the season, rams descend to lower elevation due to snow at high levels.

Transport Methods. Airplanes and highway vehicles were the primary methods of transport (Table 5). During the report period, 87% of all hunters used 1 of these 2 methods to access the area. ATVs are not commonly used because there are few areas in the TMA that are accessible to ATVs but not accessible by 4-wheel drive truck. During the report period, average success rates for hunters using aircraft and highway vehicles were 58 and 43%, respectively, while the overall success rate was 54%.

Other Mortality

Severe winter weather and predation are the most important natural mortality factors for Dall sheep (Murie 1944; Heimer and Watson 1986). Winter conditions in the TMA during the late 1980s to 1991 were mild to average and did not cause the overwinter mortality rate to increase. Based on sightings of marked animals during this period, it seemed that overwinter survival was high. During 1992 and 1993, weather conditions were unfavorable in terms of timing, duration, depth of snowfall, and summer drought conditions; consequently, lamb recruitment was low and adult mortality was high based on collar data. Since 1994 winter snowfall has been below average, benefiting the TMA sheep population.

The overall limiting effects of wolf predation on the TMA sheep population are not known. Dall sheep are not normally a preferred prey of wolves; however, the area's wolf population has increased since 1989 due to increased numbers of caribou during winter. The impacts of this larger population of wolves in the TMA could be affecting the sheep population, especially once the caribou migrate out of the area.

We have not monitored the effects of disease on the TMA population since 1990. At that time, disease was not a limiting factor (ADF&G, unpublished data). One ram killed by a hunter during RY 1998–1999 had signs of pneumonia. We did not observe or hear of any other incidences of diseased sheep in the TMA and do not believe disease has become a limiting factor to population growth. We have no data estimating mortality due to accidents.

HABITAT

Assessment

The TMA consists of rugged, glaciated terrain with *Dryas*-dominated habitats. Mixed bunchgrass and forb communities are also available and important to TMA sheep.

The largest threat to TMA sheep habitat is the possibility of mining development. The upper Tok River, upper Robertson River and Rumble Creek drainages are mineralized and could be developed. Currently, there is mining exploration in the upper Robertson River, an area that supports a high number of sheep. We will coordinate with Habitat Division to minimize impacts.

CONCLUSIONS AND RECOMMENDATIONS

Overall, management goals and objectives were met. However, crowding of hunters occurred primarily within the East Fork of the Robertson River and the upper Tok River. Between 34 and 51% of the hunters use these 2 drainages annually. Hunters selected these areas because historically they produced the biggest rams and because they are easily accessible by aircraft. For the first time since the inception of the TMA, we have received complaints from hunters concerning crowding. However, hunter interviews indicated overall hunter satisfaction remained high. In the future, hunter and harvest distribution will be closely monitored in relation to harvest objectives. If hunter crowding and harvest continue to increase, changes in the hunt structure or a reduction of permits may be necessary.

The horn length of harvested rams averaged 36.6 inches during the past 3 years, well within the harvest objective. But the TMA, especially in certain areas, has the potential to produce much larger rams. The TMA was created because it offered an area where sheep hunters could be selective and have a good opportunity to take a large-horned ram (>40 inches). Many areas that once were hunted for large rams are now within national parks and can no longer be hunted. The TMA is the only sheep hunting area now available to all hunters that has objectives for trophy sheep hunting. Based on how the area is now hunted and the size of rams harvested, these objectives may be better met if the permit system is changed to allow fewer hunters into those areas that historically produced large rams.

The Robertson, Johnson, and upper Tok River drainages could be managed more specifically to produce trophy sheep. These areas have produced 81% of the largest rams harvested in the TMA since 1989. To better meet the trophy ram objective, a portion of this area could be selectively managed. A possible scenario would be to close the selected area for 1 year and then offer a separate permit hunt for 5–10 permits. The possible benefit of a short-term closure followed by reduced hunting pressure would be a much better chance for rams to reach 11 years and older and possibly produce very large horns. These permits would be subtracted from the total number of TMA permits to protect against overcrowding in the remainder of the TMA. The objective of this newly created area would be harvests of 2–5 rams with average horn size of 39 inches. Under this permit system, harvest would have little impact on ram mortality. Following average to mild winters, the percentage of rams with horns greater than 43 inches would probably increase.

I will be discussing this idea with Fish and Game advisory committees and the Foundation of North American Wild Sheep to see if there is support. If so, I will be asking successful hunters to voluntarily bring their horns into the ADF&G office in Tok for measuring and aging. At the same time, we will record the harvest location. These data will be valuable for selecting the best possible area for further trophy management. If the area chosen is agreeable to local advisory committees, I will submit a proposal to the Board of Game for their spring 2000 or 2002 meeting.

Overall, the TMA continues to provide unique opportunities for hunters to seek large-horned rams under uncrowded hunting conditions. Low lamb recruitment during 1992 and 1993 will have some effect on trophy ram recruitment and harvest. After 2001, the ram population is expected to increase due to increased lamb production and recruitment since 1994.

LITERATURE CITED

ALASKA DEPARTMENT OF FISH AND GAME. 1976. Alaska wildlife management plans: interior Alaska. Alaska Department of Fish and Game. Juneau.

HEIMER WE. 1988. Toward a working hypothesis for mountain sheep management. Proceedings of biennial symposium northern wild sheep and goat council. 6:39–46.

———, AND AC SMITH. 1975. Dall ram horn growth and population quality and their significance to Dall sheep management in Alaska. Alaska Department of Fish and Game. Technical Bulletin 5. Juneau.

———, AND SM WATSON. 1986. Comparative dynamics of dissimilar Dall sheep populations. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Report. Grants W-22-1 through W-22-4. Juneau.

KELLEYHOUSE DG. 1989. Tok Management Area survey-inventory progress report. Pages 39–48 *in* SO Morgan, editor. Annual report of survey-inventory activities. Part II. Sheep. Volume XIX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-1. Juneau.

MURIE A. 1944. The wolves of Mt McKinley. US Department of Interior. National Park Service. Fauna Series 5.

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Table 1 Tok Management Area sheep composition counts from aerial surveys, 1980 and 1994

Sex/age class	1980	1994
Legal rams[a]	148	123
Sublegal rams[b]	263	294
Unclassified rams	9	0
Total rams	420	417
Ewes[c]	922	567
Lambs	350	137
Unidentified	6	3
Total other sheep	1278	707
Total sheep	1698	1124
Legal rams:100 ewes	16.1	21.7
Sublegal rams:100 ewes	28.5	51.9
Total rams:100 ewes	45.5	73.5
Lambs:100 ewes	38.0	24.2
Lambs % of total	20.6	12.2

[a] Full curl or larger.
[b] Greater than 1/4 curl but less than full curl.
[c] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 2 Tok Management Area harvest of Dall sheep rams, regulatory years 1990–1991 through 1997–1998

Hunt/area	Regulatory year	Permits issued	Did not hunt %	Unsuccessful hunter %	Successful hunter %	$\bar{x}$ Horn length	$n \geq 40$" (%)	Total harvest
DS102	1990–1991	120	28	56	44	37.0	6 (17)	36
	1991–1992	120	23	44	56	36.9	9 (17)	52
	1992–1993	120	26	58	42	37.1	6 (16)	37
	1993–1994	120	13	58	42	37.3	6 (13)	44
	1994–1995	120	28	54	46	36.9	3 (8)	39
	1995–1996	120	18	61	39	37.2	8 (13)	60
	1996–1997	120	17	44	56	36.2	5 (9)	56
	1997–1998	120	20	57	43	36.5	3 (7)	41

Table 3 Tok Management Area sheep harvest, regulatory years 1990–1991 through 1997–1998

Regulatory year	Rams	$\bar{x}$ horn length	Sheep ≥40" (%)	$\bar{x}$ age	Ewes	Total sheep
1990–1991	36	37.0	6 (17)	9.2	0	36
1991–1992	52	36.9	9 (17)	8.9	0	52
1992–1993	37	37.1	6 (16)	8.6	0	37
1993–1994	44	37.3	6 (13)	9.0	0	44
1994–1995	39	36.9	3 (8)	9.2	0	39
1995–1996	60	37.2	8 (13)	9.4	0	60
1996–1997	56	36.2	5 (9)	8.9	0	56
1997–1998	41	36.5	3 (7)	8.9	0	41

Table 4 Tok Management Area sheep hunter residency and success, regulatory years 1990–1991 through 1997–1998

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	
1990–1991	2	31	3	36 (44)	3	43	0	46 (56)	82
1991–1992	3	47	2	52 (56)	0	38	3	41 (44)	93
1992–1993	4	30	3	37 (42)	4	46	2	52 (58)	89
1993–1994	3	39	2	44 (42)	6	54	1	61 (58)	105
1994–1995	4	31	4	39 (46)	4	44	2	46 (54)	85
1995–1996	9	44	7	60 (61)	2	37	0	39 (39)	99
1996–1997	7	44	5	56 (56)	2	40	2	44 (44)	100
1997–1998	3	35	3	41 (43)	8	45	1	54 (57)	95

Table 5 Tok Management Area sheep harvest percent by transport method, regulatory years 1990–1991 through 1997–1998

Regulatory year	Percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1990–1991	53	0	0	8	0	3	36	0	36
1991–1992	63	2	0	0	0	6	27	2	52
1992–1993	57	3	0	3	0	3	30	3	37
1993–1994	75	0	0	5	0	0	18	2	44
1994–1995	82	0	0	3	0	0	13	3	39
1995–1996	63	0	0	6	0	5	20	5	60
1996–1997	63	2	2	7	0	0	23	4	56
1997–1998	73	0	0	12	0	0	15	0	41

LOCATION

GAME MANAGEMENT UNIT: 13A, 13E, 14A (north), and 14B (14,849 mi^2)

GEOGRAPHIC DESCRIPTION: Talkeetna Mountains and Chulitna-Watana Hills

BACKGROUND

Sheep populations in the Talkeetna Mountains and Chulitna-Watana Hills (TCW) probably increased rapidly from low numbers before 1950, reaching peak densities during the late 1960s (McIlroy 1976). Trend counts in a portion of the area indicated populations fluctuated slightly before peaking again during the 1980s.

Most of the sheep habitat in the TCW mountains was aerially surveyed in 1974, but large-scale composition surveys were not conducted before 1974. Although an estimate of the total number of sheep was not specifically stated in 1974 (McIlroy 1976), the population probably contained 2500–3000 sheep, assuming 80% of the sheep were seen. Portions of the TCW have been surveyed periodically since 1974. Sheep densities have traditionally been highest in the southeastern portion of the area, both east and west of the Chickaloon River. During the late 1980s the population estimate for TCW was approximately 2500 sheep (Grauvogel 1990). Included in that estimate were approximately 200 sheep in the Sheep Mountain Closed Area, which has been closed to hunting since the 1940s.

Minimum sheep harvest data have been collected from hunter harvest reports since 1967. The reported harvest peaked at 118 during 1969 and again in 1986. During 1974 reported harvested peaked at 114 rams, following a low of 61 rams taken in 1973. Harvests reached similar lows during 1977 and 1983.

Since statehood, sheep harvest has been restricted to adult rams. Mean annual harvest under a 3/4-curl horn minimum regulation during 1967–1978 was 90 rams. Under a 7/8-curl horn minimum during 1979–1988, the annual harvest averaged 87 rams. In 1989 hunters were required to harvest only full-curl rams, and during 1989–1997 the average harvest was 86 rams.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Provide the greatest opportunity to participate in hunting sheep (outside the Sheep Mountain Closed Area)

- Provide an opportunity to view, photograph, and enjoy sheep (within the Sheep Mountain Closed Area in Unit 13A)

MANAGEMENT OBJECTIVE

- Maintain sheep populations that will sustain an annual harvest of 75 rams.

METHODS

We monitored sheep harvest from harvest reports. Hunters were required to report within 15 days of the close of the season or within 15 days of killing a sheep. Days hunted, method of take, date and location of kill, transportation used, length of horns, and age of sheep were noted on the harvest report. The number of sheep killed but not reported is assumed to be small.

No sex and age composition surveys were conducted during the report period. The area management biologist for Unit 13 secured funding from the Foundation for North American Wild Sheep to conduct surveys during summer 1998, but bad weather prevented completion of the surveys (R. Tobey, pers. commun.)

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The estimated population for sheep in the Talkeetna Mountains and Chulitna-Watana Hills was 2000–2500 sheep during 1994 (Masteller 1996). I assume the population is currently near the low end of this range and stable or declining because predator (especially wolf) densities are high and recent winters have been relatively mild.

MORTALITY

Harvest

Season and Bag Limit. The hunting season in Subunits 13A, 13E, 14A and 14B for regulatory years 1995/96 through 1997/98 was 10 August–20 September. The bag limit was 1 ram with a full-curl horn or larger.

Hunter Harvest. Hunter harvest averaged 93 rams during 1995–1997 (Table 2), slightly higher than the 9-year average harvest of 86 rams per year (1989–1997) since the full-curl regulation went into effect in 1989. The 1995 harvest of 109 rams was the highest since that regulation went into effect, and near the historic high harvests of 118 rams in 1969 and 1986 (Griese 1993).

Hunters are clearly taking larger sheep than in the past (Table 2). When regulations allowed harvest of 7/8-curl sheep (1979–1988), the mean horn size was 33.2 inches (Griese 1993). Mean horn size has risen steadily with the adoption of the full-curl regulation, increasing from 34.0 inches in 1989 to 36.0 inches in 1996 and averaging 34.9 inches during 1989–1997. The proportion of rams >40 inches increased dramatically in 1995, climbing to 11% from just over 3% the year before, then declining during 1996 and 1997. The average for the 1995–1997 period was 7.5%, well above the 1989–1994 average of 2%.

However, after 8 years of steady increases, mean horn size dropped sharply in 1997. This may reflect predicted declines in the number of large rams due to reduced recruitment noted during 1994 surveys (Masteller 1996). More information is needed to determine whether this decline is part of a trend or simply annual variation.

Hunter Residency and Success. The proportion of TCW sheep hunters who were Alaska residents has been increasing. During 1995–1997 the proportion of resident hunters averaged 90% (Table 3), compared to an average of 83% during 1987–1991 (Griese 1993).

The total number of hunters peaked at 531 during 1995, then declined during 1996 and 1997 (Table 3). There was a 40% increase in hunters between 1992 and 1994 (Masteller 1996); both that increase and the recent decline may have been related to changes in hunting regulations for Nelchina caribou. Hunter effort for this caribou herd is closely regulated through a permit system, and in many years caribou and sheep ranges overlap, allowing permittees to pursue both species. The number of Tier II caribou permits issued increased from 6500 to 10,000 from 1992 to 1994, peaked at 12,000 in 1995, and declined to 10,000 during 1996 and 1997.

The success rate for all hunters appears to have stabilized at 19–20% (Table 3), after dropping steadily from 23% in 1990 to 18% in 1994 (Masteller 1996). During 1983–1988, with the 7/8-curl minimum restriction, success averaged 30% (Grauvogel 1990). Success rates obviously fluctuate with both hunter numbers and the number of legal rams in the population. Nonresidents are, however, disproportionately successful. From 1995 through 1997 they accounted for 9 to 11% of hunters but took 32 to 46% of the sheep. In general, nonresident success rates are higher because they are required to have a guide, and they are more likely to use aircraft to access remote areas. Success rates are unlikely to increase, given the high number of hunters and improving ground access.

Harvest Chronology. From 1995 to 1997 the average proportion of rams harvested the first week of the season was 38%; 58% were taken in the first 2 weeks (Table 4). In comparison, from 1983 to 1988 approximately 40% of the sheep harvested were killed during the first 2 weeks (Grauvogel 1990). This increase in early season harvest is undoubtedly related to increases in hunting pressure.

The pattern of harvest chronology (Table 4) was notably different during 1995, when record amounts of rain fell during the early part of sheep season. Generally poor weather in the Cook Inlet drainages of Southcentral Alaska may have caused some sheep hunters to delay their hunt or to move, especially later in the season, to portions of the Talkeetna Mountains where the weather is less affected by Cook Inlet or Prince William Sound. Accordingly, this poor weather could also be a factor contributing to the high number of sheep hunters in the Talkeetna Mountains during 1995.

Transport Methods. Most successful hunters used aircraft or 4-wheelers to access their hunting areas, and recent trends in modes of transport for these hunters are relatively stable (Table 5). The percent of successful hunters using 4-wheelers dropped in 1997, with concomitant increases in hunters using aircraft and boats. However, relatively large changes in proportions are possible when the number harvested is relatively small.

CONCLUSIONS AND RECOMMENDATIONS

The mean annual harvest of rams under the full-curl minimum requirement from 1995 to 1997 was 93, ranging between 81 and 109 sheep. This harvest met the management objective for the population. The TCW sheep population was estimated to be stable (or perhaps declining) at approximately 2000 sheep. Surveys have occurred too infrequently to identify trends.

I predicted (Masteller 1996), given low recruitment of young sheep observed in 1994 in Unit 14, that overall harvest might decline approximately 20% by 2000 or 2001. From 1992 to 1994 harvest from the western TCW (Unit 14) accounted for 16 to 25% of the overall TCW harvest, and during 1995–1997 this area accounted for 25 to 33% of overall harvest. A 20 to 25% reduction in harvest will probably result in harvest falling below the objective.

Further, I believed a decline in the proportion of young rams would become apparent during 1997. As this cohort ages, and as older, larger rams are removed from the population, there may be more hunting pressure on the smaller rams just entering the full-curl segment of the population. Indeed, mean horn size dropped significantly in 1997, after steady increases from 1989 to 1996. This may be a harbinger of declining numbers in the large ram segment of the population. In the absence of survey data, future success rates and hunter effort information may provide clues about trends in the number of legal rams in the population.

I recommend a complete TCW survey as soon as possible to adequately assess population trends. Every effort should be made to survey count areas in Units 13 and 14 during the same summer. Surveys conducted every 3 years would provide meaningful trend count information, useful in alerting biologists to significant population or composition changes.

After discussions with R. Tobey, the Unit 13 area management biologist, the management goal for sheep in the TCW mountains has been rewritten and presented in this report in the management goals section. Previously, the goals were to provide aesthetically pleasing hunting conditions in Unit 13 and maximum opportunity to hunt sheep in Unit 14. In fact, both areas have been managed for maximum hunter opportunity. Griese (1993) first discussed the need to align management goals for Units 13 and 14, and no actions have occurred since to bolster the case that Unit 13 is managed for "aesthetically pleasing" hunting conditions. Although in the past some hunters have complained about hunter crowding, hunter numbers have declined in recent years, and no proposals limiting hunter opportunity were submitted to the Board of Game for their March 1999 meeting. Until a thorough, and hopefully statewide, review of sheep management goals ensues, we should align the management goal with current management actions.

LITERATURE CITED

GRAUVOGEL, C. A. 1990. Unit 13A, 13E, 14A and 14B dall sheep survey-inventory progress report. Pages 42–55 *in* S. Morgan, ed. Annual report of survey-inventory activities. Part II. Dall sheep. Vol. XX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Proect Report. Project W-23-2, Study 6.0. Juneau. 133pp.

GRIESE, H. J. 1993. Unit 13A, 13E, 14A (north) and 14B dall sheep survey-inventory progress report. Pages 60–66 *in* S. M. Abbott, ed. Management report of survey-inventory activities, 1 July 1989–30 June 1992, Dall sheep. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Proect Report. Project W-23-3, W-23-4 and W-23-5, Study 6.0. Juneau. 158pp.

MASTELLER, M. A. 1996. Unit 13A, 13E, 14A (north) and 14B dall sheep survey-inventory progress report. Pages 65–75 *in* Hicks, M.V., ed. Management report of survey-inventory activities, 1 July 1992–30 June 1995. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Proect Report. Project W-24-1, W-24-2 and W-24-3. Study 6.0. Juneau. 166pp.

MCILROY, C. W. 1976. Unit 13 sheep survey-inventory progress report, 1974. Pages 53–58 *in* D. McKnight, ed. Annual report of survey-inventory activities. Part I. Deer, sheep, bison, mountain goat, elk and muskoxen. Vol. VI. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration Proect Report. Project W-17-7, Jobs 2, 6, 9, 12, 13, 16 and 22. Juneau. 168pp.

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Table 1 Talkeetna Mountains and Chulitna-Watana Hills summer aerial sheep composition counts and estimated population size, 1988–97

Regulatory year	Rams		Ewes[a]	Lambs (%)	Sheep/ hour	Total Sheep observed	Estimated population size
	≥7/8 curl(%)	<7/8 and >1/4-curl					
1988/89							
Unit 14[b]	24 (3)	178	500	163 (19)	44	866	2150–2600
1989/90 to 1993/94	No surveys flown						
1994/95							
Unit 14[b]	26 (8)	71	159	48 (16)	24	304	
Unit 13[c]	132 (9)	234	844	232 (16)	97	1443	
Total	158 (9)	305	1003	280 (16)	63	1747	2000–2500
1995/96 to 1997/98	No surveys flown						

[a]Includes yearlings of both sexes and rams of 1/4-curl or less.
[b]A summary of subunits 14A and 14B within the Talkeetna Mountains
[c]A summary of subunits 13A and 13E within the Talkeetna Mountains

Table 2 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest, 1993–97. Beginning in 1989, regulations required hunters take full-curl rams only.

Regulatory Year	Rams[a]	Average Horn Length (inches)	% ≥ 40"	Ewes	Total sheep
1989/90	75	34.0	1.3	0	76
1990/91	79	34.5	0.0	1	82
1991/92	86	34.7	2.2	0	91
1992/93	74	34.8	1.3	0	75
1993/94	81	35.0	3.6	0	82
1994/95	90	35.3	3.3	1	91
1995/96	109	35.7	11.0	0	109
1996/97	89	36.0	6.7	0	90
1997/98	78	34.5	4.9	0	81

[a] Includes only rams for which horn length was reported.

Table 3 Talkeetna Mountains and Chulitna-Watana Hills sheep hunter residency and success, 1989–97. Beginning in 1989, regulations required hunters take full-curl rams only.

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1989/90	13	23	33	75 (23)	59	168	12	248 (77)	323
1990/91	9	45	25	82 (23)	53	190	18	270 (77)	352
1991/92	17	41	29	91 (24)	62	213	4	284 (76)	375
1992/93	13	35	25	75 (20)	58	218	11	294 (80)	369
1993/94	5	48	27	82 (19)	48	280	7	340 (81)	422
1994/95	10	46	35	91 (18)	56	347	19	425 (82)	516
1995/96	14	58	36	109 (21)	54	338	21	422 (79)	531
1996/97	14	56	29	90 (19)	70	308	17	396 (81)	486
1997/98	12	31	37	81 (19)	65	271	9	357 (81)	438

[a]Local means residents of game management Subunits 13A, 13E, 14A and 14B.

Table 4 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest chronology percent by harvest period, 1989–97. Beginning in 1989, regulations required hunters take full-curl rams only.

Regulatory year	Harvest periods						*n*
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
1989/90	35	19	9	16	11	9	74
1990/91	45	17	15	5	9	9	76
1991/92	47	19	8	9	8	9	89
1992/93	41	24	16	7	7	5	74
1993/94	38	16	19	11	7	8	82
1994/95	43	25	9	10	7	4	89
1995/96	28	26	12	7	13	13	106
1996/97	42	19	15	6	11	7	88
1997/98	44	16	10	9	10	11	80

Table 5 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest percent by transport method 1989–97. Beginning in 1989, regulations required hunters take full-curl rams only.

Regulatory year	Percent of harvest							*n*
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unknown	
1989/90	53	13	1	24	0	8	0	75
1990/91	39	15	0	35	1	9	1	82
1991/92	52	7	0	26	5	2	8	91
1992/93	45	7	0	35	3	9	1	75
1993/94	44	1	0	27	8	17	2	82
1994/95	52	4	0	33	2	9	0	91
1995/96	49	4	0	43	2	1	2	109
1996/97	44	0	1	44	2	6	2	90
1997/98	54	9	2	27	1	5	1	81

LOCATION

GAME MANAGEMENT UNIT: Portions of 13B, 20A, 20D (1680 mi^2)

GEOGRAPHIC DESCRIPTION: Delta Controlled Use Area (DCUA)

BACKGROUND

Alaska Department of Fish and Game (ADF&G) management plans for Dall sheep (ADF&G 1976; Greg Bos, pers commun, 1988) define the management goals for this species in Alaska. These goals include protection and maintenance, scientific and educational study, diversified recreational use, and commercial and subsistence uses. 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 found that historic human use of Dall sheep rarely meets the present definitions of subsistence use. Consequently, diversified human recreation is the predominant use of Dall sheep in Alaska.

The department revised management plans (Greg Bos, pers commun, 1988) to recognize that diversified human recreational uses of Dall sheep include both consumptive and nonconsumptive uses. Nonconsumptive uses include viewing and photography. Possible goals for consumptive use of this species include maximum opportunity to hunt, opportunity to hunt under aesthetically pleasing conditions, and the opportunity to harvest unusually large rams as trophies. Providing opportunity to hunt sheep under aesthetically pleasing conditions is the present consumptive use goal for this species in the Delta Controlled Use Area (DCUA).

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

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

Designation of the Delta Management Area as a walk-in only area successfully provided walk-in only hunting opportunity but failed to reduce harvest to the desired level or provide high-quality hunting experiences. The harvest and the quality hunting experience objectives were formally selected as consumptive use guidelines during the public planning project of the mid-1970s (ADF&G 1976). Rams in the Delta Management Area 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 even though the desired harvest objective was 40 rams (Larson 1979).

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

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

The Delta Management Area was renamed the Delta Controlled Use Area in 1981 to more accurately reflect its classification as a controlled use area rather than a management area.

In 1982 the number of drawing permits issued was increased to 75 for each portion of the drawing permit hunt (Hunts D1103 and D1104).

Minimum horn size for legal sheep in Unit 20 was raised from 7/8 curl to full curl in 1984. The season and bag limit in the DCUA have not changed since 1984, with the exception of 1985, when Tier II subsistence regulations were adopted.

The size of the DCUA was reduced in July 1992 to exclude a portion of nonsheep habitat between the Richardson Highway and the Delta River. This area of nonsheep habitat is popular for hunting small game and upland game, and DCUA access restrictions unnecessarily complicated hunting in the area and confused hunters.

MANAGEMENT DIRECTION

Management Goals

- Manage to provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means so that most hunters are satisfied with the aesthetic quality of their hunt.

Management Objectives

- Manage a population of approximately 1800 sheep to 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.

Related Management Activities

- Monitor Dall sheep harvest through hunter contacts and permit reports.
- Conduct aerial and/or ground composition surveys of Dall sheep.
- Mail a questionnaire to hunters and quantify their satisfaction with aesthetics of Dall sheep hunting in the DCUA.

METHODS

Hunters selected in the permit drawing were required to report on their activities. Data contained on the permit reports were analyzed to determine hunter success, hunter residence, hunter effort, ram horn size, hunt location, transportation type, and other information. Data were summarized by regulatory year (RY = 1 July–30 June).

All hunters were mailed a sheep hunter questionnaire and asked a variety of questions about their hunt (including aesthetics) and their opinions on DCUA management (Appendix A). Not all questionnaire data were summarized for this report, but we analyzed those questions related to DCUA management goals. Hunters were asked to rate satisfaction with their hunt on a scale of 1 (very satisfied) to 10 (extremely disappointed). Hunters who rated their hunt satisfaction from 1 to 5 were considered satisfied with their hunt. A mean satisfaction rating was also calculated for all hunters. Data were pooled for both drawing hunts DS203 and DS204. Also, DCUA management goals were listed in the questionnaire, and hunters were asked to answer (by yes or no) whether they agreed with the goals.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We did not complete any surveys to estimate population size during this reporting period. Therefore, results of the July 1995 estimate are the most recent data. That survey resulted in a population estimate for the DCUA of 1673 sheep ± 14.16% at the 90% CI (lower CI = 1436 sheep; upper CI = 1910 sheep). This population estimate resulted in a mean density of 2.9 sheep/mi^2 of sheep habitat in the DCUA.

Population Composition

We did not complete any surveys to estimate population composition during this reporting period.

MORTALITY

Harvest

Season and Bag Limit. The DCUA sheep hunting season was open from 10 August through 20 September and was split between 2 drawing permit hunts, DS203 and DS204. For permit

hunt DS203, the season was open during 10 August–25 August. Hunters were not allowed to use motorized vehicles or pack animals to transport sheep hunters, sheep hunting gear, or sheep within the DCUA during 5–25 August. Vehicle travel was permitted on the Richardson Highway and at recognized airports within the DCUA boundaries. For permit hunt DS204, the season was 26 August–20 September with no access restrictions. Each permit hunt had a bag limit of 1 full-curl ram. Seventy-five permits each were issued for 2 hunts.

Board of Game Actions and Emergency Orders. At the March 1998 board meeting, the Board of Game considered 2 regulation proposals for the DCUA. Proposal 120 was a proposal from the public to establish an archery registration permit hunt in the DCUA from 10 August–15 October. This proposal was not adopted. Proposal 123 was a proposal from the department to modify motorized vehicle access restrictions in the DCUA during hunt DS203 so that restrictions applied only to big game hunters, rather than to all hunters. The board adopted this proposal.

Hunter Harvest. DCUA harvest for both hunts (DS203 and DS204) failed to meet the harvest objective in RY 1995–1996 when 32 rams were killed. Harvest met the objective for RY 1996–1997 and 1997–1998 when 41 and 40 rams were killed each year, respectively (Table 1). Harvest during this reporting period was within the range of harvest for the previous 5 years.

Mean horn length for all sheep taken in the DCUA during this reporting period was 35.7 inches in RY 1995–1996, slightly below the objective. Mean horn length during RY 1996–1997 and 1997–1998 was 36.4 inches each year (Table 1).

Mean age of all sheep taken in the DCUA met the management objective during all 3 years in this reporting period (Table 1).

Most hunters were satisfied with their DCUA hunt and agreed with DCUA harvest and aesthetic management goals. During this reporting period, 80–82% of all hunters responded that they were satisfied with their hunt. On the rating scale of 1 (very satisfied) to 10 (extremely disappointed), the mean satisfaction rating for all hunters ranged from 3.1–4.0 (Table 2).

When asked if they agreed with DCUA harvest goals, 86–96% of all hunters answered "yes" during this reporting period. When asked if they agreed with DCUA aesthetic goals, 89–92% of all hunters answered "yes" (Table 2).

Permit Hunts. The number of permit applicants steadily increased until 1997. In 1995 there were 1895 applicants. In 1996 it reached an historic high of 2082, with 1000 applications for hunts DS203 and 1082 applications for DS204. In 1997 the total number of applications then declined to 1774.

Hunter Residency and Success. Most DCUA hunters were Alaskan residents. Resident hunters were 93–94% of all hunters during this reporting period (Table 3).

Harvest Chronology. During hunt DS203, most harvest occurred during the first 5 days of the hunt. During hunt DS204, harvest was distributed more evenly throughout the season, depending on the year and prevailing weather conditions at the time (Table 4).

Transport Methods. No changes in mode of transportation were detected during this reporting period. Highway vehicles were the most popular mode of transportation during hunt DS203 because most hunters walked into the DCUA from either the Richardson or Alaska Highway due to access restrictions. Aircraft were used along the Johnson River, and a few hunters used boats. Airplanes and 3- or 4-wheelers were commonly used during hunt DS204, along with highway vehicles (Table 5).

Other Mortality

Predation rates on sheep in the DCUA are unknown. Wolves, coyotes, grizzly bears, black bears, and golden eagles inhabit the area and undoubtedly prey on sheep.

Weather is not thought to adversely affect sheep populations in the DCUA. The DCUA is located at the north end of the 2443-ft 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 little snow during much of the winter. Hence, it provides suitably stable winter range for Dall sheep.

HABITAT

Assessment

Sheep habitat appears sufficient to support the population at its current level; however, we have not conducted habitat assessment surveys. 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.

CONCLUSIONS AND RECOMMENDATIONS

The harvest objective for the DCUA is for a combined harvest during both permit hunts of 35 full-curl rams, with a mean horn length exceeding 36 inches and mean age greater than 8 years. Harvest was slightly below the objective during RY 1995–1996 but met the objective during RY 1996–1997 and 1997–1998. Mean horn size was slightly below the objective during RY 1995–1996 but met the objective in RY 1996–1997 and 1997–1998. The mean age objective was met during all 3 years of this reporting period.

Based on hunter responses to questionnaires, the management goal of providing aesthetically pleasing hunting conditions is being met in the DCUA. No change to hunting seasons or bag limits are recommended at this time because harvest objectives were met in 2 of 3 years during this reporting period and hunter satisfaction was met in all 3 years.

LITERATURE CITED

ALASKA DEPARTMENT OF FISH AND GAME. 1976. Alaska wildlife management plans: Interior Alaska. Alaska Department of Fish and Game. Juneau.

LARSON RW. 1979. Delta Management Area survey and inventory report. Pages 42–43 *in* RA Hinman, editor. Annual report of survey-inventory activities. Part IV. Sheep. Volume IX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-17-10. Juneau.

———. 1980. Delta Management Area survey and inventory report. Pages 100–101 *in* RA Hinman, editor. Annual report of survey-inventory activities. Part III. Sheep. Volume X. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-17-11. Juneau.

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Table 1 Delta Controlled Use Area sheep harvest data by permit hunt, regulatory years 1988–1989 through 1997–1998

Hunt /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest (rams)	$\bar{x}$ horn length (in)	$\bar{x}$ age (yr)	Percent ≥40"
D1103	1988–1989	75	36	47	17	13	35.4		15
	1989–1990	75	29	35	36	27	37.0		7
	1990–1991	75	32	44	20	15	34.6		0
	1991–1992	75	21	48	31	23	35.9		13
	1992–1993	75	32	43	25	19	36.0	8.4	5
DS203	1993–1994	75	33	39	28	21	36.1	8.6	14
	1994–1995	75	41	41	15	11	34.7	7.7	9
	1995–1996	75	32	48	20	15	36.7	9.0	13
	1996–1997	75	22	50	28	21	36.0	8.3	4
	1997–1998	75	13	61	25	19	35.7	9.3	10
D1104	1988–1989	75	23	39	39	29	36.3		3
	1989–1990	75	35	32	31	23	36.6		13
	1990–1991	75	27	49	17	13	34.8		8
	1991–1992	75	36	37	25	19	36.5		21
	1992–1993	75	23	48	30	22	35.9	8.9	14
DS204	1993–1994	75	29	45	25	19	35.6	8.4	5
	1994–1995	75	31	45	23	17	35.5	8.0	6
	1995–1996	75	32	45	23	17	34.8	8.2	0
	1996–1997	75	24	48	27	20	36.4	9.0	10
	1997–1998	75	32	40	28	21	37.0	8.3	14
Total for all permit hunts	1988–1989	150	29	43	28	42	35.9		7
	1989–1990	150	32	33	33	50	36.8		10
	1990–1991	150	29	47	19	28	34.6		4
	1991–1992	150	29	43	28	42	36.2		17
	1992–1993	150	27	45	27	41	35.9	8.7	10
	1993–1994	150	31	42	27	40	35.9	8.5	10

Table 1 Continued

Hunt /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest (rams)	$\bar{x}$ horn length (in)	$\bar{x}$ age (yr)	Percent ≥40"
	1994–1995	150	36	43	19	28	35.2	7.9	7
	1995–1996	150	32	47	21	32	35.7	8.3	6
	1996–1997	150	23	49	28	41	36.4	8.6	8
	1997–1998	150	23	51	27	40	36.4	8.8	13

Table 2 Hunter satisfaction ratings with Delta Controlled Use Area (DCUA) management for Dall sheep hunts D1103/DS203 and D1104/DS204, 1993–1997

Year	% Satisfied with hunt[a]	Mean satisfaction rating	% Agree with DCUA harvest goals[b]	% Agree with DCUA aesthetic goals[c]	*n*
1993	81	3.2	86	95	63
1994	93	2.7	95	97	62
1995	81	3.3	96	90	51
1996	82	4.0	86	92	51
1997	80	3.1	92	89	64

[a] Based on hunters scoring satisfaction from 1 to 5 on scale of 1 (very satisfied) to 10 (extremely disappointed).
[b] Harvest Goals = Mean annual harvest of 35 full-curl rams with a mean horn size of more than 36 inches, and a mean age exceeding 8 years.
[c] Aesthetic Goals = Provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means so that most hunters are satisfied with the aesthetic quality of their hunt.

Table 3 Delta Controlled Use Area sheep hunter residency and success, regulatory years 1988–1989 through 1997–1998

		Successful					Unsuccessful					
Hunt	Regulatory year	Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Local resident	Nonlocal resident	Nonres	Unk	Total (%)	Total hunters
D1103	1988–1989	3	10	0	0	13 (27)	19	13	1	2	35 (73)	48
	1989–1990	12	13	2	0	27 (51)	10	16	0	0	26 (49)	53
	1990–1991	6	8	1	0	15 (31)	9	22	2	0	33 (69)	48
	1991–1992	9	21	2	0	32 (39)	15	33	3	0	51 (61)	83
	1992–1993	11	8	0	0	19 (39)	15	14	2	1	32 (61)	51
	1993–1994	12	6	2	1	21 (42)	11	14	1	3	29 (58)	50
DS203	1994–1995	7	4	0	0	11 (27)	12	16	2	0	30 (73)	41
	1995–1996	1	13	1	0	15 (29)	7	25	4	0	36 (71)	51
	1996–1997	0	18	3	0	21 (36)	2	33	2	0	37 (64)	58
	1997–1998	3	15	1	0	19 (29)	6	37	3	0	46 (71)	65
D1104	1988–1989	13	15	1	0	29 (50)	18	11	0	0	29 (50)	58
	1989–1990	12	10	1	0	23 (49)	11	12	1	0	24 (51)	47
	1990–1991	8	4	0	0	12 (24)	19	17	1	0	37 (76)	49
	1991–1992	14	3	0	0	17 (38)	19	9	0	0	28 (62)	45
	1992–1993	11	9	2	0	22 (38)	22	14	0	0	36 (62)	58
	1993–1994	7	11	0	1	19 (36)	14	20	0	0	34 (64)	53
DS204	1994–1995	7	8	1	1	17 (35)	17	15	0	0	32 (65)	49
	1995–1996	2	15	0	0	17 (33)	9	23	2	0	34 (67)	51
	1996–1997	3	16	1	0	20 (36)	7	28	1	0	36 (64)	56
	1997–1998	4	16	1	0	21 (41)	3	24	3	0	30 (59)	51
Total for all permit hunts	1988–1989	16	25	1	0	42 (40)	37	24	1	2	64 (60)	106
	1989–1990	24	23	3	0	50 (50)	21	28	1	0	50 (50)	100
	1990–1991	14	12	1	0	27 (28)	28	39	3	0	70 (72)	97
	1991–1992	23	24	2	0	49 (38)	34	42	3	0	79 (62)	128
	1992–1993	22	17	2	0	41 (38)	37	28	2	1	68 (62)	109
	1993–1994	19	17	2	2	40 (39)	25	34	1	3	63 (61)	103
	1994–1995	14	12	1	1	28 (31)	29	31	2	0	62 (69)	90

Table 3 Continued

Hunt	Regulatory year	Successful: Local[a] resident	Successful: Nonlocal resident	Successful: Nonres	Successful: Unk	Successful: Total (%)	Unsuccessful: Local resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonres	Unsuccessful: Unk	Unsuccessful: Total (%)	Total hunters
	1995–1996	3	28	1	0	32 (31)	16	48	6	0	70 (69)	102
	1996–1997	3	34	4	0	41 (36)	9	61	3	0	73 (64)	114
	1997–1998	7	31	2	0	40 (35)	9	61	6	0	76 (66)	116

[a] Local is a hunter who resides in the unit.

Table 4 Delta Controlled Use Area sheep harvest chronology percent by time period, regulatory years 1990–1991 through 1997–1998

Hunt	Regulatory year	Harvest dates							
		8/10–/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unk	*n*
D1103[a]	1990–1991	60	27	7	--	--	--	7	15
	1991–1992	48	39	9	--	--	--	4	23
	1992–1993	63	37	0	--	--	--	0	19
DS203	1993–1994	62	33	5	--	--	--	0	21
	1994–1995	73	18	9	--	--	--	0	11
	1995–1996	60	40	0	--	--	--	0	15
	1996–1997	81	10	5	--	--	--	5	21
	1997–1998	79	21	0	--	--	--	0	19
D1104[b]	1990–1991	--	--	38	15	15	23	8	13
	1991–1992	--	--	42	26	11	21	0	19
	1992–1993	--	--	46	36	18	0	0	22
DS204	1993–1994	--	--	63	26	5	5	0	19
	1994–1995	--	--	41	29	18	12	0	17
	1995–1996	--	--	47	12	18	24	0	17
	1996–1997	--	--	30	40	5	25	0	20
	1997–1998	--	--	38	19	33	10	0	21
Total for all permit hunts	1990–1991	32	14	21	7	7	11	7	28
	1991–1992	26	21	24	12	5	10	2	42
	1992–1993	29	17	24	20	10	0	0	41
	1993–1994	33	18	33	13	3	3	0	40
	1994–1995	29	7	29	18	11	7	0	28
	1995–1996	28	19	25	6	9	13	0	32
	1996–1997	42	5	17	20	2	12	2	41
	1997–1998	38	10	20	10	18	5	0	40

[a] Season open from 10 Aug to 25 Aug.
[b] Season open from 26 Aug to 20 Sep.

Table 5 Delta Controlled Use Area sheep harvest percent by transport method, regulatory years 1988–1989 through 1997–1998

Permit hunt	Regulatory year	Percent by transport method								
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
D1103[a]	1988–1989	10	0	4	0	0	2	79	4	13
	1989–1990	8	0	0	2	0	0	87	4	27
	1990–1991	8	0	8	0	0	0	75	8	15
	1991–1992	12	0	5	0	0	0	76	7	23
	1992–1993	5	0	5	0	0	0	84	5	19
	1993–1994	19	0	0	0	0	0	71	10	21
DS203	1994–1995	27	0	0	0	0	0	64	9	11
	1995–1996	20	0	7	0	0	0	67	7	15
	1996–1997	29	0	5	0	0	0	62	5	21
	1997–1998	5	0	0	0	0	0	90	5	19
D1104	1988–1989	38	0	3	12	0	14	31	2	29
	1989–1990	43	0	0	13	0	13	32	0	23
	1990–1991	38	0	0	34	0	4	24	0	13
	1991–1992	26	2	0	45	0	4	23	0	19
	1992–1993	41	0	0	41	0	5	14	0	22
	1993–1994	63	0	0	21	0	5	5	5	19
DS204	1994–1995	35	0	0	59	0	0	6	0	17
	1995–1996	41	12	0	41	0	0	6	0	17
	1996–1997	30	5	10	10	0	5	35	5	20
	1997–1998	38	0	0	43	0	5	10	5	21
Total for all permit hunts	1988–1989	25	0	4	7	0	8	53	3	42
	1989–1990	24	0	0	7	0	6	61	2	50
	1990–1991	23	0	4	17	0	2	49	4	28
	1991–1992	18	1	3	20	0	2	53	4	42
	1992–1993	24	0	2	22	0	2	46	2	41
	1993–1994	40	0	0	10	0	3	40	8	40
	1994–1995	32	0	0	36	0	0	29	4	28
	1995–1996	31	6	3	22	0	0	34	3	32

Table 5 Continued

Permit hunt	Regulatory year	Percent by transport method								*n*
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
	1996–1997	29	2	7	5	0	2	49	5	41
	1997–1998	23	0	0	23	0	3	48	5	40

[a] No motorized vehicles or pack animals are allowed during Hunt 1103.

APPENDIX A 1995 Delta Controlled Use Area sheep hunter survey

August 8, 1995

Dear Delta Controlled Use Area Sheep Hunter:

Congratulations on your successful permit application for hunting Dall sheep in the Delta Controlled Use Area (DCUA). Your permit has been mailed from Anchorage. If you have not received it, please call the Anchorage Fish and Game office at 907-267-2179.

Our goal for managing sheep hunters in the Delta Controlled Use Area is to 1) 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, and 2) provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means. In other words, we want you to have a high-quality hunt.

I would appreciate your help determining how well we're achieving our management goals and if they are the correct goals for this area. Your answers to the enclosed questionnaire will help us answer this question. After your hunt, please take a few minutes to complete the questionnaire and return it in the postage paid envelope enclosed for your convenience.

I hope you have a safe and enjoyable hunt. If you have any questions, please contact Steve DuBois at the address below, or call 907-895-4484.

Sincerely,

Steve DuBois
Delta Area Wildlife Biologist
Division of Wildlife Conservation
PO Box 605
Delta Junction, AK 99737
(907) 895-4484

Enclosures

DELTA CONTROLLED USE AREA
1995 SHEEP HUNTER SURVEY

1. Name:_____
2. Address:_____
3. When did you hunt (Month/Day)? From:_____ To:_____
4. Length of hunt :_____(days)
5. What area did you hunt?
   Major drainage:_____
   Major tributaries:_____
6. How many people were in your hunting party?_____
7. How many other hunting parties did you see besides your own?_____
8. How many people were in the other parties?_____
9. How many sheep did you see?
   A. Legal rams (regardless of trophy size)_____
   B. Sublegal rams_____
   C. Ewes_____
   D. Lambs_____
10. Did you see any sheep with neckbands or eartags? Please return the enclosed map noting location of the collared sheep you saw, and list the color and number of the collar or tag if you could read it:

    _____

    _____
11. Did you hunt with a (Circle one):
    A. Rifle B. Pistol C. Bow D. Other_____
12. Do you consider the number of hunters, aircraft, or ORVs you saw to be:

		About Right	A Few Too Many	A Lot Too Many	Makes No Difference
A.	Other hunters seen	1	2	3	4
B.	Aircraft passing by	1	2	3	4
	(C and D: Applicable to August 26–September 20 season only)				
C.	Aircraft landing	1	2	3	4
D.	ORV traffic	1	2	3	4

13. Were any hunters from other parties stalking the same sheep you were? (Circle one) Yes No
14. Please indicate how the following conditions affect your hunting enjoyment.

	Strongly Detracts	Moderately Detracts	No Effect	Moderately Enhances	Strongly Enhances
Seeing other hunters.	1	2	3	4	5
Watching airborne hunters search for sheep.	1	2	3	4	5
Seeing many sheep but few legal rams.	1	2	3	4	5
Seeing many legal rams but few or no "trophies."	1	2	3	4	5
Taking a minimum legal-size ram.	1	2	3	4	5
Taking a larger "trophy" ram.	1	2	3	4	5
Enjoying mountains even if you don't get a ram.	1	2	3	4	5

15. Were you satisfied with the aesthetic quality of your hunt? (Circle one) Yes No
16. If no, why not:_____

    _____
17. Tell us in your own words what constitutes an aesthetic hunt._____

18. How should we define a trophy ram? Please give your reactions to the following statements:

	Strongly Agree	Moderately Agree	Moderately Disagree	Strongly Disagree	No Opinion
A. Size is not important, any legal ram is a trophy.	1	2	3	4	5
B. Not all full curls are trophies; only large, old rams near the end of their natural life spans are true trophies.	1	2	3	4	5

19. If you shot a ram during this hunt, how do you feel about it as a trophy? (circle one)

Very Satisfied — Extremely Disappointed — Did Not Shoot a Ram

1 2 3 4 5 6 7 8 9 10 11

20. Tell us in your own words how you define a trophy ram._____

21. Did you pass up any legal rams (i.e., decided not to stalk them)? Do not include rams stalked by someone else in your own hunting party. (Circle one) Yes No

22. If yes, how many did you pass up?_____

23. If you passed up any legal rams, was it because they were: (Check any answers that apply)

A._____Not as big as you wanted
B._____Not the kind of trophy you wanted
C._____Too early in the hunt
D._____Too far away
E._____Inaccessible
F._____Already being stalked by someone else
G._____Other (explain)_____

24. Considering everything that happened on your DCUA sheep hunt, were you satisfied with the quality of your hunt? (Circle one)

Very Satisfied — Extremely Disappointed

1 2 3 4 5 6 7 8 9 10

25. Do you agree with the DCUA management goal of providing a harvest of 35 full-curl rams with mean horn size of more than 36 inches? (Circle one) Yes No

Comments:_____

26. Do you agree with the DCUA management goal of providing aesthetically pleasing hunting conditions by 1) limiting the number of hunters by drawing permit to reduce crowding; and 2) restricting hunter access and transportation means by prohibiting motorized vehicles or pack animals from August 5–25? (Circle one)

Yes No

Comments:_____

27. Do you have any suggestions or comments for management or improvement of the DCUA sheep hunt?

_____

_____

Thank you for your time,

Steve DuBois
Delta Area Biologist
Division of Wildlife Conservation
(907) 895-4484

LOCATION

GAME MANAGEMENT UNIT: 20A (6796 mi^2)

GEOGRAPHIC DESCRIPTION: North side of the Alaska Range east of the Nenana River, west of the Delta River, and south of the Tanana River

BACKGROUND

The mountains of Unit 20A remain one of the most popular Dall sheep hunting areas in Interior Alaska because of the open general season, their proximity to Fairbanks, and the opportunity to hunt other species. Management in Unit 20A provides a wide variety of hunting opportunities and includes areas closed to the use of motorized vehicles (except aircraft) and an area open only to hunting by bow and arrow. Since 1981, harvests have ranged from 45 to 163 rams taken by 150–410 hunters.

Heimer and Watson (1986) summarized Unit 20A population trends. Sheep numbers grew relatively high by the 1960s probably due to widespread predator control programs before statehood and to favorable weather conditions. Aerial sheep surveys conducted prior to 1978 indicated a minimum estimate of 3576 sheep in Unit 20A. McNay (1990) estimated 5000 sheep inhabited the unit in 1989, based on assumed sightings of 70–80% of the sheep population, incomplete coverage of some sheep habitat, and population growth since 1977. An extensive aerial survey conducted in 1994 indicated the sheep population declined during the early 1990s to about 2000 sheep (Whitten and Eagan 1995). The population probably declined from reduced productivity and increased mortality due to a series of years with unfavorable weather. Overharvest was not a concern because hunting was restricted to the taking of old rams.

Research efforts in Unit 20A included a study comparing sheep population and horn characteristics in Unit 20A to those in Unit 12 (Heimer and Watson 1986), a study of sheep use of the Dry Creek mineral lick, and a study of movements and seasonal ecology of sheep on Fort Greely (Spiers and Heimer 1990). More recent research included Whitten and Eagan's (1995) evaluation of sheep monitoring methods and development of a double sampling technique, and Scotton's (1997) investigation of the causes and magnitude of lamb mortality.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Maintain a Dall sheep population and its habitat with biological diversity in concert with other components of the ecosystem.

MANAGEMENT OBJECTIVES

- Provide the greatest sustainable annual opportunity to hunt Dall sheep.

- Provide the greatest sustainable annual harvest of Dall sheep.

- Provide the opportunity to view and photograph Dall sheep under natural conditions.
- Manage for a Dall sheep population of approximately 5000 sheep.
- Maintain naturally regulated ewe and subadult ram segments of the population.

METHODS

We conducted 3 aerial surveys during this reporting period to monitor population status. All surveys were conducted from R-22 helicopters (Whitten and Eagan 1995). We flew contours of all sheep habitat within the survey sections. We classified sheep as lambs, yearlings, ewes, or rams based on horn size and shape and body conformation. In 1997 we also classified ram horn sizes.

On 9 June 1996 and 17 June 1997, we surveyed Sections I–III located between the Wood and Little Delta Rivers. In addition to Sections I–III, the 17 June 1998 survey included Section IV located south of Sections I–III, the area between the West Fork of the Little Delta River and Buchanan Creek, and a small portion of the upper Wood River.

We evaluated harvest, hunter use patterns, and characteristics of sheep taken by hunters from harvest report cards. Harvest data were summarized by regulatory year (RY = 1 July–30 June).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Composition

Composition data reflected improved lamb:ewe ratios beginning in 1994 (Table 1) when compared to the poor ratios observed in the early 1990s (Scotton 1997). Rams were well represented. We observed 36, 44, and 25 yearlings:100 ewes in 1996, 1997, and 1998, respectively. These ratios indicated that production and survival of lambs have improved since the early 1990s and the population was probably increasing.

MORTALITY

Harvest

Seasons and Bag Limit. The sheep hunting season was open 10 August through 20 September throughout this reporting period. The bag limit was 1 ram with a full-curl or larger horn, with both horns broken, or at least 8 years old.

Board of Game Actions and Emergency Orders. The Board of Game did not change any seasons or bag limits for sheep in Unit 20A during this reporting period, and no emergency orders were issued.

Hunter Harvest. Harvests remained low (45–60) during this reporting period (Table 2).

Mean horn length of harvested rams has ranged from 34 to 35 inches since the bag limit changed from 7/8-curl to full-curl in RY 1984–1985 (Table 2). Less than 1% of the rams harvested since RY 1986–1987 have had horns ≥40 inches long. None was taken during this reporting period.

Hunter Residency and Success. Success rates remained higher for nonresidents than for resident hunters (Table 3). During this reporting period, nonresident success was 55–88%, while resident success was 15–26%. Overall success rates were 25–37% during this reporting period.

Harvest Chronology. Roughly half of all sheep harvest in Unit 20A occurred during the first 10 days of the season (Table 4). Harvest tended to taper off as the season progressed because of hunter effort and legal ram availability.

Transport Methods. The Wood River and Yanert Controlled Use Areas were closed to the use of motorized vehicles, except aircraft, for big game hunting and transportation throughout the sheep hunting season. These areas contain approximately half of the Dall sheep range in Unit 20A. Accordingly, most of the successful sheep hunters used airplanes or horses for transportation (Table 5).

HABITAT

Assessment

No significant disturbance or destruction of sheep habitat occurred in Unit 20A through this reporting period. However, recent increases in mineral exploration and mining activity resulted in concerns about habitat and disturbance by a local advisory committee and other users.

CONCLUSIONS AND RECOMMENDATIONS

We assumed that restricting harvest to full-curl rams achieved objectives to provide the greatest annual sustainable harvest opportunity and greatest sustainable harvest, but we did not specifically address these objectives during the reporting period. These objectives are difficult to quantify and should be changed to goals. The objective to provide the opportunity to view and photograph sheep under natural conditions also was not addressed. This objective is not quantifiable and should be changed to a goal for the next 5-year plan.

The restriction to full-curl rams allowed us to meet our objective to maintain naturally regulated ewe and subadult ram segments of the population. However, we failed to meet our population objective of 5000 sheep. Current harvest was well below those sustained through the 1980s. Changes in seasons and bag limits are not recommended. We expect harvests to remain low as weak cohorts from the decline phase of the early 1990s mature and become legal to hunt. Recent improvements in recruitment will not result in increased harvests until after the year 2001.

LITERATURE CITED

HEIMER WE AND SM WATSON. 1986. Comparative dynamics of dissimilar Dall sheep populations. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Report. Grants W-22-1, W-22-2, W-22-3, W-22-4, and W-22-5. Job 6.9R. Juneau.

MCNAY ME. 1990. Dall Sheep. Manage report of survey-inventory activities. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Grant W-23-2. Study 6.0. Juneau.

SCOTTON BD. 1997. Estimating rates and causes of neonatal lamb mortality of Dall Sheep in the central Alaska Range. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Grants W-24-4 and W-24-5. Study 6.12. Juneau.

SPIERS JK AND WE HEIMER. 1990. Dall sheep movements near Fort Greely, Alaska: preliminary findings. Pages 31-37 *in* JA Bailey, editor. Proceedings of the seventh biennial symposium northern wild sheep and goat council. Clarkston, Washington.

WHITTEN KR AND RM EAGAN. 1995. Estimating population size and composition of Dall Sheep in Alaska: assessment of previously used methods and experimental implementation of new techniques. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Progress Report. Grant W-24-3. Study 6.11. Juneau.

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Table 1 Unit 20A sheep composition counts, regulatory years 1993–1994 through 1997–1998

Regulatory year	Rams:100 ewes	Full-curl rams	Lambs:100 ewes	Sample size
1993–1994	42	6	50	1425
1994–1995	54	–[a]	35	586
1995–1996	59	–[a]	51	657
1996–1997	83	–[a]	40	567
1997–1998	52	11	42	852

[a] Data not collected.

Table 2 Unit 20A sheep harvest, regulatory years 1984–1985 through 1997–1998

Regulatory year	Reported harvest	Total hunters	Percent success	$\bar{x}$ Horn length (inches)[a]
1984–1985	105	292	36	34.0
1985–1986	102	292	35	34.0
1986–1987	136	357	38	34.2
1987–1988	142	354	40	35.0
1988–1989[b]	154	404	38	34.7
1989–1990[c]	163	410	40	34.3
1990–1991[c]	124	379	33	34.4
1991–1992[c]	109	338	32	34.5
1992–1993	62	230	27	34.0
1993–1994	50	166	30	34.1
1994–1995	49	147	33	34.9
1995–1996	60	164	37	35.7
1996–1997	54	151	36	35.5
1997–1998	45	178	34	35.1

[a] Includes broomed horns.
[b] Data from harvest printout 30 Jan 1989.
[c] Data from harvest summary book.

Table 3 Unit 20A sheep hunter residency and success, regulatory years 1984–1985 through 1997–1998

Regulatory year	Successful					Unsuccessful					Total hunters
	Unit[a] resident	Alaska[b] resident	Nonresident	Unk	Total	Unit[a] resident	Alaska[b] resident	Nonresident	Unk	Total	
1984–1985	--	78	27	0	105	--	177	7	3	187	292
1985–1986	44	65	36	1	102	143	177	10	3	190	292
1986–1987	59	90	36	10	136	141	196	13	12	221	357
1987–1988	61	80	49	13	142	100	166	9	37	212	354
1988–1989	43	72	45	37	154	125	175	3	72	250	404
1989–1990	78	110	52	1	163	158	223	19	5	247	410
1990–1991	49	73	46	5	124	167	235	12	8	255	379
1991–1992	50	76	33	0	109	146	207	15	7	229	338
1992–1993	20	35	24	3	62	102	147	20	1	168	230
1993–1994	18	26	22	2	50	66	99	15	2	116	166
1994–1995	14	22	22	5	49	59	85	3	13	101	150
1995–1996	26	31	27	2	60	75	90	13	1	104	164
1996–1997	18	29	24	1	54	76	86	10	1	97	151
1997–1998	13	20	25	0	45	88	114	17	2	133	178

[a] Includes all of Unit 20.
[b] Includes unit residents.

Table 4 Unit 20A sheep harvest chronology percent by harvest period, regulatory years 1984–1985 through 1997–1998

Regulatory year	Harvest dates			
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep
1984–1985	56	18	13	13
1985–1986	52	23	15	9
1986–1987	38	29	25	8
1987–1988	49	29	13	10
1988–1989	50	26	15	9
1989–1990[a]	--	--	--	--
1990–1991[b]	60	21	7	4
1991–1992	56	20	16	5
1992–1993[b]	47	29	19	3
1993–1994[b]	56	18	18	6
1994–1995	53	25	10	12
1995–1996[b]	45	23	12	17
1996–1997[b]	65	17	7	7
1997–1998	56	24	13	7

[a] Data not readily available in this format. However, 45% of sheep harvested in 1989 were taken by 19 Aug. An additional 36% were taken by 2 Sep.
[b] Remainder — unknown/other.

Table 5 Unit 20A sheep harvest percent by transport method, regulatory years 1985–1986 through 1997–1998

Regulatory year	Percent by transport method							
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unk	*n*
1985–1986	56	27	1	1	3	12	0	96
1986–1987	48	29	0	1	6	16	0	127
1987–1988	50	30	0	2	5	13	0	131
1988–1989	62	20	0	1	5	12	0	142
1989–1990	55	20	0	5	4	15	1	160
1990–1991	56	23	0	4	6	10	1	122
1991–1992	57	19	1	6	3	8	6	109
1992–1993	52	24	0	6	6	8	3	62
1993–1994	50	28	0	4	0	16	2	50
1994–1995	49	29	0	6	4	8	4	49
1995–1996	35	38	0	10	5	8	3	60
1996–1997	37	37	4	7	2	6	7	54
1997–1998	49	31	0	13	0	2	4	45

LOCATION

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

GEOGRAPHIC DESCRIPTION: White Mountains

BACKGROUND

Dall sheep in the White Mountains provide the public with opportunities to view and hunt sheep relatively close to Fairbanks with access by road, air, or boat. These sheep have received little attention because the population is relatively small (500–600 sheep) and harvest is low (<10 sheep/yr).

Survey data indicate the population has fluctuated widely during the last 22 years. Historically, surveys were infrequent, but they have increased in frequency in recent years (Table 1). Due to survey differences (area covered, date of survey, intensity, weather conditions, pilots and observers), conclusions based on these data are speculative. They indicate a relatively high population in the early 1970s, followed by a decrease through the early 1980s, and then an increase to current numbers.

The number of rams classified as "legal" during surveys generally decreased from 1970 to 1995, largely due to changes in the definition of the term *legal*. Legal rams included 3/4-curl or larger rams from 1970 to 1978, 7/8-curl rams from 1979 to 1985, 7/8-curl rams for Unit 25 and full-curl rams for Unit 20 in 1986, and full-curl rams since 1987. Survey data from 1996 to 1997 indicated that the number of "legal" rams increased in recent years.

US Fish and Wildlife Service conducted the first studies in the 1950s (Gross 1963). The only research project during recent years was a study (1983–1988) of 10 radiocollared sheep to identify distribution, movements, and seasonal use areas. This was a cooperative effort between the Bureau of Land Management (BLM) and ADF&G (Durtsche et al. 1990).

Most sheep habitat in the White Mountains lies within the White Mountains National Recreational Area (WMNRA) and the Steese National Conservation Area (SNCA). Both were established by the Alaska National Interest Lands Conservation Act in 1980 and are managed by 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. That goal is to provide for the opportunity to hunt sheep under aesthetically pleasing conditions.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Provide the opportunity to hunt Dall sheep in the White Mountains under aesthetically pleasing conditions.

MANAGEMENT OBJECTIVES

- Manage for the annual opportunity to harvest full-curl rams from a population of at least 250 Dall sheep.

METHODS

We conducted 3 aerial surveys during this reporting period to estimate population size and composition. Observers classified sheep as lambs, "ewes," or rams based on horn size/shape and body conformation. "Ewes" included yearlings of both sexes and young rams that could not be distinguished from ewes. Rams were classified as legal (full-curl or both horns broomed) or sublegal (less than full curl). Observers searched alpine and subalpine sheep habitat by flying low-level (less than 500 feet AGL) contours and circles at 60–80 knots/hour in a Piper Supercub and an Aviat Husky. Survey areas included Big Bend to Windy Gap, Windy Gap to Sheep Creek, Cache Mountain, Lime Peak, Mount Prindle, Mount Schwatka, and Victoria Mountain. Survey intensity and coverage varied depending on weather conditions and pilot/observer availability and experience. The population was estimated assuming that 85% of the sheep were observed during the surveys (T Boudreau, pers commun).

We monitored harvest through harvest ticket report cards. Harvest data were summarized by regulatory year (RY = 1 July–30 June).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The sheep population was approximately 500–600, which is the highest estimate since the surveys began in these subunits. During aerial surveys in 1995, 1996, and 1997, observers counted 409, 464, and 417 sheep, respectively (Table 1). Although high search times (11.1, >9, and 12.1 hr, respectively) should have resulted in a high number of sightings during these surveys, sheep in this area sometimes use habitat well away from escape terrain, including timber and shrub-covered areas near mineral licks. Therefore, we adjusted our estimate upward to account for sheep not observed.

Population Composition

Lambs:100 "ewes" ranged from 20 to 35 from 1994 to 1997, which is within the annual variation limits observed since the surveys began in 1970 (Table 1).

Since 1994, the ram:"ewe" ratio was stable between 35 and 39:100 (Table 1). Number of rams counted increased during 1994–1996 and may be stabilizing (the 1997 count was lower than 1996, but survey coverage was different). The number of "legal" rams counted per survey remained small and ranged from 6 to 16.

Caution should be used in interpreting composition data. Survey areas varied throughout the years because weather often prevented portions of sheep habitat from being surveyed. The area surveyed affected composition because ram groups and ewe/lamb groups often occupied

different ranges during summer. In addition, sheep were distributed differently in September/October than in June/August, so the survey date was an important factor. Also, composition data underestimated true lamb:ewe and ram:ewe ratios because the "ewe" category contained young rams.

Distribution and Movements

Sheep in the White Mountains are found in small, widely scattered groups throughout approximately 534 mi^2 of alpine habitat near Victoria Mountain, Mount Schwatka, Mount Prindle, and Lime Peak (Rocky Mountain). They may have a relatively unique gene pool (Durtsche et al. 1990) because this area is geographically isolated from other sheep populations (ADF&G 1976).

The seasonal movements and distribution of sheep described below were taken primarily from a study of 10 radiocollared sheep (Durtsche et al. 1990). Movement from wintering areas to lambing areas usually occurred between late May and mid June, with most lambs being born between 15 May and 30 May (earliest was 10 May). Movements to rutting areas usually occurred from late September to late October. Additional movements by rams to winter range occurred from late November through December.

Individual sheep associated with one of several bands. Separate bands used disjunct ranges most of the year, intermingled with other bands during pre-rut and rut, then returned to their favored areas post-rut. Bands of ewes often used the same range as bands of rams; however, they do not occupy the range at the same time. Rams shifted notably away from easy access points during the sheep hunting season.

Although some mixing occurred, sheep were found in 2 main areas, Lime Peak/Mount Prindle and Victoria Mountain/Mount Schwatka.

Lime Peak/Mount Prindle. Rutting and wintering areas included Lime Peak, VABM Fossil, and the headwaters of Willow Creek. Ewes moved to lambing areas and summer ranges at the headwaters of Mascot Creek west of Lime Peak and in the ridge complex around Mount Prindle. Sheep used mineral licks in upper Mascot Creek and Preacher Creek.

Victoria Mountain/Mount Schwatka. During winter, sheep inhabited Victoria Mountain and the ridges north and east of Mount Schwatka. Lambing occurred on Victoria Mountain and the ridge complex in upper Jefferson Creek, upper Big Creek, and Mount Schwatka. Sheep used mineral licks in the headwaters of Jefferson Creek and along Victoria Creek north of Victoria Mountain. The major rutting area for this region appears to be east of Mount Schwatka and north of Victoria Mountain.

MORTALITY

Harvest

Season and Bag Limit. The sheep hunting season was 10 August–20 September throughout this reporting period. The bag limit was 1 full-curl ram (includes rams that are at least 8 years old or have both horns broomed; Table 2).

Board of Game Actions and Emergency Orders. There were no board actions or emergency orders issued during this reporting period.

Hunter Harvest. Reported harvest during the last 5 years was 36 sheep. The highest reported harvest in any year was 9 sheep in RY 1997–1998 (Table 3).

The average horn base measurement was 13.8 inches (range = 12.00–15.75, $n = 34$) during the last 5 years (Table 3). Average horn length measurements had little meaning in this area because many were broomed (55% of the reported harvest had at least 1 horn broomed, and 24% had both horns broomed). During the last 5 years (RY 1993–1994 through RY 1997–1998), the average reported age of harvested rams was 9.5 (range 7–13, $n = 35$), down slightly from the previous 5 year (1988–1992) average of 10.0 (range 6–15, $n = 21$).

Hunter Residency and Success. White Mountains sheep were mostly hunted by Alaska residents. Only 5 nonresidents have reported hunting sheep in the area since RY 1984–1985 (Table 4). The success rate of all hunters for the last 5 years combined was 20% (36 of 181). During the last 5 years, successful and unsuccessful hunters reported spending an average of 5 days afield (Table 5).

Harvest Chronology. Eighty percent (28 of 35) of sheep harvested since 1993 were taken during August (Table 6). In recent years the sheep harvest shifted to later in the season. During RY 1995–1996 through RY 1997–1998, 42% (10 of 24) of the total harvest occurred during the first 11 days of the season compared to 76% (13 of 17) for RY 1992–1993 through RY 1994–1995.

Transport Methods. Main access points for airplanes are gravel bars, a small airstrip on Lime Peak, 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 trails and mining roads off the Steese Highway. In 1988 BLM established ORV restrictions throughout the WMNRA and SNCA. With these restrictions, most of the sheep range in the White Mountains area was closed to the use of ORVs. However, ORVs weighing <1500 lb are allowed in most of the area between the Steese Highway and Mount Prindle, which provides good access to sheep habitat.

During RY 1993–1994 through RY 1997–1998, 81% of successful hunters used airplanes for transportation, while 3- or 4-wheelers were the most common means of transportation for unsuccessful sheep hunters (Table 7). This pattern persisted for the past several years. Hunters using ORVs and highway vehicles were usually unsuccessful. The use of 3- or 4-wheelers for hunting has increased from an average of 2 hunters per year prior to RY 1990–1991 to an average of 14 hunters per year since then.

Other Mortality

Weather and predation were probably the primary causes of natural mortality, although no data are available to confirm this. Deep snow was implicated as an important cause of sheep mortality in previous years (Heimer and Watson 1986). The record snowfall of 1991–1992 probably caused the low lamb:ewe ratio and drop in overall numbers in 1992. The winters

since have been average or slightly below average for snowfall and did not adversely affect populations in the White Mountains.

Little is known about predation rates or predator populations in the White Mountains. McNay (1989) estimated that 87 wolves resided in Unit 25C. One radiocollared ewe was killed by wolves in winter 1983–1984. Golden eagles have been seen on Lime Peak, and coyotes are probably present.

Sheep in the White Mountains frequently travel through forested areas because of scattered, low-elevation sheep habitats and because of the scarcity of rugged escape terrain in the alpine areas (ADF&G 1976). Although these forested areas may provide some escape cover from eagles, traveling through them probably increases sheep susceptibility to predation by terrestrial predators.

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 important to the long-term welfare of sheep in the White Mountains because the relatively low-elevation, discontinuous alpine areas offer limited sheep habitat and few alternatives. Sheep have also used caves in the White Mountains for many years, perhaps for relief from hot weather. In 1950 LE Powell (ADF&G files) wrote that "A cave on the eastern slope of the White Mountains had considerable sheep sign in it. The entrance was approximately 25' high and 14' wide. A water hole 25' inside the cave was inaccessible to sheep because it was sunken in shear walls below ground level. The floor of the cave was covered with an inch of old sheep droppings. No prominent or recently used trails were found in the immediate area." In 1982, 5 rams were seen leaving a cave during a "hot and buggy day" (E Crain, pers commun).

Three potential threats to sheep habitat include mineral exploration, BLM's development of recreational facilities in the WMNRA and SNCA, and forest succession encroaching on sheep range in the absence of a natural fire regime. BLM's facilities include trails and remote cabins that are intended to substantially increase human use of the area. BLM is developing the 18-mile Nome Creek Road, which links the Steese Highway with 2 new campgrounds and several trailheads, to increase recreational opportunity.

CONCLUSIONS AND RECOMMENDATIONS

Our goal to provide the opportunity to hunt sheep in the White Mountains under aesthetically pleasing conditions was met. Human use of sheep in the White Mountains area was relatively low, and it was not necessary to limit the number or distribution of hunters. However, to maintain aesthetically pleasing conditions, activities such as use of ORVs, mineral exploration, and development of trails, access, and cabins should be monitored and discouraged if necessary. Nonconsumptive use of sheep, such as viewing, will probably increase during the next few years as BLM promotes recreational use of the area.

We met our management objective to provide for the sustained opportunity to harvest full-curl rams from a population of at least 250 sheep. We have maintained a resident and nonresident open season for a full-curl ram from 10 August to 20 September. Our current population estimate of 500–600 sheep exceeds our minimum population objective. No changes to season or bag limits are recommended at this time.

We also worked cooperatively with BLM and other potentially affected groups to protect sheep habitat. Mineral licks are important year-round use areas and any activity that limits use of these areas by sheep should be closely examined and discouraged if necessary. ORV users have emerged as a potential problem by rapidly extending the existing trail system in areas where their use is both permitted and prohibited, including sheep habitat (Durtsche et al. 1990).

LITERATURE CITED

ALASKA DEPARTMENT OF FISH AND GAME. 1976. Alaska wildlife management plans: Interior Alaska. Juneau.

DURTSCHE BM, W HOBGOOD, AND J BURRIS. 1990. Distribution, movements and seasonal use areas of radio-tagged Dall sheep in the White Mountains-Tanana Hills, Alaska, 1983–1989. Bureau of Land Management, Open File Report 30, September 1990. Anchorage.

GROSS J. 1963. Range and use of range by Dall sheep on Victoria Mountain and Mount Schwatka, Alaska. Unpublished MS Thesis. University of Alaska, Fairbanks.

HEIMER WE AND SM WATSON. 1986. Comparative dynamics of dissimilar Dall sheep populations. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Report. Grants W-22-1, W-22-2, W-22-3, W-22-4, and W-22-5. Juneau.

MCNAY ME. 1989. Sheep. Unit 20A survey-inventory progress report. Pages 62–67 *in* SO Morgan, editor. Annual report of survey-inventory activities. Part II. Volume XIX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-1. Juneau.

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Table 1 White Mountains aerial sheep composition counts, 1970–1997

Date	Rams			Rams: 100 "ewes"	"Ewes"[b]	Lambs	Lambs:100 "ewes"	Total sheep	Count time (hr)
	Legal[a]	Sublegal	Total						
28 Aug 1970	19	25	44	26	171	70	41	285	5.9
5–8 Aug 1977	13	25	38	58	66	20	30	124	6.5
29 Jun–3 Jul 1982	15	30	45	58	77	10	13	132	9.6
17–29 Jun 1986	17	42	59	45	132	49	37	240	14.6
4–10 Aug 1989	6	50	56	42	132	31	23	237[c]	3.6
30 Sep–3 Oct 1991	9	72	81	37	220	53	24	345	8.8
1–4 Aug 1992	8	68	76	35	215	33	15	324	11.8
1993[d]									
4 Aug 1994[e]	8	64	72	36	201	71	35	344	10.3
1–11 Aug 1995	6	78	88[f]	35	248	73	29	409	11.1
5–7 Aug 1996	16	90	106	39	270	88	33	464	–[g]
5 Aug 1997[h]	10	88	98	37	266	53	20	417	12.1

[a] "Legal" rams = 3/4 curl in 1970 and 1977, 7/8-curl in 1982 and 1986, full curl since 1987.

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

[c] Total number includes 18 sheep that were not classified.

[d] No survey.

[e] Numbers include sheep observed during the 12–13 Jul 1994 ground survey of Mount Prindle, which was not surveyed in Aug due to severe turbulence.

[f] Total rams includes 4 rams that could not be classified because of severe winds in the area.

[g] Total count time could not be calculated from data sheets.

[h] Victoria Mountain was not surveyed in 1997 (47 sheep were counted in this area in 1996).

Table 2 White Mountains sheep seasons and bag limits, regulatory years 1983–1984 through 1997–1998

Regulatory year	Season	Bag limit	Legal horn size[a]	
			Portion in Unit 20	Portion in Unit 25
1983–1984	10 Aug–20 Sep	1 ram	7/8-curl horn or larger	7/8-curl horn or larger
1984–1985 through 1986–1987	10 Aug–20 Sep	1 ram	Full-curl horn or larger	7/8-curl horn or larger
1987–1988 through 1997–1998	10 Aug–20 Sep	1 ram	Full-curl horn or larger	Full-curl horn or larger

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

Table 3 White Mountains sheep harvest characteristics, regulatory years 1993–1994 through 1997–1998

Regulatory year	Horn			
	Age (yr)	Broomed	Length (in)	Base (in)
1993–1994	8	0	33.00	14.00
	9	2	31.00	14.50
	8	0	37.75	13.50
	9	1	35.50	14.00
	10	1	35.00	13.75
1994–1995	9	1	35.00	13.75
	10	1	36.00	14.00
	13	2	35.50	14.00
	9	0	34.50	13.75
	9	0	36.00	14.00
	10	1	39.38	13.88
1995–1996	9	0	37.00	14.50
	9	0	37.50	15.50
	9	1	40.00	15.75
	12	1	40.00	13.25
	10	0	36.50	12.00
	12	0	37.50	12.50
	7	0	31.50	14.00
1996–1997	11	0	36.00	14.50
	8	2	23.00	14.00
	13	2	35.50	13.50
	12	2	34.00	14.50
	10	2	32.00	13.00
	8	0	31.50	12.00
	10	2	38.00	14.25
	8	--	36.50	14.00
1997–1998	9	0	39.00	14.25
	8	0	31.90	13.50
	10	0	37.00	14.00
	10	2	29.00	14.25
	9	1	39.90	14.50
	9	1	37.00	13.25
	10	1	38.00	--
	8	--	35.30	13.50
	7	0	30.00	12.00

Table 4 White Mountains sheep hunter residency and success, regulatory years 1984–1985 through 1997–1998

Regulatory year	Successful hunters				Unsuccessful hunters				Total	
	Resident	Nonresident	Unspecified	Total	Resident	Nonresident	Unspecified	Total	Hunters	% Success
1984–1985	0	2	0	2	21	0	1	22	24	8
1985–1986	5	0	0	5	12	0	0	12	17	29
1986–1987	4	0	1	5	4	0	1	5	10	50
1987–1988	2	0	0	2	11	0	0	11	13	15
1988–1989	1	0	0	1	8	0	6	14	15	7
1989–1990	6	0	0	6	6	0	2	8	14	43
1990–1991	4	0	0	4	13	0	1	14	18	22
1991–1992	3	0	0	3	19	0	0	19	22	14
1992–1993	6	0	0	6	29	0	0	29	35	17
1993–1994	5	0	0	5	37	0	3	40	45	11
1994–1995	6	0	0	6	25	0	1	26	32	19
1995–1996	7	1	0	8	26	0	0	26	34	24
1996–1997	7	1	0	8	30	1	0	31	39	21
1997–1998	9	0	0	9	22	0	0	22	31	29
Total	65	4	1	70	263	1	15	279	349	

Table 5 White Mountains sheep hunter effort, regulatory years 1984–1985 through 1997–1998

Regulatory year	Successful		Unsuccessful		Total
	Hunters	$\bar{x}$ days[a]	Hunters	$\bar{x}$ days[a]	hunters[b]
1984–1985	2	8	22	7	24
1985–1986	5	6	12	4	17
1986–1987	5	9	5	6	10
1987–1988	2	6	11	4	13
1988–1989	1	2	14	4	15
1989–1990	6	3	11	4	17
1990–1991	4	5	14	4	18
1991–1992	3	5	18	6	21
1992–1993	6	6	29	4	35
1993–1994	5	4	22	6	27
1994–1995	6	6	26	5	32
1995–1996	8	4	25	4	33
1996–1997	8	5	30	6	38
1997–1998	9	4	31	4	40
1984–1997	70	19	270	19	340

[a] Includes only hunters who reported the number of days they hunted and does not include all hunters.
[b] Total number of hunters reporting days hunted, not total hunted.

Table 6 White Mountains sheep harvest chronology by harvest period, regulatory years 1984–1985 through 1997–1998

Regulatory year	Harvest dates			
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep
1984–1985	2	0	0	0
1985–1986	3	1	1	0
1986–1987	1	2	1	1
1987–1988	2	0	0	0
1988–1989	0	1	0	0
1989–1990	4	0	0	2
1990–1991	1	1	1	1
1991–1992	4	0	0	1
1992–1993	6	0	0	0
1993–1994	3	2	0	0
1994–1995	4	0	2	0
1995–1996	4	2	2	0
1996–1997	5	2	1	0
1997–1998	1	5	2	0
Total	40	16	10	5

Table 7 White Mountains sheep hunter success by transport method, regulatory years 1984–1985 through 1997–1998

Regulatory year	Transport method				
	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other\Unknown
Successful:					
1984–1985	2	0	0	0	0
1985–1986	5	0	0	0	0
1986–1987	3	0	1	0	1
1987–1988	2	0	0	0	0
1988–1989	1	0	0	0	0
1989–1990	5	0	0	0	1
1990–1991	4	0	0	1	0
1991–1992	3	0	0	0	1
1992–1993	5	0	0	0	1
1993–1994	4	0	1	0	0
1994–1995	5	0	0	1	0
1995–1996	7	1	0	0	0
1996–1997	6	0	0	1	1
1997–1998	7	2	0	0	0
Total	59	3	2	3	5
Unsuccessful:					
1984–1985	8	6	3	2	3
1985–1986	4	1	4	3	0
1986–1987	0	1	3	1	0
1987–1988	6	2	1	0	2
1988–1989	4	1	3	2	4
1989–1990	1	1	4	3	2
1990–1991	7	8	2	1	1
1991–1992	3	15	0	4	1
1992–1993	10	10	1	5	3
1993–1994	8	17	3	5	4
1994–1995	4	12	1	4	1
1995–1996	8	13	0	4	1
1996–1997	11	13	1	3	3
1997–1998	3	18	1	5	4
Total	77	118	27	42	29

LOCATION

GAME MANAGEMENT UNIT: Portions of 20D and 20E (1000 mi^2)

GEOGRAPHIC DESCRIPTION: Tanana Hills

BACKGROUND

Dall sheep populations inhabiting the Tanana Hills are separate and in low densities. These populations remain at low density because of the physical geography of the area, which is atypical Dall sheep habitat (Kelleyhouse and Heimer 1989). The Tanana Hills were not glaciated during the most recent glacial advance and have little uplift. They are at fairly low elevation and have a rolling rather than rugged physiography that limits escape terrain. In an effort to maintain sheep habitats in the Tanana Hills, where forest succession occurs to the top of most hills, ADF&G continues to support wildfire management plans that should increase the extent of this marginal sheep habitat over time. Some benefit to local sheep populations may be realized from a wolf control program implemented in fall 1997.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the sheep population and its habitat in concert with other components of the ecosystem.

- Provide an opportunity to hunt sheep under aesthetically pleasing conditions.

RELATED MANAGEMENT ACTIVITIES

- Monitor harvest through hunter contacts and harvest or permit reports.

METHODS

The goal of providing the opportunity to hunt sheep under aesthetically pleasing conditions was maintained by requiring a drawing permit to hunt sheep in the Mount Harper complex and limiting access into Glacier Mountain. Access into the Seventymile and Charley Rivers is limited due to the remoteness of these areas. Harvest was monitored through drawing permit and general harvest reports. We analyzed data on harvest success, hunt area, hunter residence and effort, transportation type used to access the hunt area, and horn size and age. Harvest data were summarized by regulatory year (RY = 1 July–30 June).

We monitored population status in 3 areas in Unit 20E during the report period. Except for one ground-based survey, all surveys were conducted from a PA-18 aircraft or from an R-22 helicopter. Sheep were classified as rams, ewes, or lambs based on horn size and body conformation. Ewes included young rams that could not be distinguished from ewes. Rams were also classified as either legal (full-curl or both horns broomed) or sublegal.

Aerial surveys consisted of flying either the PA-18 or R-22 helicopter at 200–700 feet above suitable sheep habitat. Survey speed varied from 60–80 mph in the PA-18 to 30 to 80 mph in the R-22. The ground-based survey was conducted by walking the entire Glacier Mountain complex during a 9-day period. All sheep were classified using a spotting scope. We closely monitored sheep movement patterns to protect against duplicating our count.

Composition and size of the Glacier Mountain sheep population was estimated by ground-based survey on 11–15 July 1993 and by a fixed-winged aerial survey in July 1998. Population composition of the Mount Harper sheep population was estimated by a fixed-winged aerial survey on 26 July 1993 and by a helicopter aerial survey in July 1997. National Park Service estimated population composition from a helicopter within Yukon-Charley National Preserve (YCP) in 1997 and 1998.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The 1997 total estimate for Dall sheep in the Charley, Goodpaster, Seventymile, and Fortymile drainages was 450–500 sheep. Portions of this area were surveyed between 1990 and 1994. These data indicated the sheep population declined by 25–30% following a series of adverse winters and springs. Poor lamb recruitment and high adult mortality occurred during that period. Recovery probably began in 1994 with improved lamb production and/or survival.

Prior to 1997 the last complete survey of this area was in 1982, resulting in a population estimate of 365 sheep. The National Park Service (NPS) conducted 4 aerial surveys for Dall sheep between 1983 and 1990 within the YCP (Ulvi and Knuckles 1990). Based on their data, the area's sheep population increased 5–10% annually between 1983 and 1990.

Population Composition

Composition data indicated fewer lambs were present in 1993 than in 1997 and 1998, and fewer adult sheep were seen within the Mount Harper complex in 1993 than in 1997 (Tables 1–3). However, the number of rams, particularly subadults, did not increase in 1997, indicating that lamb recruitment was low during the early 1990s. Because of this earlier poor lamb recruitment, the number of legal rams is expected to be relatively low until 2001.

Distribution and Movements

No data indicate that distribution and movements are different from earlier reports by Kelleyhouse and Heimer (1990).

MORTALITY

Harvest

Season and Bag Limit. The open season for resident and nonresident hunters in the Tanana Hills in Units 20D and 20E was 10 August to 20 September; the bag limit was 1 ram with

full-curl or longer horns. A drawing permit was required to hunt the Mount Harper area; a harvest ticket was required for the remainder of Unit 20E. Hunters who used the Glacier Mountain Controlled Use Area (GMCUA) could not use motorized vehicles from 5 August through 20 September, but participation was not limited by a drawing permit requirement.

Board of Game Actions and Emergency Orders. The Board of Game did not change seasons or bag limits for sheep in Units 20D or 20E, Tanana Hills, during the report period.

Hunter Harvest. Reported sheep harvest from the general season increased in RY 1993–1994 following removal of the permit requirements in the Charley River and Mount Sorenson areas (Table 4). Of the 32 sheep harvested in this area since RY 1993–1994, 19 (60%) were taken in the former drawing permit areas. Prior to removal of drawing permit requirements, only 20% of the permittees for the Mount Sorenson and Charley River hunts actually participated, averaging 0.2 sheep/year. Participation was low because most permit recipients did not realize how difficult and expensive it was to access these areas. Participation in sheep hunting in these areas has increased since the permit requirement was dropped. This occurred primarily because residents began hunting sheep incidentally to moose and caribou, and the licensed guide in the area started taking clients.

Twenty-two rams were harvested in the general season during the report period. The mean horn length was 35.5 inches, and the average age was 9.7 years old (Table 4). Mean horn length was 34.0 inches and mean age was 9.2 years during RY 1984–1985 through 1992–1993. Increased horn length and age were probably due to more hunters taking sheep in the Seventymile and Charley River drainages. Prior to RY 1993–1994, <2 hunters annually hunted these drainages and took 0–1 sheep. Because of the low harvest, there was probably a greater proportion of older rams in the population. During the report period, 77% of the harvest was taken within these drainages. If this harvest rate continues, I expect horn size and mean age of harvested rams will decline.

During the report period, 2–4 sheep were harvested annually in the Mount Harper drawing permit area (Table 5). Mean hunter participation rate was 75%, which is equal to the participation rate of the previous 5 years. Mean horn length was 35.8 inches; the largest ram taken had horns 39 inches long. No rams with horns ≥40 inches were harvested during RY 1992–1993 through RY 1997–1998. During the 1997 composition survey, 4 rams were observed that had horns estimated to be >40 inches.

Hunter Residency and Success. During the report period, 10 local residents, 36 state residents, and 8 nonresident hunters harvested 22 rams (41% success) during the general sheep season in Unit 20E (Table 6). The mean number of hunters per year was 18. Between RY 1990–1991 and RY 1994–1995, the mean was 9 hunters per year. The increase was due to eliminating the permit requirement in the Charley and Seventymile drainages.

During the report period 2 nonresidents and 10 residents received Mount Harper permits. Both nonresidents and 6 of 7 state residents harvested a sheep (89%). Average success since RY 1990–1991 has been 59%.

Harvest Chronology. The timing of sheep harvest varies annually in the area, possibly because many hunters also hunt caribou and do not begin their hunt until the caribou are accessible. Also, hunters may not be compelled to hunt early because competition is so low in this area.

Transport Methods. The Mount Harper permit area and most of the Mount Sorenson and Charley River areas were accessed primarily by aircraft. A few hunters (<20% annually) boated up the Charley River. In the GMCUA, all successful hunters reported walking into the area. In past years, hunting by horseback was common among successful hunters; however, during the past 5 years no hunters used horses to access this area. Mechanized transportation was prohibited for sheep hunting in the GMCUA.

Other Mortality

Most Dall sheep mortality in the Tanana Hills is attributable to natural factors. However, we do not know the primary limiting factor(s) to population growth. Wolf, grizzly bear, and golden eagle predation has been observed. Escape terrain is limited, increasing predator effectiveness. We have no data on the limiting effects of accidents, disease, or winter habitat.

Seven wolf packs reside in the Mount Harper and Glacier Mountain areas. Sheep may benefit from a nonlethal wolf control program being conducted during 1997–2001. The program was designed to benefit caribou calf survival. During the control program, 6 of the wolf packs will be reduced to 2 wolves each. Benefits to local sheep populations will be monitored. We conducted the 1997 sheep surveys to gather baseline population and composition data prior to implementation of wolf control. We will repeat these counts in 2001, following 3 years of reduced wolf numbers. Sheep numbers and composition will also be monitored in YCP during this period and will act as a control to the wolf-manipulated areas.

HABITAT

Assessment

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

Portions of the Tanana Hills included in the YCP are protected from most human disturbance. Mount Harper is known to have mineral potential and has been subjected to mining operations in the past. Currently there is renewed interest in the area; much land has been reclaimed and more exploration is expected. Any full-scale development of the area should include sufficient measures to minimize disturbance of sheep or destruction of sheep escape cover and winter range. ADF&G's Division of Wildlife Conservation biologists will coordinate with Habitat Division staff to ensure that sheep habitat is protected during future development.

Over 30 years of wildfire suppression has caused lower elevation winter ranges and travel routes to become cloaked in spruce forest. Implementation of the Alaska Interagency Fire

Management Plan-Fortymile Area should result in a near-natural fire regime throughout this area, benefiting the sheep population.

CONCLUSIONS AND RECOMMENDATIONS

Based on surveys conducted in the early 1980s and in 1990, sheep numbers in the Tanana Hills increased during the 1980s. Between 1991–1994, adverse weather conditions, and possibly predation, caused the population to decline. In 1994 the population began recovering and has steadily increased. More rapid population growth may occur due to an ongoing wolf control program in the Mount Harper and Glacier Mountain areas. Impacts of the control program on sheep will be monitored through population and composition surveys.

Harvests have been low for the past 15 years, with little effect on the population. Harvests are not expected to increase significantly due to the difficult hunting conditions and limited access to these areas. These two factors help us to continue meeting our management goal of maintaining aesthetically pleasing hunting conditions. The Tanana Hills sheep population tends to be widely dispersed, often below treeline. The area has few trails and suitable landing sites. However, currently there is renewed interest in the area; much land has been reclaimed and more exploration is expected. Any full-scale development of the area should include sufficient measures to minimize disturbance of sheep or destruction of sheep escape cover and winter range. ADF&G's Division of Wildlife Conservation biologists will coordinate with Habitat Division staff to ensure that sheep habitat is protected during future development.

LITERATURE CITED

KELLEYHOUSE DG AND WE HEIMER. 1989. Tanana Hills survey-inventory report. Pages 103–109 *in* SO Morgan, editor. Annual report of survey-inventory activities. Part II. Sheep. Volume XIX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-1. Juneau.

———, AND ———. 1990. Tanana Hills survey-inventory report. Pages 100–104 *in* SO Morgan, editor. Annual report of survey-inventory activities. Part II. Sheep. Volume XX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-2. Juneau.

ULVI SR AND P KNUCKLES. 1990. Dall sheep survey. Research and Resource Management Report Series 90-06. National Park Service, Yukon-Charley Rivers National Preserve.

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Table 1 Mount Harper Dall sheep composition counts from aerial surveys, 1982, 1993 and 1997

Sex/age class	1982[a]	1993[a]	1997[b]
Legal rams[c]	18	11	13
Sublegal rams[d]	22	15	13
Unclassified rams	--		
Total rams	40	26	26
Ewes[e]	39	30	48
Lambs	8	4	9
Yearlings	--	--	
Unidentified	--	--	
Total other sheep	47	34	57
Total sheep	87	60	83
Legal rams:100 ewes	46	37	27
Sublegal rams:100 ewes	56	73	27
Total rams:100 ewes	103	87	54
Lambs:100 ewes	21	13	19
% Lamb	9	7	11

[a] Supercub survey.
[b] Helicopter survey.
[c] Full curl or larger.
[d] Greater than 1/4 curl but less than full curl.
[e] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 2 Glacier Mountain Dall sheep composition counts from ground survey, 1993 and aerial survey, 1998

Sex/age class	1993	1998
Legal rams[a]	3	6
Sublegal rams[b]	29	17
Unclassified rams	--	
Total rams	32	23
Ewes[c]	42	54
Lambs	10	20
Yearlings	--	--
Unidentified	--	--
Total other sheep	52	74
Total sheep	84	97
Legal rams:100 ewes	7	11
Sublegal rams:100 ewes	69	31
Total rams:100 ewes	76	43
Lambs:100 ewes	24	37
% Lamb	12	21

[a] Full curl or larger.
[b] Greater than 1/4 curl but less than full curl.
[c] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 3 Yukon-Charley Rivers National Preserve Dall sheep composition counts, 1997 and 1998

Sex/age class	1997	1998
Legal rams[a]	18	24
Sublegal rams[b]	37	53
Unclassified rams	--	
Total rams	55	77
Ewes[c]	156	116
Lambs	63	63
Yearlings	35	26
Unidentified	--	--
Total other sheep	254	205
Total sheep	309	282
Legal rams:100 ewes	12	21
Sublegal rams:100 ewes	24	46
Total rams:100 ewes	35	66
Lambs:100 ewes	40	54
% Lamb	20	22

[a] Full curl or larger.
[b] Greater than 1/4 curl but less than full curl.
[c] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 4 Tanana Hills sheep harvest, regulatory years 1990–1991 through 1997–1998

Regulatory year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Ewes	Total sheep	Hunters
1990–1991[a]	1	36.0	11.0	0	1	4
1991–1992[a]	3	33.7	8.3	0	3	13
1992–1993[a]	1	33.0	10.0	0	1	5
1993–1994[b]	5	34.0	8.8	0	5	11
1994–1995[b]	3	33.7	8.0	0	3	8
1995–1996[b]	8	36.3	9.1	0	8	16
1996–1997[b]	5	35.0	9.4	0	5	16
1997–1998[b]	9	35.3	10.5	0	9	23

[a] Includes the Glacier Mountain Controlled Use Area (GMCUA) only.
[b] Includes the old 1107 and 1108 permit areas and GMCUA.

Table 5 Tanana Hills sheep harvest data by permit hunt, regulatory years 1990–1991 through 1997–1998

Hunt/Area	Regulatory year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	$\bar{x}$ Horn length	Total harvest
DS106	1990–1991	4	2	1	1	39.8	1
Mount	1991–1992	4	1	1	2	37.0	2
Harper	1992–1993	4	2	0	2	34.5	2
	1993–1994	4	1	3	0	--	0
	1994–1995	4	1	3	0	--	0
	1995–1996	4	0	0	4	37.0	4
	1996–1997	4	1	1	2	35.6	2
	1997–1998	4	2	0	2	34.8	2
1107[a]	1990–1991	4	4	0	0	--	0
	1991–1992	4	3	1	0	--	0
	1992–1993	4	2	2	0	--	0
1108[a]	1990–1991	4	4	0	0	--	0
	1991–1992	4	2	1	1	37.3	1
	1992–1993	4	3	1	0	--	0

[a] Permit hunts 1107 and 1108 were changed to general season hunts in spring 1992.

Table 6 Tanana Hills sheep hunter residency and success[a], regulatory years 1993–1994 through 1997–1998

Regulatory year	Successful				Unsuccessful				Total hunter
	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	
1993–1994	0	2	3	5 (45)	1	4	1	6 (55)	11
1994–1995	0	2	1	3 (38)	2	1	2	5 (62)	8
1995–1996	2	5	1	8 (50)	1	6	1	8 (50)	16
1996–1997	1	2	2	5 (31)	3	7	1	11 (69)	16
1997–1998	0	6	3	9 (41)	3	10	0	13 (59)	22

[a]Excludes hunters in permit hunts.

LOCATION

GAME MANAGEMENT UNITS: 23 (44,00 mi^2) and 26A (53,000 mi^2)

GEOGRAPHIC DESCRIPTION: western Brooks Range

BACKGROUND

Dall sheep are indigenous to northwest Alaska. For centuries, Inupiat residents hunted sheep for subsistence use (Georgette and Loon 1991). Now, nonlocal residents and nonresident hunters also hunt sheep in this area.

Sheep in Units 23 and 26A are at the northwestern margin of their range in Alaska. Consequently, these populations are more prone to fluctuations in population size because of adverse weather conditions than populations inhabiting areas with better and more stable range conditions. In addition, long-term local residents think wolf abundance substantially affects sheep numbers and distribution. Wolf numbers are thought to have fluctuated widely during the last 50 years in response to hunting, natural mortality (rabies), the presence of reindeer and caribou, and the establishment of moose populations (Ballard 1993).

In Units 23 and 26A, sheep are at low density compared to other areas in the state (Singer 1984). Beginning in 1990 high natural mortality through starvation, wolf predation, and disease occurred in Units 23 and 26A, reducing sheep numbers dramatically. In response, from 1991 through 1997 ADF&G and the National Park Service (NPS) closed most areas to sport and subsistence sheep hunting. Limited hunting was reestablished in 1998. Monitoring the recovery of this population continues to be a high priority for both agencies.

In future management reports, information on sheep located in the upper Noatak; east of the Cutler and Redstone Rivers (Schwatka Mountains) will be reported in a combined report for Units 23, 24, and 26A. This change consolidates data and management considerations for the central Brooks Range sheep population.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Baird Mountains

- Maintain a posthunt (fall and winter) population of 450–600 adult sheep.
- Maintain a minimum ratio of 7–10 7/8-curl and larger rams per 100 "ewes" ("ewe" defined as adult female, yearling of either sex, or 1/4-curl ram).

DeLong Mountains

- Evaluate survey area boundaries and establish management objectives based on sheep biology.

- Maintain a minimum ratio of 7–10 7/8-curl-and-larger rams per 100 "ewes."

Wulik Peaks

- Maintain a minimum ratio of 7–10 7/8-curl-and-larger rams per 100 "ewes".
- Evaluate survey area boundaries and establish criteria to open and close sport and subsistence hunts.

Management goals and objectives were modified for this reporting period to identify management objectives specifically for the Wulik Peaks. In 1998 federal action closed the remainder of the DeLong Mountains to state managed hunts of sheep. Although this was a temporary action, it forced the state to manage sheep in this portion of the DeLong Mountains separately from areas to the east.

METHODS

Baird Mountains. Aerial fixed-wing surveys were conducted annually in cooperation with NPS in a 711 mi^2 (1841 km^2) portion of the Baird Mountains. The survey area was standardized in 1988 to encompass most sheep habitat in the area. We think 80–90% of the population is contained within the count area.

Surveys in the Baird Mountains were timed to coincide with the formation of ewe-lamb bands and suitable weather conditions. During the reporting period, the area was surveyed on 5–10 July 1995, 17–20 July 1996, and 16–19 July 1997. For comparative purposes, we will report survey data from 1–10 July 1998, even though it was collected after this reporting period. For density calculations, "area" is defined as all terrain within the count area, excluding major river valleys and expanses of tundra.

In 1995 we used 3 Piper PA-18 aircraft with pilots and observers who had previous experience surveying sheep in the Baird Mountains. Two experienced teams surveyed the area in 1996 and 1997. One pilot and observer surveyed the area in 1998. Survey intensity for all years was 3 to 4 minutes/mi^2. We recorded locations of sheep on USGS 1:250,000 topographic maps. Observers classified sheep using the following categories: lambs, "ewes" (adult females, yearlings of either sex, and ¼-curl rams), ½-curl rams, ¾-curl rams, 7/8-curl rams, and full-curl rams. No effort was made to evaluate sightability of sheep. After completion of the Baird Mountain count area in 1995, Bureau of Land Management (BLM) staff surveyed an adjacent area in the Squirrel River drainage.

DeLong Mountains. This 520 mi^2 (1346 km^2) trend count area is located in the headwaters of the Kugururok River and Trail Creek drainages. Radiotelemetry data showed seasonal movements of sheep in the DeLong Mountains is less pronounced than in the Baird Mountains (Ayres 1986), making the timing of surveys in the DeLong Mountains less critical. The same pilot–observer teams who counted sheep in the Baird Mountains were used in the DeLong Mountain counts. Three teams surveyed the entire Kugururok River/Trail Creek area 7–10 July 1995. Only a portion of the area was surveyed by 1 team in 1996 (420 mi^2) due to

poor weather. In 1997 3 teams surveyed the entire area from 5–31 July. In 1998 during 8–12 July, 1 team surveyed approximately half the area (264.5 mi^2).

Wulik Peaks. This 224 mi^2 (580 km^2) count area is located at the western end of the DeLong Mountains as a fairly discrete ridge system. The area is usually surveyed by 1 or 2 pilot/observer teams. The Wulik Peaks count area was surveyed in 1995 (11–13 July) and 1998 (11–12 July). Poor weather conditions prevented surveys in 1996. Time and staff constraints prevented survey work in 1997.

RESULTS AND DISCUSSION

POPULATION SIZE, STATUS AND TREND

Population Size

Baird Mountains. During this reporting period we observed a slight increase in sheep numbers following the population decline in 1990–1991. The total sheep counted in the Baird Mountains was 351 in July 1995 and 477 in July 1998 (Table 1). Lambs increased from 7–22 lambs/100 ewes from 1991–1994 to 25 –57 lambs/100 ewes between 1995–1998 (Table 1).

We estimate the Baird Mountain trend count area includes 85–90% of the sheep population. Small groups of sheep outside the trend count area have regularly been observed in portions of the Squirrel River drainage. Additional search efforts in July 1995 by BLM located 32 sheep (20 ewes, 11 lambs and 1 ram) in this area.

The increase in sheep counted from 1996 to 1997 can not be explained by recruitment alone. Either sheep were missed in 1996, they moved out of the count area in 1996, sheep outside the count area moved into it in 1997, or double counting occurred in 1997. Ewe and lamb numbers appeared low in 1996. The most likely explanation is that sheep were missed in 1996. Two count units within the count area had unusually low numbers of sheep in 1996. These count units were not on the edge of the count area and contained a high number of sheep preceding and following the 1996 survey. Sheep may have moved out of the count area, but given the consistency of numbers over the past 10 years, it is more likely that sheep were missed and not counted.. If such movements were common for sheep in these areas, we would probably have seen differences in previous counts. A third possible explanation is that sheep were counted correctly in 1996, and they were double counted in 1997. The density of sheep in 1997 (0.60 adult sheep/mi^2) was similar to the density observed in 1998 (0.57 adult sheep/mi^2), indicating that double counting of sheep in 1997 probably did not occur.

We attribute the increase in lamb production to mild winters and favorable weather during spring and fall. A change in the age structure of the population may also be a factor. Although we have no quantitative information on predator populations in the area, reports from those traveling and hunting in the region suggested that wolf numbers declined to low levels during 1997–1998 and 1998–1999. This may have been related to recent outbreaks of rabies and distemper in foxes and domestic dogs.

DeLong Mountains. Adult sheep population trends in the DeLong Mountains are thought to be similar to those in the Baird Mountains. Variation in the proportion of areas surveyed and in the location of completed sample units makes it difficult to assess population trends based solely on DeLong Mountain surveys (Table 2). The only variable comparable between the DeLong and the Baird Mountain sheep data is the lamb: "ewe" ratio. This ratio indicates that sheep in the DeLong Mountains may be slowly increasing.

Wulik Peaks: The population trend for sheep in the Wulik Peaks is probably similar to that of sheep in the DeLong Mountains. Occasional sightings of small bands of sheep to the west of the count unit in the Lisburne Hills indicate that sheep either regularly disperse from this area or have seasonal movements that exceed 50 miles (80 km). Gray and white substrates, caves, and rugged spires along ridges make detection of sheep in this area difficult. Previous studies show that sheep in small groups, typically solitary rams, are most likely missed by survey observers (Strickland et al., 1992). Either of these factors may have contributed to the low number of 7/8-curl-and-greater rams observed in 1995 compared to those observed in 1998.

Population Composition

Following the population decline of 1990–1991, several years of low lamb recruitment resulted in relatively few middle-aged animals (4–8 years old) in the population during this reporting period. This is best demonstrated in the Baird Mountains where 1998 survey results revealed a high percentage of 7/8- curl-and-greater rams and few ½- and ¾-curl rams. These old animals would have been in their prime during the harsh period in the early 1990s. Although we cannot determine ages of ewes from survey data, we can assume their age structure is similar to rams because no hunting has been allowed. We may see a decline in future lamb:"ewe" ratios as older ewes drop out of the population; however, this effect will be dampened by current recruitment. Severe weather or intense predation could exacerbate low lamb:ewe ratios.

MORTALITY

Harvest

Seasons and Bag Limits for 1996–97 and 1997–98.

Unit Bag Limit	Hunt Type	Subsistence/Resident Open Seasons	Nonresident Open Seasons
Unit 23, that portion south and east of the Noatak River and west of the Cutler and Redstone Rivers (excluding the Upper Noatak River Canyon/ Sekuiak Bluffs, R = registration permit and H = harvest ticket):			

Unit Bag Limit	Hunt Type	Subsistence/Resident Open Seasons	Nonresident Open Seasons
Residents One ram with full curl horn or larger	R	CLOSED	
OR one sheep	R	CLOSED	
Nonresidents One ram with full curl horn or larger	R		CLOSED
Remainder of Unit 23			
Residents One ram with full curl horn or larger	H	10 Aug–20 Sep CLOSED West of Howard Pass by emergency order	
OR one sheep	H	1 Oct–30 Apr. CLOSED West of Howard Pass by emergency order	No open season
Nonresidents One ram with full curl horn or larger	H		10 Aug–20 Sep CLOSED West of Howard Pass by emergency order
Unit 26A			
Residents One ram with full curl horn or larger	H	10 Aug–20 Sep. CLOSED West of Etivluk River by emergency order	No open season
Nonresidents One ram with full curl horn or larger	H		10 Aug–20 Sep CLOSED West of Etivluk River by emergency order

Board of Game Actions and Emergency Orders. Emergency orders were issued in 1995, 1996, and 1997 that closed all sheep hunting in Unit 23 west of Howard Pass and the Cutler–Redstone Rivers and in Unit 26A west of Howard Pass and the Etivluk River. These actions continued closure of the Baird and DeLong Mountains in effect since 1991. Advisory committees, commercial operators, and interested hunters reviewed survey data and supported these closures to maintain full protection for sheep.

As sheep populations in the Baird and DeLong Mountains showed indications of recovery, public meetings were held in Kotzebue to discuss how to reopen hunting. Following these meetings ADF&G drafted a proposal that provided for subsistence and sport hunts in the Baird and DeLong Mountains (including the portion of Unit 26A west of Howard Pass). The

Board of Game passed an amended version of this proposal during the fall 1997 meeting. The proposal did 3 things: 1) identified 3 populations of sheep by using biological rather than management unit boundaries; 2) provided more control over harvest by establishing subsistence and drawing hunts; and 3) clarified boundaries of hunt areas within Unit 23. The subsistence need for sheep was determined to be 0–9 in the DeLong Mountains (including the Wulik Peaks) and 18–47 for the Baird Mountains. A Tier I hunt was established for both areas with an accompanying drawing hunt to take place when a harvestable surplus exceeded subsistence need. Conditions of the subsistence registration permits prohibited the use of aircraft for these hunts. Department and NPS staff estimated a harvestable surplus of 20 full-curl rams for each of the two hunt areas. Eleven drawing permits were made available in the DeLong Mountains, and subsistence registration hunts were established in both the Baird and DeLong Mountains.

In contrast to the state, which determined subsistence need for the Baird and the DeLong Mountains separately, the Northwest Arctic Regional Council stated the subsistence need for these areas should be combined. The Federal Subsistence Board met on 31 July 1998 and passed a Special Action that closed all federal lands in the Baird and DeLong Mountains to sheep hunting by nonqualified federal subsistence users. This action maintained the 20 sheep quota for each of the Baird and DeLong Mountains, with $\leq$10 sheep in each area allowed to be taken between 1 Aug–30 Sep and the remainder taken between 1 Oct–31 Mar. Under federal regulations, subsistence hunters could use aircraft for hunting. In addition, nonresident hunters currently residing in Unit 23 who had resided here less than 12 months were qualified to hunt sheep under federal regulations as long as they purchased the appropriate state licenses and tags.

Hunter Harvest. As a result of the emergency closures, no sheep were reported harvested in the Baird or DeLong Mountains during the report period (Table 4).

Other Mortality

The primary predators of sheep are wolves and golden eagles. Their effects on Unit 23 sheep populations have not been quantified. Disease may also play a role in this population (Dau 1992). However, no cases of disease-based mortality were observed during this reporting period.

Caribou in the Western Arctic Herd may also be affecting Units 23 and 26A sheep populations. The Western Arctic Herd has numbered over 415,000 caribou since the early 1990s (ADF&G unpub. data). Possible effects of caribou on sheep include removal of forage through ingestion, degradation of range through trampling, and inducement of locally high predator populations in areas containing sheep.

CONCLUSIONS AND RECOMMENDATIONS

The Baird Mountain sheep population is slightly below the population objective of 450–600 adult sheep, although the ram: "ewe" ratio exceeds the objective of 7–10 7/8-curl-and-greater rams per 100 "ewes." As expected, we are seeing a high proportion of old rams in the population. Harvest of full-curl rams may be possible, given the current number present;

however, the harvest may not be sustainable. We expect the number of sheep in older age classes to diminish until the 1995 cohort begins to replace them.

We need to periodically assess distribution and number of sheep outside the count area. The Baird Mountain trend count area should be enlarged if sheep outside the count area exceed 10% of the sheep counted within the area.

We cannot evaluate progress toward meeting management objectives in the DeLong Mountains using current data. Therefore, we will assume sheep population trends in the DeLong Mountains parallel those in the Baird Mountains for management decisions. A sampling approach for sheep in the DeLong Mountains west of Howard Pass (including the Wulik Peaks) would provide population data and could reflect overall sheep distribution. With the current federal closure of the Baird Mountains to sheep hunting by nonfederally qualified hunters, more emphasis needs to be placed on determining allowable harvest for state-managed sheep populations in the Wulik Peaks.

LITERATURE CITED

AYRES LA 1986. The movement patterns and foraging ecology of Dall sheep in the Noatak National Preserve. M.S. Thesis. University of California Berkeley, Berkeley, CA. 94pp.

BALLARD WB 1993. Demographics, movements, and predation rates of wolves in northwest Alaska. Ph.D. Dissertation University of AZ, Tuscon AZ. 374pp.

DAU J 1992. Western Brooks range survey-inventory progress report. Alaska Department Fish and Game Federal Aid in Wildlife Restoration Progress Report in press.

GEORGETTE S AND H LOON 1991. Subsistence hunting of Dall sheep in northwest Alaska. Technical Paper No. 208, Division of Subsistence, Alaska Department of Fish and Game, Juneau, AK 37pp.

SINGER FJ 1984. Some population characteristics of Dall sheep in six Alaska National Parks and Preserves. Pp1–10 *in* M. Hoefs, ed. Proc. 4th Biennial Sheep and Goat symp., Apr.30–May 3, 1984. Yukon Wildlife Br., Whitehorse, Yukon, Canada.

SINGER FJ AND D. JOHNSON 1984. Dall sheep ecology in the Noatak National Preserve. Unpublished Report. National Park Service Report. 2525 Gambell Street, Anchorage AK 99503. 24 pages.

STRICKLAND D, LL MCDONALD AND J KERN. 1992. Analysis of 1992 Dall's sheep and mountain goat survey data - Kenai National Wildlife Refuge. US Fish and Wildlife Service, Research Report, Kenai National Wildlife Refuge.

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Table 1 Number of Dall sheep observed during aerial surveys in the Baird Mountains, Unit 23, 1989–1998

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Rams 1/2+	162	105	108	130	123	93	90	75	114	116
Rams 7/8+	51	32	35	42	37	1	23	56	72	70
"Ewes"[a]	574	466	239	267	256	204	166	169	314	289
Lambs	170	133	17	59	47	20	95	58	83	72
Unknown	75	14	36	0	0	0	0	0	0	0
Total Sheep	981	718	400	456	426	317	351	302	511	477
Total Adults[b]	736	571	347	397	379	297	256	244	428	405
Lambs:100 "Ewes"	30	29	7	22	18	10	57	34	26	25
Rams:100 "Ewes"	28	23	45	49	48	46	54	44	36	40
Rams 7/8+: 100 Ewes	9	7	15	16	14	20	14	33	23	24
Adults/mi^2	1.03	0.80	0.49	0.56	0.53	0.42	0.36	0.34	0.60	.57

[a] "Ewes" defined as adult females, yearling of either sex, and 1/4 curl rams.
[b] "Adult" defined as all sheep excluding lambs and unknowns.

Table 2 Number of Dall sheep observed during aerial surveys in the DeLong Mountains, Units 23 and 26A, 1983–1998

	Kugururuk River/Trail Creek[a]									
Classification	1983[b]	1987[c]	1991	1992	1993	1994	1995	1996[g]	1997[h]	1998[i]
Rams 1/2 + (all)	95	77	81	72	63	27	38	19	36	28
Rams 7/8 +	54	49	38	26	16	12	13	3	18	6
Ewes[d]	171	90	159	99	112	93	137	91	121	99
Lambs	61	50	24	20	27	1	56	49	47	14
Unknown	9	0	1	0	0	0	0	2	0	0
Total	336	217	265	191	202	121	231	161	204	141
Adults[e]	266	167	240	171	175	120	175	112	157	127
Lambs:100 Ewes	36	56	15	20	24	1	41	54	39	14
Rams:100 Ewes	56	86	51	73	56	29	28	23	30	28
Rams7/8+:100	32	54	24	26	14	13	9	3	15	6
Area (mi^2)	367	367	367	367	367	520[f]	520	420	520	265
Adults/mi^2	0.72	0.45	0.65	0.46	0.48	0.23	0.33	0.27	0.30	0.48

[a] Data collected using fixed-wing aircraft except where noted.
[b] Helicopter used to conduct surveys during 1983.
[c] Incomplete survey; several large ewe bands observed in count area but not included in counts.
[d] Rams 7/8+ are included in Rams 1/2+ total.
[e] "Ewe" defined as adult female, yearling of either sex, and 1/4 curl ram.
[f] "Adult" defined as all sheep excluding lambs and unknowns.
[g] Incomplete survey; 3 units on the eastern edge of the count area were not surveyed.
[h] Survey delayed due to weather. Data collected between July 5 and July 31.
[i] Incomplete survey; areas selected to maximize number of sheep observed.

Table 3 Number of Dall sheep observed during aerial surveys in the Wulik Peaks, Units 23 and 26A, 1983–1998

Classification	1987	1991	1992	1993	1994	1995	1998
Rams 1/2 + (all)	26	38	27	27	9	15	21
Rams 7/8 +[a]	8	17	7	11	7	0	13
Ewes[b]	88	78	67	48	47	54	57
Lambs	19	11	26	18	7	28	15
Unknown	0	10	0	0	0	0	0
Total	133	137	120	93	63	97	93
Adults[c]	119	116	94	75	56	69	78
Lambs:100 Ewes	22	14	39	38	15	52	26
Rams:100 Ewes	30	49	40	56	19	28	37
Rams 7/8+:100 Ewes	9	22	10	23	15	0	23
Area (mi^2)	217	217	217	240	240	240	240
Adults/mi^2	0.55	0.53	0.43	0.33	0.25	0.31	0.32

[a] Rams 7/8+ are included in Rams 1/2+ total.
[b] "Ewe" defined as adult female, yearling of either sex, and 1/4 curl ram.
[c] "Adult" defined as all sheep excluding lambs and unknowns.

Table 4 Number of Dall sheep harvested[a] in Unit 23 (R = rams, E = ewes, U = unknown sex)

	General season harvest[b]				Winter season harvest										
					Baird Mountains			DeLong Mountains			Unknown			Total	
Year	Baird Mtn.	DeLong Mtn.	Unk	Total	R	E	U	R	E	U	R	E	U		Total harvest
1971–72	-	-	16	16	-	-	-	-	-	-	-	-	-	-	16
1972–73	-	-	26	26	-	-	-	-	-	-	-	-	-	-	26
1973–74	-	-	13	13	-	-	-	-	-	-	-	-	-	-	13
1974–75	-	-	19	19	-	-	-	-	-	-	-	-	-	-	19
1975–76	-	-	17	17	-	-	-	-	-	-	-	-	-	-	17
1976–77	-	-	22	22	-	-	-	-	-	-	-	-	-	-	22
1977–78	-	-	34	34	-	-	-	-	-	-	-	-	-	-	34
1978–79	-	-	35	35	-	-	-	-	-	-	-	-	-	-	35
1979–80	-	-	25	25	-	-	-	-	-	-	-	-	-	-	25
1980–81	-	-	16	16	-	-	-	-	-	-	-	-	-	-	16
1981–82	3	10	0	13	-	-	-	-	-	-	-	-	-	-	13
1982–83	10	11	0	21	2	2	5	0	0	0	0	0	0	9	30
1983–84	12	8	0	20	0	0	0	0	0	0	0	0	0	0	20
1984–85	8	8	3	19	2	2	0	0	0	0	0	0	0	4	23
1985–86	28	8	1	37	10	7	3	0	0	1	0	0	0	21	58
1986–87	9	14	0	23	8	4	0	0	2	0	0	0	0	14	37
1987–88	18	19	0	37	3	6	0	1	1	0	0	0	0	11	48
1988–89	17	20	0	37	6	3	0	0	0	0	1	0	0	10	47
1989–90	19	26	0	45	7	2	0	3	0	0	0	0	0	12	57
1990–91	17	16	0	33	6	0	0	0	0	0	0	0	0	6	39
1991–92[d]	0	10	0	10	0	0	0	0	0	0	0	0	0	0	10
1992–93[d]	0	7	0	7	0	0	0	0	3	0	0	0	0	3	10
1993–94[d]	0	9	0	9	0	0	0	6	1	2	0	0	0	9	18
1994–95[e]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1995–96[e]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996–97[e]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997–98[e]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[a] does not include unreported harvest; DeLong Mountains is defined as the area north of the Noatak River (excludes Schwatka Mountains and includes Wulik Peaks).

[b] August 10–September 20; 3/4+ curl rams only through 1977/78, 7/8+ curl rams only after 1978/79.

[c] October 1–April 30; season established during 1982/83; limit 1 sheep ("ewe" defined as adult female, yearling of either sex, 1/4 ram, or lamb).

[d] Baird Mountains fall and winter hunts closed by emergency order; DeLong Mountain fall hunt Sept. 1–20; DeLong Mountains winter hunt October 1–April 30.

[e] Unit 23 closed west of Howard Pass and Cutler/Redstone Rivers (Baird and DeLong Mountains).

LOCATION

GAME MANAGEMENT UNITS: 24, and portions of 23 and 26A (15,717 mi^2)

GEOGRAPHIC DESCRIPTION: Central Brooks Range west of Dalton Highway Corridor to Howard Pass, including Gates of the Arctic National Park

BACKGROUND

Dall sheep in Gates of the Arctic National Park (GAAR) are managed differently than in most areas of Alaska. Federal law mandates subsistence use as the highest priority consumptive use of wildlife when harvest is allowable.

Subsistence hunting by local residents of GAAR and its federally defined subsistence zone is the only consumptive human use permitted within its boundaries. As a result, one Alaska Department of Fish and Game (ADF&G) management goal for Dall sheep in GAAR is to provide opportunity for human subsistence. Another management goal of ADF&G and the National Park Service (NPS) for the central Brooks Range Dall sheep is to provide opportunities to view and photograph sheep. Both goals must be accomplished in the framework of protection, maintenance, and enhancement of sheep and their habitat. Management goals for sheep in the John, Alatna, and Wild River drainages south of the park provide for diverse human recreation.

Prior to expansion of the NPS park and preserve system in 1981, all of Unit 24 and those portions of Units 23 and 26A included in this report were open to general sheep hunting. The average total harvest (reported and unreported) was estimated at 50 rams per year. The take by Nunamiut hunters (inland Inupiat Eskimos) was unrecorded but was probably ≤50 per year.

Within Units 23, 24 and 26A of the central Brooks Range, Dall sheep are irregularly distributed due to the discontinuous habitat. The population grew between 1982 and 1987 (Adams 1988), then declined from 1987 to 1993 (Osborne 1996). However, high numbers of lambs and yearlings were counted in 1996, indicating the population was increasing (Whitten 1997).

This is the first time those portions of Units 23 and 26A east of Howard Pass have been included in the Unit 24 sheep survey-inventory report. In the past, sheep in these portions of Units 23 and 26A were included in the Unit 23 and 26A management report for the Baird and DeLong Mountains. Sheep in these units, which include the upper Noatak, Killik, Chandler, and Koyukuk drainages, probably constitute one population. This is an attempt to gather all management information for this population into a single report. Therefore, this report presents sheep survey-inventory information by population, rather than by game management unit.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Provide opportunity for subsistence harvest and nonconsumptive use of Dall sheep in the GAAR.

- Provide opportunity for sport and subsistence harvest and nonconsumptive use of Dall sheep in the remainder of the central Brooks Range.

MANAGEMENT OBJECTIVES

- Maintain an annual subsistence harvest of up to 50 sheep in the GAAR and a general harvest of full-curl rams in the Wild, Alatna, and John River drainages.

- Maintain a naturally regulated sheep population in the central Brooks Range.

METHODS

The central Brooks Range is bounded to the west by a line beginning at Howard Pass, running southwesterly down the Aniuk River to the Noatak River and down river to the confluence of the Cutler River. The line continues southeasterly up the Cutler River over Ivishak Pass and southerly down the Redstone River to the confluence of the Ambler and Kobuk Rivers, then easterly up the Kobuk River to the Unit 24 boundary. In Unit 26A, sheep south of the line at 68°30'N latitude, east of the Etivluk River, and west of the boundary between Units 26A and 26B will be included in this report. Sheep inhabiting the eastern portion of Unit 24, within the Dalton Highway Corridor, are covered in the Eastern Brooks Range report. The rest of Unit 24 is covered here.

We estimated the population in a 2220 mi^2 portion of GAAR (Whitten 1997). The survey area was divided into sample units. All units were initially searched with a fixed-wing Super Cub aircraft at relatively low intensity (0.74–0.93 min/km^2). Subsamples of units were then resurveyed at a higher intensity (0.97–1.34 min/km^2) using a Robinson R-22 helicopter. Estimates were calculated for all fixed-wing survey units using the corrected sightability and flight survey intensity factors.

Subsistence harvest in the GAAR was monitored using a variety of methods. With the implementation of the community harvest quota for Anaktuvuk Pass in 1997, GAAR personnel assumed responsibility for conducting personal interviews of hunters from that village. GAAR staff recorded sex and date and location of harvest during their interviews. We monitored subsistence harvest in other villages by conducting personal interviews with hunters, issuing permits, and sending out questionnaires to registered hunters after the close of the hunt.

General harvest information was obtained through the statewide harvest ticket system. The information collected from the hunter report cards included sex, date and location of kill, method of transport, days hunted, age from horn rings, horn length and base measurements, hunter residency, and commercial services. Harvest ticket reports were required for

nonregistration hunts by all other hunters. Reports were distributed by license vendors or department offices and had to be returned within 15 days of harvesting a sheep or within 15 days of the close of the season. Individuals reporting on the general harvest reports were hunting primarily in the Alatna, John, and Wild River drainages west of the Dalton Highway Corridor (Unit 24, west).

Harvest data were summarized by regulatory year (RY = 1 July–30 June).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We estimated a population of 2758 ± 8% (90% CI) sheep in a 2220 mi^2 portion of GAAR, with a density of roughly 1.24 sheep/mi^2 (Whitten 1997). Singer (1984) reported 4417 sheep in all of GAAR. Adams (1988) only surveyed 728 mi^2 but found 12% more sheep than Singer had in the same area. Singer (1984) found densities of 0.9–2.0 sheep/mi^2 and Adams (1988) found densities of 1.1–2.7 sheep/mi^2. In 1993 Osborne (1996) counted 617 sheep in an 817-mi^2 area. Densities were 0.5–0.8 sheep/mi^2.

Population Composition

Surveys conducted in 1996 (Whitten 1997) covered a larger area of the GAAR, and search intensity was greater than surveys conducted in 1993 (Osborne 1996). Comparisons between years must be cautiously interpreted because of differences in survey methods. Population levels cannot be compared. However, the data can be used to evaluate general trends in sex and age ratios.

From 1993 to 1996, the proportion of adult sheep in the count declined, and the proportion of lambs in the count increased (Table 1). Mature rams with full-curl horns made up 39% of rams counted in 1993, compared to 33% of rams counted in 1996. The lamb:"ewe" ratio was 45:100 in 1996, which was similar to values reported earlier by Singer (1984) and Adams (1988) (50:100 and 47:100, respectively).

Population composition varies from year to year depending on lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting (Heimer 1988). Low proportions of adults relative to lambs often indicate growing sheep populations.

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Units 24, 26A and 26B, that portion within the Gates of the Arctic National Park; 3 sheep.	1 Aug–30 Apr	No open season
Remainder of Unit 24; 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep
Unit 23 ("Schwatka Mountains)		
RESIDENT HUNTERS: 3 sheep by registration permit only.	1 Aug–30 Apr (Subsistence hunt only)	
ALL HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep
Unit 26(A), that portion east of the Etivluk River excluding Gates of the Arctic National Park		
RESIDENT HUNTERS: 3 sheep by registration permit only.	1 Aug–30 Aug (Subsistence hunt only)	
ALL HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep

Board of Game Actions and Emergency Orders. In Unit 24 the Board of Game deleted the requirement of harvest tickets for the subsistence sheep hunt in RY 1995–1996 and also removed the hunt from the state regulations because the board felt that federal subsistence regulations were sufficient. The season was reinstated in RY 1996–1997 to cover hunting within GAAR on private land.

Beginning in the RY 1998–1999, the Board of Game established a subsistence registration permit hunt for those portions of Units 23 and 26A included in this report. This hunt established a bag limit of 3 sheep and a 1 August–30 April season. A winter subsistence registration sheep hunt was administered by the department prior to RY 1998–1999, even though no such season existed in state statute (1 sheep; 1 Oct–30 Apr). The Board of Game action corrected this technical oversight.

The Board of Game established a harvest ticket hunt for the portion of Unit 26A within GAAR in RY 1996–1997 and increased the bag limit from 1 to 3 sheep (any sheep) during 1 April–30 April. In RY 1997–1998 the harvest ticket requirement was eliminated and that

area was closed to nonresidents. At that time, the resident season for that area was also lengthened to 1 August–30 April. For RY 1998–1999 the board further modified Unit 23 and 26A by reimplementing the harvest ticket requirement east of the Etivluk River, including GAAR, and by establishing a registration permit hunt during 1 August–30 April. The rest of Unit 26A maintained a 1 ram with full-curl bag limit with the mandatory harvest ticket requirement during 10 August–20 September.

Hunter Harvest. The reported subsistence harvest from GAAR over the last 5 years averaged 18 sheep (range 9–26). Most of these sheep were adults. Rams were preferred, making up at least 65% of the harvest (Table 2). Many sheep taken by subsistence hunters were not reported, and we believe subsistence hunters took more ewes than our harvest data indicate.

The general harvest for the central Brooks Range averaged 11.6 sheep (range 5–18) during the past 5 years (Table 3). Combined harvest of GAAR and all other areas of the central Brooks Range was variable and showed no trend over the past 5 years (Table 4). The mean age and horn length (Table 5) could not be used to make generalizations about the population due to the small sample size.

Permit Hunts. We managed the GAAR subsistence hunt from RY 1988–1989 to 1997–1998 without active participation by the National Park Service. That arrangement allowed more consistent collection of data than in previous hunts when the National Park Service was actively involved (Osborne 1989). In 1997, however, GAAR implemented a "community harvest registration hunt" for Anaktuvuk Pass (60 sheep quota, not to exceed 10 ewes). This caused confusion regarding reporting responsibilities and, as a result, incomplete sheep harvest data for the 1997–1998 season.

Hunter Residency and Success. Hunters from Anaktuvuk Pass harvested most of the sheep taken during the subsistence hunt in GAAR (Table 6). Residents of other communities that were eligible to hunt harvested very few sheep. Success rates were not relevant in the subsistence hunt because of community hunting and sharing traditions (Osborne 1989).

In the general harvest, the 5-year average success rate for the area was 35% (range 23–44%). The number of people hunting in the reporting area, GAAR subsistence and general harvest combined, decreased 52% over the past 5 years. No data were collected to explain this decline.

Harvest Chronology. Harvest of sheep in the central Brooks Range took place primarily in the first 10 days of the season (Table 7). Competition for trophy rams and avoidance of harsh weather conditions were probably the primary motivating factors for hunters. In Unit 23 the main factors affecting sheep hunting in the upper Noatak are weather and traveling conditions (i.e., snow). Harvest in this area does not take place until adequate snow cover allows access by snowmachine.

Transportation Methods. Aircraft were the major transportation means because there are few roads in the report area (Table 8). In the upper Noatak, snowmachines were the primary means

of transportation used to access sheep habitat. Occasionally people used boats. Hunters used snowmachines or "Argo" off-road vehicles to take most of the sheep in the GAAR hunt.

Other Mortality

There are no data to indicate a change in natural mortality from that reported by Osborne (1989).

CONCLUSIONS AND RECOMMENDATIONS

The management goal of providing nonconsumptive use opportunities for the central Brooks Range was met. The park was used by Dall sheep viewers and photographers, albeit sparingly. This activity is increasing as a result of increased tour bus transit on the Dalton Highway in recent years.

The goal to provide subsistence harvest in all portions of the central Brooks Range was met as evidenced by subsistence hunter participation. There was no long-term decline in the number of sheep taken by subsistence hunters and no apparent declines in sheep populations attributable to harvest by humans in any of the area covered by this report. Analysis of hunter success rate and number of rams harvested in the central Brooks Range, outside the GAAR, was comparable to previous reporting periods. Numbers of subsistence and other hunters declined throughout the central Brooks Range, including the GAAR, for unknown reasons.

Although, no evidence of declining sheep populations were observed, subtle declines in abundance could have occurred undetected because there was no systematic sheep population-monitoring program in the central Brooks Range. The survey conducted during this reporting period indicated the population was stable. Overall, protection and maintenance of this population were achieved throughout most of the sheep habitat in GAAR. Consistent hunter success rates support the conclusion that we met the management goal of providing consumptive harvest.

We also met our objectives to maintain a harvest of up to 50 sheep in the GAAR and a general harvest of full-curl rams in the Wild, Alatna, and John River drainages. Although the number of hunters declined in both of these areas, the opportunity to harvest was provided, as indicated by the consistently high hunter success rates. The objective to maintain a naturally regulated sheep population in the central Brooks Range was apparently achieved because human impact from harvest and habitat alteration was probably insignificant. However, only subjective evaluations of this broad management objective are possible.

All registered hunters in Unit 24 will continue to receive end-of-season questionnaires to ensure that subsistence harvest information is collected. Cooperative efforts with the NPS will be renewed to establish consistent harvest data collection methods. Personal interviews with community hunters will also continue.

Activities for the future will include a cooperative effort between the NPS and ADF&G to monitor sheep in this area. Additionally, regulations for the central Brooks Range are

inconsistent and need to be simplified. Coordination among state and federal managers to develop consistent regulations should be accomplished during the next reporting period.

LITERATURE CITED

ADAMS LG. 1988. Dall sheep survey, Gates of the Arctic National Park and Preserve, Alaska-1987. Natural Resource Survey and Inventory Report. AR-88/15. National Park Service. Anchorage.

HEIMER WE. 1988. Toward a working hypothesis for mountain sheep management. Proceedings biennial symposium northern wild sheep and goat council. 6:39–46.

OSBORNE TO. 1989. Dall sheep survey-inventory report, Unit 24. Pages 136–143 *in* SO Morgan, editor. Annual report of survey-inventory activities. Part II. Sheep. Volume XIX. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-1. Juneau.

———. 1996. Dall sheep management report of survey-inventory activities, Unit 24. Pages 158–166 *in* MV Hicks, editor. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Grants W-24-1, W-24-2, and W-24-3. Study 6.0. Juneau.

SINGER FJ. 1984. Aerial Dall sheep count, 1982, 1983, and 1984, Gates of the Arctic National Park and Preserve. Natural resources survey and inventory report. AR/84-2. National Park Service. Anchorage.

WHITTEN KR. 1997. Estimating population size and composition of Dall sheep in Alaska: Assessment of previously used methods and experimental implementation of new techniques. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Grants W-24-3, W-24-4, and W-24-5. Juneau.

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Table 1 Gates of the Arctic National Park aerial Dall sheep survey, Units 24 and 26[a], 1993 and 1996

		Sheep Counted (%)						
		Rams by horn size				"Ewes"		
Count Area	Year[b]	4/4	3/4	1/4–1/2	Unk	and Yrlgs	Lambs	*N*
011–016	1993	10.3	8.5	5.6	0.9	62.0	12.7	213
	1996	3.1	3.1	6.2	0.0	60.4	27.1	96
021–025	1993	21.0	6.2	16.0	2.5	39.5	14.8	81
	1996	0.0	2.6	10.3	0.0	59.0	28.2	39
031–034	1993	6.1	10.7	11.5	0.0	58.0	13.7	131
	1996	9.0	7.9	12.4	0.0	51.7	19.1	89
062–064	1993	7.8	2.6	4.2	1.6	60.4	23.4	192
	1996	11.4	7.6	9.1	0.0	48.5	23.5	132
Totals	1993	10.0	6.8	7.8	1.1	57.7	16.5	617
	1996	7.3	5.9	9.3	0.0	53.7	23.8	356

[a] Whitten (1997).
[b] Composition surveys in 1996 covered only a portion of the 1993 survey areas.

Table 2 Gates of the Arctic National Park subsistence sheep harvest, regulatory years 1989–1990 through 1997–1998

Regulatory	Harvest			
year	Rams	Ewes	Yearlings	Total harvest
1989–1990	19	8	0	27
1990–1991	18	2	2	22
1991–1992	20	3	0	23
1992–1993	16	4	2	22
1993–1994	20	0	0	20
1994–1995	6	5	0	26[a]
1995–1996	9	0	0	9
1996–1997	20	2	0	22
1997–1998	8	1	0	9

[a] Fifteen sheep sex unknown.

Table 3 Central Brooks Range hunter[a] residency and success, regulatory years 1993–1994 through 1997–1998

Regulatory year	Successful					Unsuccessful						Total hunters
	Unit[b] resident	Nonlocal resident	Nonresident	Total	%	Unit resident	Nonlocal resident	Nonresident	Unk	Total	%	
1993–1994	0	7	8	15	31	5	21	6	2	34	69	49
1994–1995	1	6	11	18	44	0	17	6	0	23	56	41
1995–1996	3	3	5	11[c]	34	3	16	2	0	21	66	32
1996–1997	0	2	3	5	23	2	9	4	2	17	77	22
1997–1998	0	1	8	9	43	0	7	5	0	12	57	21

[a] Excludes Gates of the Arctic National Park.
[b] Resident of Units 23, 24, and 26A.
[c] Includes 1 ewe.

Table 4 Central Brooks Range sheep harvest, regulatory years 1993–1994 through 1997–1998

Regulatory year	Unit[a]						Total		
	23		24		26A				
	GAAR[b]	Other[c]	GAAR	Other	GAAR	Other	GAAR	Other	Combined
1993–1994	4	0	11	9	5	6	20	15	35
1994–1995	0	0	13	6	13	12	26	18	44
1995–1996	0	0	7	6	2	5	9	11	20
1996–1997	0	0	17	3	5	2	22	5	27
1997–1998	2	0	7	3	0	6	9	9	18

[a] Because location of sheep harvest by Anaktuvuk Pass subsistence hunters was variable and uncertain, half of the annual known harvest from that community was attributed to Unit 24 and half was attributed to Unit 26A. In years where an odd number of sheep were harvested, Unit 24 was arbitrarily attributed the larger number.
[b] Gates of the Arctic National Park.
[c] Locations outside Gates of the Arctic National Park.

Table 5 Central Brooks Range sheep harvest[a], regulatory years 1993–1994 through 1997–1998

Regulatory year	$\bar{x}$ horn length	% over 40"	$\bar{x}$ age	Total rams
1993–1994	33.8	7	10.6	15
1994–1995	34.8	0	10.0	18
1995–1996	34.3	0	9.8	10
1996–1997	35.3	0	9.4	5
1997–1998	35.4	11	9.3	9

[a] Excludes Gates of the Arctic National Park.

Table 6 Gates of the Arctic National Park subsistence sheep hunter residency, regulatory years 1989–1990 through 1997–1998

Regulatory year	Permits		Successful hunters	Residence of registered hunters						
	Issued	Returned		Anaktuvuk	Bettles	Coldfoot	Wiseman	Ambler[a]	Nuiqsut	Allakaket
1989–1990	32	32	12	21	2	0	8	0	1	0
1990–1991	46	46	11	33	3	5	5	0	0	0
1991–1992	34	34	12	27	2	0	5	0	0	0
1992–1993	39	36	13	28	2	0	9	1	0	na
1993–1994	35	28	11	12	9	0	7	4	0	3
1994–1995	27	22	5	16	1	0	6	4	0	0
1995–1996	27	13	6	14	1	0	7	5	0	0
1996–1997	34	19	17	20	5	0	7	2	0	0
1997–1998	20	12	9	na	3	0	12	2	0	3

[a]Includes all hunters reporting from upper Kobuk watershed.

Table 7 Central Brooks Range sheep harvest[a] chronology percent by harvest period, regulatory years 1993–1994 through 1997–1998

	Harvest periods				
Regulatory year	8/10–8/20	8/21–8/31	9/1–9/10	9/11–9/20	*N*
1993–1994	60	27	7	7	15
1994–1995	78	6	11	6	18
1995–1996	36	45	9	9	11
1996–1997	80	20	0	0	5
1997–1998	78	22	0	0	9

[a] Excludes Gates of the Arctic National Park.

Table 8 Central Brooks Range sheep harvest[a] percent by transport method, regulatory years 1993–1994 through 1997–1998

	Percent by transport method				
Regulatory year	Airplane	Boat	3- or 4-wheeler	Unknown	*N*
1993–1994	80	20	0	0	15
1994–1995	89	0	6	6	18
1995–1996	55	36	9	0	11
1996–1997	80	20	0	0	5
1997–1998	78	22	0	0	9

[a] Excludes Gates of the Arctic National Park.

LOCATION

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

GEOGRAPHIC DESCRIPTION: Eastern Brooks Range

BACKGROUND

Dall sheep are throughout the mountains of the eastern Brooks Range. Highest densities are in northern drainages, where weather and habitat conditions provide the most favorable winter range. Sheep were generally abundant during the last several decades. Although surveys have been sporadic in most areas, available data and observations by hunters familiar with the area indicated relatively high populations during the 1980s and declines in recent years.

Human use of sheep in the eastern Brooks Range increased during the 1980s but subsequently declined as a result of the decline in sheep numbers during the 1990s. Existence of the Arctic National Wildlife Refuge (ANWR), opening of the Dalton Highway to commercial and general public use, and loss of sport hunting opportunity in Gates of the Arctic National Park (GAAR) all contributed to increased human activity in parts of the area.

Hunting, viewing, and photography have all increased as access has been developed and public interest in the area has grown. Sheep hunting continues to be important to local residents in the villages of Kaktovik and Arctic Village.

In addition to Units 25A, 26B, and 26C, the area includes a part of Unit 24, specifically the drainages of the South and Middle Forks of the Koyukuk River. Sheep populations in these areas are included as part of the eastern Brooks Range because they are contiguous with populations east of GAAR and because management issues associated with the Dalton Highway are largely the responsibility of the Fairbanks and Fort Yukon area offices.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the sheep population and its habitat in concert with the other components of the ecosystem.
- Provide for continued subsistence use of sheep by rural Alaska residents who have customarily and traditionally used the population.
- Provide an opportunity to hunt sheep under aesthetically pleasing conditions.
- Provide an opportunity to view and photograph sheep.

MANAGEMENT OBJECTIVE

- Manage for a harvest of Dall sheep rams with full-curl or larger horns.

Related Management Activities

- In cooperation with U.S. Fish and Wildlife Service (FWS), continue to monitor sheep population status using trend indicator areas.
- Monitor effects of the full-curl minimum size limit that took effect in fall 1993.
- Work with ADF&G Subsistence Division and FWS to manage subsistence sheep harvests.

METHODS

Surveys in this area generally included annual ground-based composition counts in Atigun Gorge in Unit 26B, the Hulahula drainge in Unit 26C, and the Chandalar drainage in Unit 25A. Standardized routes were surveyed in June. However, weather and logistic factors generally precluded surveys in the Hulahula and Chandalar drainages during this reporting period. During 1992–1995, we completed composition surveys using a helicopter. Subsequent surveys in the Atigun area were conducted using a highway vehicle to survey sheep east of the Dalton Highway from Atigun Pass to Atigun Gorge. Surveys in the Hulahula and Chandalar areas were accomplished by observers on foot, who hiked standardized survey routes and classified sheep with the aid of spotting scopes. The Hulahula trend area includes the entire drainage within the mountains. The Chandalar trend area includes the region west of the East Fork from Gilbeau Pass southwest to Crow Nest Creek.

Between 1988 and 1992, approximately 60 sheep were radiomarked and periodically relocated as part of a cooperative study to define sheep populations and establish areas for trend counts. However, these radio collars ceased transmitting prior to this reporting period, and no relocations were obtained this period (Heimer et al. 1994).

We gathered data on harvest, number of hunters, horn size, and hunting methods from mandatory harvest reports. Harvest data were summarized by regulatory year (RY = 1 July–30 June).

RESULTS AND DISCUSSION

Population Status and Trend

Population Size

Population size during this reporting period was unknown. However, both survey data and anecdotal reports from the public indicated that sheep numbers declined during the late 1980s and early 1990s. Poor recruitment, probably caused by severe weather and possibly influenced by predation, contributed to the decline. Heimer (1985) estimated there were 13,000 sheep in the eastern Brooks Range in 1985. Numbers have declined by approximately 40% since the mid-1980s in the Hulahula drainage in Unit 26C and probably declined similarly elsewhere in the area.

Population Composition

Limited surveys in Atigun Gorge indicated lamb:ewe ratios were moderate in 1996, low in 1997, and high in 1998 (Table 1). A ratio of 54 lambs:100 ewes was observed in the Hulahula drainage in 1998 (Table 2). Lamb production and survival were relatively good in Unit 26C, low in Unit 26B, and moderate in Unit 25A in spring 1995 (Table 1). Composition surveys show considerable variation in occurrence of lambs among areas and years, but lamb:ewe ratios in early summer populations were generally low from 1992 to 1994. Poor lamb survival seemed to be associated with severe winters and cold spring weather, especially in the northern drainages where sheep populations are relatively dense (F Mauer, pers commun). The proportion of full-curl rams in the population initially seemed to increase because of the full-curl regulation passed in 1993. Limited survey data from Atigun Gorge indicate a decline in the abundance of rams during this reporting period (Table 1). However, hunting pressure is relatively high in this area. In contrast, hunter reports indicated that large rams were well represented in the population in most parts of the eastern Brooks Range.

Distribution and Movements

Movements of radiomarked sheep showed that major drainages inhibited sheep movements, resulting in discrete subpopulations north and south of the Junjik River and east and west of the East Fork Chandalar and Hulahula Rivers. Sheep home range size was generally similar to that observed in the Alaska Range. However, movements of sheep near the East Fork Chandalar River were relatively extensive, perhaps due to less stable weather patterns and resulting changes in forage availability (Heimer et al. 1994).

MORTALITY

Harvest

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Units 25A and 26C		
RESIDENT HUNTERS: 1 ram with full-curl horn or larger 10 Aug–20 Sep or 3 sheep may be taken by registration permit 1 Oct–30 Apr.	10 Aug–20 Sep 1 Oct–30 Apr	
NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.		10 Aug–20 Sep
Units 24 and 26B, that portion within Gates of the Arctic National Park		
RESIDENT HUNTERS: 3 sheep.	1 Aug–30 Apr	No open season

Harvest

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Remainder of Unit 24, and Unit 26B, excluding Gates of the Arctic National Preserve: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep

Board of Game Actions and Emergency Orders. There were no regulatory changes or emergency orders during this reporting period. The board established a full-curl regulation for the Brooks Range in 1993.

The Federal Subsistence Board (FSB) established the Arctic Village Sheep Management Area (AVSMA) in 1991 in response to concerns raised by Arctic Village residents. Villagers felt nonlocal hunters interfered with hunting by local residents. The regulation closed the area to nonlocal hunters. In 1995 the FSB extended the original boundary of the AVSMA at Cane Creek northward to include the Red Sheep Creek drainage. An effort to monitor aircraft and hunting activity near the Red Sheep Creek airstrip was initiated by FWS in August 1995. The results indicated that hunting activity by nonlocal residents would not interfere with hunting by local residents but did not influence the status of federal regulations. The AVSMA continues to be the subject of public concern.

Hunter Harvest. The number of sheep taken in Units 25A, 26B and 26C ranged from 102 to 135 annually during this reporting period (Table 3). The total harvest in the eastern Brooks Range was 119–144 (Table 5). The eastern Brooks Range experienced a long-term increase in the number of hunters and harvest in the early 1970s that ended in 1990–1991. Harvest declined slightly during the last few years, although hunter participation remained high. From RY 1987–1988 to 1992–1993 the total reported harvest exceeded 200 sheep each year. Harvest declined after RY 1992–1993, with 129 sheep reported taken in RY 1994–1995. The relatively low harvest in RY 1996–1997 was probably related to poor weather. Hunters and guides familiar with the area reported that legal rams were common, although less abundant than during the 1980s. Average horn size increased somewhat following establishment of the full-curl regulation in 1993.

Permit Hunts. Participation in sheep registration hunt RS595 has been open to all Alaska residents since 1990–1991. Twenty-four permits were issued during the reporting period and only 2 sheep were reported taken. Reporting by local residents was limited, but interviews with residents of Kaktovik and Arctic Village indicated local residents took 30–40 sheep each year. Permit holders reported taking 2–14 sheep annually from RY 1990–1991 to 1993–1994, approximately 50% of which were ewes. The reported harvest has declined substantially since then, probably because of limited demand and poor reporting (Table 4).

Hunter Residency and Success. Most sheep hunters using the eastern Brooks Range were Alaska residents, although a large number of nonresidents also use the area (Table 5).

Nonresident hunters had a higher success rate, reflecting the advantage associated with having a guide (Golden 1990).

During this reporting period hunter success was 40–50%. Historically, success was generally higher. From RY 1985–1986 to 1989–1990, it was 60–67%. The success rate declined somewhat during the next 2 years to just over 50%, indicating that legal rams became more difficult to find. Hunter success was 36–45% from RY 1992–1993 to 1994–1995. The decline and subsequent modest increase may reflect the effects of the full-curl regulation. (Table 5)

Harvest reports show that hunter success varies considerably in the eastern Brooks Range. During the last few years, hunter success was substantially lower in areas adjacent to the Haul Road than in less accessible areas to the east.

Harvest Chronology. Prior to and during this reporting period, most sheep hunting in the eastern Brooks Range occurred during August when weather is most favorable. From 80 to 90% of the sheep harvest occurred before 1 September (Table 6). Most of the remaining harvest occurred in September, with a few sheep reported taken during October.

Transport Methods. Aircraft are the primary means of transportation for most hunters (Table 7). They were used in 80–90% of successful hunts. The remaining harvest involved the use of horses, boats, and, in the Dalton Highway area, highway vehicles.

CONCLUSIONS AND RECOMMENDATIONS

Management goals providing for subsistence use, viewing and photography, an opportunity to hunt under aesthetically pleasing conditions, and protecting sheep populations and habitat were met. However, declines in sheep numbers and availability of legal rams caused reductions in the number of hunters, success rates, and harvest. There was no progress toward restoring sheep populations to their former abundance, and the goal of maintaining and enhancing sheep populations was not met. Objectives relating to monitoring population status and the effects of the full-curl regulation, managing for the harvest of large rams, and cooperatively managing subsistence harvest were generally met. However, in view of the decline in sheep populations, I recommend the bag limit for registration hunt RS595 be changed from 3 sheep to 2 rams. This would provide a biologically more conservative subsistence harvest regime. The full-curl regulation was expected to temporarily reduce the harvest of rams for 1 or 2 years as rams that could have been taken at 7/8 curl reached the new legal limit. The time required for the adjustment in ram age structure accounted in part for the low harvest in RY 1993–1994 and 1994–1995. Although quantitative data are lacking, anecdotal reports indicate full-curl rams are currently well represented in the population.

The staff of the Arctic National Wildlife Refuge provided valuable support and played a major role in annual population monitoring. Continued cooperative efforts will be important to future success in conducting composition and trend surveys.

LITERATURE CITED

GOLDEN HN. 1990. Eastern Brooks Range sheep survey-inventory report. Pages 122–133 *in* SO Morgan, editor. Annual report of survey-inventory activities. Volume XX. Sheep. Part II. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Progress Report. Grant W-23-2. Juneau.

HEIMER WE. 1985. Population status and management of Dall sheep in Alaska, 1984. Pages 1–15 *in* M Hoefs, editor. Wild sheep distribution, abundance, management, and conservation of the sheep of the world and closely related mountain ungulates. Special Report. Northern wild sheep and goat council. Yukon Wildlife Branch, Whitehorse.

———, FJ MAUER, AND SW WATSON. 1994. The effects of physical geography on Dall sheep habitat quality and home range size. Biennial symposium northern wild sheep and goat council. 9:144–148.

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Table 1 Atigun Gorge (Unit 26B) ground–based sheep composition counts, 1986–1998

Year	Rams				Ewes[a]	Lambs	Total sheep observed
	Full curl	3/4–Full curl	1/2–3/4 curl	<1/2 curl			
1986	1	10	18	18	165	42	254
1987	0	19	20	13	137	47	236
1988	3	16	29	11	221	80	360
1989	0	19	37	15	253	40	364
1990[b]	0	18	23	8	165	69	283
1991	2	22	19	10	318	122	493
1992	0	12	15	7	309	39	382
1993	1	19	22	5	206	24	277
1994	5	16	21	10	225	89	366
1995	0	9	18	5	247	28	307
1996	0	2	6	11	90	49	184
1997	0	4	16	11	51	16	147
1998	0	2	12	11	99	70	238

[a] Includes yearlings and 2-year-olds of both sexes and rams of 1/4 curl or less.

[b] Counts prior to 1990 occurred in Atigun Gorge; during and after 1990 counts along the Dalton Highway were included.

Table 2 Hulahula (Unit 26C) and East Fork Chandalar (Unit 25A) River drainages ground–based sheep composition counts, 1992–1998

Area/year	Rams				Ewes[a]	Lambs (%)	Total sheep observed
	Full curl (%)	3/4–Full curl	1/2–3/4 curl	<1/2 curl			
Hulahula							
1992	1 (0.2)	28	26	4	318	10 (3.0)	387
1993	12 (1.0)	242	87	40	709	171 (14.0)	1219
1994	6 (0.7)	99	47	18	595	99 (11.5)	863
1995	25 (2.2)	160	111	24	631	179 (15.8)	1130
1996[a]							
1997[a]							
1998	10 (2.9)	34	36	47	190	61 (17.7)	344
East Fork Chandalar							
1992	4 (1.8)	17	6	0	155	34 (16.0)	216
1993	20 (5.6)	37	29	6	219	45 (12.6)	356
1994	16 (8.1)	24	23	13	121	0 (0.0)	197
1995	15 (9.5)	25	7	5	89	17 (10.8)	158
1996[a]							
1997[a]							
1998[a]							

[a] No surveys.

Table 3 Units 25A, 26B, and 26C[a] sheep harvest and mean horn length, regulatory years 1985–1986 through 1997–1998

Regulatory year	n	$\bar{x}$ Horn length (inches)	% ≥40"	Total sheep
1985–1986	170	34.9	n/a	170
1986–1987	185	35.4	n/a	185
1987–1988	223	34.8	n/a	223
1988–1989	208	35.1	n/a	208
1989–1990	258	35.0	10	258
1990–1991	265	34.6	9	265
1991–1992	234	34.3	7	234
1992–1993	174	34.1	2	174
1993–1994	122	34.6	2	122
1994–1995	122	34.3	4	122
1995–1996	135	35.1	2	135
1996–1997	102	34.6	0	102
1997–1998	115	34.8	2	115

[a] Excludes permit hunt and Unit 24 harvest.
[b] There was no legal harvest of ewes except in Permit Hunt 1195.

Table 4 Units 25A and 26C sheep harvest data by permit hunt, regulatory years 1985–1986 through 1997–1998

Hunt	Regulatory year	Permits issued	% Did not hunt	% Unsuccessful hunters	% Successful hunters	Rams	Ewes (%)	Unk	Total harvest
1195	1985–1986	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12–30[a]
	1986–1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12–30[a]
	1987–1988	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30–40[b]
	1988–1989	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30–40[b]
	1989–1990	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30–40[b]
	1990–1991	69	46	67	33	7	6 (46)	1	14[c]
	1991–1992	9	n/a	n/a	n/a	1	1 (50)	0	2[c]
	1992–1993	n/a	n/a	n/a	n/a	3	1 (25)	4	8[c]
	1993–1994	20	60	5	35	3	3 (43)	1	7[c]
	1994–1995	7	100	n/a	n/a	n/a	n/a	n/a	0[c]
RS595	1995–1996	10	50	40	10	1	0 (0)	0	1[c]
	1996–1997	4	100	n/a	n/a	n/a	n/a	n/a	0[c]
	1997–1998	10	70	20	10	1	0 (0)	0	1[c]

[a] Estimates based on interviews with residents of Kaktovik (S Pedersen, ADF&G, pers commun).
[b] Estimates based on interviews with residents of Kaktovik and Arctic Village (S Pedersen, ADF&G, pers commun).
[c] Based on written reports received; does not include most of the 30–40 sheep estimated taken by Kaktovik and Arctic Village residents.

Table 5 Units 25A, 26B, 26C, and eastern Unit 24 sheep hunter[a] residency and success, regulatory years 1985–1986 through 1997–1998

Regulatory year	Successful hunters					Unsuccessful hunters					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1985–1986	2	109	80	4	195 (62.5)	1	98	13	5	117 (37.5)	312
1986–1987	0	126	79	9	214 (60.0)	2	120	14	7	143 (40.0)	357
1987–1988	0	156	104	14	274 (67.1)	0	116	10	8	134 (32.9)	408
1988–1989	1	109	99	35	244 (63.2)	0	107	18	17	142 (36.8)	386
1989–1990	5	154	114	4	277 (59.8)	1	157	24	4	186 (40.2)	463
1990–1991	13	138	115	16	282 (55.5)	3	200	16	7	226 (44.5)	508
1991–1992	3	138	102	8	251 (53.3)	2	192	25	1	220 (46.7)	471
1992–1993	7	97	86	3	188 (45.0)	7	206	20	4	230 (55.0)	418
1993–1994[c]	2	91	46	0	137 (36.2)	1	219	21	2	242 (63.8)	379
1994–1995	1	79	43	7	129 (42.2)	0	155	16	2	176 (57.7)	305
1995–1996	1	90	51	2	144 (39.8)	2	180	30	6	218 (60.2)	362
1996–1997	2	72	37	8	119 (43.3)	2	130	19	5	156 (56.7)	275
1997–1998	2	61	57	9	129 (49.6)	1	111	17	2	131 (50.3)	260

[a] Excludes hunters in permit hunts.
[b] Local resident is a resident of eastern Unit 24 or Units 25A, 26B, or 26C.
[c] Regulation changed to full curl.

Table 6 Units 25A, 26B, 26C, and eastern Unit 24 sheep harvest[a] chronology percent by harvest period, regulatory years 1985–1986 through 1997–1998

Regulatory year	Harvest periods									*n*
	8/1–8/4[b]	8/5–8/11	8/12–8/18	8/19–8/25	8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29[b]	
1985–1986	8.8	38.3	22.3	16.5	6.7	4.7	1.0	0.5	1.0	191
1986–1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1987–1988	0	0	41.0	20.9	19.8	7.5	7.5	1.5	1.5	261
1988–1989	0.4	35.9	26.4	18.2	6.5	7.3	3.0	0.8	0.8	223
1989–1990	0.4	23.0	27.4	24.4	12.8	6.2	2.5	1.8	0.4	268
1990–1991	1.2	17.8	42.2	18.2	12.0	6.2	1.9	0.0	0.4	258
1991–1992	0.0	23.5	35.4	18.9	12.7	4.1	2.4	2.8	1.2	243
1992–1993	0.0	20.7	35.1	18.6	14.4	5.3	0.5	2.7	1.1	188
1993–1994	0.0	22.0	41.6	13.9	12.4	3.6	2.2	0.0	4.4	137
1994–1995	0.8	22.8	53.7	8.1	7.3	0.8	2.4	1.6	2.4	123
1995–1996	0.0	29.9	29.2	13.9	18.7	5.5	0.0	1.4	0.0	144
1996–1997	0.0	20.5	52.1	10.2	9.4	5.9	0.0	0.0	0.0	117
1997–1998	0.0	27.5	40.1	15.0	6.3	6.3	3.1	1.6	0.0	127

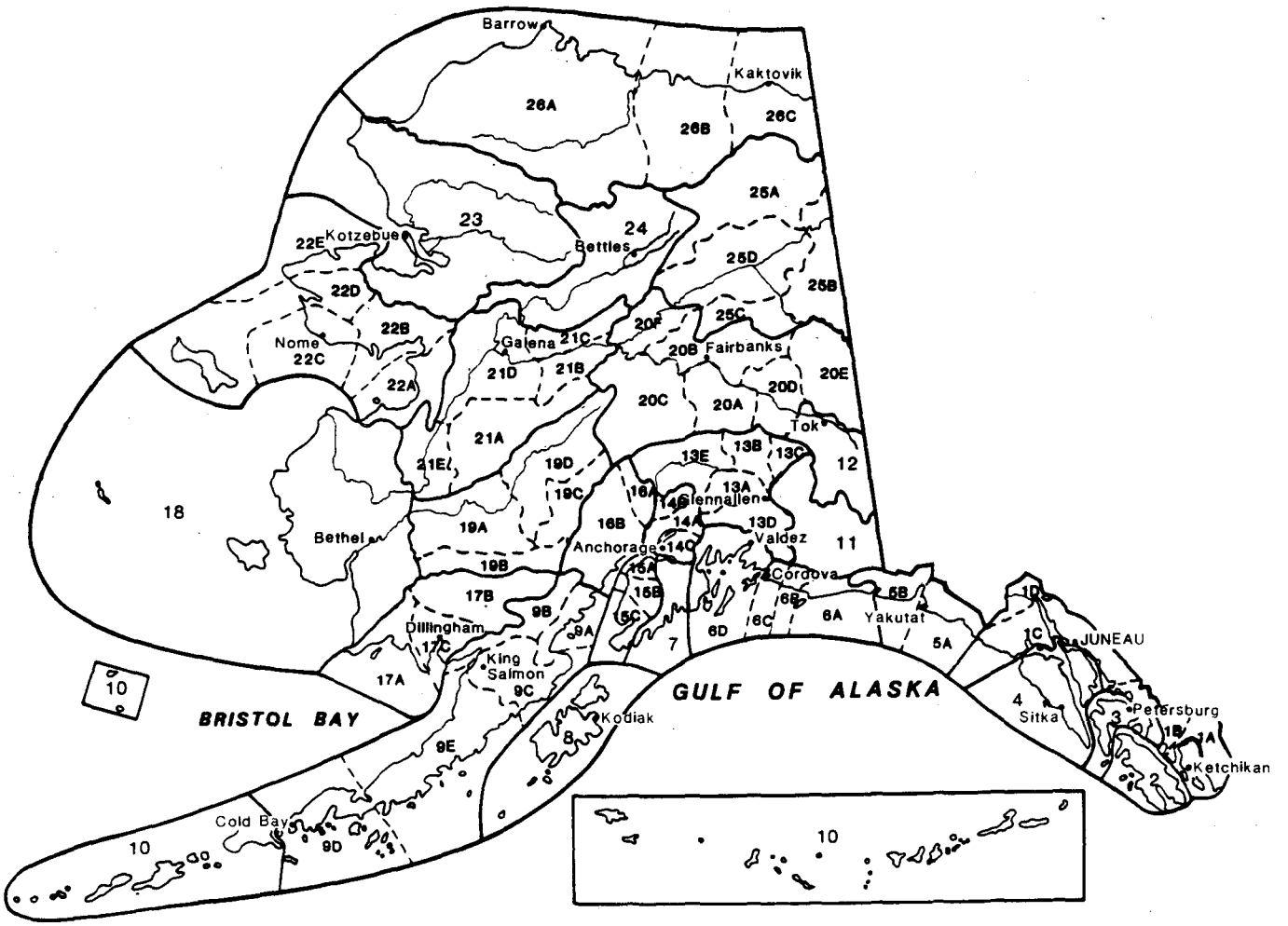
[a] Excludes permit hunt harvest and a few sheep "reported" taken in Oct or Nov or where the date was not reported.
[b] Sheep reported taken before 10 Aug or after 26 Sep were presumably incorrectly reported.

Table 7 Units 25A, 26B, 26C, and eastern Unit 24 sheep harvest[a] percent by transport method, regulatory years 1985–1986 through 1997–1998

Regulatory year	Percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	*n*
1985–1986	82.6	3.6	1.0	1.0	0.0	0.5	5.6	5.6	195
1986–1987	89.7	3.3	0.5	1.5	0.0	0.0	2.3	2.8	214
1987–1988	85.6	2.0	0.8	0.0	0.0	0.0	6.0	5.6	250
1988–1989	85.4	3.3	1.2	0.0	0.0	0.0	6.2	3.7	240
1989–1990	86.0	3.6	1.8	0.0	0.0	0.0	7.6	1.1	277
1990–1991	80.8	3.9	1.8	0.0	3.5	0.0	7.4	2.5	282
1991–1992	81.3	4.4	1.2	0.0	0.0	0.0	10.0	3.2	251
1992–1993	83.0	1.6	0.5	0.0	0.0	0.0	13.3	1.6	188
1993–1994	80.3	3.6	1.5	0.0	0.0	2.2	12.4	0.0	137
1994–1995	91.9	0.8	0.0	0.0	0.0	0.0	4.9	2.4	123
1995–1996	83.3	2.0	0.0	0.0	0.0	0.0	12.5	2.0	144
1996–1997	82.3	1.7	2.5	0.0	0.0	0.0	13.4	0.0	119
1997–1998	82.9	7.9	0.0	0.0	0.0	0.0	9.3	0.0	129

[a] Excludes hunters in permit hunts.

Alaska's Game Management Units



The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.

Ken Whitten