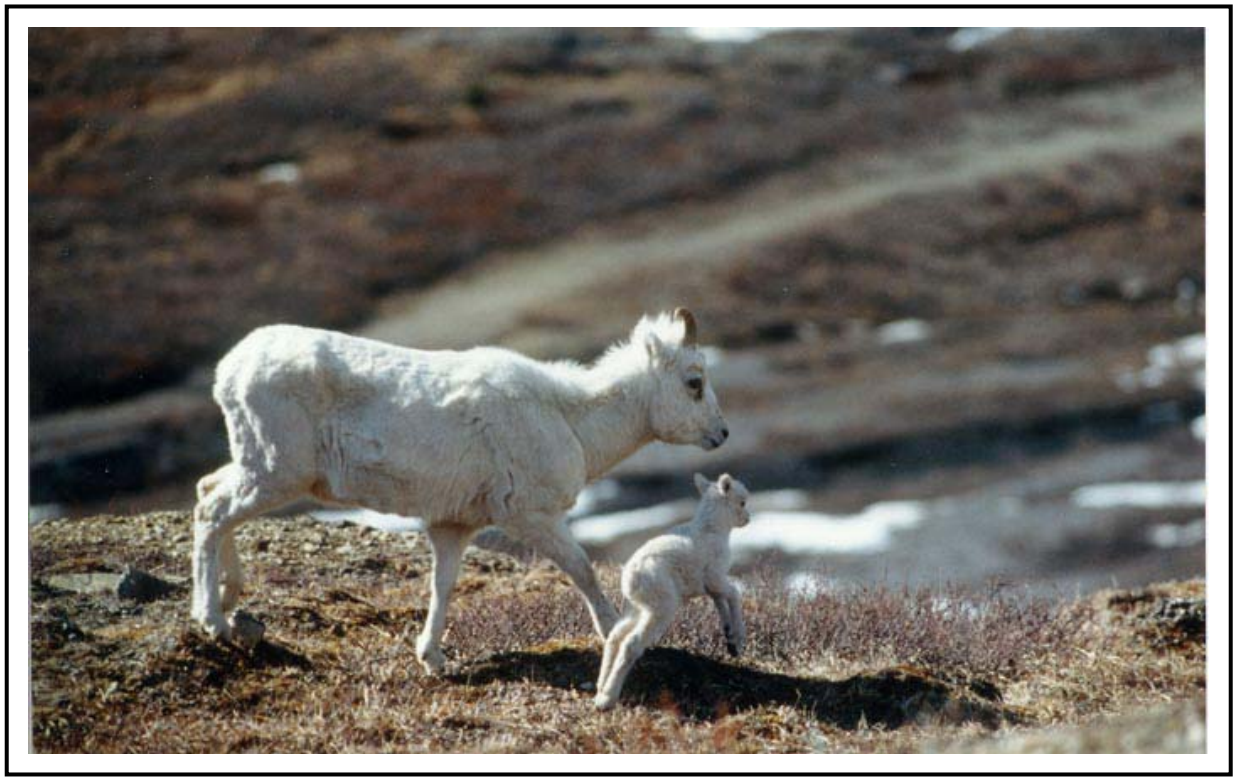
Dall Sheep
Management Report
of survey-inventory activities
1 July 1998–30 June 2001

Carole Healy, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation
December 2002



ADF&G

Please note that population and harvest data in this report are estimates and may be refined at a later date.

If this report is used in its entirety, please reference as: Alaska Department of Fish and Game. 2002. Dall Sheep management report of survey-inventory activities 1 July 1998–30 June 2001. C. Healy, editor. Project 6.0. Juneau, Alaska.

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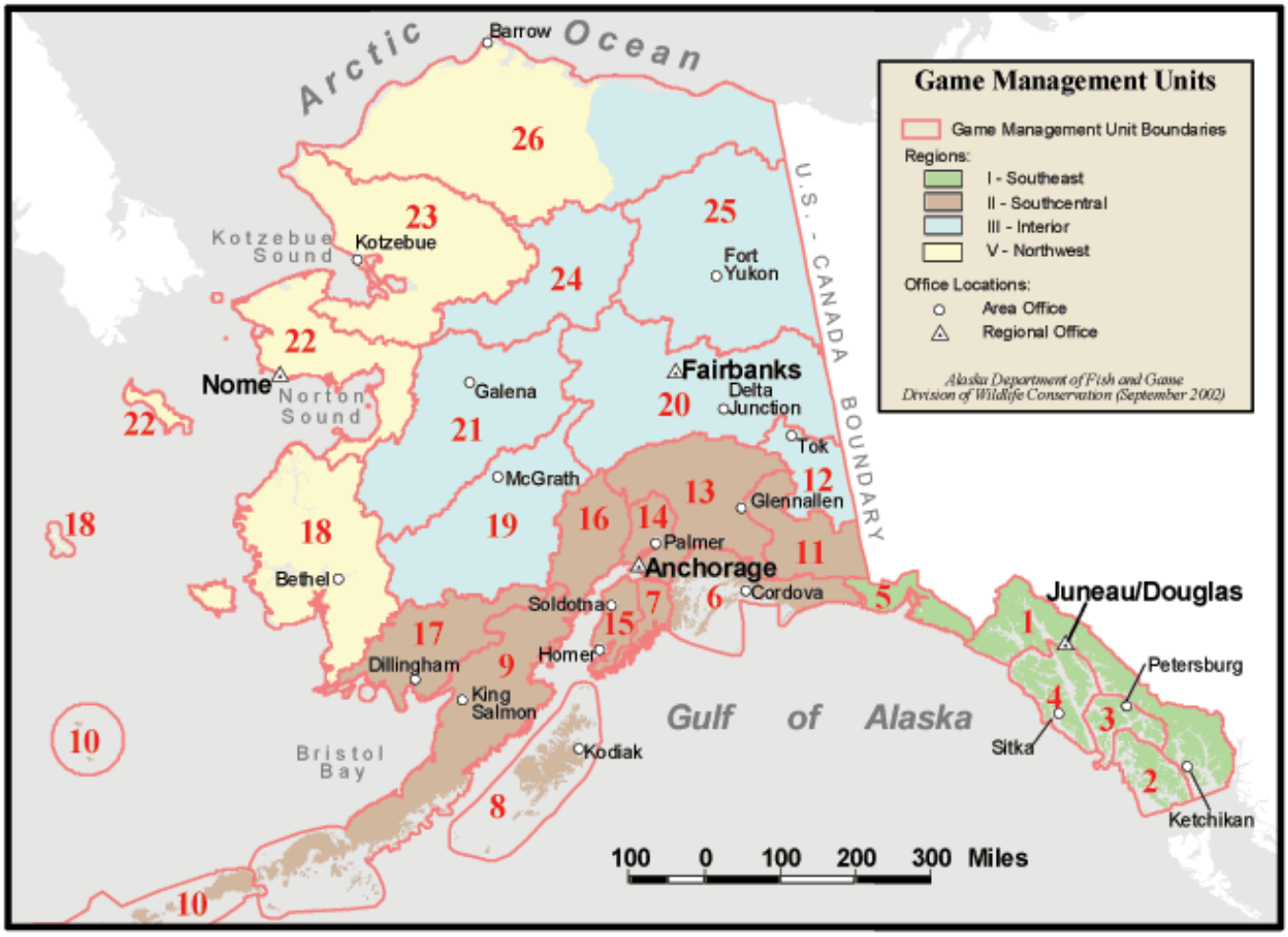
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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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. Caribou, reintroduced in Subunits 15B and C in 1985 and 1986, may be competing with sheep for winter range. Although not significant factors, predation and natural mortalities have also controlled the size of the sheep population in the Kenai Mountains. The last complete census was conduced in 1992 resulting in an estimate of 1508 to 1774 sheep.

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 elevations (AGL), to count, and determine sex and age of sheep during the summer in selected count areas of the Kenai Mountains sheep habitat. Surveys were generally conducted during early morning or late evening hours to avoid midday sun glare and turbulence. Sheep were classified into categories of legal rams (full-curl or larger), sublegal rams (7/8-curl or less), lambs, 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 (855, 856, and 857) from Skilak Glacier to Fox River were designated in 1987 to be used as areas to assess trends 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. To date, 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 1998 and 2000, a mean of 325 sheep, or 22 percent of the minimum population (1500), were classified annually (Table 1).

In 1998–1999 sheep surveys were completed in 2 of 12 count areas, including area 856, and 459 sheep were classified (Table 1). We surveyed trend count area 856 in 1998–99, finding a decline from 523 sheep found in 1997 to 425 in 1998. Surveys were not completed in the trend areas in 1999–00 or 2000–01 (Table 2). In 1999–00, sheep surveys were only completed in Round Mountain, and 96 sheep were classified. The Round Mountain trend count area (Table 3) was counted from 1996 to 2000. Results of these counts indicated an increasing count from 1996 to 1997 followed by a 36 percent decrease in 1999. The increase in 1997 was believed to have resulted from a shift in sheep distribution rather than an actual increase in population size.

Population Composition

Aerial surveys from 1998–1999 to 2000–2001 resulted in 459, 96 and 420 sheep classified, respectively (Table 1). The 1998–1999 data was the highest count during this reporting period. We classified 459 sheep, comprised of 16 (3%) legal rams (full-curl or larger), 73 (16%) sublegal rams, 69 (15%) lambs, and 301 (66%) ewes, yearlings, and 2-year-old rams.

Distribution and Movements

Sheep were found 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 (425) 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. A second drawing hunt was established in 1999 in the mountains surrounding Crescent Lake in Unit 7. Ten permits were issued for ewes and 10 for rams in each of the past two years.

Board of Game Actions and Emergency Orders. In 1999, the Board of Game approved a proposal from the Cooper Landing Advisory Committee to establish a permit hunt for ewes and rams in the Crescent Lake area in Unit 7. No emergency orders were issued during this reporting period.

Hunter Harvest. The harvest remained relatively stable between 1997 (25) and 1998 (26) then declined to 12 rams in 1999 and 14 rams in 2000 (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 1999 compared to the two previous years. The creation of the Crescent Lake permit area also contributed to the reduction in harvest by limiting the number of hunters allowed in that area. The 3-year harvest resulted in a mean harvest of 17 rams.

Mean horn length of harvested rams remained relatively stable during this reporting period, ranging between 34.7 and 35.4 (Table 4). Horn size ranged from 31.5 to 38.0 inches, and mean age of harvested rams was 8.4 years old from 1998 to 2000.

Between 1998 and 2000 a mean of 16 ewe permit holders for Round Mountain hunted (out of 20), averaging 8 ewes per year (Table 5). Hunter success ranged between 35 and 73 percent.

Hunters in the Crescent Lake permit hunt harvested 3 ewes and 2 rams in 1999 and 1 ewe and no rams in 2000. In 1999, an ewe sheep permit holder mistakenly killed a yearling ram (Tables 6 and 7).

Hunting effort remained stable (mean = 212) between 1997 and 1998 then decreased by approximately 28 percent in 1999. In 2000, the number of hunters increased to 191 (Table 8). Hunter success has ranged between 15 and 7 percent over the past 5 years in a downward trend.

Hunter Residency and Success. Fifty (96%) of the 52 successful hunters reporting residency from 1998 to 2000 were Alaska residents and 2 (4%) were nonresidents (Table 8). Unsuccessful hunters comprised 503 (99%) residents and 6 (1%) nonresidents.

Harvest Chronology. Chronology of harvest followed similar patterns over the past 3 years (Table 9). Most of the harvest occurred during the first 2 weeks of the season followed by a surge during the last week.

Transport Methods. From 1998 to 2000, successful hunters used aircraft (33%), boats (30%), and highway vehicles (29%). ATVs were not reported as a transportation method during this reporting period and horses were only used by 7 percent of the hunters in one year (Table 10).

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. Because caribou now inhabit sheep range in the three trend areas, impacts to sheep winter range caused by caribou should be investigated.

The one area (856) of the three trend count areas counted during this reporting period indicated the number of sheep in that area declined. The Round Mountain area remained stable. Percentage of lambs found in the 1998 (15%) and 2000 (12%) counts were also lower than expected. Limited survey data and reported harvests suggest the population is probably at the lower end of the estimated range of 1500 to 1775. 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 in 3 of 5 years. Horn length of harvested rams has remained stable. Horn length ranged from 31.5 to 38.0 inches, and mean age of harvested rams was 8.4 years old from 1998 to 2000. The reporting of no rams over 40 inches in the past three years is probably a result of poor lamb survival during the early 1990s.

The small population of sheep inhabiting the Round Mountain count area remained stable at approximately 96 to 110 sheep from 1999 to 2000. 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. A total of 59 ewes and approximated 25 rams were harvested from Round Mountain in the past eight years.

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.

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 2004: (1) delineate winter range, (2) determine extent of competition between sheep and caribou on winter range, (3) complete a range evaluation to provide an estimate of allowable density, (4) reduce the population by harvesting ewes in areas where we suspect habitat may be limited, and (5) 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, 1996–01

Regulatory year	Rams				Ewes	Sheep/ Lambs(%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full-curl(%)	7/8 or less[a]	1/2 to 3/4-curl	<1/2-curl					
1996–97	6(1)	92	- -	- -	338	111(20)	- -	547	1500–1775
1997–98	20(3)	127	- -	- -	486	151(19)	- -	784	1500–1775
1998–99	16(3)	73	--	--	301	69(15)	--	459 [b]	1500–1775
1999–00	0(0)	21	--	--	53	22(23)	--	96	1500–1775
2000–01	5(1)	100	--	--	265	50(12)	--	420	1500–1775

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

[b] Round Mountain was the only area counted in 1999–00.

Table 2 Kenai Mountains, Units 7 and 15 trend count areas (855, 856, and 857), 1996–01

Regulatory year	Rams			Ewes	Lambs	Total sheep
	Full-curl	7/8 or smaller	Total rams			
1996–97	No Count Data Available For These Trend Areas					
1997–98	22	103	125	396	123	644
1998–99	16	70	86	275	64	425[a]
1999–00	No Count Data Available For These Trend Areas					
2000–01	No Count Data Available For These Trend Areas					

[a] Only counted area 856

Table 3 Round Mountain, Subunit 15A summer aerial sheep composition counts and estimated population size, 1996–01

Regulatory year	Rams				Ewes	Lambs	Sheep/ hour	Total Sheep observed	Estimated population size
	Full-curl(%)	7/8 or less[a]	1/2 to 3/4 curl	<1/2 curl					
1996–97	0(0)	15	- -	- -	65	26	- -	106	119
1997–98	2(2)	20	- -	- -	90	32	- -	144	160
1998–99	NO SURVEY								
1999–00	0(0)	21	--	--	53	22	--	96	110
2000–01	0(0)	23	--	--	57	18	--	98	110

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

Table 4. Kenai Mountains, Units 7 and 15 general sheep harvest, 1996–01

Regulatory year	Rams	Mean Horn Length (in)	Mean Age	Mean Base (inches)	% ≥ 40 in	Ewes	Total
1996–97	39	35.2	--	--	3	0	39
1997–98	25	35.1	--	--	0	0	25
1998–99	26	34.7	8.3	12.8	0	0	26
1999–00	11	34.9	8.5	13.1	0	1	12
2000–01	14	35.4	8.4	13.4	0	0	14

Table 5. Round Mountain, Subunit 15A drawing permit ewe sheep hunt, 1996–01

Regulatory year	Number of Permits Issued	Number of Hunters	Number of Ewes	Percent Successful	Season Length
1996–97	20	16	9	56	Aug. 10–Sep. 20
1997–98	20	15	6	40	Aug. 10–Sep. 20
1998–99	20	15	11	73	Aug. 10–Sep. 20
1999–00	20	15	8	53	Aug. 10–Sep. 20
2000–01	20	17	6	35	Aug. 10–Sep. 20

Permit ewe hunt started in 1993 (DS-152).

Table 6. Crescent Lake, Unit 7 drawing permit ewe sheep hunt, 1999–01

Regulatory year	Number of Permits Issued	Number of Hunters	Number of Ewes	Percent Successful	Season Length
1999–00	10	8	3	38	Aug. 10–Sep. 20
2000–01	10	9	1	11	Aug. 10–Sep. 20

Permit ewe hunt started in 1999 (DS-154).
One yearling ram was killed in 2000.

Table 7. Crescent Lake, Unit 7 drawing permit ram sheep hunt, 1999–01

Regulatory year	Number of Permits Issued	Number of Hunters	Number of Rams	Percent Successful	Season Length
1999–00	10	7	2		Aug. 10–Sep. 20
2000–01	10	7	0	- -	Aug. 10–Sep. 20

Permit ram hunt started in 1999 (DS-156).

Table 8. Kenai Mountains, Units 7 and 15 general sheep hunter[a], residency and success, 1996–01

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1996–97	20	18	1	39(15)	91	133		229(85)	
1997–98	15	7	1	23(11)	86	100		187(89)	268
1998–99	18	7	1	26(12)	116		5	188(88)	210
1999–00	8	3	0	11(07)	90	72	1 0	144(93)	214
2000–01	10	3	1	14(07)	112	53 59	1 5	177(93)	155 191

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

Table 9. Kenai Mountains, Units 7 and 15 general sheep harvest chronology percent by harvest period, 1996–01

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*
1996–97		13	11	11	13	3	39
1997–98	50 52			20	0	4	25
1998–99	73	12	8			4	26
1999–00	45	16	8	4 0	0 18	9	12
2000–01	50	27 21	0 0	21	0	7	14

Table 10. Kenai Mountains, Units 7 and 15 general sheep harvest percent by transport method, 1996–01

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1996–97	28	0	42	3	0	0	28	0	39
1997–98	20	4	28	0	0	0	40	8	25
1998–99	31	0	38	0	0	0	23	8	26
1999–00	25	0	17	0	0	0	58	0	12
2000–01	43	7	36	0	0	0	7	7	14

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

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

BACKGROUND

The Alaska Range West (ARW) is a popular Dall sheep hunting area for both resident and nonresident hunters. This area is not road-accessible, and it is relatively close to Anchorage, the state's largest population center. Aircraft transportation is the predominant mode of access for sheep hunters. Guides are required for nonresident sheep hunters throughout the state of Alaska, and a large number of guide operations offer hunts for sheep in the ARW. From 1983 to 2000 an average of 220 hunters used the area annually, and average annual harvest was 123 rams.

Aerial surveys were conducted in the ARW during the 1960s, 1970s, and 1980s. The sheep population was estimated at 4000–5000 sheep and was believed to be stable from the late 1970s to the mid-1980s (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 survey efforts were 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; the most recent survey was conducted in 1996 (Didrickson 1971; Didrickson and Taylor 1979; Masteller et al., ADF&G unpublished 1997 sheep survey report, Palmer, Alaska, USA; Denali National Park and Preserve, unpublished sheep report).

Harvest data and survey work indicate that the sheep population was stable prior to 1998. However, no surveys have been flown in the ARW since 1998, and reported harvest between 1998 and 2000 has declined.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

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

- Provide an opportunity to view and photograph Dall sheep.

MANAGEMENT OBJECTIVES

- Maintain a full-curl harvest strategy for Dall sheep rams.

  Activity: Monitor hunter participation and location and assess hunter satisfaction with hunting experiences in the ARW.

- Monitor hunter participation and location and assess hunter satisfaction with hunting experiences in the ARW.

METHODS

POPULATION SIZE AND COMPOSITION

Population size was not determined, and only 1 composition count survey was flown during the reporting period (RY98–RY00). Sheep densities were calculated for some regions based on combined data from individual count areas surveyed during 1994–1998. We determined sex and age composition in count areas in the northwest portion, Sheep Creek East, and southeast portion of the ARW. These areas were representative of good sheep habitat and were selected based on their ability to sustain moderate to high sheep harvests. Surveys were conducted by flying contours with a PA-18 Super Cub in sheep habitat with both pilot and observer spotting, enumerating, and classifying sheep. Sheep were classified into 5 categories: full-curl rams, rams with less than full-curl horns, ewe-likes (include adult ewes, yearling rams, and yearling ewes), lambs, and unknown. The airplane was flown at 70–80 mph at 200–400 feet above the ground. A calm, high-overcast day with no glare off the rocks and few shadows was considered excellent conditions for a survey.

The northwest count areas were established in Units 19B and 19C 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. 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. A single count area was established during 1995 in Sheep Creek East (between Sheep Creek and the South Fork and Post Rivers) to serve as a comparison area for trends observed in the northwest portion of the range. The objective for the Sheep Creek East count area was to

survey the same area (83 mi^2) with the same survey intensity each year. Surveys were flown during 1995, 1997, and 1998.

Sheep composition surveys also were conducted during 1996 in 12 count areas (4299 mi^2) 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 included portions of Units 16B, 19C, and 20C.

HARVEST

Hunter harvest, effort, location, transportation, and horn characteristics of harvested rams were monitored using harvest reports submitted by hunters. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During 1978, ADFG staff estimated there were 4000–5000 sheep in the ARW (Shepherd 1979); 4000 were estimated during 1985 (Pegau 1986). No area-wide estimates were calculated in the ARW during the 1990s, but some count areas were surveyed and densities were estimated. Sheep densities in the northwestern count areas ranged between 1.28–2.23 sheep/mi^2 for 1994, 1995, 1997, and 1998 (Table 1). Densities in the Sheep Creek East count area ranged between 2.58–3.29 sheep/mi^2 for 1995, 1997, and 1998. 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 counted each year due to weather and other factors. Nonetheless, densities were consistently >1 sheep/mi^2, productivity was relatively good (lamb:ewe-like ratio was generally >30:100; Table 1) except in the Sheep Creek East count area (15–22 lambs:100 ewe-likes), and harvest was relatively stable during the years the count areas were surveyed. However, sheep harvest declined in recent years (Table 2) and we have not conducted another survey to assess population status during this reporting period.

Population Composition

Only 1 composition count flight was completed during this reporting period. During August 1998, 4 count areas in the northwest portion of ARW and the Sheep Creek East area were surveyed (Table 1). 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 at least 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 total rams was 20.4–32.2%. Percent lambs was 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 decreased slightly since 1994; however, due to differences in survey intensity and count areas, it was difficult to draw inferences about this decline.

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 during 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 sheep). Percent total rams was 19.8–36.9%. Percent lambs was 9.8–14.6%. The lamb:ewe-like ratios were 15–22:100. This ratio was well below 30:100, and may be due to the absence of preferred habitat for lamb and 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 this 1996 survey were compared with surveys conducted during 1970 and 1977 on the south side of the Alaska Range (Unit 16). Sheep numbers were greater in at least some of the areas on the south side of the Alaska Range during 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 ratios 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 for resident and nonresident sheep hunters 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 RY89. Before RY89 the horn size requirement was a 7/8-curl minimum. Prior to RY79 it was 3/4 curl or larger.

Hunter Harvest. Reported harvest of sheep probably approximated the actual harvest because illegal or unreported take was believed to be low. During this reporting period, 109, 78, and 80 rams were harvested during RY98, RY99, and RY00, respectively. This is a dramatic decline from the reported harvest of the previous reporting period, and falls well below

fluctuations observed during the previous 11 years when harvest ranged from 126 to 157 rams. Without survey data to assess population trends, it is difficult to determine if reduced harvest reflects a decline in sheep or hunter numbers. Total numbers of hunters using the ARW have declined markedly since 1999 (Table 3). Survey data from more eastern sections of the Alaska Range indicate that unfavorable weather conditions may have contributed to poor production of lambs during the early 1990s (Dale 1999). Low recruitment during these years likely caused a reduction in the number of legal rams (approximately 7- to 10-years old) available to hunters in the ARW during the reporting period.

Mean horn length during RY96 through RY00 was 35.3–36.4 inches (Table 2). Mean age during these 5 regulatory years was 8.8–9.5 years. Mean horn length and age are largely influenced by the full-curl regulation because most full-curl rams are at least 6- to 8-years old and usually have a horn length ≥34" (K Whitten, personal communication). A few rams with horns ≥40" have been harvested every year since 1987.

Permit Hunts. A federal subsistence hunt has occurred in Unit 9B since fall 1995. Annual harvests were 0–3 sheep during RY96 through RY00 during the federal hunt. See federal regulations for more details on seasons and bag limits.

Hunter Residency and Success. During this reporting period (RY98–RY00), over 50% of sheep hunters using the ARW were nonresidents (Table 3). Their success rates were likely higher than those for resident hunters because nonresidents typically were accompanied by licensed guides. Success rates for resident hunters during the reporting period ranged from 22 to 28%. This was the lowest level recorded during the last 11 years. The number of resident hunters also declined since RY97. Snowfall in this region has been relatively low during the last 5 years—sheep tend to stay at higher elevations when there is little snow. This may have reduced hunter effort and success, particularly among unguided hunters. Additionally, the perception that sheep numbers were low due to poor recruitment in the early 1990s may have limited efforts by residents to hunt in an area only accessible by aircraft. The knowledge that numerous guides and their hunters were present throughout the hunting season, vying for a limited number of legal rams, may have kept resident numbers low in the ARW during this reporting period.

Harvest Chronology. Traditionally, 10–25 August is considered to be the peak time for sheep hunting. Although more rain falls in the ARW during this period, hunters can hunt sheep and still have the opportunity to hunt moose during early September. During this reporting period (RY98–RY00), approximately half of the harvest occurred during the first 2 weeks of the 6-week season (Table 4).

Transport Methods. Aircraft were used by 78% of sheep hunters during this reporting period. 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 has grown in recent years, and crowded hunting conditions may have reduced the quality of the sheep hunting experience in several of the most accessible drainages. For example, there were 19 guides registered in 1998 to hunt in a single guide use area in Unit 19C along the South Fork Kuskokwim River. This level of activity is not likely to diminish over time.

CONCLUSIONS AND RECOMMENDATIONS

Aerial surveys indicated the sheep population in the ARW remained relatively stable prior to 1998, but only 1 survey in a limited area was completed during this reporting period (RY98–RY00) and the current status of the population is unknown. A decline in the proportion of young rams during the early 1990s, combined with continued harvest of mature rams in the population, probably contributed to the reduced harvest observed during this reporting period. Additionally, the winter 1995–1996 had the highest snow severity index since the early 1960s, which may have been linked to a decline in caribou harvest in Unit 19C in subsequent years. If sheep populations in the ARW experienced increased mortality during winter 1995–1996, the limited availability of harvestable rams may persist over the next few years. Continued aerial surveys and examination of hunter numbers and success will help assess population trends (particularly lamb recruitment) and clarify whether reduced harvest was a product of fewer hunters or fewer sheep.

We met our management goals of providing a sustained opportunity to harvest Dall sheep rams from a naturally-regulated population during this reporting period. With regard to the full-curl harvest objective, we harvested an average of 89 rams annually from RY98 through RY00, with a mean horn length greater than 35 inches and a mean age older than 8 years. Meeting this objective also allowed us to meet our objective of providing opportunity to view and photograph sheep.

Reports of crowded conditions have been increasing in the most accessible areas of the ARW, and it is possible that we did not meet our goal of providing hunters with opportunity to harvest rams under aesthetically pleasing conditions throughout the ARW. The conditions that hunters find "aesthetically pleasing" need to be determined, and we will continue to assess hunter satisfaction with hunting experiences in this area. For the next reporting period, the management objective to monitor hunter participation and assess hunter satisfaction has been changed to an activity. One possible approach to address this activity may be to develop and distribute a questionnaire to survey hunter opinions.

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

Date	Area (mi^2)	Survey intensity (min/mi^2)	Rams								Total sheep	Density (sheep/mi^2)
			Full curl (%)		<Full curl (%)		Total (%)		Ewe-likes[a](%)							
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]		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	4299	–[c]	114	(6.4)	259	(14.5)	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 2001–2002

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	148	36.4	10.7	9.5
1997–1998	130	36.0	6.1	9.5
1998–1999	109	35.3	6.5	9.2
1999–2000	78	35.3	2.7	9.0
2000–2001	80	35.7	8.7	8.8
2001–2002	80	35.1	3.8	8.8

[a] Hunters estimate age of harvested ram.

Table 3 Alaska Range West sheep hunter residency and success, regulatory years 1987–1988 through 2001–2002

Regulatory year	Successful				Unsuccessful				Total hunters
	Resident	Nonresident	Total[a]	(%)	Resident	Nonresident	Total[a]	(%)	
1987–1988	62	77	139	(63)	69	12	81	(37)	220
1988–1989	72	85	157	(71)	47	18	65	(29)	222
1989–1990	61	80	141	(59)	69	29	98	(41)	239
1990–1991	49	102	151	(55)	79	44	123	(45)	274
1991–1992	54	80	134	(54)	82	34	116	(46)	250
1992–1993	46	73	126	(57)	71	24	97	(43)	223
1993–1994	59	81	142	(55)	75	44	118	(45)	260
1994–1995	54	76	131	(52)	76	44	123	(49)	254
1995–1996	64	87	151	(56)	78	38	117	(44)	268
1996–1997	59	85	148	(58)	64	38	105	(42)	253
1997–1998	39	87	130	(53)	69	38	117	(47)	247
1998–1999	31	75	109	(45)	74	57	132	(55)	241
1999–2000	17	60	78	(39)	70	51	121	(61)	199
2000–2001	21	58	80	(45)	54	41	98	(55)	178
2001–2002	17	58	80	(53)	41	27	71	(47)	151

[a] Total column exceeds summary of residency columns because it includes unknown residency and federal sheep harvest.

Table 4 Alaska Range West sheep harvest chronology percent by month/day, regulatory years 1987–1988 through 2001–2002

Regulatory year	Harvest chronology percent by month/day							
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unk	*n*
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	46	18	14	11	5	2	4	148
1997–1998	39	18	18	11	6	5	3	130
1998–1999	39	12	16	13	9	6	5	109
1999–2000	27	21	18	6	8	13	8	78
2000–2001	31	20	15	10	5	16	3	80
2001–2002	41	22	11	9	6	8	3	80

Table 5 Alaska Range West sheep harvest percent by transport method, regulatory years 1987–1988 through 2001–2002

Regulatory year	Harvest percent by transport method							
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unk	*n*
1987–1988	81	5	1	<1	3	<1	8	
1988–1989	79	7	1	4	1	2	5	
1989–1990	83	6	2	3	3	<1	3	141
1990–1991	86	6	2	2	0	<1	4	151
1991–1992	79	5	2	5	1	<1	8	134
1992–1993	83	9	0	4	4	0	0	126
1993–1994	83	8	1	4	3	0	<1	142
1994–1995	75	11	4	6	1	0	<1	131
1995–1996	83	7	3	2	1	2	0	151
1996–1997	82	11	<1	1	4	0	2	148
1997–1998	82	10	3	2	3	0	<1	130
1998–1999	78	10	3	5	4	0	0	109
1999–2000	76	10	4	0	9	1	0	78
2000–2001	80	8	2	4	5	0	1	80
2001–2002	81	9	2	2	4	0	2	80

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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 trend 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 when only 184 sheep were observed. Since that time, estimates have rebounded slightly, but abundance in all age and sex classes is substantially lower than estimates from the late 1980's and early 1990's. There has been some variability in annual counts, but the trend indicates a long steady decline in CA 11. Until very recently, count area 12 (adjacent to CA 11) had comparatively stable numbers of sheep, ranging between 449–602 sheep since 1981. Estimates from the last two years indicate ewe and ram abundance may have declined. We found only 288 sheep in this count area during July 2001. In addition to the two western count areas (CA 11 & 12), count area 10 which is most of Mt Drum was surveyed this year for the first time since 1980. Only 109 sheep were observed, compared to the 201 seen in 1980. Fewer sheep in all sex and age classes were noted. Count area 14, Crystalline Hills, has declined markedly since 1980 when 209 sheep were observed. Only 60 sheep were found during the 2001 survey 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. Fewer lambs than usual were observed during the last two surveys however. Unless productivity and survival of lambs improves, the population in that area may start declining.

Historical information on the size of the Unit 11 sheep population is limited. 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) lived within WRST Park and Preserve 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 2001 ranged between 8% and 15% in the four count areas. Historically there is a lot of variability in lamb abundance during summer surveys. Recent surveys have yielded lamb estimates well below average. Abundance of ewes in CA's 11 and 12 decreased by 59% and 49%, respectively, since 1981. The number of rams counted during aerial surveys in CA's 11, 12 and 22 has also declined 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 horns 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. During the March 2001 Board of Game meeting, the bag limit for state hunters in GMU 11 was changed to any ram, from any sheep. This regulation took effect during the Fall 2001 season. 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 has ranged from 113 to 142 sheep during this 5-year reporting period (Table 2). The number of ewes killed during this period is also presented in Table 2. Ewe harvests have averaged 22 per year during this reporting period. The most ever taken from GMU 11 was 36 during the 1992 season. During the fall 2000 hunting season there were 72 rams taken with reported horn sizes large enough to consider them mature. Between 1996 and 2000 the number of rams taken that could fall into the mature ram category averaged 86 per year (range = 71–107). The number of rams with especially small horns or estimated age <6 years has averaged 22 per year (range = 20–28) during this reporting period. This is a slight increase from the last reporting period when an average of 18 immature rams were taken each year.

Hunter Residency and Success. The number of reported sheep hunters in Unit 11 is presented in Table 3. Hunting effort during the 1993 – 1997 period increased by 53% (ave. = 316 hunters per year) over a prior 4-year period from 1986–89 when an average of 238 hunters reported hunting in the GMU 11 portion of the Wrangell Mountains. The average of 305 hunters per year going afield during this five year period has decreased slightly. During this period the overall hunter success rate varied annually from 36 to 45%.

Local residents took an average of 23 sheep per year (range = 8–34) during this reporting period, while nonlocal residents averaged 73 (range = 53–87) and nonresidents 23 per year (range = 16–37). During this 5-year period, locals averaged 16% of the annual harvest, nonlocals 60%, and nonresidents 19%. 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 63% compared to 31% average success rate for locals and 37% for nonlocal hunters. The requirement for nonresidents have a guide probably explains their high success rate.

The average number of days hunted annually by successful hunters ranged from 4.3 to 5.3 days and averaged 5.0 days between 1996 and 2000 (Table 4). The average number of days hunted annually reported by unsuccessful sheep hunters for the same period ranged from 4.8 to 5.3 days and averaged 5.1 days.

Harvest Chronology. Table 5 presents harvest chronology data for sheep taken in Unit 11. In most years, the majority of the sheep taken are killed during the first two weeks of the season.

Transportation Methods. Aircraft were the primary mode of transportation for successful sheep hunters in Unit 11 (Table 6). Four-wheelers are the most important mode of transportation for local sheep hunters accessing the National Park.

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. Many of the surveys flown in recent years have been funded by the NPS. 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 one small area is counted with any degree of consistency. Even though there are limited data, we can conclude sheep numbers have declined markedly in the western portion of Unit 11 extending from the Dadina River to the Kuskalana River. Information from the Mt. Drum count area this year corroborates the evidence of a large decline in the western park/preserve area. Additional trend count data from CA 22 do not indicate the population has declined as severely in the Eastern portion of GMU 11, but low recruitment in that area for the last two years warrants watching. The decline in the Crystalline Hills could be partially due to movement of sheep from that isolated group of mountains. Ewe harvests from that isolated group of hills has, in some years been excessive, and may have contributed to the decline there.

Available composition data indicate a trend towards reduced lamb production or survival along the slopes of Mt. Drum and extending eastward to the Kennicott Glacier. 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 most severe. Recent winters have been more moderate, but summer lamb counts are well below those recorded during surveys in the 1980's.

The number of large or mature rams harvested in Unit 11 peaked in 1987 (137 rams), and has declined to the recent low of 71 full-curl rams taken during the 2000 hunting season. 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, and guiding is tightly regulated in the preserve portion of the park by the NPS. 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 level and influence wolves and other predators such as coyotes and Golden eagles have on sheep abundance and distribution.

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. Also, we need to emphasize maintaining composition trend counts. The current subsistence harvest of small rams is currently low and widely dispersed, although more hunting pressure occurs in areas accessible by transportation means other than aircraft.

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Table 1 Unit 11 summer aerial sheep composition counts and estimated population size, 1970–2001

Regulatory Year	Full Curl	(%)	¾ Curl[c]	½-3/4	< 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
1999	17	7%	35	--	--	160	44	17%	75.3	256	256
2000	11	5%	29	--	--	161	38	16%	68.2	239	239
2001	16	7%	27	--	--	147	43	14%	58.4	222	222

Table 1 Continued

Regulatory Year	Full Curl	(%)	¾ Curl[c]	½-3/4	< ½ Curl	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep observed	Estimated population size
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
1999	34	7%	113	--	--	250	59	13%	93.2	457	457
2000	27	8%	98	--	--	173	31	9%	53.1	329	329
2001	23	8%	54	--	--	185	26	9%	47.2	288	288
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	7%	14	--	--	44	13	17%	76.0	76	76
1999	5	5%	10	--	--	57	19	21%	91.0	91	91
2001	1	2%	10	--	--	43	6	10%	66.7	60	60

Table 1 Continued

Regulatory Year	Full Curl	(%)	¾ Curl[c]	½-3/4	< ½ Curl	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep observed	Estimated population size
COUNT AREA 22 – HAWKINS GLACIER											
Regulatory Year	Full Curl	(%)	¾ Curl[c]	½-3/4	< ½ Curl	Ewes[b]	Lambs	(%)	Sheep/ Hour	Sheep observed	population size
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%	69.0	266	266
1998	21	7%	11	12	1	213	47	15%	n/a	305	305
1999	1	0%	45	--	--	179	66	22%	n/a	303	303
2000	8	4%	30	--	--	143	16	8%	n/a	202	202
2001	12	5%	43	--	--	176	20	8%	68	251	251

[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
1998–99	107	34.8	8	16	123
1999–00	116	35.5	8	16	132
2000–01	91	34.9	7	24	115

[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 sheep hunter residency and success, regulatory years 1993–97 through 2000-01

Regulatory Year	Successful: Local[a] resident	Nonlocal resident	Non-resident	Total[b]	(%)	Unsuccessful:	[a] resident	Nonlocal resident	Nonresident	Total[b]	Total hunters
1993–94	22	83	27	143	(39)	Local	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
1998–99	34	68	20	123	(40)		47	130	11	188	311
1999–00	24	84	24	132	(40)		59	130	11	200	332
2000–01	8	87	16	115	(36)		48	134	15	201	316

Successful

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

Table 4 Unit 11 Wrangell Mountains sheep hunting effort[a], 1993–00

Regulatory year	Successful hunters: No. hunters	Total days	Average days	Unsuccessful hunters: No. hunters	Total days	Average days	Total hunters: 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
1998–99	121	607	5.0	186	968	5.2	307	1575	5.1
1999–00	131	688	5.3	199	947	4.8	330	1635	5.0
2000–01	114	509	4.5	199	974	4.9	313	1483	4.7

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

Table 5 Unit 11 Wrangell Mountains sheep harvest chronology percent by harvest periods, 1993–00[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
1998–99	50	7	11	14	17	1	0	121
1999–00	38	11	20	14	11	5	1	132
2000–01	65	7	9	9	9	2	0	113

[a]Includes only reports with date of kill.

Table 6 Unit 11 Wrangell Mountains sheep harvest percent by transport method, 1993–00

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
1998–99	54	2	7	16	0	4	12	3	123
1999–00	46	2	8	24	0	3	17	0	132
2000–01	42	1	8	23	0	2	23	1	115

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

GEOGRAPHIC DESCRIPTION: Chugach Mountains

BACKGROUND

Beginning around 1900, large numbers of miners, railroad workers, and market hunters probably decimated Dall sheep populations in accessible areas between Turnagain Arm and the Knik River. In 1949, during a thorough aerial survey of 29,000 mi^2 of potential sheep range, biologists discovered that the number of sheep in Alaska had declined to approximately one-quarter of that estimated nine 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; however, in accessible areas illegal hunting was also a major factor in the decline.

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 five 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 three to four 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 one 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 to depletion (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 1997–2001 included summer aerial sex and age composition surveys and monitoring the number, horn size, and location of harvested sheep. Aerial sex and age composition surveys were completed in Unit 14C in 1997, 1998 and 2000 and in Unit 14A in 1998. Incomplete surveys were flown in Unit 13D in 2000 and 2001.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

An estimated 4800–5500 sheep inhabit the Chugach Mountains, including about 400 in Unit 11. An estimated 700–900 and 2200 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 2000 and 2001 (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 1500–2000 sheep. Sheep populations have declined an estimated 10–20% throughout the Chugach Mountains during the reporting period due to severe snow and ice conditions for several winters.

Population Composition

Since 1997 the percentage of full-curl and larger rams observed in Unit 14C has ranged from 7–11% of all observed sheep (Table 2). The percentage of lambs has ranged from 11–15%, which probably reflects 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 is 4–9% of total sheep observed. Lambs comprised 12–18% 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 are found throughout the mountain range below the 7500 ft elevation, concentrations vary greatly among drainages. In Unit 14C, Indian and Falls Creeks and the Anchorage hillside supported the highest sheep densities followed by Ship Creek and Eklutna drainage.

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 two important winter and lambing sites. 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 also been observed grazing in the sedge meadow in the valley floor adjacent to the cliff. The second important habitat area is the cliff complex above Mud Lake southeast of McRoberts Creek. During spring lambing, over 100 sheep have been observed feeding and resting in this area. 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 to have horns full-curl or larger, except in Unit 14C where the bag limit was changed to "any sheep" under a drawing permit.

In 1996, the board established two kinds of drawing permits for Unit 14C. Up to 250 permits allowed a hunter to take one full-curl ram or one ewe. A bag limit of 1 ewe only for up to an additional 150 permits was also established. This management strategy attempts to 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, which 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. A very high initial winning bid is typical in auctions of this kind. From 1998–2002, bids have ranged from $19,000 to $50,000. About 20% of the bids were divided among the national and local chapters of FNAWS; the remainder has been donated to sheep research in Alaska.

In 2001, the Upper Eagle River hunt area boundary was expanded to include the Dishwater Creek drainage, and the Raven Creek drainage was removed from the Southwest hunt area. The portion of Chugach State Park in Eagle River Valley downstream from the gorge is closed to discharge of firearms. Therefore, sheep hunters are given a special use permit by Chugach State Park in addition to their drawing permit.

Hunter Harvest. Total harvests of sheep in the Chugach Mountains by regulation year were: 143 (1997–98), 172 (1998–99), 167 (1999–00), 151 (2000–01), and 135 (2001–02, Tables 4–9). The lower harvest correlates with lower success rates in 14A, and 13D. In addition, the total numbers of hunters in 13D and 14A has declined since 1998. In 1998–99, there were 202 hunters in 14A and 229 in 13D, compared to 154 and 161 hunters in 2001–02 in 14A and 13D, respectively. Illegal harvest is unknown.

Permit Hunts. During the 1997–98 and 1998–99 regulatory years, 281 drawing permits and 105 archery-only drawing permits were issued in Unit 14C (Table 6). In 1999–00, 2000–01, and 2001–02, the East Fork of the Eklutna drainage was added to the 10-day, late-season archery hunt due to low bow hunter success in the West Eklutna hunt area. This addition increased the number of archery-only drawing permits to 135 in 1999–00, 2000–01, and 2001–02. Success rates from 1997 to 2001 ranged from 24% to 26%. Since 1997, harvests have ranged from 66 sheep in 1997–98 to 74 sheep in 1998–99 (Table 6).

Hunter Residency and Success. From 1997 to 2001, nonresident hunters took 55 of 146 sheep (38%) in Unit 14A (Tables 7), 49 of 348 sheep (14%) in Unit 14C (Table 8) and 152 of 274 sheep (55%) in Unit 13D (Table 9). Seventy-one percent (349 of 494) of successful hunters in Units 14A and 14C were residents of Unit 14. Whereas, less than 1% of successful sheep hunters in Unit 13D 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 its proximity to roads, highway vehicles are the primary means of transportation. In Unit 13D most of the successful hunters used aircraft (48–74%), 11–26% used highway vehicles and 11–16% used horses (Table 11). In Unit 14A the largest proportion of successful hunters used aircraft (19–57%); however, the proportion using aircraft decreased from 57% in 1998 to 36% in 2001, with a low of 19% in 2000 (Table 12). Nine to 18% of successful hunters used highway vehicles. The majority (70–73%) of 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.

HABITAT

Assessment

Techniques for evaluating sheep winter range in Alaska have not been developed. Snow depth and snow density, 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. The results of that study are not yet available.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Unit 14C ranged from 2200–2600 during the mid-1990s and early 2000s. Winter mortality among lambs and old ewes on crowded winter range may prevent the population from increasing further. The Unit 14A population has declined in recent years to approximately 700–900 sheep. Due to partial surveys in 2000 and 2001, the status of the Unit 13D population is uncertain.

The harvest objective of a minimum of 120 full-curl or larger rams for the Chugach Mountains was surpassed in 1997 (122), 1998 (132) and 1999 (135), but not reached in 2000 (109) or 2001 (113). 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 average number of ewes harvested in 1996–2001 was 28 ewes/year, two to three times the 1994 and 1995 harvests. The average of young rams harvested in 1996–2001 was 5, about one-third the harvests in 1994 and 1995. Harvest of full-curl rams declined from 47 in 1995 to 32 in 1998, but increased to 42 in 2001.

A thorough survey of all sheep habitat in the Chugach Mountains is needed to determine the overall population level.

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Table 1. Chugach Mountains, Unit 14A sheep composition counts and estimated population size, 1997–2001.

Regulatory year	Rams		Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal					
1997–98 [c]	--	--	--	--	--	--	--
1998–99	28 (5)	190	519	166 (18)	66	907	1000
1999–00[c]	--	--	--	--	--	--	--
2000–01[c]	--	--	--	--	--	--	--
2001–02[c]	--	--	--	--	--	--	700–900

[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.

Table 2 Chugach Mountains, Unit 14C aerial sheep composition counts and estimated population size, 1997–2001

Regulatory year	Rams: ≥ full curl (%)	Rams: <full curl	Ewes[a]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
1997–98	253 (11)	403	1,243	326 (15)	--	2,286[c]	
1998–99	165 (7)	562	1,336	335 (14)		2,403[d]	
1999–00[b]	--	--	--	--	--	--	--
2000–01	172(8)	543	1,152	230 (11)	--	2,118[e]	
2001–02[b]	--	--	--	--	--	--	2,400
							2,500
							2,200

[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.
[d] Total includes 5 unclassified sheep.
[e] Total includes 21 unclassified sheep.

Table 3 Chugach Mountains, Unit 13D sheep composition counts and estimated population size, 1997–2001

Regulatory year	Rams		Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal					
1997–98	106 (9)	170	728	178 (15)	--	1,182	2,000–3,000
1998–99	--	--	--	--	--	--	--
1999–00	--	--	--	--	--	--	--
2000–01[c]	9 (4)	48	131	26 (12)	--	214	--
2001–02[d]	29 (6)	107	276	88 (18)	--	500	1,500–2,000

[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] Count Areas 1–5.

Table 4 Chugach Mountains, Unit 13D sheep harvest, 1997–2001

Regulatory year	Rams	Average horn length (in) of rams	% of horn length ≥ 40 in	Ewes	Total sheep
1997–98	54	37.7	9	0	54
1998–99	58	37.3	17	0	60
1999–00	59	36.5	2	0	61
2000–01	52	36.9	8	0	53
2001–02	46	35.4	7	0	46

Table 5 Chugach Mountains, Unit 14A sheep harvest, 1997–2001

Regulatory year	Rams	Average horn length (in) of rams	% of horn length ≥ 40 in	Ewes	Total sheep
1997–98	23	37.3	22	0	23
1998–99	36	35.6	3	0	38
1999–00	36	36.1	0	0	36
2000–01	27	35.8	0	0	27
2001–02	22	35.8	9	0	22

Table 6 Chugach Mountains, Unit 14C sheep harvest data by permit hunt, 1997–2001

Hunt area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Full Curl Rams	Horn length (inches)[a]	% Rams ≥ 40 in.	Ewes (%)	Unk	Total harvest
DS121–122,	1997–98	71	32	73	27	10	37.3	10	3 (23)	0	13
124–129	1998–99	71	32	69	31	12	35.4	17	3 (20)	0	15
Northeast,	1999–00	71	28	80	20	7	36.5	0	3 (30)	0	10
East Eklutna	2000–01	71	32	77	23	6	38.9	33	5 (45)	0	11
		71	46	81	18	4	35.6	0	3 (43)	0	7
DS111–112,	1997–98	86	28	61	39	13	35.6	0	11 (46)	0	24
130–135	1998–99	86	22	66	34	11	37.1	27	12 (52)	0	23
Northwest,	1999–00	86	22	69	31	11	36.4	0	10 (48)	0	21
Upper	2000–01	86	21	68	32	14	35.4	0	7 (32)	1	22
Eagle River	2001–02	86	21	60	40	21	37.0	9	6 (22)	0	27
DS117–118,	1997–98	53	17	68	32	10	37.0	10	4 (29)	0	14
136–138	1998–99	53	19	72	28	6	37.7	17	6(50)	0	12
Southwest	1999–00	53	19	49	51	12	37.6	8	10 (45)	0	22
	2000–01	53	23	49	51	11	37.2	9	10 (48)	0	21
	2001–02	53	19	63	37	9	33.5	11	7 (44)	0	16
DS119–120,	1997–98	70	41	83	17	4	35.0	0	3 (43)	0	7
139[g]	1998–99	70	30	67	33	4	34.1	0	12 (75)	0	16
West	1999–00	70	36	85	15	5	38.1	20	2 (29)	0	7
(late season	2000–01	70	33	77	23	4	35.4	0	7 (64)	0	11
--rifle)	2001–02	70	43	73	27	5	35.7	0	11 (54)	0	11

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	1997–98	80	31	94	6	3	35.8	0	0 (0)	0	3
West	1998–99	80	41	94	6	2	26.1	0	1 (33)	0	3
(late season	1999–00	100	42	89	11	3	36.5	0	3 (50)	0	6
--archery)	2000–01	100	33	97	3	1	27.8	0	1 (50)	0	2
		100	40	93	7	4	34.4	0	0	0	4
DS141	1997–98	25	28	72	28	5	35.5	0	0 (0)	0	5
West Eklutna	1998–99	25	12	77	23	3	33.9	0	2 (40)	0	5
(archery)	1999–00	35	17	93	7	0	--	--	2 (100)	0	2
		35	37	86	14	3	28.5	0	0	0	3
2001–02		35	17	97	3	1	33.6	0	0	0	1
Governor's	1997–98	1	0	--	--	0	0	0	0	0	0
Permit	1998–99	1	100	--	--	0	0	0	0	0	0
		1	100	--	--	0	0	0	0	0	0
2000–01		1	0	0	100	1	42.0	100	0	0	1
2001–02		1	0	0	100	1	40.8	100	0	0	1
Total all	1997–98	386	30	75	25	45	36.3	4	21 (32)	0	66
hunt areas	1998–99	386	28	73	27	38	35.5	17	36 (49)	0	74
1999–00		416	30	77	23	40	37.1	12	30 (43)	0	70
2000–01		416	29	76	24	30	35.9	10	40 (56)	1	71
2000–02		416	33	76	24	45	35.7	10	22 (49)	0	67

1999–00
2000–01
2001–02

Table 7 Chugach Mountains, Unit 14A sheep hunter residency and success, 1997-2001.

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Total hunters
1997–98	14	1	8	23 (21)	82	0	3	89 (79)	112
1998–99	21	1	16	38 (19)	152	5	6	164 (81)	202
1999–00	19	1	14	36 (19)	149	2	7	15 (81)	194
2000–01	17	2	7	27 (16)	123	9	5	140 (84)	167
2001–02	9	2	10	22 (14)	119	7	6	132 (86)	154

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

Table 8 Chugach Mountains, Unit 14C sheep hunter residency and success, 1997–2001.

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Total hunters
1997–98	47	8	10	66 (24)	180	21	4	205 (76)	271
1998–99	60	5	9	74 (26)	186	17	4	207 (74)	281
1999–00	50	9	10	70 (23)	189	32	7	228 (77)	298
2000–01	61	2	8	71 (23)	217	12	5	234 (76)	305
2001–02	51	5	12	67 (24)	175	32	5	213 (76)	280

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

Table 9 Chugach Mountains, Unit 13D sheep hunter residency and success, 1997–2001

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Total hunters
1997–98	3	18	31	54 (26)	13	107	28	152 (74)	206
1998–99	2	20	36	60 (26)	4	140	25	169 (74)	229
1999–00	3	24	33	61 (28)	9	119	31	159 (72)	220
2000–01	2	20	29	53 (27)	8	96	35	140 (73)	193
2001–02	1	21	23	46 (29)	13	78	18	115 (71)	161

[a] Local means residents of Unit 13.
[b] 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, 1997–2001

	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	9/21–9/27	*n*
1997–98	39	15	12	16	11	8		75
1998–99	44	16	10	16	5	6	1	97
1999–00	35	20	16	17	4	10	0	96
2000–01	50	17	13	8	3	9	1	78
2001–02	55	16	4	6	10	7	0	67

Table 11 Chugach Mountains, Unit 13D sheep harvest percent by transport method, 1997–2001

Regulatory year	Percent of harvest									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
1997–98	48	15	11	7	0	2	17	0	0	54
1998–99	61	12	5	2	0	0	18	0	2	60
1999–00	56	16	10	7	0	0	11	0	0	61
2000–01	74	0	7	2	0	0	17	0	0	53
2001–02	59	11	2	0	0	2	26	0	0	46

Table 12 Chugach Mountains, Unit 14A sheep harvest percent by transport method, 1997–2001

Regulatory year	Percent of harvest									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
1997–98	57	4	4	22	0	0	13	0	0	23
1998–99	45	8	16	10	0	0	18	3	0	38
1999–00	39	3	11	25	0	3	19	0	0	36
2000–01	19	7	7	26	0	11	26	4	0	27
2001–02	36	18	14	14	0	0	9	4	4	22

Table 13 Chugach Mountains, Unit 14C sheep harvest percent by transport method, 1997–2001

	Percent of harvest									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
1997–98	6	0	6	14	0	2	66	0	6	65
1998–99	11	0	5	9	0	1	70	0	3	74
1999–00	3	6	9	3	0	4	73	0	3	70
2000–01	3	4	6	10	0	1	72	0	4	71
2001–02	3	9	0	9	0	1	70	6	1	67

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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. Most rams from the WMN sheep population have smaller than average horns 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.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

- Provide the greatest level of sustainable annual opportunity to participate in hunting Dall sheep.
- Provide the greatest sustainable annual harvest of Dall sheep.
- Provide the opportunity to view and photograph Dall sheep under natural conditions.

RELATED MANAGEMENT ACTIVITY

- Monitor harvest through hunter contacts and harvest reports.

METHODS

Harvest was monitored using general harvest reports. We analyzed data on harvest success; hunt area, hunter participation rate, residence, effort, transportation type used to access the hunt area, and horn size and age. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

Population composition was estimated by aerial survey in the Wrangell–St Elias Preserve between the Nabesna and Chisana Rivers north of Cooper and Notch Creeks (Count Area 6) and east of Snag and Carl Creeks to the Yukon, Canada border north of Beaver Creek (Count Area 7) in July 2001. Results from 3 surveys conducted in July 1997 were included in this report to better analyze population and composition trends in Unit 12. Piper Super Cubs were used to conduct all of the 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, then stabilized about 1988. Based on composition data, 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 1988, weather conditions were primarily mild, but between 1989 and 1993 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, guides, and local, long-term residents also believed the number of ewes declined.

The role of predators as a limiting factor during the early 1990s and during 1999 and 2000 is not known but based on studies conducted elsewhere, we believe it was significant. During this period, predator numbers were relatively high, especially coyotes and golden eagles (Craig Gardner, ADF&G unpublished data). Elevated numbers of these predators was probably due to high snowshoe hare numbers. Coyotes were found to be an important predator on lambs (Scotton 1998), and local residents observed coyotes killing older sheep. A Dall sheep mortality study being conducted in the Alaska Range south of Fairbanks found that golden eagles can also be a significant predator on lambs (Arthur 2000). Wolves were present at 5–7 wolves/1000 km^2 but were not found to be a significant predator (Sumanik 1987).

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. Surveys conducted during 1997 and 1998 indicated that sheep populations in the Mentasta, Nutzotin, and Wrangell Mountains increased from 1994–1999 (Tables 1 and 3). Due to adverse weather conditions during winters 1999 and 2000, sheep numbers at least stabilized and probably declined (Table 2).

Population Composition

Composition data are not directly comparable between years because different areas were sampled each year (Tables 1–3). Factors that were consistent between areas were low lamb survival (9–19:100 ewes) during 1990–1993 and 2001 and moderate to high lamb survival in 1997 and 1998. No adult mortality data were collected in this area during 1990–1993, but based on our annual sightings of collared sheep, mortality was high in the adjacent Tok Management Area. We were not able to determine if adult sheep mortality was elevated during 2000 and 2001 in the MNW Mountains. The number of legal rams was low but we could not separate the effects of low lamb survival in 1992 and 1993 and winter die off in RY99 and RY00. The proportion of sublegal rams in the population was relatively high, indicating that mortality of prime-age sheep was not excessive during those 2 years. Survey data collected in the eastern Wrangell Mountains (Table 2) indicate that the number of ewes was reduced, but we do not know if the decline occurred during the last few years or if ewe numbers are low from a previous decline.

Weather, predation, and harvest management directly influence annual population composition (Heimer 1988). This observation holds true for the Dall sheep populations in the WMN Mountains. Historically, legal ram numbers in the most accessible areas of the WMN Mountains (Nabesna Road, Baultoff Creek) were maintained at low levels (2.9–8.2 legal rams:100 ewes), primarily by harvest. Sample sizes are small, but available data indicate that lamb survival had less influence on the number of legal rams present in the population 8 years later compared to areas within the WMN Mountains that received less hunting pressure and maintained legal ram:ewe ratios between 10.1–16.3 legal rams:100 ewes annually.

Based on survey and harvest data, weather conditions are the primary factor limiting lamb production, ram numbers, and population growth. During the early 1980s, winters were mild and lamb production was high (≥30:100 ewes) (Table 3; Dave Kelleyhouse, personal communication). During RY85–RY89 the annual ram harvest was the highest on record ($\bar{x}$ = 234 rams). During 1994–1998 winter conditions were favorable with below average snowfall and lamb production was moderate to high. Survey data collected during 1998 through 2001 shows relatively high sublegal ram numbers, indicating those lamb cohorts had a high survival rate.

The effects of predation on sheep composition in the WMN Mountains are not known. Incidental sightings indicate coyote predation can be important when coyote numbers are high. Based on trapper reports, coyote numbers increased substantially during 1997 through 2000 due to an increasing snowshoe hare population. We do not know if golden eagle numbers increased during the same period. Lamb production and survival were high during 1997 and 1998 but low during 2000 and 2001. During these years, winter weather was adverse with deep snow prevailing into the lambing period. In combination with adverse weather effects, coyote and golden eagle predation may have been more of a limiting factor especially in 2001. Snowshoe hares crashed during spring 2001 (Gardner, ADF&G unpublished data), and several researchers (Todd et al. 1981; O'Donoghue et al. 1997) have suggested that coyote predation on Dall sheep may increase during the low phase of the hare cycle.

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.

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game took no actions and no emergency orders were issued during RY98–RY00.

Hunter Harvest. During RY98–RY00, 288–358 hunters ($\bar{x}$ = 327) reported taking 99–160 sheep ($\bar{x}$ = 132) (Tables 4 and 5). These numbers were below the previous 5-year means of 353 hunters and 162 sheep harvested (Table 4). Harvest had declined 36% since RY92 and hunter participation by 27% since RY94. During 1991–1993, lamb recruitment was poor and during the severe winter in 1992–1993 a high proportion of the legal rams died (Gardner 1999). This reduced legal ram numbers from 1993 to 2001, which resulted in declining hunter success rates and interest. Beginning in 2002, the number of legal rams is expected to increase.

Mean horn length was 34.7 inches during RY98–RY00. The previous 5- and 10-year averages were 34.5 and 34.4 inches (Table 5). During RY98–RY00, between 0 and 2.2% of the rams taken had horns >40 inches ($\bar{x}$ = 1.2%). The mean reported age of harvested rams was 8.9 years. The previous 5-year average was 8.7 years. These data indicate that the horn growth potential in the WMN Mountains is poor. In comparison, in the Tok Management Area just north of the WMN Mountains, the percentage of the harvested rams with horns ≥40 inches normally exceeds 10%, and the average annual age of harvested rams ranges between 8.9 and 10 years. Horn size was slightly larger during RY98–RY00 in the WMN Mountains and may be due to favorable weather conditions during 1994–1997 allowing for better horn growth. The idea that horn length at 8 years old is a partial product of how weather conditions affect horn growth when the ram is 3–6 years old will be tested in the Tok Management Area starting in July 2002.

Areas within the WMN Mountains that produced the largest rams (≥38 inches) were along the Nabesna Glacier, Cheslina River, Snag Creek, and the Upper Tetlin River. The Tetlin River is within the Tetlin Indian Reservation and was closed to most hunting. The other areas were difficult to access.

Hunter Residency and Success. During RY98–RY00, the average success rate was 40% (Table 4). Nonresident success rates (65–76%) were much higher than resident success rates (23–33%). The primary reasons nonresidents had higher success rates were that most were guided and hunted in the highest density sheep areas in the remote portions of the unit. Few residents traveled to these areas and hunted mainly from the Nabesna Road or Glenn Highway where legal ram numbers were low. During RY98–RY00, nonresidents composed 26–30% of the sheep hunters and were responsible for taking 49–52% of the annual harvest. Overall, hunter participation in sheep hunting in the WMN Mountains declined but most of the reduction was

due to fewer Alaska residents (30% decline) rather than reduced nonresidents (5% decline) participating.

Historically, most harvest occurred in the Little Tok River drainage, Boyden Hills–Nabesna Road, upper Nabesna River, upper Chisana River and Wiki Peak areas. During RY98–RY00 hunters who used the upper Nabesna River, upper Chisana River and Wiki Peak areas experienced average to high success rates (45–52%). Our survey data mirrored hunter success. We found the greatest concentration of legal rams in the upper Nabesna River, upper Chisana River and Wiki Peak areas. Much of the Boyden Hills–Nabesna Road 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 RY97–RY00 success rates along the Nabesna Road were 12–17%. Success rates in the Little Tok River declined substantially during RY98–RY00 (20–32%). During RY95–RY97 success rates were >55%. Guided nonresidents and local residents took most of the harvest. Hunting pressure increased during RY98–RY00 especially in areas easily accessed from the Glenn Highway and the number of legal rams declined substantially.

Harvest Chronology. Traditionally, in the WMN Mountains most sheep were taken early in the hunting season (Table 6). During RY98–RY00, 34–36% ($\bar{x}$ = 35%) of the harvest was taken during the first week of the season, which was slightly less than most years. Harvest did not taper off as dramatically during the later season compared to most other areas in the state due to harvest by guided nonresidents. Guides booked clients throughout the season, but most Alaska 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 7). During the report period, 53–61% of the hunters used these methods and took 74–79% of the harvest. Horses were used primarily by nonresident hunters (76%). Success rates for hunters using aircraft and horses ranged between 42–55% and 56–75%, respectively. Success rates for nonresidents were much higher than residents using these methods (airplanes 68% vs. 37%; horses 79% vs. 35%) because most were guided and hunted the better quality areas of Unit 12. Annually, 32% of the hunters used 4-wheelers or highway vehicles to access sheep habitat. Success rates for hunters using 4-wheelers ranged from 5-25% and highway vehicles success rates were 21–22%. Residents were the primary users of these transportation types (≥97%).

Other Mortality

We did not conduct studies during this report period to determine changes in the rate or type of natural mortality compared to those 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 declined during RY98–RY00, probably due to declining success. Under the current season lengths, hunters in most areas of Unit 12 are able to harvest most of the legal rams. Relatively low 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. Hunter success and total harvest are expected to increase beginning in 2002. Lamb recruitment was average to high during 1994 through 1998 and subadult survival was high to 2001. As these cohorts age, a greater number of legal rams should become available.

In Unit 12, hunter numbers increased during periods of high sheep numbers and hunters were able to harvest even high-density legal ram populations to low levels each year. No changes in the season or bag limits will be necessary to meet the objectives of providing the greatest level of sustainable annual opportunity to participate in hunting Dall sheep or the greatest sustainable annual harvest of Dall sheep.

More people used southern Unit 12 especially in Wrangell–St Elias National Park and Preserve for wildlife viewing. Several hunting guide operations and several new summer guiding operations are now offering trips to wildlife viewers.

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

Sex/age class	1991	1992	1993	1998 (East)	1998 (West)
Legal rams[b]		31	111	22	34
Sublegal rams[c]		140	544	110	117
Unclassified rams		30	0	0	0
Total rams	174	201	655	132	151
Ewes[d]	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	9.0	30.3	32.3
Lambs % of total	10.4	11.5	5.7	18.3	19.7

[a] Data from National Park Service.
[b] Full curl or larger.
[c] Greater than 1/4 curl but less than full curl.
[d] 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 Wrangell Mountains within Count Areas 6 and 7, 1981 and 2001

	Count Area 6		Count Area 7[a]		Count Areas 6 and 7 Combined	
Sex/age class	1981	2001	1981	2001	1981	2001
Legal rams[b]	84	54	15	25	99	79
Sublegal rams[c]	243	207	210	88	453	295
Unclassified rams	0	0	21	0	21	0
Total rams	327	261	246	113	573	374
Ewes[d]	698	516	511	153	1209	669
Lambs	234	90	140	33	374	123
Unidentified	0	0	51	0	51	0
Total other sheep	932	606	702	186	1634	792
Total sheep	1259	867	948	299	2207	1166
Legal rams:100 ewes	12	11	3	16	8	12
Sublegal rams:100 ewes	35	40	41	58	38	44
Total rams:100 ewes	47	51	48	74	47	56
Lambs:100 ewes	34	17	27	22	31	18
Lambs % of total	19	10	15	11	17	11

[a] Count Area 7 only included from Snag Creek East.
[b] Full curl or larger.
[c] Greater than 1/4 curl but less than full curl.
[d] Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

Table 3 Unit 12 Dall sheep aerial composition counts in the Mentasta Mountains, 1971–1997

Sex/age class	1971[a]	1973[a]	1980[a]	1997[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	692	728	1242	888	1033
Total sheep	802	994	1549	1055	1326
Legal rams:100 ewes	14	26	15	10	5.8
Sublegal rams:100 ewes		20	25	14	30
Total rams:100 ewes	20	50	41	24	36
Lambs:100 ewes	25	8	47	28	27
Lambs % of total	17	4	23	19	17

[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 4 Unit 12 sheep hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters[b]
	Local[a] resident	Nonlocal resident	Nonresident	Total[b]	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total[b]	(%)	
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
1998–1999	4	75	78	160	(45)	15	149	31	198	(55)	358
1999–2000	3	60	71	137	(41)	13	162	23	199	(59)	336
2000–2001	2	47	48	99	(34)	21	141	26	189	(66)	288
2001–2002[c]	0	44	55	114	(55)	3	68	12	95	(45)	209

[a] Resident of Unit 12.

[b] Total hunters includes hunters who did not report residency.

[c] Preliminary data.

Table 5 Unit 12 sheep harvest, regulatory years 1990–1991 through 2001–2002

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
1998–1999	156	34.7	9.2	160	358
1999–2000	135	34.5	9.0	137	336
2000–2001	96	34.8	8.6	99	288
2001–2002[b]	112	34.6	8.5	114	209

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

[b] Preliminary harvest.

Table 6 Unit 12 sheep harvest chronology percent by time period, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest chronology percent by time period						
	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
1998–1999	34	18	14	12	12	11	160
1999–2000	36	19	16	14	7	8	137
2000–2001	35	14	22	14	11	3	99
2001–2002[a]	46	13	15	12	7	7	114

[a] Preliminary harvest.

Table 7 Unit 12 sheep harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest 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	12	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
1998–1999	54	25	6	6	0	1	8	0	160
1999–2000	48	26	8	9	0	1	7	1	137
2000–2001	59	20	7	3	0	1	10	0	99
2001–2002[a]	59	22	5	7	0	2	4	2	114

[a] Preliminary harvest.

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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 component of a management goal to provide for diversified human recreational use in this area (Kelleyhouse 1989) and was based on the horn growth potential of rams in the TMA. In comparing horn growth qualities of Dall sheep rams inhabiting 7 mountain ranges in Alaska, rams in the TMA exhibit the second greatest horn length and the fourth greatest horn mass qualities (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 through the 1990s in achieving the TMA's horn quality objectives.

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 prevented hunter crowding and competition, and resulted in an abundance of legal rams, including rams with horns ≥40 inches. 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

We monitored harvest using drawing permit report cards. Data on harvest success, harvest location, hunter distribution, hunter residence, hunter effort, transportation type, horn size, and age were analyzed to determine if the harvest goals and objectives were met. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

Population composition and productivity have been periodically estimated in the TMA using aerial or ground survey techniques (Wayne Heimer, personal communication). During this report period, aerial composition surveys were conducted during 1999 and 2000. Beginning in summer 2002, a portion of the TMA will be surveyed annually to determine population and composition trends.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We did not obtain a sheep population estimate for the TMA during RY98–RY00. The last estimate was 2000 sheep in 1989 (Kelleyhouse 1989). 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.

Between 1990 and 1993, winters were unfavorable in terms of total snowfall and the number of snow-present days; however, winter 1992–1993 was the most severe, with the fewest snow-free days in the past 20 years. Data collected at the Sheep Creek mineral lick indicated poor lamb recruitment during 1992 and 1993, accompanied by a large die-off of older sheep. Incidental sightings by area staff also indicated poor lamb recruitment throughout the TMA during 1992

and 1993. The TMA sheep population declined by at least 20–30% based on the number of sheep observed/hour during a 1994 aerial survey and population declines observed in adjacent areas.

During 1994 to summer 1999, weather conditions were favorable throughout Interior Alaska and the TMA sheep population appeared to increase. Lamb survival improved and remained at average to high levels during that period. Survival rates were high based on increasing numbers of subadult rams. During winter 1999–2000, and spring 2000, weather conditions were unfavorable and sheep numbers stabilized or declined slightly.

Population Composition

We conducted population composition surveys in 1999 (Robertson and Johnson River drainages) and 2000 (Front Range and Tok River drainages). Ratios of lamb and ram:100 ewe-like sheep were 31 lambs and 47 rams:100 in 1999 and 10 lambs and 50 rams:100 in 2000 (Table 1). Full-curl rams composed 30% of the total ram population in both years. The number of legal rams has been relatively low since 1994 because of the effects of poor lamb production during 1992 and 1993 and high adult mortality in 1992. Composition data collected during the 1980s indicated that legal rams composed ≥36% of the ram population. During the 1980s, lamb production and adult survival were high and annual harvest was 15% lower compared to RY94–RY00. The number of legal rams in the population is expected to increase after 2002 due to moderate-to-high lamb recruitment during 1994–1999.

Distribution and Movements

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. During RY98–RY00 we collected no additional data on distribution and movements.

MORTALITY

Harvest

Season and Bag Limit. During the report period, 120 permits were issued in RY98 and RY99 and 121 in RY00. The extra permit in RY00 was a Governor's permit auctioned to raise funds for sheep research and management in Alaska. The season was 10 August–20 September with a bag limit of 1 full-curl ram every 4 regulatory years. Legal rams were defined as having at least 1 full-curl horn or both horns broken or ≥8 years old.

Alaska Board of Game Actions and Emergency Orders. In spring 2000 the Alaska Board of Game changed the number of drawing permits from 120 to up to 120 to allow ADF&G to reduce the number of permits during years the sheep population is at low levels and the management objectives jeopardized. The board rejected a proposal to allow the recipient of the Governor's permit to hunt 10 days prior to the established season. In spring 1996 the board considered a proposal for a separate registration permit hunt for bowhunters with a longer season. The board rejected the proposal because the change would have conflicted with harvest goals and objectives.

Hunter Harvest. During RY98–RY00, annual harvest ranged from 33–56 rams ($\bar{x}$ = 44 rams). The previous 5-year mean was 48 rams (Table 2). Hunter participation averaged 84%, compared to 81% between RY93 and RY97. Hunter participation increased substantially in RY93

compared to the 5 previous years (68%). Participation is expected to remain high because of the area's reputation for high success and few hunters.

Reduced harvest during RY98–RY00 was due primarily to reduced lamb recruitment during 1992 and 1993. The effects of poor recruitment on legal ram numbers were not as great in the TMA (11–15 legal rams:100 ewes) compared to the adjacent Mentasta Mountains (3–8 rams:100 ewes) because harvest was limited by the drawing permit, allowing more legal rams to survive each year.

Hunting pressure and harvest were highest north of the Tok River and between the east and west forks of the Robertson River. During RY98–RY00, 34% of the hunters used these 2 areas, taking 37% of the harvest.

Mean horn length during RY98–RY00 was 36.2 inches compared to the previous 5-year mean of 36.8 inches (Table 3). The number of harvested rams with horn length ≥40 inches was 3–4 and averaged 8.6% of the annual harvest. The previous 5-year mean was 10.0%. Average horn size and percent of rams with horn length ≥40 inches have declined since 1995. These declines are due to a combination of factors including poor recruitment during the early 1990s, relatively high harvests during RY95–RY98, and poor horn growth due to unfavorable environmental conditions since 2000. The average reported age of rams harvested during RY98–RY00 was 9.3 years, slightly older than the previous 5-year mean of 9.1. The older mean age of harvested sheep but smaller mean horn size indicates that horn growth was below average since 1998.

Within the TMA, the areas north of the Tok River and between the east and west forks of the Robertson River have produced the greatest number of rams with horns ≥38 inches in the harvest. These 2 areas receive the greatest hunting pressure in the TMA. There are 2 areas located south of the Tok River and between Rumble Creek and the headwaters of the east fork of the Robertson River that have produced the greatest percentage of large rams during the past 13 years. If hunt management were changed to enhance horn quality, the East Fork of the Robertson River to the headwaters of the Tok River would be the best area because of its ability to produce large rams, and if more restrictions were enacted, few hunters would be displaced.

Hunter Residency and Success. During RY98–RY00, 2366–2573 applicants applied for 120 permits (4.7–5.0% chance of being drawn). The number of applicants increased 3–7% during each 3-year report period since 1990. Alaska residents composed 96% of the participating hunters and took 96% of the harvested rams between RY98 and RY00 (Table 4). Three to 10 nonresidents were drawn annually during that period. Overall, 59% of the nonresidents who drew a permit participated compared to 86% of selected residents. When the TMA was first created, 10% of the permits were designated for nonresidents but no mechanism was developed to ensure that allocation. Currently, there is little support among Alaska residents to guarantee up to 12 permits to nonresidents.

Success rates during RY98–RY00 ranged from 34% to 54% ($\bar{x}$ = 43%) compared to the previous 5-year mean of 50% (Table 4). During RY98 hunters had the greatest success rates and expended more effort. These hunters were in the field an average of 6 days compared to 4 and 5 days during RY00 and RY99, respectively. Since RY95, success rates ≥54% were only

accomplished during years hunters expended an average of 6 days hunting. The primary reason hunters spent more time hunting during certain years was favorable weather conditions.

During RY92–RY00 the mean annual success rate was 46%, substantially below the mean annual success rate between RY87 and RY91 (58%). The ram population in the TMA was much higher during the late 1980s and early 1990s compared to RY93–RY01.

Harvest Chronology. Since the inception of the TMA, most harvest usually occurred during the first 10 days of the sheep season (10–20 Aug). Since RY95, in response to an increasing number of hunters, we have attempted to distribute hunters spatially and temporally to reduce crowding in the more popular hunt areas. We talked to over 90% of the permit recipients prior to the hunt and also included a letter with the permit discussing the benefits of delaying their hunt later in the season. Our main points were reduced crowding and increased odds of taking a ram with horns ≥40 inches. Our efforts had mixed results. Between RY95 and RY97, 41–48% of the harvest occurred during the first 10 days of the season and there appeared to be an increasing trend for sheep hunters to go to the field later (20 Aug–10 Sep). During RY98–RY00, hunters again selected for the early portion of the season and 48–58% of the harvest occurred during the first 10 days. If hunters did not hunt during the first 10 days, the next most popular period was during the Unit 12 moose season (1–15 Sep). During RY98 and RY99, 25–33% of the harvest occurred during this 15-day period. During RY00 hunter participation was low due to adverse weather and only 6% of the harvest was taken during this period. Concerns about adverse weather later in the season and the perception that they had to be hunting on opening day to take the largest ram were the reasons hunters chose to hunt during the first week of the season.

Transport Methods. Airplanes and highway vehicles were the primary methods of transport (Table 5). During the report period, 82% of all hunters used 1 of these 2 methods to access the area. ATVs are not commonly used because few areas in the TMA are accessible to ATVs but not accessible by 4-wheel drive trucks. During the report period, average success rates for hunters using aircraft and highway vehicles were 45% and 37%, respectively, while the overall success rate was 43%. Hunters using airplanes for access did relatively poorly this report period, especially during RY99 (38% success) and RY00 (41% success). The causes of these reduced success levels are not known, but it was not due to more hunters flying their own aircraft instead of using the established air charter companies.

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. 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; consequently, lamb recruitment was low and data from collared sheep indicated that adult mortality was high. During 1994–1998, winter snowfall was below average, benefiting the TMA sheep population. During winters 1999–2000 and 2000–2001, winter and spring snowfalls were extreme, resulting in low lamb recruitment.

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 affect the sheep population, especially when 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 in RY98 had signs of pneumonia. We have not observed or heard 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 bunch-grass 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 throughout the east fork of the Robertson River and in the upper Tok River, areas that support high numbers of sheep. We will coordinate with Habitat Division to minimize impacts.

NONREGULATORY MANAGEMENT PROBLEMS AND NEEDS

The TMA was created in 1974 to provide a limited number of Dall sheep hunters the opportunity to harvest large-horned, trophy rams. Trophy sheep were not defined but the objectives to maintain an average harvest of rams with horns between 36–37 inches, including a minimum percentage of rams with horns ≥40 inches (7–10%), indicate that horn quality should be an important aspect of TMA management. Based on the number of permit applications, hunters were satisfied with the TMA but we did not know why or if they were willing to accept alternative management options.

In 2000 we conducted a mail survey of randomly selected TMA applicants to assess satisfaction with TMA's management goals, objectives, and hunt structure and to determine how hunters defined trophy sheep. We also evaluated how willingly hunters would accept changes in the hunt structure that would affect both hunting opportunity and ram horn quality.

Over 90% of the respondents supported the current management objectives of maintaining the limited number of drawing permits, limiting harvest to benefit trophy ram management, and preventing hunter crowding. Even though these objectives were supported, there were 4 distinct philosophies/groups, categorized by how respondents defined trophy ram and what was acceptable hunting opportunity and hunter crowding.

The largest group represented 77% of the respondents and supported no change to current TMA management unless there were biological or crowding issues. This group included hunters with

the greatest variety of sheep hunting experience and desires from the most ardent trophy hunters to first time hunters. For differing reasons, respondents in this group found common ground in their desire to maintain hunting opportunity.

Some highly experienced hunters within this group were satisfied only with a ram with exceptional horns. This required 2 conditions: an opportunity to hunt and the availability of exceptional rams. In terms of horn length, the TMA has the second best growth potential in Alaska and even following bad winters there were relatively high numbers of rams with horns ≥40-inch horns. For these hunters, the most difficult aspect of hunting the TMA was obtaining a permit, so they were against management that may further reduce their chances of getting a permit or moving throughout the TMA to find a large ram.

For the remainder of this group, the opportunity to hunt sheep in pristine conditions and a high probability of success were the primary attributes of the TMA. They believed these conditions were available under present management and changes were not necessary. These respondents viewed any full-curl ram as a trophy, were not disappointed if they did not see a ≥40-inch ram, and were more disappointed if they did not harvest a ram.

The next largest group represented 18% of respondents. About 90% of this group had hunted sheep for 3 or more years. They were more discerning about what constituted a trophy ram and strongly supported additional management that ensured a certain percentage of rams with horns ≥40 inches in the harvest. They were also more willing to forego harvesting a ram if they did not see what they wanted.

The next group represented 3% of the respondents. This group was more interested in protecting uncrowded hunting conditions and harvest success rates and was willing to reduce hunting opportunity to do so. They viewed any full-curl ram as a trophy.

The smallest group represented 2% of the respondents. This group desired maximum opportunity to hunt the TMA regardless of the impact on trophy ram abundance or hunter crowding.

Should there be changes in TMA management considering the desires of these 4 user groups? The group desiring maximum hunting opportunity is better served by general hunts in the state. However, the philosophies of the other 3 groups fit the founding objectives of the TMA. Should we manage according to the wishes of the majority and maintain current regulations or should we try to find ways to also satisfy the minority groups that support some restrictions to hunter opportunity to increase production of large horned rams and/or reduce the chance of hunter crowding?

The common desire of 98% of all respondents was to preserve the opportunity to hunt trophy rams in uncrowded hunting conditions. Although the definitions of trophy ram and uncrowded hunting differed between the groups, there was common ground on acceptable management. The first or second preferred management option for these 3 groups was to maintain the number of permits but to subdivide the TMA into smaller areas, each with its own drawing permit. Under this direction, trophy ram production could be enhanced, uncrowded hunting ensured, and overall opportunity maintained. Also, by including a permit that allows recipients to hunt

anywhere in the TMA the desires of hunters who like the greatest flexibility to hunt would be met.

Another option would be to optimize the number of large rams throughout the TMA by periodically reducing the number of permits. From this survey, it is apparent that reduced opportunity is acceptable to at least 21% of the TMA hunters either to enhance numbers of exceptionally large rams or to maintain or improve uncrowding hunting conditions. There are also a number of very experienced sheep hunters who would support management that increased numbers of large rams but did not substantially reduce hunting opportunity.

From these findings, additional management actions in the TMA are appropriate to meet the desires of hunters who want either larger sheep or more pristine hunting conditions if hunting opportunity is not permanently or substantially reduced from current levels. One possible method is to determine the number of drawing permits based on horn growth. Tok Management Area rams experience the greatest horn growth when they are 3–6 years old and the average age of rams reaching ¾-curl is 5.5 years. Climatic conditions affect how much growth occurs annually, with the greatest growth occurring during years of favorable conditions. Intuitively, rams that experienced favorable climatic conditions when they were 3–6 years old would reach full-curl faster and have longer horns at 8–10 years than if they had experienced adverse weather conditions that retarded horn growth.

To provide the greatest potential opportunity for horn growth in the TMA, the number of permits could be reduced when a cohort that experienced excellent horn growth at 3–5 years (reach ¾-curl at 5 years instead of 5.5) became a full curl. This management strategy would theoretically enhance horn size by enabling more of the first year full-curl rams to get at least another year of growth. To meet the desires of TMA hunters, permits will not be reduced to enhance horn growth and to benefit pristine hunt conditions on average more than once every 5 years (20%).

Cohorts that will be given extra protection will be selected by comparing growth rates. We will obtain an annual sample by looking at rams that visit licks during June and early July. The amount of fieldwork necessary will be 3 days during peak sheep visitation times at the lick.

CONCLUSIONS AND RECOMMENDATIONS

The management goals and objectives were met during the report period. Even though the TMA population was depressed, mean horn length, age of harvested rams, and the percentage of harvested rams ≥40 inches met the minimum harvest management objectives. For the first time since the inception of the TMA, we received complaints from hunters concerning crowding. Several incidents of hunter crowding occurred within the east fork of the Robertson River and the upper Tok River during the first week of the season. Between 34% and 51% of the hunters use these 2 drainages annually. Historically, hunters selected these areas because they produced the biggest rams and because they are easily accessible by aircraft.

The average horn length of harvested rams declined during RY98–RY00 to 36.2 inches and is approaching the minimum desired size. Primary reasons for the decline were lower number of older rams due to poor lamb recruitment during the early 1990s, higher harvests, and possible slower horn growth during 1999 and 2000 due to adverse weather conditions. We expect horn

size to increase after 2002 as the relatively large lamb cohorts during 1994–1998 reach full-curl status. Average horn size may still be low compared to past years because increased hunting pressure in certain areas will limit the number of rams reaching their full size and the effects of 2 years of poor horn growth.

Most TMA applicants supported maintaining uncrowded hunting conditions (98%) and a minimum horn quality (90%) and were willing to see changes in the hunt structure to meet these objectives. Since RY98 both these qualities have become an issue. To ensure the management objectives will continue to be met, we will reduce the number of permits offered. In 2002 the number of permits offered will be 100. Our objective is to reduce the number of hunters to about 85 and maintain the harvest at 35–45 rams. Historical data indicate this will minimize hunter crowding and maintain ram horn quality within current harvest objectives.

The TMA is the only area in Alaska designated for trophy sheep management. Based on questionnaire results, we now know what TMA hunters want, how they define a trophy ram, and what different hunt structures they would accept. The best management scheme would be to continue comparable hunting opportunity, maintain uncrowded hunting conditions, maintain horn quality, and if possible, create an area within the TMA where horn size can be optimized. This scenario could be realized by designating a small portion of the TMA to optimize horn growth potential and leave the remainder of the TMA under current management.

The best area for optimizing horn potential is between the east fork of the Robertson River and the Tok River, north of Tushtena Pass. This area has produced the most large-horned rams per hunter effort compared to the remainder of the TMA. Survey data concurs that this area produces a high number of large rams. Hunter participation in this area ranges from 5 to 15 hunters annually. A possible scenario would be to close this area for 1 year and then offer a separate permit hunt for 3–5 permits. A short-term closure followed by reduced hunting pressure would provide a much better chance for rams to reach 11 years and older with very large horns. To protect against overcrowding in the remainder of the TMA, these permits would be subtracted from the total number of TMA permits. The objective of this newly created area would be harvests of 1–3 rams. 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.

The effects on the remainder of the TMA would be minimal because the number of permits offered in the new area would not be much lower than average historical use. Another option would be to substantially reduce the number of permits during the year a cohort that displayed exceptional horn growth turns 8 years old. This might allow greater survival of age classes that have better potential to grow larger horns. Permits would be reduced only once every 5 years. I will be discussing these ideas with Fish and Game advisory committees and the Foundation of North American Wild Sheep to see if there is support. Until these discussions take place, the management objectives will not be changed.

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Table 1 Tok Management Area sheep composition counts from aerial surveys, 1980, 1994, 1999, and 2000

Sex/age class	1980	1994	1999[a]	2000[b]
Legal rams[c]	148	123	38	59
Sublegal rams[d]	263	294	89	144
Unclassified rams	9	0	38	0
Total rams	420	417	165	199
Ewes[e]	922	567	352	402
Lambs	350	137	110	39
Unidentified	6	3	0	0
Total other sheep	1278	707	462	441
Total sheep	1698	1124	627	640
Legal rams:100 ewes	16.1	21.7	10.8	14.7
Sublegal rams:100 ewes	28.5	51.9	25.3	35.8
Total rams:100 ewes	45.5	73.5	46.9	49.5
Lambs:100 ewes	38.0	24.2	31.3	9.7
Lambs % of total	20.6	12.2	17.5	6.1

[a] Surveyed the Robertson and Johnson River drainages only.
[b] Surveyed portions of the Tok River drainage and all of the Front Range from the Glenn Highway to Robertson River.
[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 Tok Management Area harvest of Dall sheep rams, regulatory years 1990 through 2000

Hunt/area	Regulatory year	Permits issued	Did not hunt %	Unsuccessful hunter %	Successful hunter %	$\bar{x}$ Horn length	n ≥40" (%)	Total harvest
DS102	1990	120	28	56	44	37.0	6 (17)	36
		120	23	44	56	36.9	9 (17)	52
		120	26	58	42	37.1	6 (16)	37
		120	13	58	42	37.3	6 (13)	44
		120	28	54	46	36.9	3 (8)	39
	1991	120	18	61	39	37.2	8 (13)	60
	1992	120	17	44	56	36.2	5 (9)	56
	1993	120	20	57	43	36.5	3 (7)	41
	1994	120	13	46	54	36.2	4 (7)	56
	1995	120	13	60	40	36.3	4 (10)	42
	1996	121	19	66	34	36.1	3 (9)	33
	1997							
	1998							
	1999							
	2000							

Table 3 Tok Management Area sheep harvest, regulatory years 1990 through 2000

Regulatory year	Rams	$\bar{x}$ Horn length	Sheep ≥40" (%)	$\bar{x}$ age	Ewes	Total sheep
1990	36	37.0	6 (17)	9.2	0	36
1991	52	36.9	9 (17)	8.9	0	52
1992	37	37.1	6 (16)	8.6	0	37
1993	44	37.3	6 (13)	9.0	0	44
1994	39	36.9	3 (8)	9.2	0	39
1995	60	37.2	8 (13)	9.4	0	60
1996	56	36.2	5 (9)	8.9	0	56
1997	41	36.5	3 (7)	8.9	0	41
1998	56	36.2	3 (7)	9.0	0	56
1999	42	36.3	4 (10)	9.5	0	42
2000	33	36.1	3 (9)	9.3	0	33

Table 4 Tok Management Area sheep hunter residency and success, regulatory years 1990 through 2000

Regulatory year	Successful: Local resident	Successful: Nonlocal resident	Successful: Nonresident	Successful: Total (%)	Unsuccessful	Unsuccessful: Local resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonresident	Unsuccessful: Total (%)	Total hunters
1990	2	31	3	36 (44)	Local	3	43	0	46 (56)	82
1991	3	47	2	52 (56)		0	38	3	41 (44)	93
1992	4	30	3	37 (42)		4	46	2	52 (58)	89
1993	3	39	2	44 (42)		6	54	1	61 (58)	105
1994	4	31	4	39 (46)		4	40	2	46 (54)	85
1995	9	44	7	60 (61)		2	37	0	39 (39)	99
1996	7	44	5	56 (56)		2	40	2	44 (44)	100
1997	3	35	3	41 (43)		8	45	1	54 (57)	95
1998	1	55	0	56 (54)		2	43	2	47 (46)	104
1999	2	39	1	42 (40)		1	58	2	61 (60)	104
2000	0	29	4	33 (34)		1	63	1	65 (66)	98

Table 5 Tok Management Area sheep harvest percent by transport method, regulatory years 1990 through 2000

Regulatory year	Percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1990	53	0	0	8	0	3	36	0	36
1991	63	2	0	0	0	6	27	2	52
1992	57	3	0	3	0	3	30	3	37
1993	75	0	0	5	0	0	18	2	44
1994	82	0	0	3	0	0	13	3	39
1995	63	0	0	6	0	5	20	5	60
1996	63	2	2	7	0	0	23	4	56
1997	73	0	0	12	0	0	15	0	41
1998	54	0	0	5	0	4	36	2	56
1999	57	0	0	21	0	0	21	0	42
2000	67	0	0	18	0	6	6	3	33

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

GEOGRAPHIC DESCRIPTION: Talkeetna Mountains and Chulitna-Watana Hills

BACKGROUND

A large scale sheep survey was first conducted in the Talkeetna Mountains and Chulitna-Watana Mountains (TCW) in 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 counted. 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. The low harvest of 61 rams in 1973 was surpassed in 2000 when only 50 rams were harvested.

Since statehood, sheep harvest has been restricted to adult rams in the TCW. Mean annual harvest under a minimum 3/4-curl horn 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 full-curl or larger rams, the 1989–2000 harvest averaged 81 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 by hunters on the harvest report. The number of sheep killed but not reported is assumed to be small.

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 in 1994 (Masteller 1996). Between 1994 and 1999, the overall sheep population increased by about 13% including a 25% increase in lambs (Table 1). However, the legal ram segment of the population decreased by about 25% during this same time period (Table 1). A severe winter in 1999–00 decreased the overall sheep population about 40% and reducing that year's lamb recruitment by 75% (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The hunting season in Units 13A, 13E, 14A and 14B for regulatory years 1998–99 through 2000–01 was 10 August–20 September. The bag limit was 1 ram with a full-curl horn or larger.

Hunter Harvest. Hunter harvest averaged 70 rams during 1998–2000 (Table 2), much lower than the average harvest of 86 rams per year (1989–1997) since the full-curl regulation went into effect in 1989. This 1998-2000 average was lowered by the record low harvest of 50 rams in 2000. Harvest was impacted that year by a population drop following the severe winter of 1999-2000.

Hunter Residency and Success. The total number of hunters has decreased since the 1995 high of 531 (Table 3). The success rate for all hunters dropped in 2000 due to the large mortality of legal rams after the severe 1999–00 winter (Table 3). Success rates obviously fluctuate with both hunter numbers and the number of legal rams in the population. Nonresidents, however, are disproportionately successful. From 1998–2000 they accounted for 14% of hunters but took 48% of the sheep (Table 3). In general, nonresident success rates are higher because they are required to have a guide and are more likely to use aircraft to access remote areas.

Harvest Chronology. From 1998–2000 the average proportion of rams harvested the first week of the season was 44%; 63% were taken in the first 2 weeks (Table 4). The general pattern of harvest chronology has not dramatically changed in the past 10 years (Table 4).

Transport Methods. Most successful hunters used aircraft or 4-wheelers to access their hunting areas, and this has been a stable pattern for the last 10 years (Table 5).

CONCLUSIONS AND RECOMMENDATIONS

The mean annual harvest of rams from 1998–2000 was 70, ranging between 50 and 85 sheep. This 3-year average harvest is below the harvest objective because of the population decrease after the severe winter of 1999–00. The winter of 2000–01 was not severe and several mild winters will be needed before the population can rebound to 1999 levels.

I recommend periodic surveys of the TCW sheep population 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 and be useful in alerting biologists to significant population or composition changes.

Recent proposals to the Board of Game in the spring and fall of 2001 addressed the issue of how to improve the sheep hunting environment statewide. There are a growing number of complaints that the sheep hunting environment is crowded and more equitable restrictions are needed to improve hunt conditions. The Department of Fish & Game did not support restrictions such as changing general season hunts to drawing permits or bag limit changes of 1 sheep every 3 years. However, if the nonresident segment of the sheep hunting population grows, public concern and desire to change the sheep hunting environment through hunt restrictions will escalate.

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Table 1 Talkeetna Mountains and Chulitna-Watana Hills summer aerial sheep composition counts and estimated population size, 1988–2000

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							
[b]	24 (3)	178	500	163 (19)	44	866	2150–2600
Unit 14							
1989–90							
to		No surveys flown					
1993–94							
1994–95							
[b]	26 (8)	71	159	48 (16)	24	304	
Unit 14 [c]	132 (9)	234	844	232 (16)	97	1443	
Unit 13	158 (9)	305	1003	280 (16)	63	1747	2000–2500
Total							
1995–96							
to		No surveys flown					
1997–98							
1999							
[b]	15 (3)	100	292	98 (19)	43	505	
Unit 14 [c]	82 (5)	299	986	372 (21)	157	1809	
Unit 13	97 (4)	399	1278	470 (20)	99	2314	2500–3000
Total							
2000							
[b]	14 (4)	91	200	33 (10)	22	338	
Unit 14 [d]	42 (6)	164	483	51 (7)	123	740	
Unit 13 [d]	56 (5)	255	683	84 (8)	50	1078	1500–2000
Total							

[a]Includes yearlings of both sexes and rams of 1/4-curl or less.
[b]A summary of units 14A and 14B within the Talkeetna Mountains
[c]A summary of units 13A and 13E within the Talkeetna Mountains
[d] Includes 3 less count areas than were assessed during the 1994 and 1999 surveys in units 13A and 13E

Table 2 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest, 1993–2000.

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
1998–99	76	36.1	6.8	0	76
1999–00	84	34.3	2.4	0	85
2000–01	50	34.4	2.0	0	50

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

Table 3. Talkeetna Mountains and Chulitna-Watana Hills sheep hunter residency and success, 1989–2000 (local vs. nonlocal data has been corrected to better reflect the definition in note [a]).

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1989–90	18	22	33	76 (23)	99	140	12	252 (77)	328
1990–91	27	27	25	82 (23)	111	136	18	274 (77)	356
1991–92	31	27	29	91 (24)	126	149	4	284 (76)	375
1992–93	29	19	25	75 (20)	143	133	11	294 (80)	369
1993–94	22	31	27	82 (19)	161	169	7	340 (81)	422
1994–95	30	26	35	91 (18)	212	191	19	425 (82)	516
1995–96	40	32	36	109 (20)	195	200	21	425 (80)	534
1996–97	33	27	29	90 (18)	195	188	17	401 (82)	491
1997–98	23	20	37	81 (18)	180	161	9	361 (82)	442
1998–99	22	13	39	76 (18)	164	159	20	346 (82)	422
1999–00	32	18	34	85 (19)	190	153	29	374 (81)	459
2000–01	11	12	28	51 (13)	170	135	25	332 (87)	383

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

Table 4 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest chronology percent by harvest period, 1989–2000.

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
1998–99	49	18	13	13	3	4	76
1999–00	40	20	11	11	10	8	85
2000–01	44	18	8	10	10	10	50

Table 5 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest percent by transport method 1989–2000.

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
1998–99	58	8	0	25	3	7	0	76
1999–00	55	6	0	26	5	5	4	85
2000–01	54	2	2	30	0	12	0	50

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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 component of a management goal to provide for diversified human recreational use in this area (Kelleyhouse 1989) and was based on the horn growth potential of rams in the TMA. In comparing horn growth qualities of Dall sheep rams inhabiting 7 mountain ranges in Alaska, rams in the TMA exhibit the second greatest horn length and the fourth greatest horn mass qualities (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 through the 1990s in achieving the TMA's horn quality objectives.

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 prevented hunter crowding and competition, and resulted in an abundance of legal rams, including rams with horns ≥40 inches. 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

We monitored harvest using drawing permit report cards. Data on harvest success, harvest location, hunter distribution, hunter residence, hunter effort, transportation type, horn size, and age were analyzed to determine if the harvest goals and objectives were met. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

Population composition and productivity have been periodically estimated in the TMA using aerial or ground survey techniques (Wayne Heimer, personal communication). During this report period, aerial composition surveys were conducted during 1999 and 2000. Beginning in summer 2002, a portion of the TMA will be surveyed annually to determine population and composition trends.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We did not obtain a sheep population estimate for the TMA during RY98–RY00. The last estimate was 2000 sheep in 1989 (Kelleyhouse 1989). 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.

Between 1990 and 1993, winters were unfavorable in terms of total snowfall and the number of snow-present days; however, winter 1992–1993 was the most severe, with the fewest snow-free days in the past 20 years. Data collected at the Sheep Creek mineral lick indicated poor lamb recruitment during 1992 and 1993, accompanied by a large die-off of older sheep. Incidental sightings by area staff also indicated poor lamb recruitment throughout the TMA during 1992

and 1993. The TMA sheep population declined by at least 20–30% based on the number of sheep observed/hour during a 1994 aerial survey and population declines observed in adjacent areas.

During 1994 to summer 1999, weather conditions were favorable throughout Interior Alaska and the TMA sheep population appeared to increase. Lamb survival improved and remained at average to high levels during that period. Survival rates were high based on increasing numbers of subadult rams. During winter 1999–2000, and spring 2000, weather conditions were unfavorable and sheep numbers stabilized or declined slightly.

Population Composition

We conducted population composition surveys in 1999 (Robertson and Johnson River drainages) and 2000 (Front Range and Tok River drainages). Ratios of lamb and ram:100 ewe-like sheep were 31 lambs and 47 rams:100 in 1999 and 10 lambs and 50 rams:100 in 2000 (Table 1). Full-curl rams composed 30% of the total ram population in both years. The number of legal rams has been relatively low since 1994 because of the effects of poor lamb production during 1992 and 1993 and high adult mortality in 1992. Composition data collected during the 1980s indicated that legal rams composed ≥36% of the ram population. During the 1980s, lamb production and adult survival were high and annual harvest was 15% lower compared to RY94–RY00. The number of legal rams in the population is expected to increase after 2002 due to moderate-to-high lamb recruitment during 1994–1999.

Distribution and Movements

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. During RY98–RY00 we collected no additional data on distribution and movements.

MORTALITY

Harvest

Season and Bag Limit. During the report period, 120 permits were issued in RY98 and RY99 and 121 in RY00. The extra permit in RY00 was a Governor's permit auctioned to raise funds for sheep research and management in Alaska. The season was 10 August–20 September with a bag limit of 1 full-curl ram every 4 regulatory years. Legal rams were defined as having at least 1 full-curl horn or both horns broken or ≥8 years old.

Alaska Board of Game Actions and Emergency Orders. In spring 2000 the Alaska Board of Game changed the number of drawing permits from 120 to up to 120 to allow ADF&G to reduce the number of permits during years the sheep population is at low levels and the management objectives jeopardized. The board rejected a proposal to allow the recipient of the Governor's permit to hunt 10 days prior to the established season. In spring 1996 the board considered a proposal for a separate registration permit hunt for bowhunters with a longer season. The board rejected the proposal because the change would have conflicted with harvest goals and objectives.

Hunter Harvest. During RY98–RY00, annual harvest ranged from 33–56 rams ($\bar{x}$ = 44 rams). The previous 5-year mean was 48 rams (Table 2). Hunter participation averaged 84%, compared to 81% between RY93 and RY97. Hunter participation increased substantially in RY93

compared to the 5 previous years (68%). Participation is expected to remain high because of the area's reputation for high success and few hunters.

Reduced harvest during RY98–RY00 was due primarily to reduced lamb recruitment during 1992 and 1993. The effects of poor recruitment on legal ram numbers were not as great in the TMA (11–15 legal rams:100 ewes) compared to the adjacent Mentasta Mountains (3–8 rams:100 ewes) because harvest was limited by the drawing permit, allowing more legal rams to survive each year.

Hunting pressure and harvest were highest north of the Tok River and between the east and west forks of the Robertson River. During RY98–RY00, 34% of the hunters used these 2 areas, taking 37% of the harvest.

Mean horn length during RY98–RY00 was 36.2 inches compared to the previous 5-year mean of 36.8 inches (Table 3). The number of harvested rams with horn length ≥40 inches was 3–4 and averaged 8.6% of the annual harvest. The previous 5-year mean was 10.0%. Average horn size and percent of rams with horn length ≥40 inches have declined since 1995. These declines are due to a combination of factors including poor recruitment during the early 1990s, relatively high harvests during RY95–RY98, and poor horn growth due to unfavorable environmental conditions since 2000. The average reported age of rams harvested during RY98–RY00 was 9.3 years, slightly older than the previous 5-year mean of 9.1. The older mean age of harvested sheep but smaller mean horn size indicates that horn growth was below average since 1998.

Within the TMA, the areas north of the Tok River and between the east and west forks of the Robertson River have produced the greatest number of rams with horns ≥38 inches in the harvest. These 2 areas receive the greatest hunting pressure in the TMA. There are 2 areas located south of the Tok River and between Rumble Creek and the headwaters of the east fork of the Robertson River that have produced the greatest percentage of large rams during the past 13 years. If hunt management were changed to enhance horn quality, the East Fork of the Robertson River to the headwaters of the Tok River would be the best area because of its ability to produce large rams, and if more restrictions were enacted, few hunters would be displaced.

Hunter Residency and Success. During RY98–RY00, 2366–2573 applicants applied for 120 permits (4.7–5.0% chance of being drawn). The number of applicants increased 3–7% during each 3-year report period since 1990. Alaska residents composed 96% of the participating hunters and took 96% of the harvested rams between RY98 and RY00 (Table 4). Three to 10 nonresidents were drawn annually during that period. Overall, 59% of the nonresidents who drew a permit participated compared to 86% of selected residents. When the TMA was first created, 10% of the permits were designated for nonresidents but no mechanism was developed to ensure that allocation. Currently, there is little support among Alaska residents to guarantee up to 12 permits to nonresidents.

Success rates during RY98–RY00 ranged from 34% to 54% ($\bar{x}$ = 43%) compared to the previous 5-year mean of 50% (Table 4). During RY98 hunters had the greatest success rates and expended more effort. These hunters were in the field an average of 6 days compared to 4 and 5 days during RY00 and RY99, respectively. Since RY95, success rates ≥54% were only

accomplished during years hunters expended an average of 6 days hunting. The primary reason hunters spent more time hunting during certain years was favorable weather conditions.

During RY92–RY00 the mean annual success rate was 46%, substantially below the mean annual success rate between RY87 and RY91 (58%). The ram population in the TMA was much higher during the late 1980s and early 1990s compared to RY93–RY01.

Harvest Chronology. Since the inception of the TMA, most harvest usually occurred during the first 10 days of the sheep season (10–20 Aug). Since RY95, in response to an increasing number of hunters, we have attempted to distribute hunters spatially and temporally to reduce crowding in the more popular hunt areas. We talked to over 90% of the permit recipients prior to the hunt and also included a letter with the permit discussing the benefits of delaying their hunt later in the season. Our main points were reduced crowding and increased odds of taking a ram with horns ≥40 inches. Our efforts had mixed results. Between RY95 and RY97, 41–48% of the harvest occurred during the first 10 days of the season and there appeared to be an increasing trend for sheep hunters to go to the field later (20 Aug–10 Sep). During RY98–RY00, hunters again selected for the early portion of the season and 48–58% of the harvest occurred during the first 10 days. If hunters did not hunt during the first 10 days, the next most popular period was during the Unit 12 moose season (1–15 Sep). During RY98 and RY99, 25–33% of the harvest occurred during this 15-day period. During RY00 hunter participation was low due to adverse weather and only 6% of the harvest was taken during this period. Concerns about adverse weather later in the season and the perception that they had to be hunting on opening day to take the largest ram were the reasons hunters chose to hunt during the first week of the season.

Transport Methods. Airplanes and highway vehicles were the primary methods of transport (Table 5). During the report period, 82% of all hunters used 1 of these 2 methods to access the area. ATVs are not commonly used because few areas in the TMA are accessible to ATVs but not accessible by 4-wheel drive trucks. During the report period, average success rates for hunters using aircraft and highway vehicles were 45% and 37%, respectively, while the overall success rate was 43%. Hunters using airplanes for access did relatively poorly this report period, especially during RY99 (38% success) and RY00 (41% success). The causes of these reduced success levels are not known, but it was not due to more hunters flying their own aircraft instead of using the established air charter companies.

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. 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; consequently, lamb recruitment was low and data from collared sheep indicated that adult mortality was high. During 1994–1998, winter snowfall was below average, benefiting the TMA sheep population. During winters 1999–2000 and 2000–2001, winter and spring snowfalls were extreme, resulting in low lamb recruitment.

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 affect the sheep population, especially when 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 in RY98 had signs of pneumonia. We have not observed or heard 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 bunch-grass 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 throughout the east fork of the Robertson River and in the upper Tok River, areas that support high numbers of sheep. We will coordinate with Habitat Division to minimize impacts.

NONREGULATORY MANAGEMENT PROBLEMS AND NEEDS

The TMA was created in 1974 to provide a limited number of Dall sheep hunters the opportunity to harvest large-horned, trophy rams. Trophy sheep were not defined but the objectives to maintain an average harvest of rams with horns between 36–37 inches, including a minimum percentage of rams with horns ≥40 inches (7–10%), indicate that horn quality should be an important aspect of TMA management. Based on the number of permit applications, hunters were satisfied with the TMA but we did not know why or if they were willing to accept alternative management options.

In 2000 we conducted a mail survey of randomly selected TMA applicants to assess satisfaction with TMA's management goals, objectives, and hunt structure and to determine how hunters defined trophy sheep. We also evaluated how willingly hunters would accept changes in the hunt structure that would affect both hunting opportunity and ram horn quality.

Over 90% of the respondents supported the current management objectives of maintaining the limited number of drawing permits, limiting harvest to benefit trophy ram management, and preventing hunter crowding. Even though these objectives were supported, there were 4 distinct philosophies/groups, categorized by how respondents defined trophy ram and what was acceptable hunting opportunity and hunter crowding.

The largest group represented 77% of the respondents and supported no change to current TMA management unless there were biological or crowding issues. This group included hunters with

the greatest variety of sheep hunting experience and desires from the most ardent trophy hunters to first time hunters. For differing reasons, respondents in this group found common ground in their desire to maintain hunting opportunity.

Some highly experienced hunters within this group were satisfied only with a ram with exceptional horns. This required 2 conditions: an opportunity to hunt and the availability of exceptional rams. In terms of horn length, the TMA has the second best growth potential in Alaska and even following bad winters there were relatively high numbers of rams with horns ≥40-inch horns. For these hunters, the most difficult aspect of hunting the TMA was obtaining a permit, so they were against management that may further reduce their chances of getting a permit or moving throughout the TMA to find a large ram.

For the remainder of this group, the opportunity to hunt sheep in pristine conditions and a high probability of success were the primary attributes of the TMA. They believed these conditions were available under present management and changes were not necessary. These respondents viewed any full-curl ram as a trophy, were not disappointed if they did not see a ≥40-inch ram, and were more disappointed if they did not harvest a ram.

The next largest group represented 18% of respondents. About 90% of this group had hunted sheep for 3 or more years. They were more discerning about what constituted a trophy ram and strongly supported additional management that ensured a certain percentage of rams with horns ≥40 inches in the harvest. They were also more willing to forego harvesting a ram if they did not see what they wanted.

The next group represented 3% of the respondents. This group was more interested in protecting uncrowded hunting conditions and harvest success rates and was willing to reduce hunting opportunity to do so. They viewed any full-curl ram as a trophy.

The smallest group represented 2% of the respondents. This group desired maximum opportunity to hunt the TMA regardless of the impact on trophy ram abundance or hunter crowding.

Should there be changes in TMA management considering the desires of these 4 user groups? The group desiring maximum hunting opportunity is better served by general hunts in the state. However, the philosophies of the other 3 groups fit the founding objectives of the TMA. Should we manage according to the wishes of the majority and maintain current regulations or should we try to find ways to also satisfy the minority groups that support some restrictions to hunter opportunity to increase production of large horned rams and/or reduce the chance of hunter crowding?

The common desire of 98% of all respondents was to preserve the opportunity to hunt trophy rams in uncrowded hunting conditions. Although the definitions of trophy ram and uncrowded hunting differed between the groups, there was common ground on acceptable management. The first or second preferred management option for these 3 groups was to maintain the number of permits but to subdivide the TMA into smaller areas, each with its own drawing permit. Under this direction, trophy ram production could be enhanced, uncrowded hunting ensured, and overall opportunity maintained. Also, by including a permit that allows recipients to hunt

anywhere in the TMA the desires of hunters who like the greatest flexibility to hunt would be met.

Another option would be to optimize the number of large rams throughout the TMA by periodically reducing the number of permits. From this survey, it is apparent that reduced opportunity is acceptable to at least 21% of the TMA hunters either to enhance numbers of exceptionally large rams or to maintain or improve uncrowding hunting conditions. There are also a number of very experienced sheep hunters who would support management that increased numbers of large rams but did not substantially reduce hunting opportunity.

From these findings, additional management actions in the TMA are appropriate to meet the desires of hunters who want either larger sheep or more pristine hunting conditions if hunting opportunity is not permanently or substantially reduced from current levels. One possible method is to determine the number of drawing permits based on horn growth. Tok Management Area rams experience the greatest horn growth when they are 3–6 years old and the average age of rams reaching ¾-curl is 5.5 years. Climatic conditions affect how much growth occurs annually, with the greatest growth occurring during years of favorable conditions. Intuitively, rams that experienced favorable climatic conditions when they were 3–6 years old would reach full-curl faster and have longer horns at 8–10 years than if they had experienced adverse weather conditions that retarded horn growth.

To provide the greatest potential opportunity for horn growth in the TMA, the number of permits could be reduced when a cohort that experienced excellent horn growth at 3–5 years (reach ¾-curl at 5 years instead of 5.5) became a full curl. This management strategy would theoretically enhance horn size by enabling more of the first year full-curl rams to get at least another year of growth. To meet the desires of TMA hunters, permits will not be reduced to enhance horn growth and to benefit pristine hunt conditions on average more than once every 5 years (20%).

Cohorts that will be given extra protection will be selected by comparing growth rates. We will obtain an annual sample by looking at rams that visit licks during June and early July. The amount of fieldwork necessary will be 3 days during peak sheep visitation times at the lick.

CONCLUSIONS AND RECOMMENDATIONS

The management goals and objectives were met during the report period. Even though the TMA population was depressed, mean horn length, age of harvested rams, and the percentage of harvested rams ≥40 inches met the minimum harvest management objectives. For the first time since the inception of the TMA, we received complaints from hunters concerning crowding. Several incidents of hunter crowding occurred within the east fork of the Robertson River and the upper Tok River during the first week of the season. Between 34% and 51% of the hunters use these 2 drainages annually. Historically, hunters selected these areas because they produced the biggest rams and because they are easily accessible by aircraft.

The average horn length of harvested rams declined during RY98–RY00 to 36.2 inches and is approaching the minimum desired size. Primary reasons for the decline were lower number of older rams due to poor lamb recruitment during the early 1990s, higher harvests, and possible slower horn growth during 1999 and 2000 due to adverse weather conditions. We expect horn

size to increase after 2002 as the relatively large lamb cohorts during 1994–1998 reach full-curl status. Average horn size may still be low compared to past years because increased hunting pressure in certain areas will limit the number of rams reaching their full size and the effects of 2 years of poor horn growth.

Most TMA applicants supported maintaining uncrowded hunting conditions (98%) and a minimum horn quality (90%) and were willing to see changes in the hunt structure to meet these objectives. Since RY98 both these qualities have become an issue. To ensure the management objectives will continue to be met, we will reduce the number of permits offered. In 2002 the number of permits offered will be 100. Our objective is to reduce the number of hunters to about 85 and maintain the harvest at 35–45 rams. Historical data indicate this will minimize hunter crowding and maintain ram horn quality within current harvest objectives.

The TMA is the only area in Alaska designated for trophy sheep management. Based on questionnaire results, we now know what TMA hunters want, how they define a trophy ram, and what different hunt structures they would accept. The best management scheme would be to continue comparable hunting opportunity, maintain uncrowded hunting conditions, maintain horn quality, and if possible, create an area within the TMA where horn size can be optimized. This scenario could be realized by designating a small portion of the TMA to optimize horn growth potential and leave the remainder of the TMA under current management.

The best area for optimizing horn potential is between the east fork of the Robertson River and the Tok River, north of Tushtena Pass. This area has produced the most large-horned rams per hunter effort compared to the remainder of the TMA. Survey data concurs that this area produces a high number of large rams. Hunter participation in this area ranges from 5 to 15 hunters annually. A possible scenario would be to close this area for 1 year and then offer a separate permit hunt for 3–5 permits. A short-term closure followed by reduced hunting pressure would provide a much better chance for rams to reach 11 years and older with very large horns. To protect against overcrowding in the remainder of the TMA, these permits would be subtracted from the total number of TMA permits. The objective of this newly created area would be harvests of 1–3 rams. 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.

The effects on the remainder of the TMA would be minimal because the number of permits offered in the new area would not be much lower than average historical use. Another option would be to substantially reduce the number of permits during the year a cohort that displayed exceptional horn growth turns 8 years old. This might allow greater survival of age classes that have better potential to grow larger horns. Permits would be reduced only once every 5 years. I will be discussing these ideas with Fish and Game advisory committees and the Foundation of North American Wild Sheep to see if there is support. Until these discussions take place, the management objectives will not be changed.

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Table 1 Tok Management Area sheep composition counts from aerial surveys, 1980, 1994, 1999, and 2000

Sex/age class	1980	1994	1999[a]	2000[b]
Legal rams[c]	148	123	38	59
Sublegal rams[d]	263	294	89	144
Unclassified rams	9	0	38	0
Total rams	420	417	165	199
Ewes[e]	922	567	352	402
Lambs	350	137	110	39
Unidentified	6	3	0	0
Total other sheep	1278	707	462	441
Total sheep	1698	1124	627	640
Legal rams:100 ewes	16.1	21.7	10.8	14.7
Sublegal rams:100 ewes	28.5	51.9	25.3	35.8
Total rams:100 ewes	45.5	73.5	46.9	49.5
Lambs:100 ewes	38.0	24.2	31.3	9.7
Lambs % of total	20.6	12.2	17.5	6.1

[a] Surveyed the Robertson and Johnson River drainages only.
[b] Surveyed portions of the Tok River drainage and all of the Front Range from the Glenn Highway to Robertson River.
[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 Tok Management Area harvest of Dall sheep rams, regulatory years 1990 through 2000

Hunt/area	Regulatory year	Permits issued	Did not hunt %	Unsuccessful hunter %	Successful hunter %	$\bar{x}$ Horn length	n ≥40" (%)	Total harvest
DS102	1990	120	28	56	44	37.0	6 (17)	36
		120	23	44	56	36.9	9 (17)	52
		120	26	58	42	37.1	6 (16)	37
		120	13	58	42	37.3	6 (13)	44
		120	28	54	46	36.9	3 (8)	39
	1991	120	18	61	39	37.2	8 (13)	60
	1992	120	17	44	56	36.2	5 (9)	56
	1993	120	20	57	43	36.5	3 (7)	41
	1994	120	13	46	54	36.2	4 (7)	56
	1995	120	13	60	40	36.3	4 (10)	42
	1996	121	19	66	34	36.1	3 (9)	33
	1997							
	1998							
	1999							
	2000							

Table 3 Tok Management Area sheep harvest, regulatory years 1990 through 2000

Regulatory year	Rams	$\bar{x}$ Horn length	Sheep ≥40" (%)	$\bar{x}$ age	Ewes	Total sheep
1990	36	37.0	6 (17)	9.2	0	36
1991	52	36.9	9 (17)	8.9	0	52
1992	37	37.1	6 (16)	8.6	0	37
1993	44	37.3	6 (13)	9.0	0	44
1994	39	36.9	3 (8)	9.2	0	39
1995	60	37.2	8 (13)	9.4	0	60
1996	56	36.2	5 (9)	8.9	0	56
1997	41	36.5	3 (7)	8.9	0	41
1998	56	36.2	3 (7)	9.0	0	56
1999	42	36.3	4 (10)	9.5	0	42
2000	33	36.1	3 (9)	9.3	0	33

Table 4 Tok Management Area sheep hunter residency and success, regulatory years 1990 through 2000

Regulatory year	Successful: Local resident	Successful: Nonlocal resident	Successful: Nonresident	Successful: Total (%)	Unsuccessful	Unsuccessful: Local resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonresident	Unsuccessful: Total (%)	Total hunters
1990	2	31	3	36 (44)	Local	3	43	0	46 (56)	82
1991	3	47	2	52 (56)		0	38	3	41 (44)	93
1992	4	30	3	37 (42)		4	46	2	52 (58)	89
1993	3	39	2	44 (42)		6	54	1	61 (58)	105
1994	4	31	4	39 (46)		4	40	2	46 (54)	85
1995	9	44	7	60 (61)		2	37	0	39 (39)	99
1996	7	44	5	56 (56)		2	40	2	44 (44)	100
1997	3	35	3	41 (43)		8	45	1	54 (57)	95
1998	1	55	0	56 (54)		2	43	2	47 (46)	104
1999	2	39	1	42 (40)		1	58	2	61 (60)	104
2000	0	29	4	33 (34)		1	63	1	65 (66)	98

Table 5 Tok Management Area sheep harvest percent by transport method, regulatory years 1990 through 2000

Regulatory year	Percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1990	53	0	0	8	0	3	36	0	36
1991	63	2	0	0	0	6	27	2	52
1992	57	3	0	3	0	3	30	3	37
1993	75	0	0	5	0	0	18	2	44
1994	82	0	0	3	0	0	13	3	39
1995	63	0	0	6	0	5	20	5	60
1996	63	2	2	7	0	0	23	4	56
1997	73	0	0	12	0	0	15	0	41
1998	54	0	0	5	0	4	36	2	56
1999	57	0	0	21	0	0	21	0	42
2000	67	0	0	18	0	6	6	3	33

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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, personal communication, 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, personal communication, 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 the 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 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.

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 non-sheep habitat between the Richardson Highway and the Delta River. This area of non-sheep habitat is popular for hunting small game and upland game, and DCUA access restrictions unnecessarily complicated hunting in the area and confused hunters. This portion of habitat was reestablished inside the DCUA in 2002 to facilitate Macomb caribou herd management.

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 for 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), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

During RY99 and RY00, 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). 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

No funds were available to complete surveys to estimate population size during this reporting period.

Population Composition

No funds were available to complete 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–20 September and was split between 2 drawing permit hunts, DS203 and DS204. For permit hunt DS203, the season was open during 10–25 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 were issued for each of the 2 hunts.

Alaska Board of Game Actions and Emergency Orders. At their March 2002 meeting, the board adopted regulation proposal 11 to change the boundary of the DCUA. Proposal 11 was submitted by the department to change the western boundary of the DCUA from the Richardson Highway to the Delta River. The purpose of the proposal was to incorporate the Donnelly Dome area between the highway and the river into the DCUA to include caribou in this area within the DCUA access restrictions during a 15–25 August registration permit hunt for the Macomb caribou herd.

Hunter Harvest. DCUA harvest for both hunts (DS203 and DS204) met the harvest objective in regulatory years 1998, 1999, and 2001 and failed to meet the objective in RY00 by 1 sheep (Table 1). Harvest during RY98–RY01 averaged 44 sheep/year, which was higher than the average of 36/year for the previous 5 years.

Mean horn length for all sheep taken during this reporting period only met the objective in RY98 with 36.5 inches, but was only slightly below the objective in RY00 with 35.8 inches and RY01 with 35.7 inches (Table 1). Mean horn length was 35.6 inches during this reporting period and was shorter than the mean for the previous 5 years of 35.9 inches.

Mean age of all sheep taken in the DCUA met the management objective during RY98–RY01 (Table 1).

Most hunters (83–84%) that responded to questionnaires in RY99 and RY00 were satisfied with their DCUA hunt. On the rating scale of 1 (very satisfied) to 10 (extremely disappointed), the mean satisfaction rating for all hunters ranged from 2.6 to 3.2 (Table 2).

When asked if they agreed with DCUA harvest goals, 88–93% of responding hunters answered "yes". When asked if they agreed with DCUA aesthetic goals, 92–95% answered "yes" (Table 2).

Permit Hunts. The number of permit applicants continued to slowly increase to a high of 2235 in RY00. The number of applications for hunt DS204 continued to be slightly higher than for DS203, with 58% of applications in RY99 and 55% in RY00 (Table 3).

Hunter Residency and Success. Most DCUA hunters were Alaskan residents (Table 4).

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 5).

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 and a few boats were used along the Johnson River. Airplanes, 3– or 4–wheelers, and highway vehicles were commonly used during hunt DS204 (Table 6).

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 in most years. 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

Objectives for harvest and mean age of rams were met during this reporting period (RY98–RY00), but the horn length objective was not met. During the last 10 years, the horn length objective was met only 3 times (RY96–RY98), but in most other years, mean horn length was less than 1 inch short of the objective. Because the harvest objective was easily met and exceeded, the number of permits could be decreased to reduce harvest, while still meeting the harvest objective, and thus allow mean horn size to increase. However, based on hunter questionnaire results, hunters appear to be satisfied with DCUA harvest results, and no reduction in the number of permits will be considered at this time.

Based on hunter response to questionnaires, the management goal of providing aesthetically pleasing hunting conditions was met in the DCUA. No changes to hunting seasons or bag limits are recommended at this time.

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Table 1 Delta Controlled Use Area sheep harvest data by permit hunt, regulatory years 1988–1989 through 2001–2002

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
	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
	1998–1999	75	31	51	17	13	38.2	9.4	8
	1999–2000	75	33	40	27	20	34.7	8.6	0
	2000–2001	75	27	55	19	14	35.8	9.1	7
	2001–2002	75	24	45	31	23	36.0	9.2	17
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
	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
	1998–1999	75	24	36	37	28	35.8	8.5	7
	1999–2000	75	29	31	40	30	36.4	8.8	10
	2000–2001	75	17	56	27	20	35.9	9.3	0
	2001–2002	75	15	41	44	33	35.5	8.1	0
DS203	1988–1989								
	1989–1990								
	1990–1991								
	1991–1992								
	1992–1993								
	1993–1994								
	1994–1995								
	1995–1996								
	1996–1997								
	1997–1998								
	1998–1999								
	1999–2000								
	2000–2001								
	2001–2002								
DS204	1988–1989								
	1989–1990								
	1990–1991								
	1991–1992								
	1992–1993								
	1993–1994								
	1994–1995								
	1995–1996								
	1996–1997								
	1997–1998								
	1998–1999								
	1999–2000								
	2000–2001								
	2001–2002								
Total	1988–1989	150	29	43	28	42	35.9		7

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"
for all	1989–1990	150	32	33	33	50	36.8		10
permit	1990–1991	150	29	47	19	28	34.6		4
hunts	1991–1992	150	29	43	28	42	36.2		17
		150	27	45	27	41	35.9	8.7	10
		150	31	42	27	40	35.9	8.5	10
		150	36	43	19	28	35.2	7.9	7
		150	32	47	21	32	35.7	8.3	6
1992–1993		150	23	49	28	41	36.4	8.6	8
1993–1994		150	23	51	27	40	36.4	8.8	13
1994–1995		150	27	43	27	41	36.5	8.2	12
1995–1996		150	31	35	33	50	34.3	8.7	4
1996–1997		150	22	55	23	34	35.8	9.3	3
1997–1998		150	26	39	35	51	35.7	8.5	7
~~1998–1999~~									
1999–2000									
2000–2001									
2001–2002									

Table 2 Hunter satisfaction ratings with Delta Controlled Use Area (DCUA) management for Dall sheep hunts D1103/DS203 and D1104/DS204, 1993–2001

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
1998[d]					
1999	84	2.6	93	95	57
2000	83	3.2	88	92	75
2001[d]					

[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.
[d] No data.

Table 3 Number of applications received for Delta Controlled Use Area Hunts DS203 (restricted access) and DS204 (unrestricted access), 1989–2000

Regulatory year	Hunt DS203	Hunt DS204	Total applications
1989–1990	514	670	1184
1990–1991	673	872	1545
1991–1992	781	846	1627
1992–1993	740	953	1693
1993–1994	677	971	1648
1994–1995	929	970	1899
1995–1996	901	994	1895
1996–1997	1000	1082	2082
1997–1998	820	954	1774
1998–1999	802	1013	1815
1999–2000	855	1156	2011
2000–2001	1011	1224	2235

Table 4 Delta Controlled Use Area sheep hunter residency and success, regulatory years 1988–1989 through 2001–2002

		Successful					Unsuccessful					
Hunt	Regulatory year	Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Local resident	Nonlocal resident	Nonres	Unk	Total (%)	Total hunters
D1103	19881989	3	10	0	0	13 (27)	19	13	1	2	35 (73)	48
		12	13	2	0	27 (51)	10	16	0	0	26 (49)	53
		6	8	1	0	15 (31)	9	22	2	0	33 (69)	48
		9	21	2	0	32 (39)	15	33	3	0	51 (61)	83
	1989–1990	11	8	0	0	19 (39)	15	14	2	1	32 (61)	51
	1990–1991	12	6	2	1	21 (42)	11	14	1	3	29 (58)	50
	1991–1992											
D1203	1994–1995	7	4	0	0	11 (27)	12	16	2	0	30 (73)	41
	1992–1993	1	13	1	0	15 (29)	7	25	4	0	36 (71)	51
	1993–1994	0	18	3	0	21 (36)	2	33	2	0	37 (64)	58
		3	15	1	0	19 (29)	6	37	3	0	46 (71)	65
	1995–1996	1	11	1	0	13 (26)	2	36	0	0	38 (75)	51
	1996–1997	1	17	2	0	20 (40)	5	21	4	0	30 (60)	50
	1997–1998	2	10	2	0	14 (26)	2	37	2	0	41 (75)	55
	1998–1999	4	17	2	0	23 (40)	2	32	1	0	35 (60)	58
	1999–2000											
	2000–2001											
D1104	1988–1989	13	15	1	0	29 (50)	18	11	0	0	29 (50)	58
	2001–2002											
		12	10	1	0	23 (49)	11	12	1	0	24 (51)	47
		8	4	0	0	12 (24)	19	17	1	0	37 (76)	49
		14	3	0	0	17 (38)	19	9	0	0	28 (62)	45
	1989–1990	11	9	2	0	22 (38)	22	14	0	0	36 (62)	58
	1990–1991	7	11	0	1	19 (36)	14	20	0	0	34 (64)	53
	1991–1992											
D820	1994–1995	7	8	1	1	17 (35)	17	15	0	0	32 (65)	49
	1992–1993											
	1993–1994	2	15	0	0	17 (33)	9	23	2	0	34 (67)	51
		3	16	1	0	20 (36)	7	28	1	0	36 (64)	56
		4	16	1	0	21 (41)	3	24	3	0	30 (59)	51
	1995–1996	3	24	0	0	28 (51)	1	25	1	0	27 (49)	55
	1996–1997	2	26	2	0	30 (57)	3	19	1	0	23 (43)	53
	1997–1998	5	15	0	0	20 (32)	8	33	1	0	42 (68)	62
	1998–1999	4	29	1	0	34 (53)	2	29	0	0	31 (48)	65
	1999–2000											
	2000–2001											
	2001–2002											

Hunt	Regulatory year	Successful					Unsuccessful					Total hunters
		Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Local resident	Nonlocal resident	Nonres	Unk	Total (%)	
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
		22	17	2	0	41 (38)	37	28	2	1	68 (62)	109
		19	17	2	2	40 (39)	25	34	1	3	63 (61)	103
		14	12	1	1	28 (31)	29	31	2	0	62 (69)	90
	1992–1993	3	28	1	0	32 (31)	16	48	6	0	70 (69)	102
	1993–1994	3	34	4	0	41 (36)	9	61	3	0	73 (64)	114
	1994–1995	7	31	2	0	40 (35)	9	61	6	0	76 (66)	116
	1995–1996	4	35	1	0	40 (38)	3	61	1	0	65 (62)	105
	1996–1997	3	43	4	0	50 (49)	8	40	5	0	53 (52)	103
	1997–1998	7	25	2	0	34 (29)	10	70	3	0	83 (71)	117
	1998–1999	8	46	3	0	57 (46)	4	61	1	0	66 (54)	123
	1999–2000											
	2000–2001											
	2001–2002											

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

Table 5 Delta Controlled Use Area sheep harvest chronology percent by month/day, regulatory years 1990–1991 through 2001–2002

Hunt	Regulatory year	Harvest chronology percent by month/day							
		8/10–8/16	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
	1998–1999	77	23	0	--	--	--	0	13
	1999–2000	85	15	0	--	--	--	0	**??**
	2000–2001	85	15	0	--	--	--	0	13
	2001–2002	91	4	4	--	--	--	4	23
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
	1998–1999	--	--	32	39	7	21	0	28
	1999–2000	--	--	56	30	15	0	0	27
	2000–2001	--	--	15	35	25	25	0	20
	2001–2002	--	--	66	16	13	3	3	32
Total	1990–1991	32	14	21	7	7	11	7	28
for all	1991–1992	26	21	24	12	5	10	2	42
permit	1992–1993	29	17	24	20	10	0	0	41
hunts	1993–1994	33	18	33	13	3	3	0	40
	1994–1995	29	7	29	18	11	7	0	28

Hunt	Regulatory year	Harvest chronology percent by month/day							
		8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unk	*n*
	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
	1998–1999	24	7	22	27	5	15	0	41
	1999–2000	28	5	38	20	10	0	0	40
	2000–2001	33	6	9	21	15	15	0	33
	2001–2002	36	3	40	9	7	3	4	55

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

Table 6 Delta Controlled Use Area sheep harvest percent by transport method, regulatory years 1988–1989 through 2001–2002

Permit hunt	Regulatory year	Sheep harvest percent by transport method									
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
D1103[a]	1988–1989	10	0	4	0	0	2	79		4	13
		8	0	0	2	0	0	87		4	27
		8	0	8	0	0	0	75		8	15
		12	0	5	0	0	0	76		7	23
		5	0	5	0	0	0	84		5	19
		19	0	0	0	0	0	71		10	21
DS203	1989–1990 1994–1995	27	0	0	0	0	0	64		9	11
	1990–1991	20	0	7	0	0	0	67		7	15
	1991–1992	29	0	5	0	0	0	62		5	21
	1992–1993	5	0	0	0	0	0	90		5	19
	1993–1994	17	0	8	0	0	0	67	0	8	12
		15	0	0	0	0	0	80	0	5	20
	1995–1996	36	0	7	0	0	0	50	0	7	14
	1996–1997	26	0	9	0	0	0	44	22	0	23
	1997–1998										
	1998–1999										
D1104	1988–1989	38	0	3	12	0	14	31		2	29
	1999–2000	43	0	0	13	0	13	32		0	23
	2000–2001	38	0	0	34	0	4	24		0	13
	2001–2002	26	2	0	45	0	4	23		0	19
		41	0	0	41	0	5	14		0	22
		63	0	0	21	0	5	5		5	19
DS204	1989–1990 1994–1995	35	0	0	59	0	0	6		0	17
	1990–1991	41	12	0	41	0	0	6		0	17
	1991–1992	30	5	10	10	0	5	35		5	20
	1992–1993	38	0	0	43	0	5	10		5	21
	1993–1994	50	0	0	39	0	11	0		0	28
		33	0	3	47	0	10	7	0	0	30
	1995–1996										
	1996–1997										
	1997–1998										
	1998–1999										
	1999–2000										

Permit hunt	Regulatory year	Sheep harvest percent by transport method									
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
		15	0	0	65	0	5	15	0	0	20
		18	0	6	64	0	3	6	0	3	33
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
	1996–1997	29	2	7	5	0	2	49		5	41
	1997–1998	23	0	0	23	0	3	48		5	40
	1998–1999	40	0	3	28	0	8	20	0	3	40
	1999–2000	26	0	2	28	0	6	36	0	2	50
	2000–2001	24	0	3	38	0	3	29	0	3	34
	2001–2002	21	0	7	38	0	2	21	9	2	56

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

APPENDIX Delta Controlled Use Area sheep hunter survey questionnaire

(Date)

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
(DATE) 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

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

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 their proximity to Fairbanks, the general hunting season, and the opportunity to hunt other species. Management in Unit 20A provides for a wide variety of hunting opportunities, and includes areas closed to the use of motorized vehicles (except aircraft) and an area open to hunting by bow and arrow only. Since 1984, reported harvests ranged from 27 to 163 rams taken by 143–410 hunters.

Heimer and Watson (1986) summarized Unit 20A population trends. Sheep numbers grew relatively high by the 1960s likely due to widespread predator control programs before statehood and 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 an assumed sightability of 70–80%, 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 likely 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 older rams.

Research in Unit 20A included a study comparing population and horn characteristics of sheep in Unit 20A with 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, Scotton's (1997) investigation of the causes and magnitude of lamb mortality, and sheep–coyote predator–prey dynamics (in progress).

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 evaluated harvest, hunter use patterns, and characteristics of sheep taken by hunters from harvest report cards. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

We conducted 3 aerial surveys during RY98–RY00 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. We also classified ram horn sizes.

On 10–11 June 1999, 24–25 June 2000, and 21–22 June 2001, we surveyed Sections I–III located between the Wood and Little Delta Rivers and Section IV located south of Sections I–III between the West Fork of the Little Delta River and Buchanan Creek, and a small portion of the upper Wood River (Arthur 2000).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Composition

Lamb:ewe ratios (Table 1) were higher than the poor ratios observed in the early 1990s (Scotton 1997), but in 2000 dropped to the lowest level in 7 years and remained low in 2001. Dale (1999) reported the Unit 20A sheep population likely increased between 1996 and 1998, based on strong lamb:ewe and yearling:ewe ratios during those years (Table 1). However, the lower lamb:ewe and yearling:ewe ratios observed in 2000 and 2001 indicate the Unit 20A sheep population probably stopped increasing and likely was stable between 1998 and 2001. Over the last 3 years we observed no noticeable declines in the annual survival rates of adult sheep radiocollared in the central mountains of Unit 20A, we did not hear of any declines in

sheep numbers from hunters or guides using the area, and the last 3 winters were all relatively mild, suggesting the sheep population did not decline noticeably during RY98–RY00.

MORTALITY

Harvest

Seasons and Bag Limit. The sheep hunting season was open 10 August through 20 September throughout RY98–RY00. The bag limit was 1 ram with a full-curl or larger horn, with both horns broken, or at least 8-years old.

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game did not change any seasons or bag limits for sheep in Unit 20A during RY98–RY01, and no emergency orders were issued.

Hunter Harvest. Harvests remained low (27–50) during RY98–RY01 (Table 2).

Mean horn length of harvested rams ranged from 34 to 35 inches since the bag limit changed from 7/8 curl to full curl in RY84 (Table 2). Less than 1% of the rams harvested since RY86–RY87 had horns ≥40 inches long. Two were reported taken during the RY98 hunting season.

Hunter Residency and Success. Success rates remained higher for nonresidents than for resident hunters (Table 3). During RY98–RY01, nonresident success was 37–66%, while resident success was 12–20%. Overall success rates were 19–34% during RY98–RY01.

Harvest Chronology. Approximately half of the 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.

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 the Dall sheep range in Unit 20A. Accordingly, most of the successful sheep hunters used airplanes or horses for transportation (Table 5). Reported use of 3- or 4-wheelers by successful sheep hunters has been increasing since the mid-1980s, reaching the highest level ever reported (22%) in RY00.

HABITAT

Assessment

No significant disturbance or destruction of sheep habitat occurred in Unit 20A through RY98–RY01. During RY95–RY97, increases in mineral exploration and mining activity resulted in concerns about habitat and disturbance by a local advisory committee and other users. Although these concerns were not expressed during RY98–RY00, a local advisory committee did present concerns regarding disturbance caused by helicopter sightseeing tours.

CONCLUSIONS AND RECOMMENDATIONS

We assumed that restricting harvest to full-curl rams achieved objectives to provide the greatest sustainable annual hunting opportunity and greatest sustainable annual harvest, but

we did not specifically address these objectives during RY98–RY00. The objective to provide the opportunity to view and photograph sheep under natural conditions also was not addressed. All of the above objectives are not quantifiable and should be changed to goals in the next 5-year plan.

Restricting harvest 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. As a result, current harvest was well below those sustained through the 1980s. However, this population objective seems unrealistic for a relatively small sheep population subject to occasional severe weather events and variable levels of predation. Thus, 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 potentially result in increased harvests, but not until after 2001.

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Table 1 Unit 20A sheep composition counts, regulatory years 1993–1994 through 2000–2001

Year	Rams:100 ewes[a]	% Full-curl rams	Lambs:100 ewes[a]	Yearlings: 100 ewes[a]	Sample size
1994[b]	59	–[c]	34		442
1995[b]	67	–[c]	44	24	586
1996[b]	59	–[c]	51	36	657
1997[b]	83	–[c]	40	44	567
1998[b]	52	21	41	24	686
1999[b]	70	12	52	28	690
2000[b]	66	6	30	24	615
2001[b]	66	15	31	21	550

[a] Counts of ewes likely include some young rams.
[b] Observed values for Sections I–III.
[c] Data not collected.

Table 2 Unit 20A sheep harvest, regulatory years 1984–1985 through 2001–2002

Regulatory year	Reported harvest	Total hunters	Percent success	$\bar{x}$ Horn length (in)[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	25	35.1
1998–1999	44	176	25	35.3
1999–2000	51	171	30	34.0
2000–2001	27	143	19	34.5
2001–2002[d]	50	146	34	34.3

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

Table 3 Unit 20A sheep hunter residency and success, regulatory years 1984–1985 through 2001–2002

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
1998–1999	14	19	24	1	44	84	108	23	1	132	176
1999–2000	15	26	24	1	51	81	105	14	1	120	171
2000–2001	4	12	15	0	27	64	89	26	1	116	143
2001–2002[c]	10	16	31	3	50	54	75	16	5	96	146

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

Table 4 Unit 20A sheep harvest chronology percent by day/month, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest chronology percent by day/month					
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep	Unknown	*n*
1990–1991	60	21	7	4	8	122
1991–1992	56	20	16	5	3	109
1992–1993	47	29	19	3	2	62
1993–1994	56	18	18	6	2	50
1994–1995	53	25	10	12	0	49
1995–1996	45	23	12	17	3	60
1996–1997	65	17	7	7	4	54
1997–1998	56	24	13	7	0	45
1998–1999	55	14	18	14	0	44
1999–2000	59	22	12	6	2	51
2000–2001	59	11	15	15	0	27
2001–2002[a]	50	28	10	12	0	50

[a] Preliminary.

Table 5 Unit 20A sheep harvest percent by transport method, regulatory years 1985–1986 through 2001–2002

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
1998–1999	43	32	2	11	2	7	2	44
1999–2000	41	35	0	6	0	14	4	51
2000–2001	48	19	4	22	0	7	0	27
2001–2002[a]	40	38	0	12	2	2	6	50

[a] Preliminary.

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

GEOGRAPHICAL DESCRIPTION: White Mountains area

BACKGROUND

Dall sheep in the White Mountains provide opportunities to view and hunt sheep relatively close to Fairbanks with access by road, air, or boat. However, these sheep have received little attention because the population is relatively small (500–600 sheep) and harvest is low (<13 sheep/year).

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

The number of rams classified as legal during surveys generally decreased from 1970 to 1995, largely due to changes in the definition of legal rams. From 1970 to 1978, legal rams included 3/4-curl or larger rams; from 1979 to 1985, 7/8-curl rams were legal; in 1986, 7/8-curl rams were legal in Unit 25 and full-curl rams were legal in Unit 20; and only full-curl rams have been legal since 1987. Survey data from 1996 to 2000 indicate the number of legal rams increased in recent years.

The US Fish and Wildlife Service conducted the first Dall sheep studies in the White Mountains during the 1950s (Gross 1963). During 1983–1988, the Bureau of Land Management (BLM) and ADF&G did a cooperative study of 10 radiocollared sheep to identify distribution, movements, and seasonal use areas (Durtsche et al. 1990). Sheep in the White Mountains were found in small, widely scattered groups throughout approximately 534 mi^2 of alpine habitat in the vicinity of Victoria Mountain, Mount Schwatka, Mount Prindle, and Lime Peak (Rocky Mountain). They speculated these sheep may have a relatively unique gene pool (Durtsche et al. 1990) because this area is geographically isolated from other sheep populations (ADF&G 1976).

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 the BLM. Increasing 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 of providing 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 OBJECTIVE

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

METHODS

We conducted 2 aerial surveys in August 1999 and 2000 to estimate population size and composition. Observers classified sheep as lambs, ewes, or rams based on horn size/shape and body conformation. The ewe category 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 ft AGL) contours and circles at 60–80 km in Piper Super Cubs and an Aviat Husky. Survey areas included Big Bend to Windy Gap, Windy Gap to Willow 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. Because sheep in this area sometimes use habitat well away from escape terrain, including timber and shrub-covered areas near mineral licks, we estimated the population assuming 85% of the sheep were observed during surveys.

We monitored harvest through harvest ticket report cards. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The estimated sheep population during RY98–RY00 was 650–800, the highest estimate since surveys began. During aerial surveys in 1999 and 2000, observers counted 717 and 568 sheep, respectively (Table 1). Because of low sightability of this sheep population we adjusted our estimate upward by 15% to account for sheep not observed. Likewise, the difference between

counts in 1999 and 2000 was assumed due to low sightability and variation in survey efficiency, rather than a real change in population size. Surveys were not completed during 1998 and 2001 due to logistical constraints and poor weather conditions.

Population Composition

The 11 lambs:100 ewes observed in 2000 was the lowest ratio observed since surveys began in 1970 (Table 1). Reasons for the low ratio are unknown.

Caution should be used in interpreting these composition data. Survey areas varied between years because weather often precluded complete coverage of the survey area each year. The area surveyed affected composition data because ram groups and ewe/lamb groups often occupy different ranges during summer. In addition, survey date was an important factor because sheep are distributed differently during September–October compared to June–August. Finally, composition data underestimated true lamb:ewe and ram:ewe ratios because the ewe category contained young rams.

Distribution and Movements

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 to lambing areas usually occurred between late May and mid-June, with most lambs 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 typically associated themselves with one of several bands in the White Mountains. Bands tended to use discrete ranges most of the year, intermingling during pre-rut and rut, then returning to their traditional areas post-rut. Bands of ewes and bands of rams often used the same ranges, although not at the same time. Rams shifted notably away from human access points during the sheep hunting season.

Although some mixing occurs, sheep were found in 2 core 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 seemed 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 RY98–RY00. The bag limit was 1 ram with full-curl horns, both horns broomed, or at least 8 years old (Table 2).

Alaska Board of Game Actions and Emergency Orders. There were no board actions or emergency orders during RY98–RY00.

Hunter Harvest. The total reported harvest for RY98–RY01 was 35 sheep and ranged from 5 to 13 annually (Table 3). The reported harvest of 13 sheep during fall 1999 is the highest on record.

The average horn base measurement for RY98–RY01 was 13.4 inches (range = 12.00–15.00, n = 31; Table 4). Average horn length measurements have little meaning in this area because many are broomed (41% of the reported harvest had at least 1 horn broomed, and 28% had both horns broomed). During RY98–RY01 the average reported age of harvested rams was 10.2 (range 7–14, n = 32), up slightly from the previous 5-year (RY93–RY97) average of 9.5 (range 7–13, n = 32).

Hunter Residency and Success. Sheep in the White Mountains were mostly hunted by Alaska residents. Since RY84, only 9 nonresidents reported hunting sheep in the area (Table 3). The average success rate of all hunters during RY98–RY01 was 25% (35 of 141, annual range 14–37%) and both successful and unsuccessful hunters reported spending an average of 5 days afield (Table 5).

Harvest Chronology. Sixty-nine percent (18 of 26) of the sheep harvested during RY98–RY01 were taken during August (Table 6). In recent years the sheep harvest shifted to later in the season. During the 4-year period from RY90–RY93, 3 sheep were reported taken during September. From RY94 through RY97, 7 sheep were reported taken in September, and during RY98–RY01, 8 were taken.

Transport Methods. Main access points for airplanes were a small airstrip on Lime Peak and gravel bars and several private strips along Beaver Creek. Floatplanes could land on several small lakes north of Mount Schwatka and sometimes on Beaver Creek. Ground access was primarily from trails and mining roads off the Steese Highway. In 1988 BLM established off-road vehicle (ORV) restrictions throughout the WMNRA and SNCA that closed most sheep range to ORVs. However, ORVs weighing < 1500 lb were allowed in most of the area between the Steese Highway and Mount Prindle, which provided good access to sheep habitat.

During RY98–RY01, 85% 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 has persisted for the past decade. Hunters who used ORVs and highway vehicles were usually unsuccessful. However, use of 4-wheelers for hunting has increased from an average of 2 hunters per year prior to RY90 to an average of 14 hunters per year since then.

Other Mortality

Weather and predation are probably the primary causes of Dall sheep mortality in the White Mountains, 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 caused a low lamb:ewe ratio and drop in overall numbers in 1992. Subsequent winters have had average or slightly below average snowfall.

Little is known about predation rates or predator populations in the White Mountains. McNay (1989) estimated 87 wolves reside 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 (Scotton 1997).

Sheep in the White Mountains frequently travel through forested areas because sheep habitats are scattered, often at low elevations 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, they probably increase sheep susceptibility to terrestrial predators.

HABITAT

Assessment

Important features of sheep habitat include summer range, winter range, mineral licks, lambing areas, escape terrain, and travel routes between these habitats. Protecting 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. Sheep have also used caves in the White Mountains, perhaps for relief from hot weather. In 1950 LE Powell (ADF&G files) wrote: "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, personal communication).

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

CONCLUSIONS AND RECOMMENDATIONS

Our goal to provide opportunity to hunt sheep in the White Mountains under aesthetically pleasing conditions was met. Human use of sheep in the White Mountains area is relatively low, and it is unnecessary to limit the number or distribution of hunters or recreation activities. However, to maintain aesthetically pleasing conditions, use of ORVs, mineral exploration, trail development, access, and cabins should be monitored and managed accordingly.

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 sustained opportunity to harvest full-curl rams from a population of at least 250 sheep. We maintained a resident and nonresident general season from 10 August to 20 September for a full-curl ram. Our population estimate of 650–800 sheep meets our minimum population objective. No changes to season or bag limits are recommended at this time.

We also worked cooperatively with BLM and other stakeholders 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 curtailed if necessary. Off-road vehicle users have emerged as a potential problem by rapidly expanding the existing trail system into areas where their use is both permitted and prohibited, including sheep habitat (Durtsche et al. 1990). We will continue to work closely with BLM and other stakeholders on these issues.

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Table 1 White Mountains aerial sheep composition counts, 1970–2001

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]		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]		88	98	37	266	53	20	417	12.1
1998[d]									
1–3 Aug 1999[i]		125	151	37	406	160	39	717	13.1
5–7 Aug 2000[i]		130	157	41	381	41	11	568	13.1
2001[j]									

[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 include 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).
[i] Big Bend to Windy Gap, Windy Gap to Willow Creek, Cake Mountain, Lime Peak, Mount Prindle, Mount Schwatka, and Victoria Mountain.
[j] Incomplete survey.

Table 2 White Mountains sheep seasons and bag limits, regulatory years 1983–1984 through 2001–2002

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 2001–2002	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 hunter residency and success, regulatory years 1984–1985 through 2001–2002

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
1998–1999	5	0	0	5	19	0	0	19	24	21
1999–2000	11	1	1	13	30	2	0	32	45	29
2000–2001	6	0	0	6	35	1	0	36	42	14
2001–2002	9	0	2	11	19	0	0	19	30	37
Total	96	5	4	105	366	4	15	385	490	

Table 4 White Mountains sheep harvest characteristics, regulatory years 1993–1994 through 2001–2002

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
Avg	8.8			13.95
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
Avg	10.0			13.90
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
Avg	9.7			13.90
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
Avg	10.0			13.70
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
Avg	8.9			13.70
1998–1999	14	2	36.00	14.00
	10	1	36.00	14.25
	8	0	33.00	14.00
	11	1	37.00	15.00
	11	2	34.00	14.50
Avg	10.8			14.35
1999–2000	8	0	37.50	--
	14	2	34.00	14.00

Regulatory year	Horn			
	Age (yr)	Broomed	Length (in)	Base (in)
	11	0	38.75	14.13
	12	2	34.00	14.00
	10	2	34.50	13.25
	9	0	34.00	13.50
	9	0	35.00	13.00
	7	2	34.00	12.63
	9	1	30.00	13.50
	8	0	35.00	12.00
	11	2	31.00	13.00
	8	0	34.00	13.63
Avg	9.7			13.33
2000–2001	11	0	42.50	14.50
	12	0	41.00	14.00
	12	2	35.00	13.50
	10	1	37.00	14.50
	12	0	39.00	13.00
	8	0	33.25	13.00
Avg	10.8			13.75
2001–2002	13	0	36.00	12.00
	8	0	38.00	13.00
	13	0	43.00	13.00
	11	2	35.00	13.00
	8	0	30.00	13.00
	8	0	34.00	14.00
	10	0	37.00	13.00
	9	0	35.00	13.00
	11	0	31.50	12.00
Avg	10.1			12.90

Table 5 White Mountains sheep hunter effort, regulatory years 1984–1985 through 2001–2002

Regulatory year	Successful		Unsuccessful		Total hunters[b]
	Hunters	$\bar{x}$ days[a]	Hunters	$\bar{x}$ days[a]	
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
1998–1999	5	4	19	5	24
1999–2000	13	4	32	4	45
2000–2001	6	6	36	5	42
2001–2002	11	5	19	5	30

[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 who hunted.

Table 6 White Mountains sheep harvest chronology by day/month, regulatory years 1984–1985 through 2001–2002

Regulatory year	Harvest chronology by day/month			
	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
1998–1999	2	2	0	0
1999–2000	5	3	0	3
2000–2001	1	3	0	0
2001–2002	0	2	3	2
Total	48	26	13	10

Table 7 White Mountains sheep hunter success by transport method, regulatory years 1984–1985 through 2001–2002

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
1998–1999	4	0	0	0	0
1999–2000	10	1	0	0	0
2000–2001	4	0	0	0	0
2001–2002	4	3	0	0	0
Total	81	7	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

Regulatory year	Transport method				
	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other\Unknown
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
1998–1999	2	6	4	1	2
1999–2000	1	18	3	6	3
2000–2001	7	17	0	5	1
2001–2002	3	17	0	7	4
Total	90	176	34	61	39

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

GEOGRAPHIC DESCRIPTION: Tanana Hills

BACKGROUND

The Dall sheep population in the Tanana Hills comprises several small, discrete groups or subpopulations separated by areas of unsuitable habitat. These subpopulations persist at low density because the physical geography of the area provides relatively low-quality 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.

Most of the sheep habitat in this area is remote and difficult to access and historically there was little consumptive and nonconsumptive use of the sheep populations. Since the early 1970s, the wilderness aspects associated with these sheep populations have been incorporated in hunt management.

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 under a controlled-use regulation. Access into the Seventymile and Charley Rivers was 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 participation rate, residence and effort, transportation type used to access the hunt area, and horn size and age. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001).

We monitored population status in 3 areas in Unit 20E during the report period. All surveys were conducted from a PA-18 aircraft or an R-22 helicopter. Sheep were classified as rams, ewes, or lambs based on horn size and body conformation. If a PA-18 was used as the survey platform, then ewes included young rams that could not be distinguished from ewes. Young rams and all yearlings were distinguishable from a R-22. Rams were also classified as either legal (full-curl or both horns broomed) or sublegal. The areas surveyed were part of a greater area where wolf numbers were reduced by nonlethal wolf control. Survey data collected before and after control activities will be used to determine effects of wolf reduction on Dall sheep population trends in the Tanana Hills.

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 30–80 mph in the R-22. A ground-based survey was conducted in 1992 and consisted of 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.

The National Park Service (NPS) estimated population composition from a helicopter within Yukon–Charley National Preserve (YCP) in 1997–2001. These data will be used as a comparison for determining effects of the nonlethal wolf control program on Dall sheep in the Tanana Hills.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We did not estimate total sheep numbers in the Tanana Hills during the report period. Based on changes in population trends and composition in individual survey areas, sheep numbers remained stable or declined slightly (Tables 1–3) compared to the 1997 estimate of 450–500 sheep.

During the remainder of the 1990s, composition data indicated the sheep population declined by 25–30% during 1990–1993 following a series of adverse winters and springs. Both poor lamb recruitment and high adult mortality contributed to the decline. From 1994 to 1997 the population increased due to improved lamb production and/or survival.

A complete survey of this area was conducted in 1982, resulting in a population estimate of 365 sheep. The 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 during this period.

Population Composition

Between July 1997 and July 2001, there appeared to be survivorship differences based on sex and age. The number of ewe/yearlings and lambs appear to be lower but the number of rams remained stable and in several areas increased. We expected the number of legal rams to decline in all sheep populations in Units 20E and 12 due to poor lamb crops during 1992 and 1993. However, within the Tanana Hills the number of legal rams remained stable and compared to the adjacent eastern Alaskan Range and north Wrangell Mountains, the relative number of legal rams was higher (18:100 ewes vs. 12:100 ewes) (Gardner, ADF&G unpublished data). The primary reason these reduced cohorts had less effect on legal ram numbers in the Tanana Hills were the lower harvest rates compared to the other areas, indicating that harvest in the Tanana Hills was more compensatory. Reduced harvest effects were also reflected in the average age of harvested rams ($\bar{x}$ = 10.0 years old, Tanana Hills; $\bar{x}$ = 8.5 years old, northern Wrangell Mountains) indicating relatively fewer rams were harvested the first year they become legal in the Tanana Hills compared to the northern Wrangell Mountains.

We do not know why our survey data indicate the number of ewes/yearlings were lower during 1999–2001. Count areas were the same during 1999 and 2000 and the same helicopter/pilot and observer were used, indicating survey bias was not likely. We do not believe that sheep distribution has changed because numbers did not increase in adjacent areas. Also, sightings made by other experienced pilots and hunters indicated fewer ewes in the Tanana Hills. Reduced lamb production was probably due to unfavorable weather conditions during winters 1999–2000 and 2000–2001 and spring 2001.

Distribution and Movements

We found no evidence that distribution and movements were 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–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.

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game did not change seasons or bag limits for sheep in the Mount Harper area or in the remainder of Unit 20E during the report period.

Hunter Harvest. During RY98 through RY00, the reported general harvest ranged from 5 to 10 rams ($\bar{x}$ = 6.7) (Table 4). The previous 5-year average was 6.0 rams/year. Reported sheep harvest from the general season increased in RY93 following removal of the permit requirements in the Charley River and Mount Sorenson areas. Of the 50 sheep harvested under general permit in Unit 20E since RY93, 33 (66%) 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 local residents could participate every year, a greater number of nonlocal Alaskan residents began hunting sheep incidentally to moose and caribou, a licensed guide in the area started taking clients, and since 1999, 2 additional air taxi operators began using the area resulting in greater access opportunities.

During RY98 through RY00, the mean horn length of the harvested rams was 37.2 inches, and the average age was 10.3 years old (Table 4). Three rams had horns ≥40 inches (15% of harvest). During the previous 5 years, mean horn length was 34.9 inches and mean age was 9.2 years. Increased horn length and age were probably a reflection of fewer 8- and 9-year-olds in the population due to poor lamb survival in the early 1990s and to low annual harvest rates.

During RY98 through RY00, 1–3 sheep were harvested annually in the Mount Harper drawing permit area (Table 5). Each year, 4 permits were issued and 3–4 of the recipients participated, which is comparable to the previous 8 years. Mean horn length was 36.8 inches; and 1 ram had horns 40 inches long. No rams with horns ≥40 inches were harvested in the Mount Harper area during RY92–RY97. During the 1999–2001 composition surveys, 3–4 rams were observed annually that had horns estimated to be ≥40 inches (30–45% of the legal ram population).

Hunter Residency and Success. During RY98–RY00, 14 local residents, 53 state residents, and 6 nonresident hunters harvested 20 rams (27% success) during the general sheep season in Unit 20E (Table 6). The mean number of hunters per year was 25. Hunter participation has increased from 9 hunters per year during RY90–RY94 and 18 hunters per year during RY95–RY97. The initial increase was due to eliminating the permit requirement in the Charley and Seventymile drainages allowing more people to participate. The number of hunters increased during RY98–RY00 because of increased public awareness (several newspaper and magazine articles) and because 2 additional air taxi operators began operation in the area. Nonlocal Alaska residents comprised most of the increase.

During the report period 1 nonresident and 11 residents received Mount Harper permits. The nonresident and 5 of 9 Alaska residents harvested sheep (60%). Average success since RY90 has been 61%.

Harvest Chronology. Historically, the timing of sheep harvest varied annually in the area, because many hunters also hunted caribou and did not begin their hunt until the caribou were accessible. During this report period, 60% of the harvest occurred during the first 4 days of the season. This change of hunting behavior is probably due to a greater proportion of hunters learning about sheep hunting opportunities in this area and no longer approaching the sheep hunt

as incidental to caribou hunting because few caribou have been in the area during the first week of sheep and caribou season. If the hunter participation rate continues to increase and if most hunters choose to hunt the first week of the season, the objective of uncrowded hunting will not be met. The primary area of concern is the Charley River. We do not believe we need to change management to address these concerns at this time but will monitor trends and evaluate public satisfaction during the next report period (RY01–RY03).

Transport Methods. Except for GMCUA and the lower Charley River, terrain features and land ownership restrictions limit sheep hunters to using aircraft to access sheep habitat. A few hunters (8–12% annually) drive riverboats up the Charley River. In the GMCUA, all successful hunters reported walking into the area. During the 1980s, hunting by horseback was common among successful hunters; however, since 1992 no hunters used horses to access this area.

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.

We have documented that at least 7 wolf packs reside in the Mount Harper and Glacier Mountain sheep areas. To document the effects of the Fortymile Nonlethal wolf control program on Dall sheep, we monitored sheep numbers and composition within the Glacier Mountains and Mount Harper complexes. Wolf control was not found to be effective in causing short-term increases in sheep numbers in the Alaska Range (Gasaway et al. 1983). However, we hypothesized that sheep in these 2 areas would benefit from an 80% reduction in wolf population size. This prediction is based on the theory that wolf predation is a more important limiting factor in the Tanana Hills compared to the Alaska Range, because of the lack of escape terrain in the Tanana Hills. Surveys conducted during summers 2000 and 2001 indicate no change in population composition or short-term increases in population size. We will continue annual surveys and present the data in the next Tanana Hills sheep management report.

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 inches/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 mineral 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, possibly 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 and 1994, adverse weather conditions, and possibly predation, caused the population to decline. In 1994 the population began recovering and increased through 1997. It appears sheep numbers stabilized by 1998 and were stable to slightly declining until 2001. There appeared to be survivorship differences based on sex and age since 1997. Ram numbers remained relatively stable while ewe/yearling and lamb numbers declined. Unfavorable weather was probably the cause of reduced lamb production/survival but no limiting factors have been identified explaining the lower number of ewes/lambs. Legal ram numbers were stable, indicating minimum harvest effects.

Harvests have been low for the past 15 years, with little effect on the population. Hunter participation increased by 39% between the current report period RY98–RY00 and RY95–RY97 and by 212% since RY90–RY94. If hunter use continues to increase, crowding will occur in several areas and harvest will probably initially increase. Under this scenario, our management goal of maintaining aesthetically pleasing hunting conditions will not be met. We will monitor hunter and harvest trends during the next 2 years and determine a suitable management direction.

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 mining 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.

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Table 1 Mount Harper Dall sheep composition counts from aerial surveys, 1982, 1993 and 1997–2001

Sex/age class	1982[a]	1993[a]	1997[b]	2000[b]	2001[a]
Legal rams[c]	18	11	13	7	9
Sublegal rams[d]	22	15	16	19	23
Unclassified rams				0	0
Total rams	40	26	29	26	32
Ewes[e]	39	30	40	25	30
Lambs	8	4	9	9	12
Yearlings			5	9	
Unidentified				0	0
Total other sheep	47	34	54	43	42
Total sheep	87	60	83	69	74
Legal rams:100 ewes	46	37	33	28	30
Sublegal rams:100 ewes	56	50	40	76	77
Total rams:100 ewes	103	87	73	104	107
Lambs:100 ewes	21	13	23	36	40
% Lamb	9	7	11	13	16

[a] Super Cub 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 a ground survey in 1993 and aerial surveys during 1998–2001

Sex/age class	1993	1998	1999[a]	2000	2001
Legal rams[b]	3	6	4	6	7
Sublegal rams[c]	29	17	16	27	18
Unclassified rams			1	0	0
Total rams	32	23	21	33	25
Ewes[d]	42	54	40	61	50
Lambs	10	20	15	6	11
Yearlings					
Unidentified			0	0	0
Total other sheep	52	74	55	67	61
Total sheep	84	97	76	100	86
Legal rams:100 ewes	7	11	10	10	14
Sublegal rams:100 ewes	69	31	43	44	36
Total rams:100 ewes	76	43	53	54	50
Lambs:100 ewes	24	37	38	10	22
% Lamb	12	21	20	6	13

[a] Partial survey.
[b] Full curl or larger.
[c] Greater than 1/4 curl but less than full curl.
[d] 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, 1997–2001

Sex/age class	1997	1998	1999	2000[a]	2001
Legal rams[b]	18	24	24	7	27
Sublegal rams[c]	37	53	46	25	60
Unclassified rams	0	0	0	0	0
Total rams	55	77	70	32	87
Ewes[d]	156	116	149	54	121
Lambs	63	63	65	18	43
Yearlings	35	26	45	16	39
Unidentified					0
Total other sheep	254	205	259	88	203
Total sheep	309	282	329	120	290
Legal rams:100 ewes	12	21	16	13	22
Sublegal rams:100 ewes	24	46	31	46	50
Total rams:100 ewes	35	66	47	59	72
Lambs:100 ewes	40	54	44	33	36
% Lamb	20	22	20	15	15

[a] Partial survey.
[b] Full curl or larger.
[c] Greater than 1/4 curl but less than full curl.
[d] 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 through 2001

Regulatory year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Ewes	Total sheep	Hunters
1990[a]	1	36.0	11.0	0	1	4
1991[a]	3	33.7	8.3	0	3	13
1992[a]	1	33.0	10.0	0	1	5
1993[b]	5	34.0	8.8	0	5	11
1994[b]	3	33.7	8.0	0	3	8
1995[b]	8	36.3	9.1	0	8	16
1996[b]	5	35.0	9.4	0	5	16
1997[b]	9	35.3	10.5	0	9	23
1998[b]	5	35.6	10.0	0	5	15
1999[b]	10	36.9	10.8	0	10	28
2000[b]	5	37.4	9.8	0	5	31
2001[b]	7	37.3	10.2	0	7	14

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

Table 5 Mount Harper drawing permit sheep harvest, regulatory years 1990 through 2000

Regulatory year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	$\bar{x}$ Horn length	$\bar{x}$ Age	Total harvest
1990	4	2	1	1	39.8		1
1991	4	1	1	2	37.0		2
1992	4	2	0	2	34.5		2
1993	4	0	3	1	32.5	8.0	1
1994	4	1	3	0			0
1995	4	0	0	4	37.0	8.0	4
1996	4	1	1	2	35.6	10.5	2
1997	4	2	0	2	34.8	10.0	2
1998	4	1	2	1	40.0	10.0	1
1999	4	0	1	3	37.0	8.8	3
2000	4	1	1	2	35.0	7.0	2

Table 6 Tanana Hills sheep hunter residency and success[a], regulatory years 1993 through 2001

Regulatory year	Successful: Local resident	Successful: Nonlocal resident	Successful: Nonresident	Successful: Total (%)	Unsuccessful	Unsuccessful: resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonresident	Unsuccessful: Total (%)	Total hunters
1993	0	2	3	5 (45)	Local	1	4	1	6 (55)	11
1994	0	2	1	3 (38)		2	1	2	5 (62)	8
1995	2	5	1	8 (50)		1	6	1	8 (50)	16
1996	1	2	2	5 (31)		3	7	1	11 (69)	16
1997	0	6	3	9 (41)		3	10	0	13 (59)	22
1998	2	3	0	5 (33)		1	7	2	10 (67)	15
1999	0	7	2	10[b] (36)		8	10	0	18 (64)	28
2000	0	3	2	5 (16)		3	23	0	26 (84)	31
2001	0	4	1	7[b] (50)		2	2	0	7[b] (50)	14

[a] Excludes hunters in permit hunts.

[b] Total includes hunters of unknown residency.

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNITS: 23 (44,000 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 (Georgette and Loon 1991). Prior to 1991 resident and nonresident hunters living outside Unit 23 also hunted sheep for recreation in this area.

Sheep in Units 23 and 26A are at the northwestern margin of their range in Alaska. Consequently, these populations may be more prone to fluctuations in population size because of adverse weather 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, disease (rabies and distemper), and availability of reindeer, caribou and moose (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 reduced sheep numbers dramatically in Units 23 and 26A. In response, during 1991-2001 the department and the National Park Service (NPS) closed or shortened recreational or subsistence sheep hunting in most of these Units. Limited hunting was first reestablished in 1998.

Information about sheep in the upper Noatak drainage (i.e., the Schwatka Mountains: that area east of the Cutler, Redstone, Aniuk and Etivluk Rivers) will be reported in a separate report covering the central Brooks Range (Units 23, 24, and 26A).

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Baird Mountains

- Federal management on federal public land in the Baird Mountains has precluded State management goals and objectives

De Long Mountains

- Census sheep between the Wulik Peaks and Howard Pass prior to 2006.
- Maintain a minimum 7–10 7/8-curl-and-larger rams:100 "ewes."
- Establish criteria to regulate recreational and subsistence hunts.

Units 23 and 26A

- Increase consistency between state and federal hunting regulations in Units 23 and 26A.
- Monitor harvests through the harvest ticket system, permit hunts, community-based harvest assessments, public contacts and field observations.

METHODS

The department has not participated in Baird Mountain sheep surveys since 1999. In 2000 and 2001 the NPS conducted Baird Mountain sheep surveys in conjunction with a sheep research project. The De Long Mountain sheep trend count area (Kugururok River/Trail Creek area) was last surveyed in 1999 by the NPS. The Wulik Peaks trend count area was not surveyed during this reporting period because of staff constraints and unavailability of survey pilots and planes. Survey techniques used during this reporting period have been previously reported (Dau 1992). We use the term "lamb" to include sheep <12 mos old; "ewe" to include female sheep and males with ewe-like horns (1- 2-year-old rams); "small ram" to include rams <7/8 curl; and "large ram" to include rams ≥7/8 curl.

RESULTS AND DISCUSSION

POPULATION SIZE, STATUS AND TREND

Population Size

Baird Mountains. The Baird Mountain sheep population last peaked in 1989 (Table 1). Severe winters in 1989-1990 and 1990-1991 initiated the decline of sheep in this area through starvation. By 1991 the adult sheep population had declined by about 50%. From 1992 to 1996 wolf predation and disease may have affected the magnitude and duration of this decline. This sheep population appears to have bottomed out in 1996; at that time, the adult population constituted only about 33% of the population peak (1989). Lamb production was relatively low during 1991-1994 but rebounded to pre-1991 levels during 1995-2000. Lamb production was again low in 2001 compared to most other years perhaps because of an unusually late breakup.

We think the Baird Mountain trend count area includes 85–90% of the sheep population. Small groups of sheep regularly occur outside the trend count area in portions of the Squirrel River drainage. For many years we assumed sheep surveys conducted by Super Cubs with pilot/observer teams with years of sheep survey experience in this area observed 80-90% of the sheep in the count area. The NPS sheep research project will evaluate this assumption. Movements of sheep in and out of the trend count area and sightability undoubtedly affected sheep survey results (e.g. in 1996 and 1997). However, we think these effects were small in most years and not worth the cost of correcting them. The long-term trend in numbers of adults observed during minimum-count surveys appear plausible given what we know about weather, predators and adult sheep mortality.

De Long Mountains. We think sheep population dynamics in the De Long Mountains are similar to those in the Baird Mountains. In 1990-1991, after the sheep population declined in the Baird Mountains, the department and NPS delineated 2 trend count areas in the De Long Mountains to better monitor sheep: 1 in the Kugururuk/Trail Creek area and 1 in the Wulik Peaks. The Kugururuk/Trail Creek trend count area was completely surveyed only in 1994, 1995 and 1997. In all other years we surveyed only a portion of this area because of weather constraints and unavailability of survey planes, pilots and observers. In addition to the inconsistency in survey coverage, it appeared that relatively small trend count areas in extensive areas of potential habitat are no better for sheep than they are for moose. Sheep simply move in and out of the trend count area and mask changes in abundance and ram:"ewe" ratios. The lamb:"ewe" ratio is probably the only useful parameter in the Kugururuk/Trail Creek trend count data. This ratio has shown no clear trend through time. Sheep survey data from the Baird Mountains, which approaches a closed system, is probably the best index available for the status of sheep in the De Long Mountains, including the Wulik Peaks.

Wulik Peaks: The Wulik Peaks differs from other sheep habitat in Units 23 and 26A only in that it is managed by the State of Alaska. As with the Kugururuk/Trail Creek sheep trend count area, we think movements of sheep confounded trends in abundance and ram:ewe ratios. This area should be surveyed in conjunction with other portions of the De Long Mountains because it probably does not constitute a discreet population of sheep. Even so, the department may need to survey sheep in the Wulik Peaks given that federal lands may be closed to nonfederally-qualified subsistence users. If that occurs, as it has in the past, then all sheep taken under state hunts would be taken in the Wulik Peaks.

Population Composition

Following the Baird Mountain population decline of 1990–1991, relatively few lambs were observed during surveys in 1991-1994. This probably caused the decline in small rams (2-6-years-old) that bottomed out in 1996. Lamb production was high in 1995 and comparable to pre-crash levels through 2000. As a result, the number of small rams observed during surveys steadily increased since 1996. Trends in numbers of large rams and in the ratio of large rams:100 'ewes' in the Baird Mountains are unclear.

MORTALITY

Harvest

Seasons and Bag Limits.

1998–1999, 1999-2000, 2000-2001 Unit Bag Limit	Hunt Type	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
Unit 23, that portion south and east of the Noatak River and west of the Cutler and Redstone Rivers ("Baird Mountains)			
Resident hunters One sheep by registration permit only	R	10 Aug-30 Apr (CLOSED ALL YEARS BY EMERGENCY ORDER)	
All hunters One ram with full curl horn or larger by drawing permit only provided that the harvestable surplus in >47 sheep	D	Aug. 10-Sept. 20 (CLOSED ALL YEARS BY EMERGENCY ORDER)	Aug. 10-Sept. 20 (CLOSED ALL YEARS BY EMERGENCY ORDER)
Unit 23, that portion north of Rabbit Creek, Kiyak Creek, and the Noatak River, and west of the Aniuk River ("De Long Mountains)			
Resident hunters One sheep by registration permit only	R	1 Aug-30 Apr (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)	
All hunters One ram with full curl horn or larger by drawing permit only, provided that the harvestable surplus is >9 sheep in combination with that portion of Unit 26A, west of the Etivluk	D	10 Aug–20 Sep (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)	10 Aug–20 Sep (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)

1998–1999, 1999-2000, 2000-2001 Unit Bag Limit	Hunt Type	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
River			
Remainder of Unit 23 ("Schwatka Mountains)			
Resident hunters Three sheep by registration permit only	R	1 Aug-30 Apr	
All hunters 1 ram with full-curl horn or larger	H	10 Aug-20 Sept	10 Aug-20 Sept
Unit 26A, that portion west of the Etivluk River			
Resident hunters One sheep by registration permit only	R	10 Aug–30 Apr (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)	10 Aug–20 Sep (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)
All hunters One ram with full curl horn or larger by drawing permit only, provided that the harvestable surplus is greater than 9 in combination with that portion of Unit 23 in the De Long Mountains	D	10 Aug–20 Sep (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)	10 Aug–20 Sep (CLOSED 1999-2000 & 2000-2001 BY EMERGENCY ORDER)
Unit 26A, that portion east of the Etivluk River excluding Gates of the Arctic National Park			
Resident hunters Three sheep by registration permit only	R	1 Aug-30 Apr	
All hunters			

1998–1999, 1999-2000, 2000-2001 Unit Bag Limit	Hunt Type	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
One ram with full curl horn or larger	H	10 Aug-20 Sept	10 Aug-20 Sep
Unit 26A, that portion within Gates of the Arctic National Park			
Three sheep		1 Aug-30 Apr	No open season

Board of Game Actions and Emergency Orders. In 1998 the Federal Subsistence Board closed state sheep regulations on federal lands in the Baird and De Long Mountains by special action. The department subsequently issued an emergency order (Number 05-02-98) that: 1) closed all state sheep hunting in the Baird Mountains; 2) closed all state sheep hunting in those portions of the De Long Mountains in Units 23 and 26A not drained by the Wulik, Kivalina, Kukpowruk or Kukpuk Rivers; and 3) stipulated that all state sheep hunting in the Wulik Peaks would be closed when the combined harvest of sheep on state and federal lands reached 20 full-curl horn or larger rams. State sheep hunting regulations have not been in effect in the Baird Mountains since that time.

Assuming there would be a harvestable surplus of full curl rams for the 1999-2000 regulatory year, the department and NPS negotiated cooperative sheep hunting regulations. An informal agreement was developed that specified:

1. Sheep harvest in the Baird Mountains of Unit 23 will be allocated by the FSB.

2. Sheep harvest in the De Long Mountains of Units 23 and 26A would be allocated jointly by the FSB and the BOG. Assuming a harvestable surplus of 20 full curl rams in 1999-2000, the FSB and the BOG would authorize the following:

    A. The National Park Service would issue federal registration permits to harvest 10 full curl rams. This harvest could be divided between fall and spring hunts. Federal permits would allow use of aircraft, and would be valid only on federal public lands.

    B. The Alaska Department of Fish and Game would issue state registration permits to Alaska residents in Kotzebue, Noatak, and Kivalina to harvest 5 full curl rams. Additionally, 5 state drawing permits to take full curl rams would be issued by lottery to residents and non-residents of Alaska. Registration permits would not allow use of aircraft while drawing permits would allow use of aircraft. State registration and drawing permits would be valid on federal public lands.

3. If 1999 sheep surveys indicated the harvestable surplus in the De Long Mountains would be less than 20 full curl rams, the Alaska Department of Fish and Game would close the drawing permit hunt.

Sheep surveys in the Baird Mountains suggested there was no harvestable surplus of rams in the De Long Mountains for the 1999-2000 regulatory year. As a result ADF&G issued an emergency orders (Number 05-01-99) that closed all sheep hunting in Units 23 and 26A west of the Etivluk, Aniuk, Cutler and Redstone Rivers. Quotas for all federal hunts in this area were 0.

Baird Mountain sheep surveys conducted by NPS in July 2000 again suggested there was no harvestable surplus of rams in the Baird or De Long Mountains for the 2000-2001 regulatory year. The department issued an emergency order (Number 05-02-00) that closed all sheep hunting in Units 23 and 26A west of the Etivluk, Aniuk, Cutler and Redstone Rivers. Quotas for all federal hunts in this area were 0.

Based on sheep surveys conducted in the Baird Mountains by NPS in July 2001, NPS determined there was a harvestable surplus of 10 full curl rams in the Baird Mountains and 10 full curl rams in the De Long Mountains. A public meeting was held by NPS and representatives of Noatak, Kivalina and Kotzebue supported these quotas. The department issued an emergency order (Number 05-06-01) that: 1) closed all state sheep hunting in the Baird Mountains; 2) closed the state drawing permit sheep hunt (DS384) in the De Long Mountains; and 3) closed the state season for all but full-curl or larger rams in the De Long Mountain registration permit subsistent hunt (RS388)

Hunter Harvest. Regulatory actions by the FSB and the department precluded any sheep being harvested under state regulations in the Baird Mountains during this reporting period (Table 4).

During the 1998-1999 regulatory year the single ram reported harvested in the De Long Mountains was taken under federal regulations. Fall weather was very poor during 1998 when the state drawing permit hunt was administered in the Wulik Peaks. As a result only 2 drawing permit hunters flew into the area and both parties were restricted to their tents during their entire hunt. Many drawing permit winners decided to not hunt the Wulik Peaks because of the uncertainty that lasted until just prior to August 10 as to whether this hunt would occur.

Regulatory restrictions by ADF&G and NPS precluded sheep harvests in the De Long Mountains during 1999-2000 and 2000-2001.

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 or reported during this or the last reporting periods.

CONCLUSIONS AND RECOMMENDATIONS

The Baird Mountain sheep population is approaching pre-crash population levels. We assume this means sheep in the De Long Mountains are recovering as well. Since 1998 the department and NPS have worked with Advisory Committees, the Northwest Arctic Regional Advisory Council and members of the public to gradually resume sheep hunting in Unit 23. Despite good intentions by most agencies and individuals that have been involved in regulatory decisions, dual management has created a complex suite of regulations that are confusing even to agency staff.

It's not surprising that most hunters, regardless whether they hunt primarily for subsistence or recreation, find sheep hunting regulations very difficult to understand. Increasing the consistency of state and federal regulations regarding season dates, methods of transportation, destruction of trophy value and proxy requirements is needed to reduce confusion.

A census should be conducted to estimate sheep abundance and composition in the De Long Mountains west of Howard Pass (including the Wulik Peaks). It would be advantageous to cooperatively conduct such this work with NPS.

In 1998 federal action closed the Baird Mountains and that portion of the De Long Mountains east of and including the Kelly River drainage to state-managed sheep hunts. It is unlikely that federal subsistence needs will ever be met in the Baird Mountains; therefore, the state should continue to not publish sheep hunts for this area.

The cooperative approach established in 1998 between ADF&G and NPS to formulating sheep hunting regulations in the De Long Mountains should be continued. However, the department should seek a greater role in determining the harvestable surplus of sheep in the De Long Mountains than has occurred in recent years (e.g. 2000-2002).

The department should not publish the De Long Mountain sheep drawing hunt (DS384) until there is a reasonable probability of actually conducting the hunt. Closing this hunt by emergency order just prior to the season opening date in 1999-2001 angered many successful applicants and some guides.

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Table 1 Number of Dall sheep observed during aerial surveys in the Baird Mountains, Unit 23, 1989–2001

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Rams 1/2+	162	105	108	130	123	93	90	75	114	116	86	107	145
Rams 7/8+	51	32	35	42	37	1	23	56	72	70	28	25	50
"Ewes"[a]	574	466	239	267	256	204	166	169	314	289	243	317	389
Lambs	170	133	17	59	47	20	95	58	83	72	77	101	73
Unknown	75	14	36	0	0	0	0	0	0	0	0	0	9
Total Sheep	981	718	400	456	426	317	351	302	511	477	406	525	616
Total Adults[b]	736	571	347	397	379	297	256	244	428	405	329	424	534
Lambs:100 "Ewes"	30	29	7	22	18	10	57	34	26	25	32	32	19
Rams:100 "Ewes"	28	23	45	49	48	46	54	44	36	40	35	34	37
Rams 7/8+: 100 Ewes	9	7	15	16	14	20	14	33	23	24	12	8	13
Adults/mi^2	1.03	0.80	0.49	0.56	0.53	0.42	0.36	0.34	0.60	.57	.46	.60	.75

[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, 1983–1999

Classification	1983[b]	1987[c]	1991	1992	1993	1994	1995	1996[g]	1997[h]	1998[i]	1999[i]
Rams 1/2 + (all)	95	77	81	72	63	27	38	19	36	28	39
Rams 7/8 +	54	49	38	26	16	12	13	3	18	6	12
Ewes[d]	171	90	159	99	112	93	137	91	121	99	74
Lambs	61	50	24	20	27	1	56	49	47	14	29
Unknown	9	0	1	0	0	0	0	2	0	0	0
Total	336	217	265	191	202	121	231	161	204	141	142
Adults[e]	266	167	240	171	175	120	175	112	157	127	113
Lambs:100 Ewes	36	56	15	20	24	1	41	54	39	14	39
Rams:100 Ewes	56	86	51	73	56	29	28	23	30	28	53
Rams7/8+:100	32	54	24	26	14	13	9	3	15	6	16
Area (mi^2)	367	367	367	367	367	520[f]	520	420	520	265	493
Adults/mi^2	0.72	0.45	0.65	0.46	0.48	0.23	0.33	0.27	0.30	0.48	0.23

[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 in Units 23 and 26A[a] (R = rams, E = ewes, U = unknown sex) under state and federal hunts

	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]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995–96[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996–97[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997-98[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998-99[f]	0	0	0	0	16	0	0	1	0	0	0	0	0	17	17
1999-00[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-01[e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] does not include unreported harvest; DeLong Mountains is defined as the area north of the Noatak River and west of Aniuk-Etivluk Rivers (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).
[f] All sheep taken under federal regulations

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

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

BACKGROUND

The Central Brooks Range is located in portions of Units 23, 24, and 26A. It includes the drainages of the upper Noatak, Killik, Chandler, and Koyukuk Rivers, encompassing the Schwatka and Endicott Mountains. Dall sheep are sporadically distributed within the Central Brooks Range, but probably constitute one population. Thus, beginning in fall 1995, sheep data in these drainages were combined into a single report. Previously, harvest and population data for sheep in those portions of Units 23 and 26A east of Howard Pass were included in the Units 23 and 26A sheep management report for the Baird and DeLong Mountains, and data for sheep in Unit 24 West (west of the Dalton Highway Corridor Management Area [DHCMA]) were included in the Unit 24 sheep management report. Data for sheep in Unit 24 within and east of the DHCMA were and currently are included in the eastern Brooks Range sheep management report. Within Unit 24 West, sheep in Gates of the Arctic National Park (GAAR) are managed under federal law and federal subsistence hunting regulations have applied in the GAAR since 1981.

Few sheep surveys have been conducted within the Central Brooks Range, most within GAAR. During the early to mid-1970s, the population was thought to be low (Whitten 1997). Surveys conducted during the 1980s and 1990s suggested that the population increased between 1982 and 1984, was stable during 1984 through 1987, and declined dramatically by 1996 (Whitten 1997; Brubaker and Whitten 1998). During the late 1980s and early 1990s, the sheep population experienced poor lamb crops as a result of heavy snowfalls. However, high numbers of lambs and yearlings were counted in 1996, indicating that the population was stable or increasing (Whitten 1997). From 1996 to 2002 the population was stable with annual fluctuations that were probably related to weather.

Prior to expansion of the GAAR 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 annual total harvest

(reported and estimated unreported) was 50 rams. The take by Nunamiut hunters (inland Inupiat Eskimos) was unrecorded but was likely ≤50 per year (Osborne 1996). During the 1980s, hunting regulations for this area changed substantially, resulting in general sheep hunting being closed in GAAR. Recently, harvest in the state general hunt has been low (7–10), probably partially due to scarcity of full-curl rams because of poor lamb crops in the early 1990s (cohorts that would currently be full curl). Reported harvest in GAAR has changed little since 1990, with an average of 18 sheep harvested annually; except in RY01 when only 5 sheep were reported taken.

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 as well as 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 area in which population and harvest data were collected for this report is known as the Central Brooks Range, which includes the Schwatka and Endicott Mountains. It is bounded to the west in Unit 23 by a line beginning at Howard Pass, then running southwesterly down the Aniuk River to the Noatak River then downriver 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 and including Unit 24, west of the DHCMA. The Central Brooks Range also includes sheep in Unit 26A, south of the line at 68°30'N latitude, east of the Etivluk River, and west of the boundary between Units 26A and 26B. Sheep in Unit 24 inhabiting the DHCMA, and east of the DHCMA, were included in the eastern Brooks Range sheep report.

POPULATION STATUS

In 1996, GAAR and ADF&G cooperated in a sheep population survey in a 2220 mi^2 portion of GAAR (Whitten 1997; Brubaker and Whitten 1998). The survey area was divided into 92 sample units ranging in size from 24 to 60 mi^2. Seventy-nine sample units were searched with a fixed-wing Super Cub aircraft at relatively low intensity (0.74–0.93 min/km^2). Thirty-four of those units were randomly selected and resurveyed at a higher intensity (0.97–1.34 min/km^2) using a Robinson R-22 helicopter. High-intensity counts were usually initiated in a unit within 30 minutes of the completion of the low-intensity units. Eleven units were surveyed only with

the Robinson R-22 helicopter because of poor weather conditions for the fixed-winged aircraft. The purpose of the 2 techniques was to assess previously used methods and experimentally implement a new technique. See Whitten (1997) for an analysis of these techniques. Population estimates were calculated for all fixed-wing survey units using corrected sightability and flight survey intensity factors (Whitten 1997; Brubaker and Whitten 1998). Sheep were classified as rams, ewe-like, and lambs when using fixed-winged aircraft. The ewe-like category included ewes and rams smaller than ¼ curl. When using the helicopter, sheep were classified as lambs, yearlings, ewes, and rams. Rams were further classified into ¼-, ½-, ¾-, and full-curl rams. Lambs were sheep less than 1 year of age for both techniques.

A subsample of the 1996 population survey area was surveyed during 1998–2002 in June or July by staff from GAAR using a fixed-wing Super Cub aircraft (Lawler 2001). Sheep were classified as rams, ewe-like, and lambs, similar to the 1996 surveys except that rams smaller than ½ curl were included in the ewe-like category.

Harvest

During 1988–1997, ADF&G staff monitored the federal subsistence harvest in GAAR by conducting personal interviews with hunters, issuing permits, and sending out questionnaires to registered hunters after the close of the hunt. Sex, date of kill, and location of kill were recorded. During this period, we collected subsistence harvest data from the following villages in Unit 24: Anaktuvuk Pass, Wiseman, Bettles, Coldfoot, and Allakaket. In Unit 23 subsistence data was collected from Ambler. In 1997 GAAR implemented a community harvest quota for Anaktuvuk Pass (60 sheep, not to exceed 10 ewes) and GAAR personnel assumed responsibility for collecting harvest data from that village. In addition, beginning in 1992, the Bureau of Land Management (BLM) administered another federal subsistence hunt along the DHMCA for residents of Unit 24 north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia. Three agencies are involved in collecting subsistence harvest data on federal lands, which creates substantial confusion for local residents. Because GAAR does not allow hunting other than by residents of Unit 24 north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia, ADF&G staff will no longer be directly involved in collecting these data. However, we will continue to cooperate with GAAR staff to summarize the federal subsistence harvest data and the state general harvest data collected by ADF&G through the statewide harvest ticket system. Harvest ticket reports were required from all hunters not qualified to hunt under the federal system. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY01 = 1 Jul 2001 through 30 Jun 2002). Harvest data for the DHCMA and east of the DHCMA obtained through the statewide harvest ticket system and the BLM registration hunt were reported in the eastern Brooks Range sheep report.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Sheep population estimates within the Central Brooks Range were from within the GAAR. Sheep numbers probably increased during the 1980s, decreased during the early to mid-1990s,

and were stable during 1996–2002. In 1982, Singer (1984) reported 4417 sheep in all of the GAAR (12,600 mi^2) with an estimated density of 0.9–2.0 sheep/mi^2. In 1987, Adams (1988) only surveyed 728 mi^2 and reported 12% more sheep than Singer did in the same area; however, upon reexamination of the data, Adams did not have the correct figures for Singer's 1982 data and Whitten (1997) reported that sheep numbers were stable between 1984 and 1987 in that 728 mi^2 area. In 1993, Osborne (1996) counted 617 sheep in an 817-mi^2 area with an estimated density of 0.5–0.8 sheep/mi^2. Sightability was poor in a portion of that survey. In 1996, ADF&G and GAAR counted 618 sheep in almost the same area as was surveyed in 1993. In addition, most of the GAAR (2220 mi^2) was surveyed in 1996. A population of 2758 ±8% (90% CI) sheep, with densities of 0.3–1.6 sheep/mi^2, was estimated using sightability correction and flight survey intensity factors (Whitten 1997; Brubaker and Whitten 1998). This estimate was substantially lower than the 4605 Dall sheep counted in the same area in 1982 (densities ranged 1.1–2.8 sheep/mi^2).

Although different portions of the GAAR were surveyed during 1982–1996, some of the same sample units (Singer 1984, sample units 1, 2, and 5) were surveyed in 1982, 1984, 1987, and 1996. In these sample units, 882 sheep were counted in 1982, 1079 were counted in 1984, 1043 were counted in 1987, and 358 sheep were estimated in 1996 (Table 1; Singer 1984; Adams 1988; Whitten 1997; Brubaker and Whitten 1998). Table 1 also records a 1993 survey (617 sheep; Singer 1984, sample units 1, 2, and 3) that overlaps some of the same sample units surveyed in 1982, 1984, 1987, and 1996. We also compared portions of the sample units surveyed in 1993 with those same portions of units surveyed in 1982, 1984, 1987, and 1996 (Table 2; Whitten 1997). The trends observed in Table 2 were the same as those observed in Table 1. Whitten (1997) suggested that sheep increased 11% per year between 1982 and 1984, were stable during 1984 and 1987, and declined 66% by 1996 (Table 1). However, comparisons of population levels among years should be done cautiously because search intensity and methods varied among years. Nonetheless, Brubaker and Whitten (1998) and Whitten (1997) suggested that the decrease in sheep numbers from 1982 to 1996 could not be explained by search intensities. Thus, sheep were far less abundant in the mid-1990s compared with the 1980s. This trend also was observed in the eastern Brooks Range and the Alaska Range (Osborne 1996; Scotton 1997; Whitten 1997; Gardner 1999; Arctic National Wildlife Refuge, FWS, unpublished data). The decline in sheep populations across all these areas appeared to be correlated with severe, deep snowfall winters between 1988 and 1993 (Whitten 1997). In the Central Brooks Range, snowfall during 1988 through 1993 was above a 42-year average of 90 inches (range: 95–170 inches, Bettles, Alaska airport), except in 1991 when snowfall was approximately 53 inches. During RY94, snowfall was approximately 90 inches and was low in RY95 (56 inches). This low snowfall year preceded the 1996 sheep survey in which a higher proportion of lambs was observed (Whitten 1997).

Staff from GAAR continued to conduct sheep surveys in portions of the 1996 survey area. During 1998–2002, sheep numbers ranged from 186 to 460 (Table 3). The low value of 186 during the 1999 survey was influenced by high winds and poor visibility. Whitten (1997) suggested the population was increasing in 1996. However, recent surveys indicate that, ignoring annual fluctuations, the population was stable from 1996 to 2002 (Jim Lawler, GAAR, personal communication).

Population Composition

Population composition varies from year to year depending on lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting (Heimer 1988). Although it is difficult to directly compare population numbers across years because of varied methods, the data can be valuable to evaluate trends in composition. Whitten (1997) indicated that the sheep population was probably stable between 1984 and 1987 and percent lambs and the lamb:100 ewe ratios support this suggestion. In the same 3 sample units in 1982, 1984, and 1987, percent lambs were 18%, 19%, and 18%, respectively, and the lamb:100 ewe ratio was 45, 51, and 47, respectively (Table 1; Singer 1984; Adams 1988). By 1993 the lamb:ewe ratio was 29:100 with 16.5% lambs (not the same area as the 1982–1987 or 1996 surveys). In 1996, increases in percent lambs and lamb:ewe ratio in the same area as the 1982, 1984, and 1987 surveys, indicated that reproductive success had increased and the population might have been growing (22% lambs with helicopter classification only; lamb:ewe ratio estimated at 47:100 ±8% [90% CI]; Table 1; Whitten 1997; Brubaker and Whitten 1998).

To compare the 1998–2002 classification data to the 1996 surveys, Lawler (2001) used classification from the surveys conducted by fixed-wing aircraft in 1996, which used the same method as surveys conducted during 1998–2002. In addition, classification of ewes conducted by fixed-wing aircraft in 1996 and 1998–2002 included rams smaller than ½ curl (ewe-likes.) The ratio for 1996 was 38 lambs:100 ewe-like, with 24% lambs. This ratio was similar to estimates obtained for the entire 1996 survey in which only helicopter classification data was used to estimate lamb:ewe ratios and percent lambs. The high lamb:ewe ratio in 1996 may have indicated an increase in the population as Whitten (1997) suggested. From 1998 to 2001, percent lambs ranged from 11% to 21% and lambs:100 ewe-likes ranged from 17 to 34 (Table 3). The low number of lambs observed in 2001 may have been related to high snowfall during winter 2000–2001 (111 in). In 1998–2002 the actual lamb:ewe ratio was likely higher than observed because of the inclusion of young rams in the ewe-like category. Thus, the actual ratio may have been consistently greater than 30 lambs:100 ewes, except for 2001. This suggests a stable to increasing population. However, population numbers did not increase from 1996 to 2002 (Table 3). Adult ewe mortality during 1998–2001 ranged 17–29% annually on radiocollared ewes (n = 14–18; Jim Lawler, GAAR, personal communication) and may have slowed or prevented a population increase.

Rams were classified differently during 1982–2002. Singer (1984) combined ram statistics for surveys that occurred during 1982–1984 and reported that GAAR had 28% rams and only 8% of those rams were 7/8 curl or larger. Adams (1988) determined that within the area he surveyed, the population contained 35% rams with 50% of those rams full curl or larger. The proportion of rams and large rams observed in the 3 sample units surveyed in 1982, 1984, and 1987 was similar to the trend observed in the complete surveys for those years (Table 1). In 1982 and 1984, percent rams were 27% and 30% and percent of rams greater than or equal to full curl was 10% and 13%, respectively. In 1987, percent rams was similar at 31%, but percent of rams greater than or equal to full curl was 48%. Prior to 1982, sheep hunting within GAAR was open to both residents and nonresidents (Osborne 1996). During 1982–1984 only residents of Anaktuvuk Pass were allowed to hunt sheep within GAAR (Singer 1984). The increase in percent rams greater than or equal to full curl observed in 1987 may have been influenced by

changes in hunting regulations, although differences in sizes of cohorts produced during the period also may have contributed. In 1993, Osborne (1996) reported 26% rams and 39% greater than or equal to full curl (Table 1; not the identical area as the 1982–1987 or 1996 surveys). (Note: Osborne [1996] calculated 39% by including 7 rams in the total that were not classified. By using only classified rams, the percent of rams greater than or equal to full curl was 41%). By 1996, percent rams was estimated at 22% and the percent of rams greater than or equal to full curl was 33% for the 3 sample units surveyed in 1982, 1984, and 1987 (Table 1). The decrease in proportion of rams observed, particularly full curl and greater, may have been influenced by deep snows that occurred during 1988–1993, which probably reduced survival of lambs born during these years. These lambs would have become full-curl rams during 1994–2000. Furthermore, if larger cohorts were produced beginning in 1994, then there would be more young rams included in the "ewe-like" category, which would further reduce the perceived proportion of rams in the population. In addition, hunting regulations varied little during the 1990s. The classification from helicopter for the entire 1996 survey was 20% rams with 29% of those rams greater than or equal to full curl (Whitten 1997). Because rams were classified as ½ curl and greater for the 1998–2002 surveys, it is difficult to compare ram statistics for these years to previous surveys. Percent rams ranged 15–20% during 1998–2002 with the lowest number of rams observed in 2002.

MORTALITY

Harvest

(Note: Only state regulations are listed below.)

Season and Bag Limit (RY98–RY02).

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 on private lands.		
RESIDENT HUNTERS: 3 sheep.	1 Aug–30 Apr	No open season
Remainder of Unit 24.		
RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep
Units 23 (Schwatka Mountains) and 26A, east of the Cutler, Redstone, Aniuk, and Etivluk Rivers.		
RESIDENT HUNTERS: 3 sheep by registration permit only (RS389).	1 Aug–30 Apr (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep

Alaska Board of Game Actions and Emergency Orders.

Unit 24 — For RY95 the Alaska Board of Game eliminated the requirement of harvest tickets for the subsistence sheep hunt in GAAR and also removed the hunt from the state regulations as it was under federal subsistence regulations. However, the season and harvest ticket requirement was reinstated in RY96 to cover hunting on private lands within GAAR. The rest of Unit 24 maintained a 1 ram with full-curl bag limit with the mandatory harvest ticket requirement during 10 August–20 September. Seasons and bag limits have remained the same since RY96 for Unit 24.

Units 23 and 26A — To make regulations consistent within GAAR, the Board of Game established a general hunt (with a harvest ticket requirement) for RY96 for that portion of Units 26A and 26B within GAAR on private lands. The bag limit was increased from 1 to 3 sheep with a 1 August–30 April season for both residents and nonresidents. In RY97 this area was closed to nonresidents. This season and bag limit has remained the same since RY97.

For those portions of Unit 23 in the Schwatka Mountains and Unit 26A, east of the Cutler, Redstone, Aniuk, and Etivluk Rivers, excluding GAAR, a subsistence registration permit hunt was established beginning in RY98. The bag limit was 3 sheep with a 1 August–30 April season. Prior to RY98, ADF&G administered a winter subsistence sheep hunt (1 sheep; 1 Oct–30 Apr) even though no such season existed in state regulation. The Board of Game action corrected the technical oversight, increased the bag limit and extended the season. The rest of Unit 26A maintained a 1 ram with full-curl bag limit with the mandatory harvest ticket requirement during a 10 August–20 September season. See ADF&G's Unit 23, western Brooks Range sheep management report for regulatory changes for the remainder of Unit 23.

Hunter Harvest. The combined harvest from the GAAR and the state general hunt declined slightly during the past 5 years ($\bar{x}$ = 22; RY97–RY01) compared to the previous 5 years ($\bar{x}$ = 31; RY92–RY96; Table 4). Most of the decline in this harvest occurred in the general hunt, but some decline in the GAAR subsistence hunt also occurred (Table 4). In addition, GAAR hunters harvested most of the sheep ($\bar{x}$ = 60%; range: 42–81%; RY90–RY01; Table 4).

The general harvest for the Central Brooks Range (excluding GAAR) averaged 8 sheep during the past 5 years (range: 7–10; RY97–RY01; Table 5) compared to the previous 5 years ($\bar{x}$ = 12; RY92–RY96; Table 5). The decline in harvest actually began in RY96. This may be related to availability of full-curl rams after 1996. Poor lamb crops during the late 1980s and early 1990s may have reduced the number of full-curl rams in the population during the mid- to late 1990s. However, some of the lower harvest was also probably related to fewer hunters in the field as

numbers of hunters also began to decrease in RY96 (Table 5). Individuals reporting on the general harvest reports hunted primarily in the Alatna, John, and Wild river drainages. The mean age and horn length could not be used to make generalizations about the harvest or population due to the small sample size (Table 6).

Permit Hunts. The reported federal subsistence harvest from GAAR during the last 5 years averaged 14 sheep (range: 5–19; RY97–RY01; Table 4). This harvest declined somewhat compared with the previous 5 years ($\bar{x}$ = 19; range: 9–26; Table 4). Most of the sheep harvested were adults, and rams usually made up 75% or greater of the harvest (Table 7). Where local residents should report harvest has been confusing since 1997 when GAAR personnel assumed responsibility for collecting harvest data from Anaktuvuk Pass. Problems incurred were duplication of reporting between the federal and state systems and/or lack of reporting. In most subsistence hunts we believe some sheep are taken and not reported, but confusion about where to report also may have influenced recent reporting. In addition, some ewe harvest probably was not reported.

Hunter Residency and Success. In the state general harvest, the 5-year average success rate for the area was 39% (range: 27–50%; RY97–RY01). Success rates did not change much compared with previous years (Table 5). During the past 5 years (RY97–RY01), success rates were higher for nonresident hunters (range: 70–89%) compared with resident hunters (range: 11–30%). Nonresident hunters primarily used guides. The percent of nonresident and resident hunters was variable during RY97–RY01 (Table 5). However, in Unit 26A almost all hunters were nonresidents. In general, most hunting occurred in Unit 24 and little or no hunting occurred in Unit 23.

Hunters from Anaktuvuk Pass harvested most of the sheep taken during the subsistence hunt in GAAR. Residents of Wiseman were the other primary local sheep hunters. Success rates were difficult to determine because reporting by unsuccessful hunters can be inconsistent and recently there was no attempt to obtain information about hunter effort. However, in RY01, only 5 sheep were harvested compared to a mean of 17 sheep for the previous 5 years. A small harvest also occurred during RY95 (9 sheep). These smaller harvests could be related to weather and traveling conditions, or confusion about where to report. In addition, it may be more difficult for federal subsistence hunters to find sheep in GAAR.

Harvest Chronology. Harvest of sheep in the Central Brooks Range in the state general hunt took place primarily in the first 10 days of the season during RY93–RY01 (Table 8). In some years, more harvest occurred during the second 10 days. Timing of harvest was probably related to weather and the desire of hunters to be in the field before a great deal of hunting has occurred causing sheep to become more wary.

Federal subsistence hunters who hunted in GAAR in Units 24 and 26A took sheep in both fall (Aug and Sep) and spring (Mar and Apr). The season in which most sheep were taken was variable during RY90–RY01. In the upper Noatak in Unit 23, the main factors affecting sheep hunting were weather and traveling conditions (i.e., snow).

Transportation Methods. In the RY93–RY01 state general hunts, aircraft were the major transportation means because access by other means is limited (Table 9). Boats, primarily out of Bettles, were the second most used means of transportation.

Federal subsistence hunters who hunted in GAAR primarily used ATVs in the fall and snowmachines in the winter and spring. In the upper Noatak in Unit 23, snowmachines were the primary means of transportation used to access sheep habitat.

Other Mortality

GAAR personnel monitored radiocollared sheep in GAAR during 1997–2002 (Jim Lawler, GAAR, personal communication). Annual mortality rates were reported as follows: 1998 (22%; $n = 19$), 1999 (18%, $n = 17$), 2000 (17%, $n = 18$), and 2001 (29%, $n = 14$).

CONCLUSIONS AND RECOMMENDATIONS

There was some indication that the sheep population in the Central Brooks Range was stable during the past 5 years (RY98–RY02; Table 3). In the GAAR survey, the lamb crop was good. The average percent lambs was 18% and lambs:100 ewe-likes remained ≥27, except in 2001 when there was a late spring. Yet, adult ewe mortality of radiocollared sheep was somewhat high and may have prevented an increase in the population even though lamb production appeared good. The combined reported harvest from the GAAR subsistence hunt and the state general hunt remained <30 with rams as the largest proportion of the harvest. Because the harvest was low and predominantly rams, this likely had little effect on the sheep population. However, if more ewes were harvested and not reported, this could affect the population. The number of hunters and sheep harvested in the state general hunt has declined during the past 5 years (RY97–RY01; Table 4).

The 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 increased as a result of increased tour bus transit on the Dalton Highway in recent years.

The goal of providing opportunity for a 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. The goal of providing an opportunity for a general harvest outside of GAAR was met as there was a season and bag limit.

The 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 were met. Seasons and bag limits did not change for GAAR hunters; thus allowing them ample opportunity to harvest sheep. In the general hunt, seasons and bag limits also remained the same, providing opportunity to harvest full-curl rams. And although the number of hunters declined, success rates remained good ($\bar{x}$ = 39% for RY97–RY01; Table 4).

The objective to maintain a naturally regulated sheep population in the Central Brooks Range is not a meaningful objective because harvest of sheep was allowed; thus we have eliminated this objective for the next reporting period.

We will continue to work with staff from GAAR to summarize harvest data. We suggest a cooperative effort between the 3 agencies to continue existing sheep surveys already conducted by GAAR staff. We recommend revising the management goal and objective as follows:

MANAGEMENT GOAL

- Provide opportunity for a general harvest and a subsistence harvest as well as nonconsumptive use of Dall sheep.

MANAGEMENT OBJECTIVE

- Maintain a general harvest of full-curl rams in the Central Brooks Range, in addition to federal subsistence hunts.

Activity

- Monitor harvest in the Central Brooks Range through the harvest ticket system, cooperative effort with GAAR and BLM staff, and through hunter contacts. Analyze harvest data.

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Table 1 Aerial composition counts of Dall sheep in Gates of the Arctic National Park and Preserve (Singer 1984, sample units 1, 2, and 5) for years 1982, 1984, 1987, and 1996 (1993 sample units were 1, 2, and 3)

Year	Lambs (%)[a]	Ewes[b] (%)[a]	Lamb:100 Ewes	Yearlings (%)	Rams (%)[a]	Rams:100 Ewes	% of Rams ≥ full curl[a]	Unk adults	Total[a]
1982	162 (18)	359 (42)	45	105 (12)	229 (27)	64	10	27	882
1984	204 (19)	400 (38)	51	127 (12)	322 (30)	80	13	26	1079
1987	192 (18)	406 (39)	47	114 (11)	328 (31)	81	48	3	1043
1993	102 (17)	356[c] (58)	29		159 (26)	45	41[d]		617
1996[e]	85 (24)	191 (54)	45		80 (22)	42	33	0	358

[a] When calculating percent ratios, unknown classified animals were subtracted from total.
[b] Ewes included ewes, yearlings, and rams smaller than ¼ curl.
[c] In Osborne 1996, Table 1, the number reported is 393, but this was a typographical error.
[d] Osborne 1996 reported 39%, but 7 rams were unclassified; thus we subtracted 7 from the total to obtain 41%.
[e] The 1996 survey for total sheep was an estimate, not a count. Numbers for composition were derived from helicopter classification; thus, the numbers do not add up to 358 (ADF&G files, Whitten 1997).

0

Table 2 Number of Dall sheep and time spent searching in portions of Gates of Arctic National Park and Preserve (Whitten 1997)

Year	Whitten 1997 count areas			Combined 21–25 and 31–34 (min)
	11–16 (min)	21–25 (min)	31–34 (min)	
1982	354 (180)	462 (408)	216 (210)	678 (618)
1984		578 (unk)	237 (unk)	815 (unk)
1987		666 (666)	264 (314)	930 (980)
1993	131 (267)	213 (514)	81 (232)	294 (746)
1996[a]	[b] (298)	227 (622)	80 (280)	307 (902)

[a] The 1996 survey is an estimate, not a count (Whitten 1997).
[b] In Whitten (1997) the number reported is 184; but upon reexamination at a later date, the number should be 150.

150

Table 3 Aerial surveys of Dall sheep in Gates of Arctic National Park and Preserve (Jun–Jul), 1996–2002 (data source: Jim Lawler, GAAR)

Year	Lambs (%)	Ewe-like[a]	Lambs:100 Ewe-like	Rams (%)	Unk adults	Total	Area survey (mi^2)
1996	108 (24)		38		337	445	475.3
1998	66 (17)	228	29	61 (15)	31	386	475.3
1999[b]	39 (21)	116	34	31 (17)	0	186	449.6
2000	93 (20)	279	33	88 (19)	0	460	344.0
2001[c]	32 (11)	193	17	57 (20)	0	282	307.7
2002	76 (19)	260	29	56 (14)	0	392	475.3

[a] Ewe-like includes adult ewes, yearlings, and rams smaller than ½ curl.
[b] Poor survey conditions; high winds and poor visibility.
[c] Late spring.

Table 4 Central Brooks Range sheep harvest, regulatory years 1993–1994 through 2001–2002

Regulatory year	23		24[a]		26A		Total		
	GAAR[b]	Other[c]	GAAR	Other	GAAR	Other	GAAR	Other	Combined (% GAAR)
1990–1991							22	28	50 (44)
1991–1992							23	32	55 (42)
1992–1993							22	15	37 (59)
1993–1994	4	0	6	9	5	6	15	15	30 (50)
1994–1995	0	0	13	6	13	11	26	17	43 (60)
1995–1996	0	0	7	6	2	4	9	10	19 (47)
1996–1997	0	0	17	3	5	2	22	5	27 (81)
1997–1998	2	0	12	3	5	6	19	9	28 (68)
1998–1999	2	0	8	5	8	3	18	8	24 (67)
1999–2000	0	0	10	4	8	4	18	8	26 (69)
2000–2001	0	0	6	6	6	1	12	7	19 (63)
2001–2002	0	0	3	7	2	3	5	10	15 (33)

[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] GAAR includes harvest by federally qualified hunters in Gates of the Arctic National Park (since 1981).

[c] Other sheep harvest includes all other harvest besides the GAAR harvest.

Table 5 Central Brooks Range (excluding Gates of the Arctic National Park and Preserve) hunter residency and success, regulatory years 1993–1994 through 2001–2002

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters (% Nonresident)
1993–1994	0	7	8	0	15 (31)	5	21	6	1	33 (69)	48 (29)
1994–1995	0	6	11	0	17 (44)	0	17	5	0	22 (56)	39 (41)
1995–1996	2	3	5	0	10 (36)	3	13	2	0	18 (64)	28 (25)
1996–1997	0	2	3	0	5 (26)	2	8	3	1	14 (74)	19 (32)
1997–1998	0	1	8	0	9 (47)	0	6	4	0	10 (53)	19 (63)
1998–1999	0	2	6	0	8 (27)	0	17	5	0	22 (73)	30 (37)
1999–2000	0	1	7	0	8 (35)	0	14	1	0	15 (65)	23 (35)
2000–2001	0	2	5	0	7 (35)	1	4	8	0	13 (65)	20 (65)
2001–2002	0	2	7	1	10 (50)	0	8	2	0	10 (50)	20 (45)

[a] Local residents includes residents of Units 23, 24, and 26A. Most of these residents harvest sheep under the federal system.

Table 6 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park), regulatory years 1993–1994 through 2001–2002

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	17
1995–1996	34.3	0	9.8	10
1996–1997	35.3	0	9.4	5
1997–1998	35.4	11	9.3	9
1998–1999	34.5	0	9.1	8
1999–2000	34.8	0	9.5	8
2000–2001	37.2	14	10.0	7
2001–2002	36.9	20	11.0	10

Table 7 Gates of the Arctic National Park subsistence sheep harvest, regulatory years 1989–1990 through 2001–2002

Regulatory year	Harvest				
	Rams	Ewes	Yearlings	Unknown	Total
1989–1990	19	8	0	0	27
1990–1991	18	2	2	0	22
1991–1992	20	3	0	0	23
1992–1993	16	4	2	0	22
1993–1994	15	0	0	0	15
1994–1995	6	5	0	15	26
1995–1996	9	0	0	0	9
1996–1997	20	2	0	0	22
1997–1998	15	2	0	2	19
1998–1999	10	6	0	2	18
1999–2000	14	4	0	0	18
2000–2001	4	7	1	0	12
2001–2002	3	2	0	0	5

Table 8 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park) chronology percent by month/day, regulatory years 1993–1994 through 2001–2002

	Harvest chronology percent by month/day				
Regulatory year	8/10–8/20 (*n*)	8/21–8/31 (*n*)	9/1–9/10 (*n*)	9/11–9/20 (*n*)	*N*
1993–1994	60 (9)	27 (4)	7 (1)	7 (1)	15
1994–1995	82 (14)	6 (1)	12 (2)	6 (1)	17
1995–1996	30 (3)	50 (5)	20 (2)	0 (0)	10
1996–1997	80 (4)	20 (1)	0 (0)	0 (0)	5
1997–1998	78 (7)	22 (2)	0 (0)	0 (0)	9
1998–1999	25 (2)	63 (5)	12 (1)	0 (0)	8
1999–2000	88 (7)	12 (1)	0 (0)	0 (0)	8
2000–2001	43 (3)	43 (3)	14 (1)	0 (0)	7
2001–2002	70 (7)	30 (3)	0 (0)	0 (0)	10

Table 9 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park and Bureau of Land Management federal subsistence hunts) percent by transport method, regulatory years 1993–1994 through 2001–2002

	Harvest percent by transport method					
Regulatory year	Airplane (*n*)	Boat (*n*)	3- or 4-wheeler (*n*)	Horses (*n*)	Unknown (*n*)	*N*
1993–1994	80 (12)	20 (3)	0 (0)	0 (0)	0 (0)	15
1994–1995	94 (16)	0 (0)	0 (0)	0 (0)	6 (1)	17
1995–1996	60 (6)	40 (4)	0 (0)	0 (0)	0 (0)	10
1996–1997	80 (4)	20 (1)	0 (0)	0 (0)	0 (0)	5
1997–1998	78 (7)	22 (2)	0 (0)	0 (0)	0 (0)	9
1998–1999	37 (3)	63 (5)	0 (0)	0 (0)	0 (0)	8
1999–2000	63 (5)	37 (3)	0 (0)	0 (0)	0 (0)	8
2000–2001	71 (5)	29 (2)	0 (0)	0 (0)	0 (0)	7
2001–2002	70 (7)	20 (2)	0 (0)	10 (1)	0 (0)	10

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 1998
To: 30 June 2001

LOCATION

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

GEOGRAPHIC DESCRIPTION: Eastern Brooks Range

BACKGROUND

Dall sheep are found throughout the mountains of the eastern Brooks Range. Highest densities are in the 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 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.

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 US 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

The eastern Brooks Range includes that portion of Unit 24 in the Dalton Highway Corridor Management Area (DHCMA) and east of the DHCMA, Unit 25A, Unit 26B, and Unit 26C. Harvest and survey data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001). Surveys in this area generally included annual ground-based composition counts in Atigun Gorge in Unit 26B, the Hulahula drainage in Unit 26C, and the Chandalar drainage in Unit 25A. Standardized routes were surveyed in June. Surveys were conducted in the Atigun area in RY98 and RY00 and in the Hulahula drainage in RY99. No surveys were conducted in the Chandalar drainage during RY98–RY00.

During 1992–1995 a helicopter was used to complete composition surveys. 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 (F Mauer, personal communication).

Between 1988 and 1992 approximately 60 sheep were radiocollared and periodically relocated as part of a cooperative study to define sheep populations and establish areas for trend counts (Heimer et al. 1994).

There were 3 agencies involved in managing sheep hunting in the eastern Brooks Range (ADF&G, Bureau of Land Management [BLM], and Arctic National Wildlife Refuge [ANWR]). People were confused about which agency to report hunting and harvest to and often reporting was duplicated among the different agencies. Beginning in 1992, BLM administered 2 federal subsistence hunts along the DHMCA: RS424 in Unit 24 was for residents of Unit 24 north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia; RS699 in Unit 26B was for rural residents of Unit 26B and residents of Anaktuvuk Pass, Wiseman, and Point Hope. Nonfederally qualified hunters also were allowed to hunt in the DHCMA under more restrictive state regulations. The Arctic National Wildlife Refuge administered a hunt in Unit 26C (RS799) for residents of Unit 26, Anaktuvuk Pass, Arctic Village, Chalkyitsik, Fort Yukon, Point Hope,

and Venetie. RS799 is similar to the state registration sheep hunt RS595. ANWR also administered a hunt for the Arctic Village Sheep Management Area in Unit 25A for residents of Arctic Village, Venetie, Fort Yukon, Kaktovik, and Chalkyitsik. Harvest ticket reports were required from all hunters not qualified to hunt under the federal system. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year (RY), which begins 1 July and ends 30 June. Data obtained from BLM hunts (RS424 and RS699) were analyzed with data obtained from the statewide harvest ticket system because season and bag limits were similar to the state hunt.

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 indicate that sheep numbers declined during the late 1980s and early 1990s. The most likely cause of the decline was severe weather, which reduced recruitment and may have increased predation. 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 similar declines appear to have occurred elsewhere in the area. Anecdotal reports suggest that sheep populations continued to be relatively low in most of the eastern Brooks Range. Snow was deep on the south slope of the Brooks Range during RY99 and RY00. This may have both short- and long-term effects on sheep numbers in Unit 25A.

Population Composition

During RY96–RY00, surveys in the Atigun drainage indicated lamb:ewe ratios ranged from 18 to 50:100, with the lowest level observed in RY97. Lamb:ewe ratios were 29 and 33:100 in RY99 and RY00. These data indicate relatively low lamb survival during this report period (Table 1). A ratio of 32 lambs:100 ewes was observed in the Hulahula drainage in RY97, but only 9:100 were observed in RY99, probably reflecting unusually deep snow in winter 1999–2000 (Table 2). Composition surveys show considerable variation in occurrence of lambs among areas and years. Poor lamb survival is generally associated with severe winters and cold spring weather. Survey data indicate the proportion of full-curl rams in the population in some areas increased after the full-curl regulation passed in 1993. However, limited survey data from the Atigun area indicate full-curl rams continue to be scarce, probably because of high hunting pressure in this accessible area (Table 1). In contrast, hunter reports indicated that large rams were fairly well represented in most parts of the eastern Brooks Range (Table 3).

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 because of 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
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

Alaska Board of Game Actions and Emergency Orders. There were no regulatory changes or emergency orders during RY98–RY00. In March 2002 the board extended the vehicle restrictions for the Dalton Highway Corridor Management Area (DHCMA) to the Prudhoe Bay Closed Area. This regulation will curtail snowmachine access to areas outside the DHCMA. The board considered, but did not pass, proposals for an expanded archery-only sheep hunting area in the Atigun and adjacent drainages east and west of the DHCMA, and a drawing permit for nonresident sheep hunting in western Unit 25A. In March 2000 the Board of Game rejected a proposal to change the bag limit for the winter registration hunt from 3 sheep to 2 rams. The last major regulatory change for the eastern Brooks Range occurred in 1993 when the Board of Game established a full-curl regulation.

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 a source of public concern.

Hunter Harvest. The number of sheep taken in Units 24 East, 25A, 26B, and 26C ranged from 120 to 134 annually during RY98–RY00 (Table 3). The eastern Brooks Range experienced a long-term increase in the number of hunters and harvest that began in the early 1970s and ended in RY90. Harvest declined slightly during the last few years, although hunter participation was nearly stable. From RY86 to RY91 the total reported harvest exceeded 200 sheep each year. Harvest declined beginning in RY92 and was stable since RY97 with an average of 127 sheep reported taken. Hunters and guides familiar with the area reported that legal rams were common, but continue to be less abundant than during the 1980s. Average horn size apparently increased somewhat following establishment of the full-curl regulation in 1993 (Table 4).

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 RY90 to RY93, approximately 50% of which were ewes. The reported harvest has generally declined since then, probably because of limited demand and poor reporting. However, it increased in RY00 after a small number of hunters found a way to access hunting areas in Unit 26C with snowmachine by initiating travel from the Prudhoe Bay Closed Area and traveling around the northern end of the Dalton Highway corridor (Table 5).

Limited data was available for the Arctic Village Sheep Management Area federal hunt. In 1995, 4 permits were issued with 2 hunters and no reported kills and, in 1997, 2 permits were issued with 1 hunter and no reported kills.

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 3). Nonresident hunters continued to have a higher success rate, reflecting the advantage of having a guide (Golden 1990). Hunter success was 38–45% during RY98–RY00, representing a continuation of the lower success rates observed during the 1990s, which compare to rates of 60–67% in the late 1980s (Table 4). Harvest reports show that hunter success varied considerably in the eastern Brooks Range. During the last few years, success was lower in areas adjacent to the Dalton Highway than in less accessible areas to the east.

Harvest Chronology. Most sheep hunting in the eastern Brooks Range continued to occur during August, when weather was most favorable. Eighty 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 were 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. 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, declines in sheep numbers and availability of legal rams led to reductions in the number of hunters, success rates, and harvest during the past decade. The goal of maintaining and enhancing sheep populations was not met. In view of the decline in sheep populations, it would be prudent to change the bag limit for registration hunt RS595 from 3 sheep to 2 rams. This would provide a biologically more conservative subsistence harvest regime, but is opposed by some representatives of subsistence hunters. The full-curl regulation appears to be working as intended, with the general decline in harvests being attributable to the overall decline in sheep numbers rather than the increase in minimum legal horn size. However, there are growing concerns that unregulated guiding of nonresident hunters on state land is resulting in excessive hunting pressure. The only area where this issue affects sheep management in the eastern Brooks Range is in the middle and north forks of the Chandalar River. The staff of the Arctic National Wildlife Refuge played a major role in annual population monitoring and provided valuable support for management efforts. Continued cooperative efforts will be important to future success in conducting composition and trend surveys.

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Table 1 Atigun Gorge (Unit 26B) ground–based sheep composition counts, 1986–2001. Surveys occurred in June of the year indicated (source: F Mauer, Arctic NWR).

	Rams							
Year[a]	Full curl	3/4–Full curl	1/2–3/4 curl	<1/2 curl	Ewes[b]	Lambs (%)	Lambs:100 ewes	Total sheep observed
1986	1	10	18	18	165	42 (17)	25	254
1987	0	19	20	13	137	47 (20)	34	236
1988	3	16	29	11	221	80 (22)	36	360
1989	0	19	37	15	253	40 (11)	16	364
1990	0	18	23	8	165	69 (24)	42	283
1991	2	22	19	10	318	122 (25)	38	493
1992	0	12	15	7	309	39 (10)	13	382
1993	1	19	22	5	206	24 (9)	12	277
1994	5	16	21	10	225	89 (24)	39	366
1995	0	9	18	5	247	28 (9)	11	307
1996[c]	0	2	6	11	114	49 (27)	43	182
1997	0	11	8	21	91	16 (11)	18	147
1998	0	2	12	11	141	70 (30)	50	236
1999	0	7	8	17	140	40 (19)	29	212
2000[d]								
2001	0	7	7	17	133	44 (21)	33	208

[a] Counts prior to 1990 occurred in Atigun Gorge only; during and after 1990 counts along the Dalton Highway (Atigun Gorge to Atigun Pass) were included.

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

[c] Incomplete count in Atigun Gorge (snow).

[d] No survey was conducted in 2000.

Table 2 Hulahula (Unit 26C) and East Fork Chandalar (Unit 25A) River drainages ground–based sheep composition counts, 1992–2001. Surveys occurred in June of the year indicated (source: F Mauer, Arctic NWR).

	Rams								
Area/year	Full curl (%)		3/4–Full curl	1/2–3/4 curl	<1/2 curl	Ewes[a]	Lambs (%)		Lambs:100 ewes	Total sheep observed
Hulahula										
1992	1	(0.2)	28	26	4	318	10	(3)	3	387
1993[b]	12	(1.0)	242	87	40	709	171	(14)	24	1261
1994[b]	6	(0.7)	99	47	18	595	99	(12)	17	864
1995[b]	25	(2.2)	160	111	24	631	179	(16)	28	1130
1996[c]										
1997[c]										
1998[d]	10	(2.9)	34	36	47	190	61	(16)	32	378
1999[c]										
2000[b]	7	(1.9)	40	32	34	219	20	(6)	9	352
2001[c]										
East Fork Chandalar										
1992	4	(1.8)	17	6	0	155	34	(16)	22	216
1993	20	(5.6)	37	29	6	219	45	(13)	21	356
1994	16	(8.1)	24	23	13	121	0	(0.0)	0	197
1995	15	(9.5)	25	7	5	89	17	(11)	19	158
1996[c]										
1997[c]										
1998[c]										
1999[c]										
2000[c]										
2001[c]										

[a]Adult females, yearlings and 2 year-olds.
[b] Helicopter surveys over most of the drainage.
[c] No survey conducted.
[d] Ground survey: upper Hulahula only.

Table 3 Units 25A, 26B, and 26C and eastern Unit 24 sheep hunter[a] residency and success, regulatory years 1985–1986 through 2000–2001

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	90	86	3	186 (45.0)	7	199	20	4	230 (55.0)	416
1993–1994[c]	2	89	46	0	137 (36.2)	1	218	21	2	242 (63.8)	379
1994–1995	1	78	43	1	123 (42.6)	0	155	16	2	173 (56.7)	296
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
1998–1999	2	73	58	1	134 (44.6)	6	140	20	0	166 (55.3)	300
1999–2000	9	51	66	0	126 (42.0)	6	141	27	0	174 (58.0)	300
2000–2001	3	56	59	2	120 (37.6)	1	165	33	0	199 (62.4)	319

[a] Excludes hunters in Permit Hunts 1195, RS595, RS799, and Arctic Village Sheep Management Area.
[b] Local resident is a resident of Units 25A, 26B, 26C, Coldfoot, or Wiseman.
[c] Regulation changed to full curl.

Table 4 Units 24 East, 25A, 26B, and 26C[a] mean Dall ram horn length, regulatory years 1985–1986 through 2000–2001

Regulatory year	n	$\bar{x}$ Horn length (inches)	% ≥40"
1985–1986	170	34.9	n/a
1986–1987	185	35.4	n/a
1987–1988	223	34.8	n/a
1988–1989	208	35.1	n/a
1989–1990	258	35.0	10
1990–1991	265	34.6	9
1991–1992	234	34.3	7
1992–1993	174	34.1	2
1993–1994	122	34.6	2
1994–1995	122	34.3	4
1995–1996	135	35.1	2
1996–1997	102	34.6	0
1997–1998	115	34.8	2
1998–1999	134	33.8	4
1999–2000	125	35.3	6
2000–2001	114	35.1	5

[a] Excludes permit hunt harvest (Hunts 1195, RS595, RS799, and Arctic Village Management Area).

Table 5 Units 25A and 26C sheep harvest data by permit hunt, regulatory years 1985–1986 through 2000–2001

Regulatory year	Hunt[a]	Permits issued	% Did not hunt	% Unsuccessful hunters	% Successful hunters	Rams	Ewes	(%)	Unk	Total harvest[b]
1985–1986	1195	n/a	n/a	n/a	n/a	n/a	n/a		n/a	12–30
1986–1987	1195	n/a	n/a	n/a	n/a	n/a	n/a		n/a	12–30
1987–1988	1195	n/a	n/a	n/a	n/a	n/a	n/a		n/a	30–40
1988–1989	1195	n/a	n/a	n/a	n/a	n/a	n/a		n/a	30–40
1989–1990	1195	n/a	n/a	n/a	n/a	n/a	n/a		n/a	30–40
1990–1991	1195	69	46	67	33	7	6	(46)	1	14
1991–1992	1195	9	n/a	n/a	n/a	1	1	(50)	0	2
1992–1993	1195	n/a	n/a	n/a	n/a	3	1	(25)	4	8
1993–1994	1195	16	75	25	75	3	3	(43)	1	7
		3		33	66	4	1			5
1994–1995	1195	7	100	n/a	n/a	n/a	n/a		n/a	0
										0
1995–1996	RS595	10	50	80	20	1	0	(0)	0	1
		4	n/a	75	25	1				1
1996–1997	RS595	4	100	n/a	n/a	n/a	n/a		n/a	0
RS799(F)		2	n/a	0	100	3	2			4
1997–1998	RS595	10	70	67	33	1	0	(0)	0	1
RS799		1		100						0
1998–1999	RS595	6	33	75	25	1	0	0	0	1
RS799(F)		1	n/a		100	0	2			2
1999–2000	RS595	9	89	0	100	1	0	0	0	1
RS799(F)		1	n/a	0	100	2				2
2000–2001	RS595	16	37	56	44	8	0	0	0	8
RS799(F)		2	n/a	0	100	6				6
RS799(F)										
RS799(F)										

[a] Hunts 1195 and RS595 are state registration hunts that include that portion of Unit 25A east of the Middle Fork Chandalar River and Unit 26C. RS799(F) is a federal subsistence hunt which is essentially the same area as the RS595 state hunt.

[b] In RY85 and RY86, estimates were based on interviews with residents of Kaktovik only; RY87 through RY89 estimates were based on interviews with residents from Kaktovik and Arctic Village (S Pedersen, ADF&G, personal communication). Since RY90 total harvest was based on written reports received and does not include the 30–40 sheep estimated taken by Kaktovik and Arctic Village residents.

Table 6 Units 24 East, 25A, 26B, and 26C sheep harvest[a] chronology percent by harvest month/day, regulatory years 1985–1986 through 2000–2001

Regulatory year	Harvest chronology percent by month/day									*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	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
1998–1999	0.0	11.6	40.3	23.2	10.8	6.2	6.2	0.8	0.0	129
1999–2000	0.0	19.8	29.4	26.2	13.5	1.6	6.3	3.2	0.0	126
2000–2001	0.8	23.9	29.9	15.4	14.5	10.2	3.4	1.7	0.0	117

[a] Excludes permit hunt harvest (Hunts 1195, RS595, RS799, and Arctic Village Management Area) and a few sheep "reported" taken in Oct or Nov.
[b] Sheep reported taken before 10 Aug or after 26 Sep were presumably incorrectly reported.

Table 7 Units 24 East, 25A, 26B, and 26C sheep harvest[a] percent by transport method, regulatory years 1985–1986 through 2000–2001

Regulatory year	Harvest 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
1998–1999	83.6	2.2	2.2	0.0	0.0	0.0	11.9	0.7	134
1999–2000	76.2	5.5	3.2	0.0	0.0	0.0	13.5	1.6	126
2000–2001	79.2	10.0	0.8	0.0	0.0	0.0	8.3	1.6	120

[a] Excludes hunters in permit hunts (Hunts 1195, RS595, RS799, and Arctic Village Management Area).