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.

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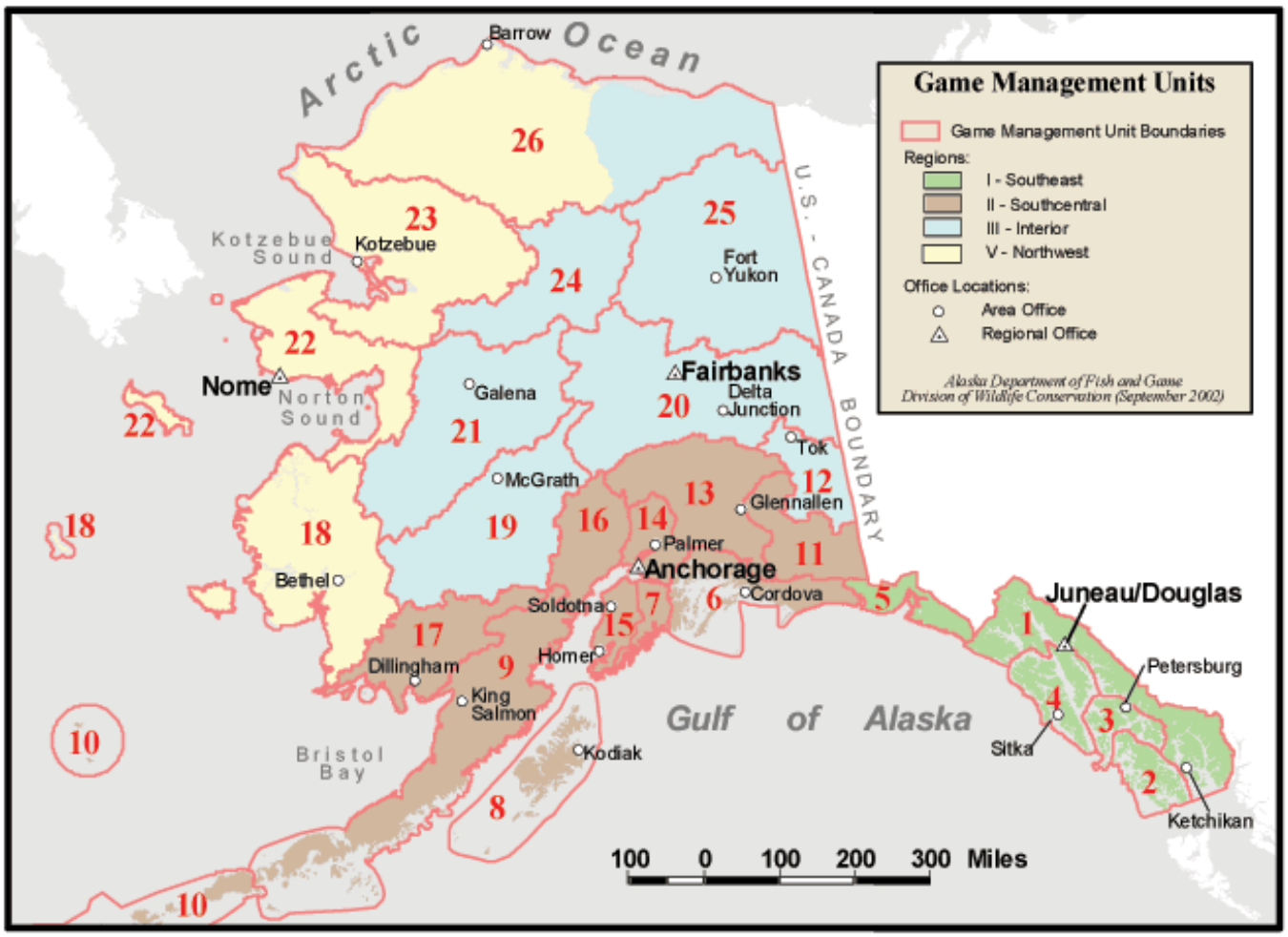
Game Management Units
Game Management Unit Boundaries
Regions:
I - Southeast
II - Southcentral
III - Interior
V - Northwest
Office Locations:
Area Office
Regional Office
Alaska Department of Fish and Game
Division of Wildlife Conservation (September 2002)
Arctic Ocean
Barrow
Kotzebue Sound
Kotzebue
Nome
Norton Sound
Galena
Fairbanks
Delta Junction
Fort Yukon
Tok
McGrath
Glennallen
Palmer
Anchorage
Bethel
Soldotna
Cordova
Homer
Dillingham
King Salmon
Kodiak
Bristol Bay
Gulf of Alaska
Juneau/Douglas
Petersburg
Sitka
Ketchikan
U.S. - CANADA BOUNDARY
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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

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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 Full-curl(%)	Rams 7/8 or less[a]	Rams 1/2 to 3/4-curl	Rams <1/2-curl	Ewes	Sheep/ Lambs(%)	Sheep/ hour	Total sheep observed	Estimated population size
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	1500–1775
1999–00	0(0)	21	--	--	53	22(23)	--	96[b]	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 Full-curl	Rams 7/8 or smaller	Rams Total rams	Ewes	Lambs	Total sheep
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 Full-curl(%)	Rams 7/8 or less[a]	Rams 1/2 to 3/4 curl	Rams <1/2 curl	Ewes	Lambs	Sheep/ hour	Total Sheep observed	Estimated population size
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	29	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	5	229(85)	268
1997–98	15	7	1	23(11)	86	100	1	187(89)	210
1998–99	18	7	1	26(12)	116	72	0	188(88)	214
1999–00	8	3	0	11(07)	90	53	1	144(93)	155
2000–01	10	3	1	14(07)	112	59	5	177(93)	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	Harvest Periods						
year	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	*n*
1996–97	50	13	11	11	13	3	39
1997–98	52	16	8	20	0	4	25
1998–99	73	12	8	4	0	4	26
1999–00	45	27	0	0	18	9	12
2000–01	50	21	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](%)		Lambs (%)		Unk (%)			
Northwest portion																
28 Jul 1994	479	1.76	72	(8.7)	141	(17.1)	213	(25.8)	443	(53.6)	169	(20.4)	2	(0.2)	827	1.73
18 and 19 Jul 1995	515	2.13	85	(7.4)	149	(13.0)	234	(20.4)	676	(58.9)	226	(19.7)	11	(0.9)	1147	2.23
29 Jul 1997[b]	794	1.56	118	(10.2)	196	(16.9)	314	(27.1)	659	(56.9)	186	(16.0)	0	(0.0)	1159	1.28
1 Aug 1998	307	2.06	30	(6.8)	112	(25.4)	142	(32.3)	229	(52.0)	69	(15.7)	0	(0.0)	440	1.43
Sheep Creek East																
18 and 19 Jul 1995	83	2.28	22	(9.3)	41	(17.4)	63	(26.7)	150	(63.5)	23	(9.8)	0	(0.0)	236	2.85
28 Jul 1997	83	2.17	11	(4.0)	43	(15.7)	54	(19.8)	179	(65.6)	40	(14.6)	0	(0.0)	273	3.29
1 Aug 1998	83	3.08	19	(8.9)	60	(28.0)	79	(36.9)	112	(52.3)	23	(10.7)	0	(0.0)	214	2.58
Southeast portion																
30 Jun–11 Jul 1996	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 Curl	< ½ Curl	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep observed	Estimated population size
COUNT AREA 11 – DADINA											
1981	24	4%	48	--	--	359	126	23%	168.8	557	557
1983	12	3%	59	--	--	283	60	14%	118.3	414	414
1986	52	9%	71	--	--	330	106	19%	192.8	559	414
1989	28	8%	24	--	--	231	78	22%	109.4	361	361
1993	25	9%	36	--	--	172	35	13%	76.6	268	268
1994	18	6%	21	--	--	197	85	26%	84.5	321	321
1995	9	3%	18	--	--	237	83	24%	102.0	347	347
1996	8	3%	31	--	--	169	46	39%	79.4	254	254
1997	8	3%	41	--	--	198	50	17%	110	297	297
1998	7	4%	42	--	--	109	26	14%	55.8	184	184
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 Curl	< 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 Curl	< 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 Curl	< 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					Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Non-resident	Total[b]	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total[b]	
1993–94	22	83	27	143	(39)	50	158	10	228	371
1994–95	22	64	26	114	(31)	43	195	12	255	369
1995–96	28	57	26	111	(38)	50	117	9	180	291
1996–97	26	72	37	141	(45)	42	124	15	174	315
1997–98	24	53	19	100	(40)	47	98	13	152	252
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

[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			Unsuccessful hunters			Total hunters		
	No. hunters	Total days	Average days	No. hunters	Total days	Average days	No. hunters	Total days	Average days
1993–94	143	645	4.5	228	978	4.3	371	1714	4.6
1994–95	111	580	5.2	252	1,213	4.8	363	1793	4.9
1995–96	111	499	4.5	180	927	5.2	291	1426	4.9
1996–97	140	699	5.0	167	888	5.3	307	1587	5.2
1997–98	100	526	5.3	148	781	5.3	248	1307	5.3
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]	2,400
1998–99	165 (7)	562	1,336	335 (14)		2,403[d]	2,500
1999–00[b]	--	--	--	--	--	--	--
2000–01	172(8)	543	1,152	230 (11)	--	2,118[e]	2,200
2001–02[b]	--	--	--	--	--	--	--

[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: Full curl (%)[a]	Rams: Sublegal	Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
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
	2001–02	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
	2001–02	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
	2000–01	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
	1999–00	1	100	--	--	0	0	0	0	0	0
	2000–01	1	0	0	100	1	42.0	100	0	0	1
	2000–02	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
	2001–02	416	33	76	24	45	35.7	10	22 (49)	0	67

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								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
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
	1991	120	23	44	56	36.9	9 (17)	52
	1992	120	26	58	42	37.1	6 (16)	37
	1993	120	13	58	42	37.3	6 (13)	44
	1994	120	28	54	46	36.9	3 (8)	39
	1995	120	18	61	39	37.2	8 (13)	60
	1996	120	17	44	56	36.2	5 (9)	56
	1997	120	20	57	43	36.5	3 (7)	41
	1998	120	13	46	54	36.2	4 (7)	56
	1999	120	13	60	40	36.3	4 (10)	42
	2000	121	19	66	34	36.1	3 (9)	33

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

	Successful				Unsuccessful				
Regulatory year	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1990	2	31	3	36 (44)	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 ≥7/8 curl(%)	Rams <7/8 and >1/4-curl	Ewes[a]	Lambs (%)	Sheep/ hour	Total Sheep observed	Estimated population size
1988–89							
Unit 14[b]	24 (3)	178	500	163 (19)	44	866	2150–2600
1989–90 to 1993–94	No surveys flown						
1994–95							
Unit 14[b]	26 (8)	71	159	48 (16)	24	304	
Unit 13[c]	132 (9)	234	844	232 (16)	97	1443	
Total	158 (9)	305	1003	280 (16)	63	1747	2000–2500
1995–96 to 1997–98	No surveys flown						
1999							
Unit 14[b]	15 (3)	100	292	98 (19)	43	505	
Unit 13[c]	82 (5)	299	986	372 (21)	157	1809	
Total	97 (4)	399	1278	470 (20)	99	2314	2500–3000
2000							
Unit 14[b]	14 (4)	91	200	33 (10)	22	338	
Unit 13[d]	42 (6)	164	483	51 (7)	123	740	
Total[d]	56 (5)	255	683	84 (8)	50	1078	1500–2000

[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