Dall Sheep
Management Report
of survey-inventory activities
1 July 2001–30 June 2004

Cathy Brown, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation

Jeff Mondragon, ADF&G

Funded through
Federal Aid in Wildlife Restoration
Grants W-27-5, W-33-1 and W-33-2
December 2005

STATE OF ALASKA

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McKie Campbell, Commissioner

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

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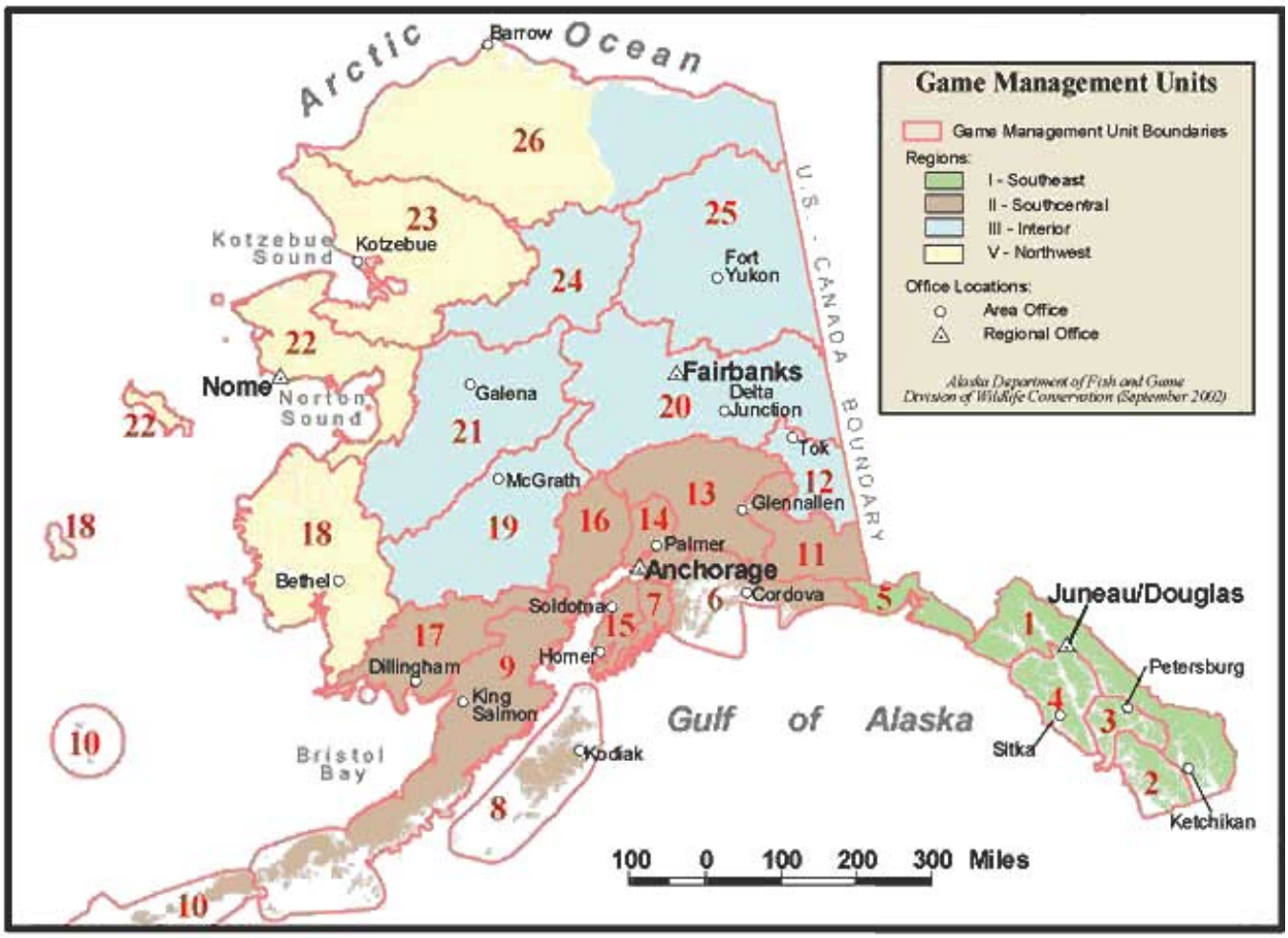
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DALL SHEEP MANAGEMENT REPORT

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To: 30 June 2004

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
JUNEAU, AK 99802-5526

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

GAME MANAGEMENT UNIT: 7 and 15 (8397 mi^2)

GEOGRAPHICAL DESCRIPTION: Kenai Mountains

BACKGROUND

The Kenai Mountains represent the southern limits of Dall sheep range in Alaska. Aerial sheep surveys were initiated in some portions of the Kenai Mountains in 1949. Surveys showed the sheep populations in many areas increased from 1949 to the late 1960s and early 1970s, before declining in the late 1970s. Extensive surveys to estimate population numbers throughout traditional sheep range on the Kenai Peninsula have only been conducted in 1968 and 1992.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

To adequately monitor population trends and allow for hunting opportunities with a sustainable harvest.

METHODS

We conducted surveys of selected count areas in the Kenai Mountains, in conjunction with mountain goat surveys, using fixed-winged aircraft. Surveys were flown at 200–400 feet above ground level and generally were conducted during the early morning or late evening hours, when the animals are most active. Sheep were classified into the following categories: legal rams (full curl or larger); sublegal rams (⅞ curl or less); lambs; ewes and yearling rams; and unidentified sheep. Yearling rams are difficult to distinguish from ewes and are, therefore, summarized together.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

About 1600 sheep were counted on the Kenai Peninsula in 1992, when an extensive survey was conducted covering most areas containing significant sheep populations. This is down from a comparable count conducted in 1968, which tallied more than 2000 sheep. Some of the decrease in numbers from 1968 to 1992 may be due to variation in counting conditions or survey effort.

No comparable, wide-ranging survey has been conducted since 1992; however, it is apparent from counts in some areas that sheep numbers throughout the Kenai Peninsula likely have decreased from the levels found in the early 1970s (Table 1).

Population Composition

The sheep composition in certain count areas the past 3 years has shown a relatively low proportion of lambs (Table 1). Low lamb production could be due to poor habitat conditions, predation, competition from goats or caribou in some areas, or other factors.

Distribution and Movements

Sheep range throughout the central portion of the Kenai Mountains. Sheep are found north of Sheep Creek in Unit 15C and north to the Skilak Glacier and Russian Mountain in Unit 15B. In Unit 7, the sheep range extends north of Kenai Lake and the Snow River, but south of Trail Creek and west of the Seward Highway from Upper Trail Lake to Six Mile Creek.

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

MORTALITY

Harvest

Season and Bag Limit. The sheep season for resident and nonresident hunters on the Kenai Peninsula has been 10 August–20 September since 1964. The bag limit has been one ram with a full-curl horn or larger since 1989. A drawing permit hunt for ewes (DS 152) started in 1993 (Table 2). Two drawing permit hunts, one for ewes (DS154) and one for full-curl rams (DS156), started in the Crescent Lake area in 1999 (Tables 3–4).

Board of Game Actions. In 2003, the Board of Game expanded the eastern boundary for the Round Mountain ewe hunt (DS152) from Dike Creek east through the divide south of Trout Lake to Juneau Creek. The board also created a drawing permit hunt for full-curl rams in this newly expanded Round Mountain area. This was done due to the overcrowding of full-curl ram hunters in this relatively small area.

Hunter Harvest, Residency, and Success. The harvest has averaged 16 rams over the last 5 seasons (Table 5). The number of general season hunters has averaged 170 over the past 5 seasons, and a majority of both successful and unsuccessful hunters were local residents of the Kenai Peninsula (Table 5).

Harvest Chronology. Chronology of harvest followed similar patterns over the past 5 years; most of the harvest occurred during the first 2 weeks of the season (Table 6).

Transport Methods. Transportation methods followed similar patterns over the past 5 years (Table 7).

HABITAT

Assessment

There have been no recent direct habitat assessments, significant habitat disturbance, or habitat improvements in the sheep range of the Kenai Mountains.

CONCLUSIONS AND RECOMMENDATIONS

ADF&G has not had funding allocated for sheep management on the Kenai Peninsula for several years. Considering these budgetary limitations, it is difficult to address the primary goal for managing sheep in the Kenai Mountains, which is to conduct surveys that adequately monitor general trends in sheep abundance and distribution and quantify sex and age composition. Recently, we have managed to obtain limited sheep data by recording sheep sightings while conducting goat surveys. Ewe permit hunts will continue only if the population counts indicate an area can sustain a harvest.

The Kenai National Wildlife Refuge and ADF&G have renewed and improved a protocol to periodically survey sheep between Skilak and Chernof Glaciers, including the high-density area between the Killey and Tustumena Glaciers. Future reports will hopefully reflect this expanded trend-count area. ADF&G will continue to work with other agencies to improve our knowledge of sheep populations in the Kenai Mountains.

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Table 1 Kenai Mountains, Units 7 and 15 summer aerial sheep composition counts and estimated population size, 1999–2000 through 2003–04[a]

Regulatory year	Rams		Ewes and yearling rams	Lambs (%)	Total sheep observed	Estimated population size
	Full-curl	<Full-curl or unclassified				
1999–00	0	21	53	22 (23)	96	1500–1775
2000–01	5	100	265	50 (12)	420	1500–1775
2001–02	5	76	187	36 (12)	304	1000–1700
2002–03	3	77	189	41 (13)	310	1000–1700
2003–04	4	86	165	42 (14)	297	1000–1700

[a]The amount of area surveyed varies each year.

Table 2 Round Mountain, drawing permit ewe hunt, 1999–2000 through 2003–04

Regulatory year	Nr of permits issued	Nr of hunters	Nr of ewes taken	% Success
1999–00	20	15	8	53
2000–01	20	17	6	35
2001–02	20	14	2	14
2002–03	20	17	5	29
2003–04	20	18	7	39

Table 3 Crescent Lake, drawing permit ewe hunt, 1999–00–2003–04

Regulatory year	Nr of permits issued	Nr of hunters	Nr of ewes taken	% Success
1999–00	10	8	3	38
2000–01 [a]	10	9	1	11
2001–01	10	8	2	25
2002–03 [a]	10	7	2	29
2003–04	10	10	5	50

[a] One yearling ram was mistakenly taken.

Table 4 Crescent Lake, drawing permit full-curl ram hunt, 1999–2000 through 2003–04

Regulatory year	Nr of permits issued	Nr of hunters	Nr of rams taken	% Success
1999–00	10	7	2	29
2000–01	10	7	0	0
2001–02	10	9	2	22
2002–03	10	9	1	11
2003–04	10	7	2	29

Table 5 Kenai Mountains, Units 7 and 15 general season sheep harvest, hunter residency, and success, 1999–2000 through 2003–04

Regulatory year	Successful				Unsuccessful				
	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Total	Total hunters
1999–00	8	3	0	11 (7)	90	53	1	144	155
2000–01	10	3	1	14 (7)	112	59	5	177	191
2001–02	13	3	2	18 (11)	90	51	0	141	159
2002–03	12	7	0	19 (12)	70	57	8	135	154
2003–04	10	7	1	18 (9)	102	68	2	172	190

[a] Residents of Units 7 and 15.

Table 6 Kenai Mountains, Units 7 and 15 general season sheep harvest chronology (shown as % of the harvest), 1999–2000 through 2003–04

Regulatory year	Harvest Periods						
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	*n*
1999–00	45	27	0	0	18	9	11
2000–01	50	21	0	21	0	7	14
2001–02	61	11	5	11	0	11	18
2002–03	47	11	5	5	11	21	19
2003–04	44	11	11	11	6	17	18

Table 7 Kenai Mountains, Units 7 and 15 transport methods used during the general season for sheep (shown as % of harvest), 1999–2000 through 2003–04

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1999–00	25	0	17	0	0	0	58	0	11
2000–01	43	7	36	0	0	0	7	7	14
2001–02	17	0	56	0	0	0	28	0	18
2002–03	32	5	32	5	0	0	26	0	19
2003–04	56	6	17	0	0	0	22	0	18

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004[a]

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 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 (Shepherd 1979; Pegau 1986), and since 1994 a more systematic approach has been applied to improve comparability between surveys. Some aerial surveys were conducted in the southeastern portion of the range (Didrickson 1971; Didrickson and Taylor 1979); the most recent survey was conducted in 1996 (Szepanski and Lenart 2002).

Harvest data and survey work indicate that the ARW sheep population was relatively stable prior to regulatory year (RY) 1998 (RY = 1 Jul through 30 Jun; e.g., RY98 = 1 Jul 1998 through 30 Jun 1999). However, numbers of sheep observed during aerial surveys and reported harvest of rams have declined since that time.

[a] This unit report also includes data collected outside the reporting period at the discretion of the reporting biologist.

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 OBJECTIVE

- 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.

METHODS

POPULATION SIZE AND COMPOSITION

Population size was not determined during the reporting period (RY01–RY03). We determined sex and age composition in count areas in the northwest portion, Sheep Creek East, and southeast portion of the ARW during 2002 and 2003. These areas were representative of good sheep habitat and were selected based on their ability to sustain moderate 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 (includes 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.

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 and Preserve. Six (479 mi^2), 7 (515 mi^2), 11 (794 mi^2), 4 (307 mi^2), 5 (396 mi^2), and 5 (327 mi^2) count areas were flown in 1994, 1995, 1997, 1998, 2002, and 2003, respectively. Not all of the same count areas were flown each year. No surveys were conducted in the northwest section during 1996 and 1999–2001 due to limited personnel or poor weather for flying. Data from all count areas were combined annually to obtain an overall estimate of sex and age composition and to calculate densities.

In Sheep Creek East (between Sheep Creek and the South Fork and Post Rivers), a single count area was established during 1995 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 (approx. 90 mi^2) with the same survey intensity each year. During the reporting period, surveys were flown in Sheep Creek East in 2002 and 2003. Differences in population parameters between years were analyzed using a Student's *t*-test.

In the southeastern portion of ARW, sheep composition surveys were conducted in 12 count areas during 1996 and in 4 count areas during 2003 by staff from ADF&G Region II in cooperation with the National Park Service (Masteller et al., ADF&G unpublished sheep survey report, 1997, Palmer, Alaska, USA; T. Kavalok, ADF&G, personal communication). 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Average sheep density was 1.56 sheep/mi^2 in the northwestern count areas and 2.10 sheep/mi^2 in the Sheep Creek East count area during RY01–RY03 (Table 1). These estimates are lower than those averages from preceding reporting periods in each area. Densities for the southeastern portion of the ARW were not estimated.

It was not possible to estimate sheep population size or to determine recent sheep population trends in the ARW with statistical bounds because different count areas were surveyed each year due to weather and other factors. Although densities were consistently >1 sheep/mi^2 in the northwest count areas, sheep densities in the ARW have declined since RY97. Average density in the northwest and Sheep Creek East count areas was 1.75 and 3.06 sheep/mi^2, respectively, from 1994 to 1997, and 1.51 and 2.24 sheep/mi^2, respectively, from 1998 to 2003. Similarly, the average number of sheep observed during surveys in the Sheep Creek East count area since RY98 (n = 196) was 23% less than the average number of sheep observed between RY95 and RY97 (n = 254).

Population Composition

Composition count flights were completed during 2 years within RY01–RY03 (Table 1). Five count areas per year were surveyed in the northwest portion of ARW, including Sheep Creek East, during 2002 and 2003 (Table 1). The average proportion of full-curl rams observed in the northwestern portion was 9% per year during 1994–1998; this declined to an average of 4% full-curl rams observed per year during 1998–2003. Similar declines were also noted in nonhunted segments of the population. Overall productivity was moderate in the northwest area, and ratios of lambs:ewe-like sheep typically were >30:100 between 1994 and 2003. However, the number of lambs observed declined from an average of 194 (1994–1998) to 89 per year (1998–2003), while the number of ewe-like sheep declined from an average of 593 (1994–1998) to 289 per year (1998–2003).

In the Sheep Creek East index area, full-curl rams constituted approximately 3–9% of the population during 1995–2003 (Table 1). The average proportion of full-curl rams did not show a substantial decline between 1995–1997 and 1998–2003. It remained at or above 6% per year for both time periods. Although the average number of ewe-likes observed showed a decline similar to that in the northwest count areas (164 per year for 1995–1997 to 93 per year for 1998–2003), the number of lambs observed during those 2 periods remained relatively constant. However, productivity was lower in the Sheep Creek East index area than in the northwest area, ranging from 15–39 lambs:100 ewe-likes during 1995–2003. The average lamb:ewe-like ratio for these years was 25:100.

In the southern portion of the ARW, 3–6% of the sheep observed during recent surveys were full-curl rams, 14–23% were sublegal rams, and 19–22% were lambs (Table 1). The average lamb:ewe ratio was 37:100. The number of sheep observed in 4 count areas during 2003 was 290 sheep. This was 60% less than the 723 sheep observed during 1996 in the portion of the count area also counted during 2003. In general, sheep in the southern portion of ARW have shown marked declines from numbers observed during surveys in the 1970s (T. Kavalok, personal communication).

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). Although this may explain declines observed in most composition groups, the number and percent of sublegal rams do not show the same decline in either the northwest or Sheep Creek areas. 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 pronounced when examining only 1 count area with a relatively low sample size (<300 sheep). Sheep composition data underestimate 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). It will be important to continue to survey the ARW sheep population to determine whether the observed declines are a reasonable estimate of declines in the population or an artifact of survey conditions.

Distribution and Movements

We did not study movements during RY01–RY03. However, incidental observations and analyses of kill locations reported by hunters indicated sheep distribution was generally the same as in previous years.

MORTALITY

Harvest

Alaska Board of Game Actions. The Alaska Board of Game did not change any seasons or bag limits for sheep in ARW during RY01–RY03, and no emergency orders were issued. However, in 2004 the board adopted a statewide provision that required sealing by ADF&G personnel of sheep horns in most units, including ARW.

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 horns or both horns broomed. The full-curl regulation has been in effect since RY89. Before RY89 the minimum horn size requirement was a ⅞ curl, and prior to RY79 it was ¾ curl or larger.

Harvest by Hunters. Reported harvest of sheep probably approximated the actual harvest because illegal or unreported take was believed to be low. During this reporting period, 80, 76, and 75 rams were harvested during RY01, RY02, and RY03, respectively (Table 2). This is similar to harvest during the previous reporting period, but is a substantial decline from reported harvest prior to RY97. From RY90 to RY97, on average 139 full-curl rams were harvested per year in ARW. From RY98 to RY04, 82 full-curl rams were harvested per year. The total number of hunters using the ARW also has declined markedly since RY97 (Table 3). From RY90 to RY97, an average of 251 hunters per year hunted for sheep. From RY98 to RY04, the average number of hunters declined to 181 per year.

Average horn length of rams harvested was 36.0 inches during RY90–RY97 and 35.3 inches during RY98–RY04 (Table 2). Although horn measurements were obtained from hunters prior to mandatory sealing implemented during RY04 and can, therefore, be relatively subjective, the difference in horn length between these 2 periods was significant ($t = 5.03$, $P<0.0001$). Average age of rams harvested during RY90–RY97 and RY98–RY04 was 9.1 and 8.9 years, respectively. As with horn length, the difference in age between the 2 periods was significant ($t = 3.11$, $P = 0.002$). In general, average horn length and age are 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 inches (K. Whitten, ADF&G, personal communication). However, average horn size of harvested rams may be influenced by fewer larger rams available in the population. A few rams with horns ≥40 inches (approximately 5% of rams taken) have been harvested in ARW every year since RY90. During RY90–RY97, 7% of legal rams harvested were ≥40 inches and during RY98–RY04, 4% were ≥40 inches.

A reduction in the number of legal rams (approximately 7 to 10 years old) available to hunters in the ARW, fewer total numbers of hunters, and smaller mean horn length and ages since RY97 could be lingering artifacts of reduced productivity and low recruitment observed in the early 1990s.

Permit Hunts. A federal subsistence hunt has occurred in Unit 9B since RY95. A total of 6 sheep were harvested in Unit 9B during the federal hunt since this time; none of the harvest occurred during the reporting period. See federal regulations for more details on seasons and bag limits.

Hunter Residency and Success. Although total numbers of hunters have declined since the early 1990s, the proportion of residents/nonresidents did not change between RY90 and RY04 and was roughly equal during RY01–RY03 (Table 3). However, success rate trends for residents and nonresidents did show marked changes during this time. Average percent success for residents and nonresidents during RY90–RY97 was 39% and 61%, respectively. During RY98–RY04, average percent success for residents and nonresidents was 28% and 72%, respectively.

Overall, success rates for nonresidents likely were higher than those for resident hunters because nonresidents typically were accompanied by licensed guides. Numbers of resident hunters declined in ARW since RY97, possibly due to weather and factors related to hunter satisfaction. Recent warmer temperatures and wildfires, which create smoky conditions during late summer, may reduce visibility during early weeks of the hunting season and limit participation by resident hunters. The perception that sheep numbers were low due to poor recruitment in the early 1990s also may have limited efforts by residents to hunt in an area only accessible by aircraft. Another possible reason for the reduced number of resident hunters in ARW may be the knowledge that numerous guides and their hunters were present throughout the hunting season, vying for a limited number of legal rams.

Harvest Chronology. Traditionally, 10–25 August is considered to be the peak time for sheep hunting. During this period, hunters can hunt sheep and still have the opportunity to hunt moose during early September. As in previous reporting periods, a majority of the sheep harvest in ARW occurred during the first week of the 6-week season (Table 4). However, timing of harvest effort has shifted slightly from early to late season. During RY90–RY97, an average of 42% of the harvest occurred during 10–16 August; during RY98–RY04, the average harvest during this week declined to 37%. A small increase in harvest was noted during 7–20 September (from an average of 7% during RY90–RY97 to an average of 10% during RY98–RY04). Increases in percent harvest during September may be attributed to the desire by resident hunters to avoid crowded conditions and competition during the early season. Cooler temperatures and improved visibility during September also may play a role.

Transport Methods. Aircraft were used by 85% of successful sheep hunters during this reporting period (Table 5). There are no occupied villages or roads within or adjacent to ARW sheep habitat, and most rivers are not suitable for boat travel. Other means of access were used in a small percentage of sheep hunts.

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 guide–outfitter industry in the ARW was unregulated during this and previous reporting periods and has grown in recent years. Crowded hunting conditions may have reduced the quality of the sheep hunting experience in several of the most accessible drainages. For example, 27 guides were registered in RY05 to hunt in 3 guide use areas adjacent to the South Fork Kuskokwim River in Unit 19C. This level of activity is not likely to diminish over time as demand for accessible hunt areas increases. However, a Big Game Commercial Services Board, consisting of members to be appointed by the governor of Alaska and confirmed by the legislature, will oversee guide, outfitter, and transporter activities in Alaska in the future.

CONCLUSIONS AND RECOMMENDATIONS

Aerial surveys indicated the sheep population in the ARW remained relatively stable prior to 1998, but declines in numbers of legal rams, ewe-likes, and lambs were observed from 1998 to 2003. 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 RY01–RY03. Additionally, winter 1995–1996 had the highest snow severity index since the early 1960s, which may have also been linked to a decline in reported caribou harvest in Unit 19C in subsequent years. If sheep populations in the ARW also experienced increased mortality during winter 1995–1996, the limited availability of harvestable rams may persist over the next few years. Continued aerial surveys and monitoring of sheep harvest reports will be necessary to determine population trends (particularly lamb recruitment) and whether the substantial reduction in overall sheep harvest reflects declines in sheep, hunter numbers, or both.

Although the decline in proportion of mature rams in the population since RY98 may warrant further management consideration, we met our management goals of providing a sustained opportunity to harvest Dall sheep rams from a naturally regulated population during RY01–RY03. With regard to the full-curl harvest objective, we harvested an average of 77 rams annually from RY01 through RY03, with an average horn length greater than 35 inches and an average age older than 8 years. Meeting this objective also allowed us to meet our goal 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. One possible approach may be to develop and distribute a questionnaire to survey hunter opinions. No actions to evaluate hunter satisfaction were taken during RY01–RY03.

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TABLE 1 Alaska Range West sheep composition counts, 1994–2003

Date	Area (mi^2)	Survey intensity (min/mi^2)	Rams						Ewe-likes[a]	(%)	Lambs	(%)	Unk	(%)	Total sheep	Density (sheep/mi^2)
			Full curl	(%)	<Full curl	(%)	Total	(%)								
Northwest portion																
28 Jul 1994	479	1.76	72	(8.7)	141	(17.1)	213	(25.8)	443	(53.6)	169	(20.4)	2	(0.2)	827	1.73
18 and 19 Jul 1995	515	2.13	85	(7.4)	149	(13.0)	234	(20.4)	676	(58.9)	226	(19.7)	11	(0.9)	1147	2.23
29 Jul 1997[b]	794	1.56	118	(10.2)	196	(16.9)	314	(27.1)	659	(56.9)	186	(16.0)	0	(0.0)	1159	1.28
1 Aug 1998	307	2.06	30	(6.8)	112	(25.4)	142	(32.3)	229	(52.0)	69	(15.7)	0	(0.0)	440	1.43
17 and 18 Jun 2002	396	2.34	11	(1.5)	145	(19.7)	156	(21.2)	442	(60.2)	128	(17.4)	8	(1.1)	734	1.80
18–20 Jun 2003	327	1.88	18	(4.2)	144	(33.6)	162	(37.8)	196	(45.8)	69	(16.1)	1	(0.2)	428	1.31
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	2.84
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
17 Jun 2002	90	3.33	4	(2.8)	47	(32.9)	51	(35.7)	69	(48.2)	19	(13.3)	0	(0.0)	139	1.54
18 Jun 2003	90	2.78	12	(5.1)	84	(35.7)	96	(40.8)	99	(42.1)	39	(16.6)	0	(0.0)	234	2.60
Southeast portion																
30 Jun–11 Jul 1996	–[c]	–[c]	114	(6.4)	259	(14.5)	373	(21.0)	1012	(57.0)	396	(22.0)	5	(0.3)	1786	–[c]
24 Jun–5 Aug 2003	–[c]	–[c]	10	(3.4)	68	(23.4)	78	(26.8)	156	(53.8)	56	(19.3)	0	(0.0)	290	–[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 1990–1991 through 2004–2005

Regulatory year	Rams harvested	$\bar{x}$ Horn length (inches)	% ≥40 in.	$\bar{x}$ Age[a]
1990–1991	151	36.1	7.0	8.9
1991–1992	135	36.0	5.2	8.8
1992–1993	125	35.4	8.1	8.9
1993–1994	142	35.8	7.9	9.1
1994–1995	131	35.6	1.6	8.9
1995–1996	152	36.4	7.5	9.0
1996–1997	148	36.4	11.0	9.5
1997–1998	130	36.0	6.3	9.5
1998–1999	109	35.3	6.5	9.2
1999–2000	75	35.3	2.7	9.0
2000–2001	80	35.5	8.7	8.8
2001–2002	80	35.1	3.8	8.8
2002–2003	76	35.2	0.0	8.7
2003–2004	75	35.0	1.3	8.4
2004–2005	81	35.5	2.6	8.9

[a] Hunters estimate age of harvested ram.

TABLE 3 Alaska Range West sheep hunter residency and success, regulatory years 1990–1991 through 2004–2005

Regulatory year	Successful				Unsuccessful				Total hunters
	Resident	Nonresident	Total[a]	(%)	Resident	Nonresident	Total[a]	(%)	
1990–1991	47	101	151	(59)	62	41	107	(41)	258
1991–1992	53	76	135	(54)	82	31	116	(46)	251
1992–1993	46	72	125	(57)	70	22	94	(43)	219
1993–1994	59	81	142	(55)	73	44	118	(45)	260
1994–1995	54	76	131	(52)	75	44	119	(48)	250
1995–1996	64	88	152	(56)	78	39	120	(44)	272
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	14	60	75	(39)	65	51	116	(61)	191
2000–2001	21	58	80	(45)	55	41	97	(55)	177
2001–2002	17	61	80	(51)	48	28	77	(49)	157
2002–2003	21	51	76	(41)	75	29	108	(59)	184
2003–2004	22	53	75	(45)	61	28	90	(55)	165
2004–2005	35	46	81	(52)	55	18	75	(48)	156

[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 1990–1991 through 2004–2005

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*
1990–1991	46	12	10	14	9	8	2	151
1991–1992	42	9	16	13	6	12	2	135
1992–1993	34	12	26	9	14	3	2	125
1993–1994	46	12	13	10	9	4	6	142
1994–1995	42	17	8	16	7	4	6	131
1995–1996	43	16	12	7	11	8	3	152
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	17	7	8	13	7	75
2000–2001	31	20	15	10	5	16	3	80
2001–2002	41	22	11	9	6	8	3	80
2002–2003	40	8	21	14	11	5	1	76
2003–2004	32	11	12	12	16	12	5	75
2004–2005	49	11	9	7	17	6	0	81

TABLE 5 Alaska Range West sheep harvest percent by transport method, regulatory years 1990–1991 through 2004–2005

Regulatory year	Harvest percent by transport method							
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unk	*n*
1990–1991	85	9	0	2	0	0	4	151
1991–1992	81	7	1	5	1	0	5	135
1992–1993	83	9	0	4	4	0	0	125
1993–1994	82	8	1	4	4	0	<1	142
1994–1995	76	11	3	6	2	0	2	131
1995–1996	82	7	3	2	1	2	3	152
1996–1997	82	11	<1	<1	4	0	2	148
1997–1998	81	10	3	2	3	0	<1	130
1998–1999	78	10	3	5	4	0	0	109
1999–2000	79	11	1	0	8	1	0	75
2000–2001	80	8	2	4	5	0	1	80
2001–2002	81	9	2	2	4	0	2	80
2002–2003	87	3	1	4	4	0	1	76
2003–2004	87	3	1	7	1	0	1	75
2004–2005	91	1	1	1	5	0	0	81

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

GAME MANAGEMENT UNIT: 11 (12,784 mi^2) Wrangell Mountains

GEOGRAPHIC DESCRIPTION: East of the Copper River, north of the Chitina Valley

BACKGROUND

Dall sheep inhabit most alpine and subalpine areas of the Wrangell Mountains and have a long hunt history in Unit 11. The Wrangells are well known for trophy 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 harvest numbers and locations.

In late 1978, the Wrangell Mountains and the eastern Chugach Mountains in 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.

In 1980, the Wrangell St. Elias (WRST) National Park and Preserve was established by the Alaska National Interest Lands and Conservation Act (ANILCA). Harvest of sheep in the portion designated as park has since been limited to federal subsistence hunting by rural residents of designated communities in Units 11, 13, and a portion of 12. Rural residents can also hunt under federal subsistence regulations in the preserve. General hunting for sheep in the preserve is open to residents and nonresidents under state hunting regulations. Since July 1, 1990, all Alaska residents have been considered subsistence hunters under state law for purposes of state hunting regulations. All sheep hunting in Unit 11 is reported under the state harvest ticket system.

Sheep numbers in the Wrangell Mountains are unavailable prior to the 1950s. Sheep surveys were done during the late 1950s and 1960s, though they are generally not comparable to more recent surveys because early survey intensity and specific area boundaries 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. These surveys have continued to date in select areas.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

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

METHODS

During this reporting period, mostly with grant funding from the Foundation for North American Wild Sheep (FNAWS), aerial surveys were conducted to determine sex and age composition and population trends of sheep in selected trend count areas within Unit 11. Hunters were required to submit posthunt harvest ticket reports, which provided information on the location, timing, and magnitude of effort and harvest.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Status

Population trends for sheep in Unit 11 are estimated in individual trend count areas; however, unitwide sheep population data are limited. Extrapolations from department fixed-wing surveys of specific count areas during this reporting period indicated a minimum of 3000 sheep inhabiting the south Wrangell Mountains from Mount Drum southeast to the Canadian border. Following sheep surveys in the WRST National Park and Preserve during 1990 and 1991, (McDonald et al. 1990, 1991) the National Park Service (NPS), through extrapolation, estimated 5071 (± 137) sheep for this southern portion of the Wrangell Mountains (Strickland et al. 1993).

The NPS estimated 25,972 sheep ± 6233 (95% CI) within the entire WRST National Park and Preserve in 1990 and 27,972 sheep ± 6448 (95% CI) in 1991. The area covered by these NPS surveys included a portion of Unit 12 in the northern Wrangell Mountains and southern Unit 11 in the eastern Chugach Mountains. In 1993, Strickland et al. revised this NPS estimate to 17,455 ± 3883 sheep. Trend count surveys over the last decade, however, suggest the population may have declined by as much as 30% or more in some areas.

Population Trends

Data for selected sheep trend count areas surveyed in Unit 11 are presented in Table 1. The most recent surveys included Count Areas (CAs) 10, 11, and 12 located between the Sanford and Kuskulana Rivers, CA 14 the Crystalline Hills, CA 22 Canyon Creek to the Barnard Glacier, and CA23 Barnard Glacier to the Chitina Glacier.

Surveys in 2001 and 2002 in CA 10 (Mount Drum) indicated a dramatic decline in overall sheep numbers since 1992. In CA 11 (Dadina River to Long Glacier) the lowest recorded sheep count occurred in 2002, when only 175 sheep were observed. The numbers were up slightly in 2003, then down to 178 in 2004. Surveys indicated 40–50 rams in this area during the 1990s. During the 2004 survey, however, only 29 rams were counted. The number of ewes counted in this area has steadily declined since the mid 1990s as well. Surveys in CA 11 indicated a 32% decline in

total sheep numbers since the late 1980s. Most recently, the percent lambs increased from a low of 14% seen in 2001 to 20% seen in both 2003 and 2004.

Until recently, CA 12 (Long Glacier to Kuskulana River) had fairly stable numbers of sheep, ranging between 449 and 602 since the early 1980s. Since 1998, sheep numbers in this area have steadily declined. During the 2004 survey, only 222 sheep were counted. Over the last 5 years, the percentage of lambs counted in this area has been lower too, averaging only 11% versus the 16% seen in the late 1990s. The 2004 survey indicated only 8% lambs.

Sheep in CA 14 (Crystalline Hills) have declined markedly since 1980 when 209 sheep were observed. About 70 sheep have been counted annually in this area since the mid 1990s. Sheep abundance in CA 22 (Canyon Creek to the Barnard Glacier) remained fairly stable through the late 1990s. The lamb count was fairly low in 2000 and 2001 (8% both years) and was partly responsible for lower total sheep numbers seen in 2002 and 2004. Lamb numbers rebounded slightly in 2004, up to 24%. While overall sheep numbers should improve in this area with increased recruitment, the hunting pressure remains high and may keep mature ram numbers down. The number of full-curl rams counted annually has declined 40% between the late 1990s and 2004.

Similar to CA 22, sheep in CA 23 West (Barnard Glacier to the park/preserve boundary) have also declined dramatically in recent years. No surveys were flown between 1983 and 1999, though surveys in 1999 and 2000 suggested population stability. More recent surveys in 2001 and 2003, though, indicated a recent decline. Ewe numbers declined 55% between the 2000 and 2003 surveys. The percentage of lambs has averaged only 9% since 2000.

Surveys were also flown in CA 23 East (park/preserve boundary east to Anderson Glacier) in 2001 and 2003. Prior to these recent surveys, CA 23 East had only been surveyed once in 1982. In this count area, sheep numbers in the recent surveys were much higher than in 1982. This is the only count area in the southern Wrangells that falls entirely within the WRST National Park, where aircraft are prohibited for hunting purposes.

Population Composition

The number of sheep has declined dramatically since the mid to late 1980s across the western Wrangell Mountains, and more recently in the southeastern Wrangells as well (Table 1). Rams and ewes have declined at similar rates, resulting in steady ram:ewe ratios during this reporting period. The western Wrangells had 34 rams:100 ewes in CA 11 and 49:100 in CA 12. The southeastern Wrangells had 35:100 in CA 22 and 66:100 in CA 23 East. The ratio was lower, only 25:100 in CA 23 West; rams have declined faster than ewes in this heavily hunted area.

Lamb abundance has been highly variable during summer surveys (Table 1). Because adjacent areas probably experience similar weather and nutritional factors, these are not likely causing the population decline. Increased predation is probably the reason for the population decline in the south Wrangell Mountains.

Distribution and Movement

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

MORTALITY

Harvest

Seasons and Bag Limit. Prior to 1979, the Unit 11 bag limit was one ram with ¾-curl or larger horns for all hunters. Beginning in 1979, the minimum horn size was increased to ⅞ curl or larger. In 1989, the bag limit was changed to one sheep for state subsistence hunters and one ram with full-curl or larger horns for other hunters. In 1989, subsistence hunters for the state were defined as rural Alaska residents who have been determined to have a customary and traditional use of a particular species of game in a particular area. Following a ruling on the McDowell appeal late that year, the subsistence definition was changed back to any Alaska resident.

Between 1991 and 2000, the state season for resident/subsistence and nonresident sheep hunters was 10 August–20 September. For resident/subsistence hunters, the bag limit was one sheep through 2000. In 2001, the regulation was changed to one ram. In 2003, it changed again to include only rams ¾ curl or larger.

The bag limit for nonresident hunters has been one ram with full-curl horns or larger since 1989. Guides were required for nonresident sheep hunters. Federal subsistence hunting regulations for local rural residents have allowed one sheep since 1990.

Hunter Harvest. For purposes of comparing the Unit 11 harvest to other mountain ranges that have full-curl regulations, a 28-inch minimum horn length is used to roughly assess "full-curl." The smallest full-curl rams measured from the Wrangells were 28 inches.

The reported sheep harvest ranged from 80 to 101 sheep during this 3-year reporting period (Table 2). The number of ewes killed during this period is also presented in Table 2. Ewe harvests averaged 19 per year during the last reporting period, though less than one per year during this reporting period. Since 2001, ewes have been legal only under federal subsistence regulations.

The trophy quality of the average Dall ram taken in Unit 11 has declined dramatically in recent years (Table 2). The horn size for all rams >28 inches averaged 35.3 inches during the early 1990s, but has declined to 34.4 inches since 2001. The number of rams ≥38 inches declined from an average of 24 per year during the early 1990s to an average of 11 per year since 2001. The number of rams ≥40 inches has also declined from an average of 11 per year during the early 1990s to fewer than 5 per year since 2001.

Hunter Residency and Success. Sheep hunter residency and success in Unit 11 is presented in Table 3. During the late 1980s, hunter success was high, near 50%. The success rate slowly declined until it hit a low of 31% in 1994. In 1995, the success rate was back up to 38%, although there were 20% fewer hunters in the field than in previous years. Hunter success averaged 39% between 1995 and 2001, then in 2002 it dropped down to 31% again. In 2003 the

success rate rebounded to 37%, this time with 24% fewer hunters in the field than in previous years.

Sheep hunting effort has steadily decreased since the early 1990s (Table 3). In 1993, 371 hunters pursued sheep in Unit 11. During this reporting period, the average number of hunters per season was down to 259. Both resident and nonresident hunter effort have declined, likely a reflection of the decline in the sheep population.

Between 1991 and 1993, local residents took an average of 32 sheep per year, nonlocal residents averaged 93 sheep per year, and nonresidents averaged 27 sheep per year. These harvest levels remained fairly consistent until 2000. Since then, these numbers have declined, averaging 13, 66, and 16 sheep per year respectively. While lower than in past years, the nonresident success rate has averaged 58% since 2000, still the most successful group of hunters in Unit 11. Success rates for local and nonlocal resident hunters were similar during this time period, averaging about 33% success.

Reported in Table 4, the average number of days hunted annually by successful hunters ranged from 3.9 to 4.9 days and averaged 4.5 days during this reporting period. The average number of days hunted annually reported by unsuccessful sheep hunters for this same period ranged from 5.5 to 5.7 days and averaged 5.6 days.

Harvest Chronology. Harvest chronology data for sheep taken in Unit 11 is presented in Table 5. Consistent with earlier years, the majority of the harvest during this reporting period has been during the early part of the season. During the early 1990s, the majority of the harvest was spread across the first 2 weeks of the season. Since 1997, the majority of the harvest has shifted to the first week of the season. The harvest percentage during the second week of the season averaged 26% during the early 1990s; since 1997 this percentage has decreased to 10%. This decline, similar to the decline in hunter effort, is likely related to the decline in sheep numbers and resultant increased hunter competition over the season opener. If a hunter does not get a sheep early in the season, the chances of success decline dramatically.

Transportation Methods. Aircraft continued to be the primary mode of transportation for sheep hunters in Unit 11; 43% of hunters used aircraft between 2001 and 2003. The use of four-wheelers has steadily increased over the past decade. The use of three-wheelers began during the 1980s, though most have been replaced by the safer, more popular four-wheeler. During the most recent season, 2003, 36% of hunters used four-wheelers (Table 6). While four-wheeler access is quite limited across most of Unit 11, the few available access points are growing in popularity. Considering federal laws pertaining to aircraft use in the hard park, four-wheelers continue to be the most important mode of transportation for local subsistence sheep hunters in these portions of Unit 11.

Other Mortality

Studies of natural mortality of sheep in Unit 11 have not been conducted. Predation by coyotes and golden eagles on Dall sheep lambs has been documented in the Brooks Range and the Alaska Range, and has been observed in the Wrangells as well. 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 estimated in Unit 11.

Other sources of natural mortality common to sheep include accidents and starvation during periods of deep snow and icing conditions. Severe winter conditions have the potential to increase adult mortality and affect lamb production and survival. Prior to 1993, snow depths were only available from 2 sites, Sanford River and Dadina Lake in the western Wrangells. In 1993, three additional locations in the southern Wrangells were added: Lost Creek, Chokosna, and May Creek. The Unit 11 snow survey data set has not been consistent, and its usefulness for sheep management to date has been insignificant.

HABITAT

There are no historical studies of sheep habitat assessment or carrying capacity in the Wrangell Mountains. During this reporting period, however, Miranda Terwilliger, Department of Biology & Wildlife, Alaska Cooperative Wildlife Unit, University of Alaska Fairbanks, began work on her master's thesis titled "Assessing Habitat Suitability for Dall's sheep (Ovis dalli dalli) in Wrangell-St. Elias National Park & Preserve."

CONCLUSIONS AND RECOMMENDATIONS

Annual sheep surveys have been difficult to maintain in Unit 11 due to budget constraints. Many of the surveys flown during the early 1990s were funded by the NPS; some recent surveys have been funded by FNAWS. 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 Wrangell Mountains.

Historically, Dall sheep in the Wrangells were considered abundant and the population seemed productive. The trophy potential of Wrangell rams was well known. Some of the largest Dall rams in the world were harvested in the Wrangell Mountains.

Estimating the Dall sheep population in the Wrangells has been difficult due to the expense and logistical problems with conducting surveys across the entire area. Early population estimates were based on surveys conducted over a period of years. The 1992 population estimate of 17,455 ± 3883 sheep for the Wrangell Mountains by the NPS (Strickland et al. 2003) represents the most recent total estimate, though individual count area surveys conducted during this reporting period indicate a major decline across much of the range since then.

No surveys have been conducted in the north Wrangell Mountains since 1997, although hunting pressure and success there continue to be fairly high. Sheep in the west Wrangell Mountains extending from the Dadina River southeast to the Kuskulana River have declined dramatically over the past 15 years. Without the benefit of a mortality study in that area, there is no way to assess the future trends of the western Wrangells.

Surveys in the south Wrangells indicated a similar though more recent population decline. Similar to the western range, lamb numbers were down considerably in 2000 and 2001,

potentially contributing to the lower overall numbers since then. Snow depths during the winter of 2000–01 were also deeper than average and may have contributed to increased winter mortality that year. The percentage of lambs was up slightly in 2002 and 2003 in some count areas, though this has been quite variable across the range.

Even given some years of increased lamb production (reflected in percentage of lambs counted), the total number of sheep in the Wrangells has definitely declined over the past decade. Good lamb production from half as many ewes may not provide the recruitment necessary to stop the population decline. The lower population has led to a decline in hunter effort and harvest, particularly in the south Wrangells. The sheep harvest from Unit 11 dropped about 23% after 2000 when the ewe portion was dropped from the state bag limit. While the total ram harvest has not dropped, the take of mature rams >28 inches has dropped consistently since the late 1980s.

The number of large rams harvested in Unit 11 has declined dramatically over the past decade. With continued heavy harvest pressure and a ¾-curl harvest regulation, the large ram component of the harvest will likely continue to decline. Removing most of the large rams from the population affects both the trophy quality of the unit, as well as reproduction biology and genetics.

Nonlocal Alaska residents continued to take the most sheep from Unit 11, followed by the harvest from local residents and nonresidents, which was equal (Table 3). If the trophy quality of the area continues to decline, the nonlocal residents will likely shift hunting pressure to other mountain ranges. Local residents will continue to hunt Unit 11 due to the subsistence priority under federal regulations. Nonresidents will also continue to hunt Unit 11 because the guides in this unit operate under exclusive federal guide use regulations, and the number of guides there will be consistent year to year.

Recent changes in state regulations removing ewes and small rams from the general hunting bag limit were necessary given the unitwide decline in ewe numbers over the past decade. Given current ram:ewe ratios, the harvest of ¾-curl or larger rams should be sustainable. Though the trophy quality of the area may continue to decline, as long as the population has a healthy ram:ewe ratio, the population will maintain adequate recruitment each year. The harvest of small rams and ewes is still allowed under federal subsistence regulations, though the federal take is low and is mostly limited to the few four-wheeler accessible hunting areas.

In addition to the decline in large trophy rams available for harvest in the south Wrangells, competition among hunters will increase if the sheep population continues to decline. Continued population and harvest monitoring over the next few years will be necessary to assess these trends.

Due to the decline in quality rams available for harvest and breeding, I recommend the implementation of a limited harvest area in the south Wrangells where trophy Dall sheep hunting has historical importance and access is mostly limited to aircraft. This is also the area that produced the world record ram. Obviously the genetic and nutritional factors in this area coexist to produce large bodied and large horned rams. While we cannot influence nutrition, we can and are likely already influencing the genetic traits of sheep in this area. High harvests of the better rams results in selection for the poor quality rams left to breed. The continuation of this policy

will result in the loss of a valuable genetic pool in this area. Regulations that limit the harvests of large rams and assure maintenance of the gene pool are necessary.

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Table 1 Unit 11 summer aerial sheep composition counts, 1973–2004

Regulatory Year	Full [a] Curl	%	≤ Full Curl	Ewes[b]	Lambs	%	Sheep/ Hour	Total Sheep Observed
CA 10 – Mt. Drum								
1973 [a]				150	23	11%	83.2	208
1980 [a]	4	2%	31	107	59	29%	51.5	201
1992				273	83	17%		481
2001	11	10%	20	65	13	12%	51.9	109
2002	8	9%	13	53	13	15%		87
CA 11 – Dadina River to Long Glacier								
1981 [a]	24	4%	48	359	126	23%	168.8	557
1983 [a]	12	3%	59	283	60	14%	118.3	414
1986 [a]	52	9%	71	330	106	19%	192.8	559
1989	28	8%	24	231	78	22%	109.4	361
1993	25	9%	36	172	35	13%	76.6	268
1994	18	6%	21	197	85	26%	84.5	321
1995	9	3%	18	237	83	24%	102.0	347
1996	8	3%	31	169	46	39%	79.4	254
1997	8	3%	41	198	50	17%	110	297
1998	7	4%	42	109	26	14%	55.8	184
1999	17	7%	35	160	44	17%	75.3	256
2000	11	5%	29	161	38	16%	68.2	239
2001	16	7%	27	147	32	14%	58.4	222
2002	7	4%	41	100	27	15%	44.9	175
2003	14	7%	26	128	41	20%	59.7	209
2004	14	8%	15	113	36	20%	55.6	178

Table 1 continued

Regulatory Year	Full [a] Curl	%	≤ Full Curl	Ewes[b]	Lambs	%	Sheep/ Hour	Total Sheep Observed
CA 12 – Long Glacier To Kuskulana River								
1973 [a]	51	12%	--	--	47	11%	--	410
1981 [a]	26	5%	52	359	129	23%	--	566
1982 [a]	60	12%	49	341	64	12%	111.7	514
1983 [a]	65	13%	67	290	68	14%	122.5	490
1993	36	6%	67	426	39	7%	145.6	568
1996	37	6%	113	346	105	17%	88.5	602
1998	36	8%	96	242	75	17%	89.8	449
1999	34	7%	113	250	59	13%	93.2	457
2000	27	8%	98	173	31	9%	53.1	329
2001	23	8%	54	185	26	9%	47.2	288
2002	23	9%	64	139	33	13%	78.9	259
2003	25	11%	42	121	34	15%	55.3	222
2004	23	14%	15	109	12	8%	55.5	159
CA 14 – Crystalline Hills								
1980 [a]	2	1%	5	142	60	29%	90.9	209
1993	13	10%	8	85	18	15%	103.3	124
1994	5	6%	12	56	6	8%	79.0	79
1996	5	7%	14	44	13	17%	76.0	76
1999	5	5%	10	57	19	21%	91.0	91
2001	1	2%	10	43	6	10%	66.7	60
2002	0	0%	0	39	11	22%	71.4	50
2003	0	0%	2	43	15	25%	40.0	60
2004	3	4%	8	52	11	15%	98.7	74

Table 1 continued

Regulatory Year	Full [a] Curl	%	≤ Full Curl	Ewes[b]	Lambs	%	Sheep/ Hour	Total Sheep Observed
CA 22 – Canyon Creek To Barnard Glacier								
1981[a]	27	11%	28	143	51	20%	71.1	249
1984[a]	33	14%	34	125	43	18%	94.0	235
1993	20	7%	31	190	63	21%	86.9	304
1994	14	5%	29	191	32	12%	69.0	266
1998	21	7%	24	213	47	15%	n/a	305
1999	1	0%	45	179	66	22%	n/a	291
2000	8	4%	30	143	16	8%	n/a	197
2001	12	5%	43	176	20	8%	67.8	251
2002	15	6%	41	142	45	19%	60.8	243
2004	11	5%	31	119	50	24%	60.3	211
CA 23W – Barnard Glacier East To Park/Preserve Boundary								
1980[a]	26	11%	14	158	49	20%	123.5	247
1981[a]	20	7%	23	194	66	22%	116.5	303
1983[a]	21	8%	26	168	41	16%	160.0	256
1999	36	15%	21	142	45	18%	128.4	244
2000	14	4%	90	174	29	9%	161.6	307
2001	4	3%	13	105	10	8%	66.0	132
2003	7	6%	19	78	12	10%	81.7	116

Table 1 continued

Regulatory Year	Full [a] Curl	%	≤ Full Curl	Ewes[b]	Lambs	%	Sheep/ Hour	Total Sheep Observed
CA 23E – Park/Preserve Boundary East To Anderson Glacier								
1982 [a]	26	33%	20	26	7	9%	43.9	79
2001	46	19%	42	129	26	11%	121.5	243
2003	25	12%	50	117	25	12%	113.0	217

[a] Prior to 1989, the "full curl" column included rams ⅞ curl and larger.
[b] Includes yearlings of both sexes and rams of ¼ curl or less.

Table 2 Unit 11 Wrangell Mountains sheep harvest, 1993–2003

Regulatory Year	Rams			Ewe Harvest	Total[b] Sheep Harvest
	Total Ram Harvest	Average Horn Length (in.) [a]	Large Rams ≥ 38 in.		
1993	113	36.0	27	21	134
1994	92	35.8	18	18	110
1995	89	35.9	20	19	108
1996	125	36.3	29	16	141
1997	92	36.4	19	14	106
1998	90	34.8	11	16	106
1999	105	35.5	24	16	121
2000	91	34.9	13	24	115
2001	101	34.4	15	0	101
2002	86	34.2	8	2	88
2003	80	34.5	11	0	80

[a] Excluding subsistence rams ≤ 28 in.

[b] Includes sheep of unknown sex.

Table 3 Unit 11 Wrangell Mountains sheep hunter residency and success, 1993–2003

	Successful						Unsuccessful				
	Local[a]	Nonlocal	Nonresident		Total		Local[a]	Nonlocal	Non-	Total	Total
Year	resident	resident	Nr	(%)	Nr	(%)	resident	resident	resident	Nr	hunters
1993	22	89	27	(20)	138	(37)	50	173	10	233	371
1994	22	64	26	(23)	112	(31)	46	192	12	250	362
1995	26	61	26	(23)	113	(38)	47	127	9	183	296
1996	26	74	37	(27)	137	(44)	46	116	15	177	314
1997	25	53	19	(20)	97	(39)	50	88	13	151	248
1998	33	68	20	(17)	121	(40)	45	117	11	173	294
1999	22	82	23	(18)	127	(40)	56	123	9	188	315
2000	6	83	17	(16)	106	(37)	42	127	15	184	290
2001	14	74	17	(16)	105	(37)	31	130	15	176	281
2002	10	59	19	(22)	88	(31)	48	131	13	192	280
2003	16	50	16	(20)	82	(37)	25	99	11	135	217

[a] Local residents include residents of Unit 11, eastern Unit 13, and southwestern Unit 12.

Table 4 Unit 11 Wrangell Mountains sheep hunting effort, 1993–2003[a]

	Successful hunters			Unsuccessful hunters			Total hunters		
Year	Nr hunters	Total days	Average days	Nr hunters	Total days	Average days	Nr hunters	Total days	Average days
1993	143	645	4.5	235	1098	4.7	378	1743	4.6
1994	110	573	5.2	249	1206	4.8	359	1779	4.9
1995	111	499	4.5	180	927	5.2	291	1426	4.9
1996	140	699	5.0	167	888	5.3	307	1587	5.2
1997	100	526	5.3	148	781	5.3	248	1307	5.3
1998	121	607	5.0	186	968	5.2	307	1575	5.1
1999	131	688	5.3	199	947	4.8	330	1635	5.0
2000	114	509	4.5	199	974	4.9	313	1483	4.7
2001	115	545	4.7	202	1124	5.6	317	1669	5.3
2002	93	363	3.9	195	1078	5.5	288	1441	5.0
2003	79	390	4.9	136	770	5.7	215	1160	5.4

[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, 1993–2003[a]

	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	9/21–9/30
1993	21%	32%	10%	11%	12%	9%	5%
1994	25%	25%	10%	11%	16%	7%	7%
1995	26%	21%	15%	12%	12%	10%	5%
1996	7%	37%	12%	6%	23%	8%	6%
1997	36%	6%	21%	18%	9%	9%	0%
1998	50%	7%	11%	14%	17%	1%	0%
1999	38%	11%	20%	14%	11%	5%	1%
2000	65%	7%	9%	9%	9%	2%	0%
2001	48%	12%	14%	13%	9%	5%	0%
2002	41%	8%	12%	11%	8%	18%	3%
2003	37%	19%	11%	14%	14%	6%	0%

[a] Includes only those hunters reporting date of kill on their report.

Table 6 Unit 11 Wrangell Mountains sheep harvest percent by transport method, 1993–2003[a]

	Transport Method							
Year	Airplane	Horse	Boat	3-or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown
1993	31%	1%	5%	15%	0%	4%	39%	4%
1994	31%	4%	5%	20%	0%	5%	31%	4%
1995	38%	4%	5%	18%	0%	4%	27%	4%
1996	40%	4%	3%	19%	0%	3%	24%	5%
1997	51%	2%	4%	20%	0%	2%	20%	2%
1998	42%	2%	5%	24%	0%	4%	19%	4%
1999	37%	1%	5%	25%	0%	3%	27%	1%
2000	36%	1%	3%	25%	0%	3%	31%	2%
2001	46%	0%	2%	23%	0%	3%	21%	4%
2002	41%	2%	5%	30%	0%	3%	17%	3%
2003	41%	1%	4%	36%	0%	1%	12%	3%

[a] Includes only those hunters reporting method of transportation on their report.

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

GEOGRAPHIC DESCRIPTION: Chugach Mountains

BACKGROUND

Large numbers of miners, railroad workers, and market hunters probably decimated Dall sheep populations in accessible areas between Turnagain Arm and the Knik River beginning around 1900. During a thorough aerial survey of 29,000 mi^2 of potential sheep range in 1949, biologists discovered the number of sheep in Alaska had declined to approximately one-quarter of that estimated 9 years earlier (Scott et al. 1950). Sheep populations in the Chugach, Talkeetna, and Kenai Mountains were estimated at 600, 300, and 350 animals, respectively. The statewide population decline was attributed primarily to several severe winters; however, in accessible areas illegal hunting also was 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 5 times larger than estimated in 1951.

Sport hunting was not considered to have had much influence on sheep populations in the early 20th century. However, the annual harvest reported to the U.S. Fish and Wildlife Service was 3–4 times higher in the mid 1940s compared to a decade earlier, increasing from about 200 per year to 600 per year (Scott et al. 1950). Beginning in 1942, the bag limit was reduced from 2 or 3 rams in various areas to 1 ram. Hunting pressure was heaviest near human settlements, and accessible ranges near Anchorage were closed to sheep hunting to protect sheep that otherwise might have been hunted to depletion (Scott et al. 1950). 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 ¾-curl rams

was restricted to ⅞-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 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 regulatory years (RY) 2001–2003 included conducting 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 2002 and 2003 and in Unit 14A in 2002. Incomplete surveys were flown in Unit 13D in 2001, 2002, and 2003.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

An estimated 4100–4800 sheep inhabit the Chugach Mountains, including Units 14A, 14C, and 13D. An estimated 900–1000 inhabit Unit 14A, and an estimated 1800 inhabit Unit 14C (Tables 1 and 2). It is difficult to estimate the Unit 13D population based on partial aerial surveys during the reporting period (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. The sheep population in Unit 14C has declined steadily since the late 1990s, with a small increase in numbers during 2003. Sheep numbers in Units 14A and 13D have declined since the last decade; however, the numbers in both units have increased slightly in recent years. Overall population declines in the Chugach Mountains during the reporting period have been due to severe snow and ice conditions for several winters. Notably, the winter of 2003–04 was characterized by deep snow, which may have significantly impacted sheep survival.

Population Composition

Since 1999, the percentage of full-curl and larger rams observed in Unit 14C has ranged from 5 to 8% of all observed sheep (Table 2). The percentage of lambs has ranged from 11 to 13%,

which probably reflects inclement 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 was 2–6% of total sheep observed. Lambs composed 12–18% of the total population in both units.

The number of full-curl rams reported is a minimum count. When conducting aerial composition counts, full-curl rams are reported conservatively. Therefore, a portion of the rams reported as being less than full curl were probably full curl under the regulatory definition.

Distribution and Movements

Sheep distribution and movements during the summer months have been documented by aerial surveys. Major late summer concentration areas have been determined from harvest records and discussions with hunters. Although sheep are found throughout the mountain range below 7500 feet in elevation, concentrations vary greatly among drainages. In Unit 14C, closed areas, such as Indian and Falls Creeks and the Anchorage Hillside, supported the highest sheep densities, followed by Ship Creek and the archery-only Eklutna drainage.

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

Infrequent ground-based observations in the Unit 14A portion of the range indicate 2 important 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 has 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, more than 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 Matanuska-Susitna Borough brings highway and recreational vehicles very near the base of this cliff complex, providing excellent sheep-viewing opportunities. However, informal shooting occurs 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 10 August–20 September. The bag limit was one 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 one sheep by drawing permit only and by bow and arrow only.

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

Board of Game Actions and Emergency Orders. In March 2004, the Board of Game passed a regulation requiring all rams harvested to have their horns sealed by ADF&G or the Alaska Bureau of Wildlife Enforcement. This regulation became effective July 2004.

Hunter Harvest. Total harvests of sheep in the Chugach Mountains by regulatory year (RY) were: 135 (2001–02), 169 (2002–03), and 173 (2003–04; Tables 4–6). The total numbers of hunters in 13D and 14A has declined since 1999. In 1999–2000, there were 194 hunters in 14A and 220 in 13D, compared to 165 and 193 hunters in 2001–02 in 14A and 13D, respectively. The number of hunters has ranged from 257–322 in Unit 14C during the reporting period. Illegal harvest is unknown; however, illegal harvest is suspected to be substantial in some areas of 14A due to road access.

Permit Hunts. During this reporting period, 416 drawing permits, including 135 archery-only drawing permits, were issued in Unit 14C (Table 6). In RY 2003–04, the number of permits issued was reduced to 375, with no reduction in the number of archery-only permits. This reduction in overall permit numbers was in response to a declining sheep population and reports of hunter overcrowding in certain drainages. Success rates from 2001 to 2003 ranged from 24% to 28%. Since 1999, harvests have ranged from a low of 67 sheep in 2001–02 to a high of 81 sheep in 2002–03 (Table 6).

Hunter Residency and Success. During the 5-year period 1999–2003, nonresident hunters took 51 of 146 sheep (35%) in Unit 14A (Table 7), 44 of 360 sheep (12%) in Unit 14C (Table 8) and 154 of 289 sheep (53%) in Unit 13D (Table 9). Sixty-eight percent (346 of 506) of successful hunters in Units 14A and 14C were residents of Unit 14, whereas only 3% 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). This period corresponded to the typical pattern, in which 30–50% of the harvest occurs during the first week of the season and 10–20% of the sheep are taken during each of the second and third weeks of the season.

Transport Methods. Methods of transport used by sheep hunters differed widely in the units because of motorized access restrictions in Chugach State Park and proximity of roads. In Unit 13D during the report period, most of the successful hunters used aircraft (39–66%), 15–26% used highway vehicles and 11–16% used horses (Table 11). In Unit 14A the largest proportion of successful hunters used aircraft (36–62%; Table 12). Seven to 10% of successful hunters used highway vehicles. The majority (60–70%) 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.

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 Foundation for North American Wild Sheep (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. Recent years have seen a decline in sheep numbers in 14C, primarily attributed to several harsh winters. The Unit 14A population has declined over the past decade, but recent surveys may indicate a slight increase in numbers to approximately 900–1000 sheep. Partial surveys during the reporting period suggest the number of sheep in Unit 13D is stable or slightly increasing; however, total sheep numbers continue to be down from the past decade.

The harvest objective of a minimum of 120 full-curl or larger rams for the Chugach Mountains was exceeded in 2002 (146) and 2003 (141), but not reached in 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 1999–2003 was 49 ewes/year. The number of full-curl rams has ranged from 30 to 58 during this reporting period.

Department funding for sheep surveys continues to be scarce or nonexistent. In recent years, the Alaska Chapter of FNAWS has graciously funded the majority of sheep surveys in the Chugach Mountains.

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Table 1 Chugach Mountains, Unit 14A sheep composition counts and estimated population size, 1999–2003

Regulatory year	Rams		Ewes[b]	Lambs (%)	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal				
1999–00[c]						
2000–01[c]						
2001–02[c]						
2002–03	19 (2)	257	469	121 (14)	866	900–1000
2003–04[c]						

[a] Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed.
[b] Includes yearlings of both sexes and rams of ¼ curl or less.
[c] No survey conducted.

Table 2 Chugach Mountains, Unit 14C aerial sheep composition counts and estimated population size, 1999–2003

Regulatory year	Rams		Ewes[a]	Lambs (%)	Total sheep observed[b]	Estimated population size
	≥ full curl (%)	<full curl				
1999–00[c]						
2000–01	172 (8)	543	1,152	230 (11)	2118	2200
2001–02[c]						
2002–03	85 (5)	475	865	153 (9)	1654	1700
2003–04	115 (7)	373	912	226 (13)	1685	1800

[a] Includes yearlings of both sexes and rams of ¼ curl or less.
[b] Total includes unclassified sheep.
[c] No survey due to inclement weather.

Table 3 Chugach Mountains, Unit 13D sheep composition counts and estimated population size, 1999–2003

Regulatory year	Rams		Ewes[b]	Lambs (%)	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal				
1999–00						
2000–01[c]	9 (4)	48	131	26 (12)	214	
2001–02[d]	29 (6)	107	276	88 (18)	500	1500–2000
2002–03[c]	13 (6)	28	133		233	
2003–04[d]	29 (5)	113	355	108 (18)	605	1500–2000

[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 ¼-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, 1999–2003

Regulatory year	Rams	Average horn length (in) of rams	% of horn length ≥ 40 in	Ewes	Total sheep
1999–00	59	36.5	2	0	61
2000–01	52	36.9	8	0	53
2001–02	46	35.4	7	0	46
2002–03	56	35.2	4	0	56
2003–04	73	36.6	8	0	73

Table 5 Chugach Mountains, Unit 14A sheep harvest, 1999–2003

Regulatory year	Rams	Average horn length (in) of rams	% of horn length ≥ 40 in	Ewes	Total sheep
1999–00	36	36.1	0	0	36
2000–01	27	35.8	0	0	27
2001–02	22	35.8	9	0	22
2002–03	32	34.8	3	0	32
2003–04	29	35.8	3	0	29

Table 6 Chugach Mountains, Unit 14C sheep harvest data by permit hunt, 1999–2003

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
DS121-122,	1999–00	71	28	80	20	7	36.5	0	3 (30)	0	10
124-129	2000–01	71	32	77	23	6	38.9	33	5 (45)	0	11
Northeast,	2001–02	71	46	81	18	4	35.6	0	3 (43)	0	7
East Eklutna	2002–03	71	24	74	26	10	36.3	0	4 (29)	0	14
	2003–04	46	43	62	38	5	37.9	20	5 (50)	0	10
DS111-112,	1999–00	86	22	69	31	11	36.4	0	10 (48)	0	21
130-135	2000–01	86	21	68	32	14	35.4	0	7 (32)	1	22
Northwest,	2001–02	86	21	60	40	21	37.0	9	6 (22)	0	27
Upper	2002–03	86	15	71	29	16	35.1	0	5 (23)	0	21
Eagle River	2003–04	70	20	67	33	10	35.8	10	8 (44)	0	18
DS117-118,	1999–00	53	19	49	51	12	37.6	8	10 (45)	0	22
136-138	2000–01	53	23	49	51	11	37.2	9	10 (48)	0	21
Southwest	2001–02	53	19	63	37	9	33.5	11	7 (44)	0	16
	2002–03	53	8	57	43	13	36.0	8	8 (38)	0	21
	2003–04	53	20	60	40	10	36.8	10	7 (41)	0	17
DS119-120,	1999–00	70	36	85	15	5	38.1	20	2 (29)	0	7
139[g]	2000–01	70	33	77	23	4	35.4	0	7 (64)	0	11
West	2001–02	70	43	73	27	5	35.7	0	6 (54)	0	11
(late season	2002–03	70	33	77	23	7	35.8	0	4 (36)	0	11
--rifle)	2003–04	70	27	69	31	6	37.0	0	10 (63)	0	16

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	1999–00	100	42	89	11	3	36.5	0	3 (50)	0	6
West	2000–01	100	33	97	3	1	27.8	0	1 (50)	0	2
(late season	2001–02	100	40	93	7	4	34.4	0	0	0	4
--archery)	2002–03	100	28	89	11	7	28.5	0	1 (13)	0	8
	2003–04	100	37	87	13	8	28.1	0	0	0	8
DS141	1999–00	35	17	93	7	0	--	0	2 (100)	0	2
West Eklutna	2000–01	35	37	86	14	3	28.5	0	0	0	3
(archery)	2001–02	35	17	97	3	1	33.6	0	0	0	1
	2002–03	35	29	80	20	4	35.2	0	1 (20)	0	5
	2003–04	35	43	95	5	1	36.3	0	0	0	1
Governor's	1999–00	1	100	--	--	0	0	0	0	0	0
Permit	2000–01	1	0	0	100	1	42.0	100	0	0	1
	2002–02	1	0	0	100	1	40.8	100	0	0	1
	2002–03	1	0	0	100	1	35.8	0	0	0	1
	2003–04	1	100	--	--	--	--	--	--	--	--
Total all	1999–00	416	30	77	23	40	37.1	12	30 (43)	0	70
hunt areas	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 (33)	0	67
	2002–03	416	23	75	25	58	34.8	2	23 (28)	0	81
	2003–04	375	36	71	29	40	35.1	8	30 (42)	0	70

Table 7 Chugach Mountains, Unit 14A sheep hunter residency and success, 1999–2003

	Successful				Unsuccessful				
Regulatory year	Local[a] Resident	Nonlocal resident	Nonresident	Total (%)[b]	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Total hunters
1999–00	19	1	14	36 (19)	149	2	7	158 (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
2002–03	6	17	9	32 (18)	75	63	7	145 (82)	177
2003–04	12	6	11	29 (18)	68	62	6	136 (82)	165

[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, 1999–2003

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Total hunters
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	11	67 (24)	175	32	5	213 (76)	280
2002–03	61	12	8	81 (25)	200	9	32	241 (75)	322
2003–04	60	5	6	71 (28)	165	16	5	186 (72)	257

[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, 1999–2003

Regulatory year	Successful				Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	Local[a] resident	Nonlocal resident	Nonresident	Total (%)[b]	
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
2002–03	2	26	28	56 (30)	11	103	17	131 (70)	187
2003–04	3	29	41	73 (38)	11	97	12	120 (62)	193

[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, 1999–2003

Regulatory year	Harvest periods							
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	9/21–9/27	*n*
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
2002–03	44	20	14	13	8	2	0	87
2003–04	41	18	9	15	15	3	0	101

Table 11 Chugach Mountains, Unit 13D sheep harvest percent by transport method, 1999–2003

Regulatory year	Percent of harvest									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
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
2002–03	39	16	12	12	0	0	18	0	4	56
2003–04	66	7	7	5	0	0	15	0	0	73

Table 12 Chugach Mountains, Unit 14A sheep harvest percent by transport method, 1999–2003

Regulatory year	Percent of harvest									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
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
2002–03	45	0	3	42	0	0	10	0	0	32
2003–04	62	7	7	17	0	0	7	0	0	29

Table 13 Chugach Mountains, Unit 14C sheep harvest percent by transport method, 1999–2003

Regulatory year	Percent of harvest									*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	
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
2002–03	6	5	4	10	0	2	60	10	2	81
2003–04	4	6	1	8	0	1	70	4	4	71

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DALL SHEEP REPORT

From: 1 July 2001
To: 30 June 2004[a]

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 GOAL

- 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.

[a] This unit report also includes data collected outside the reporting period at the discretion of the reporting biologist.

METHODS

We monitored harvest by analyzing data from general harvest reports on harvest success, hunt area, hunter participation rate, residence, effort, transportation type used to access the hunt area, horn size and age. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY01 = 1 Jul 2001 through 30 Jun 2002).

We estimated population composition by conducting aerial surveys in the Wrangell–St Elias Preserve between the Nabesna and Chisana Rivers north of Cooper and Notch Creeks (Count Area 6), east of Snag and Carl Creeks to the Yukon, Canada, border north of Beaver Creek (Count Area 7), and in the Nutzotin Mountains south of Beaver Creek to the White River and east of Solo/Flat Creeks to the Yukon, Canada border (Count Area 9). Results from 3 surveys in the Mentasta Mountains conducted in July 1997 (Table 2) were included in this report to better analyze population and composition trends in the whole of 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 that 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 RY01–RY03 is not known, but based on studies conducted elsewhere, it may have been significant. Coyotes were found to be an important predator on lambs (Scotton 1998), and local residents have observed coyotes killing older sheep. A Dall sheep mortality study conducted in the Alaska Range south of Fairbanks found that golden eagles can also be a significant predator on lambs (Arthur 2003). 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 (Gardner 1999) indicated that lamb production improved to above 25 lambs:100 ewes. Surveys conducted in 1997 and 1998 indicated that sheep populations in the WMN Mountains increased during 1994–1999 (Tables 1–3). Due to adverse weather in winters 1999 and 2000, sheep numbers stabilized or declined (Table 3), although 2002 survey data do not indicate a decline.

Population Composition

Composition data are not directly comparable between years because different areas were sampled each year (Tables 1–3). Low lamb survival (9–19 lambs:100 ewes) during 1990–1993, 2001 and 2002 was noticeable in many of the count areas, and moderate to high lamb survival in 1997 and 1998 was noted in all counts. No adult mortality data were collected in this area during 1990–1993, but based on our annual sightings of collared sheep in the adjacent Tok Management Area (Gardner 1999), mortality was high during that time. We were not able to determine if adult sheep mortality was elevated during RY01–RY03 in the WMN 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 3) indicate that the number of ewes was reduced between 1981 and 2001, but we do not know when the decline occurred. Ewe numbers in the Wrangell Mountains appeared to rebound in 2002, but this may be due, in part, to the fact that only Count Area 7 was surveyed. Population composition in the Nutzotin Mountains (Count Area 9) was comparable to that in 1981. Although total sheep counted, percent lambs, and lambs:100 ewes were lower in 2002, the ratios of legal and sublegal rams:100 ewes were substantially higher (Table 3). This may indicate low adult mortality, low harvest rates of legal sheep, and/or low lamb productivity during RY01–RY03.

Weather, predation, and harvest management directly influence annual population composition (Heimer 1988). During RY01–RY03, we observed ratios of 11–16 legal rams:100 ewes, 17–35 lambs:100 ewes, and 11–17% lambs in the portion of the population counted.

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 2). Survey data collected during 1998 through 2002 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 in 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. However, recent studies in the Central Alaska Range indicate that coyote predation on Dall sheep is greatest during the peak and initial decline of cyclic hare populations (Arthur 2003). Therefore, coyote predation may have been a significant factor limiting the sheep population during RY01 but likely was less important during RY02 and RY03.

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 RY01–RY03.

Hunter Harvest. During RY01–RY03, 264–322 hunters ($\bar{x}$ = 288) reported taking 124–146 rams ($\bar{x}$ = 134) (Tables 4 and 5). These numbers were below the previous 5-year means of 313 hunters and 138 rams harvested (Table 4). Since RY92, harvest has declined 24% and hunter participation declined by 29%. 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. Based on surveys (Table 3), the number of legal rams increased during RY01–RY03.

Mean horn length was 34.6 inches during RY01–RY03. The previous 5- and 10-year averages were 34.7 and 34.5 inches (Table 5). During RY01–RY03, 11 rams taken had horns ≥40 inches (2.7%). The mean reported age of harvested rams was 8.6 years. The previous 5-year average was 8.9 years. 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 RY01–RY03 than the previous report period. That may be due to favorable weather conditions during 1994–2000, allowing for better horn growth.

As during the previous report period, 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. Overall success rate increased from an average of 40% during the previous report period to 46% during RY01–RY03 (Table 4). Nonresident success rates (63–93%) were much higher than resident success rates (30–39%) during RY01–RY03. The primary reasons nonresidents had higher success rates were that most were guided, and they hunted in the highest density sheep areas in the remote portions of the unit. Few residents traveled to these areas; they hunted mainly from the Nabesna Road or Glenn Highway, where legal ram numbers were low. During RY01–RY03, nonresidents made up an average of 30% of the sheep hunters and were responsible for taking an average of 22% of the annual harvest.

Harvest Chronology. Traditionally, in the WMN Mountains most sheep were taken early in the hunting season (Table 6). During RY01–RY03, 44–50% ($\bar{x}$ = 47%) of the harvest was taken during the first week of the season, 10% more than the average during the previous 5 years. Harvest decreased dramatically to 13–14% during the next 3 weeks, and 6% of rams were harvested during the final week of the season.

Transport Methods. During RY01–RY03, airplanes and horses were used by 68–77% of successful hunters (Table 7). The average success rates for hunters who used aircraft and horses were 52% and 83%, respectively. Success rates for nonresidents were much higher than residents who used these methods (airplanes 72% vs. 43%; horses 90% vs. 39%) because most were guided and hunted the better quality areas. Ninety-eight percent of successful hunters who used horses were nonresidents. Annually during RY01–RY03, 10–25% of successful hunters used 4-wheelers, other ORVs, or highway vehicles to access sheep habitat. Hunters who used 4-wheelers and other ORVs averaged 22% success, and hunters who used highway vehicles averaged 30% success. These transportation methods were primarily used by resident hunters ($\bar{x}$ = 92%).

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 RY01–RY03, while hunter success and total harvest increased. Under the season in place, hunters in most areas of Unit 12 were able to harvest most of the legal rams. Increased harvests in the WMN Mountains during RY01–RY03 were probably due to improved lamb recruitment and lower adult mortality during the mid to late 1990s. Lamb recruitment was average to high during 1994–1998 and 2002, and subadult survival was high through 2002. As the 1994 cohort aged, a greater number of legal rams likely became available to hunters during RY01–RY03.

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.

As in the last report period, more people used southern Unit 12, especially in Wrangell–St Elias National Park and Preserve, for wildlife viewing. Several hunting guide operations and 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 ¼ curl but less than full curl.
[d] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

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

Sex/age class	1971[a]	1973[a]	1980[a]	1997[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 ≥¾ 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 ≥ full curl.
[e] Greater than ¼ curl but less than legal size.
[f] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 3 Unit 12 Dall sheep aerial composition counts in the Wrangell Mountains and Nutzotin Mountains, 1981, 2001, and 2002

	Year	Legal rams[a]	Sublegal rams[b]	Unclassified rams	Total rams	Ewes[c]	Lambs	Unidentified	Total other sheep	Total sheep	Legal rams:100 ewes	Sublegal rams:100 ewes	Total rams:100 ewes	Lambs: 100 ewes	Lambs % of total
Count	1981	84	243	0	327	698	234	0	932	1259	12	35	47	34	19
Area 6[d]	2001	54	207	0	261	516	90	0	606	867	11	40	51	17	10
Count	1981	15	210	21	246	511	140	51	702	948	3	41	48	27	15
Area 7[d]	2001[e]	25	88	0	113	153	33	0	186	299	16	58	74	22	11
	2002	58	191	0	249	426	129	0	555	804	14	45	59	30	16
Count	1981	99	453	21	573	1209	374	51	1634	2207	8	38	47	31	17
Areas 6	2001	79	295	0	374	669	123	0	792	1166	12	44	56	18	11
and 7 combined[d]															
Count	1981	9	110	136	255	682	249	0	931	1186	1	16	37	37	21
Area 9[f]	2002	40	194	0	234	358	125	18	501	735	11	54	65	35	17

[a] Full curl or larger.
[b] Greater than ¼ curl but less than full curl.
[c] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.
[d] Wrangell Mountains.
[e] Count Area 7 only included from Snag Creek East.
[f] Nutzotin Mountains.

TABLE 4 Unit 12 sheep hunter residency and success, regulatory years 1990–1991 through 2004–2005

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	1	62	61	124	(44)	12	121	22	155	(56)	279
2002–2003	3	72	56	131	(50)	8	108	17	133	(50)	264
2003–2004	3	66	77	146	(45)	8	151	17	176	(55)	322
2004–2005[c]	1	90	58	149	(42)	13	168	19	200	(57)	349

[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 2004–2005

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	124	34.7	8.5	126	279
2002–2003	130	34.8	8.5	131	264
2003–2004	145	34.3	8.6	147	315
2004–2005[b]	151	34.5	8.1	153	346

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

TABLE 6 Unit 12 sheep harvest chronology percent by time period, regulatory years 1990–1991 through 2004–2005

Regulatory	Harvest chronology percent by time period						
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*
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	47	14	14	11	7	7	123
2002–2003	50	10	16	15	6	3	131
2003–2004	44	16	9	13	8	9	171
2004–2005[a]	46	11	15	10	12	6	170

[a] Preliminary data.

TABLE 7 Unit 12 sheep harvest percent by transport method, regulatory years 1990–1991 through 2004–2005

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1990–1991	53	21	2	9	0	2	12	1	266
1991–1992	56	22	4	5	0	2	9	3	272
1992–1993	62	27	1	2	0	2	6	1	177
1993–1994	62	24	2	5	0	1	5	2	173
1994–1995	59	20	6	9	0	0	5	1	167
1995–1996	50	27	4	10	0	1	8	1	179
1996–1997	53	26	3	7	0	3	8	0	164
1997–1998	55	23	4	5	0	0	12	1	129
1998–1999	54	25	6	6	0	1	8	0	160
1999–2000	48	26	8	9	0	1	7	1	137
2000–2001	59	20	7	3	0	1	10	0	99
2001–2002	57	20	6	9	0	2	4	0	126
2002–2003	45	23	9	9	0	0	14	0	133
2003–2004	43	31	5	8	0	1	11	0	146
2004–2005[a]	42	23	5	14	0	1	15	1	151

[a] Preliminary data.

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

GAME MANAGEMENT UNITS: Portions of Units 12, 13C, and 20D (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 reports returned by drawing permit holders. 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., RY02 = 1 Jul 2002 through 30 Jun 2003).

Population composition and productivity have been periodically estimated in the TMA using aerial or ground survey techniques (Gardner 2002). Aerial composition surveys were conducted during this report period in a 580-mi^2 portion of the TMA during mid July 2002 and 2003 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 RY01–RY03. 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. The sheep population suffered high mortality in 1992 and low productivity in 1992 and 1993. Age structure data collected during 1992–2003 composition surveys indicated the adult mortality rate was low and lamb survival was generally high (Table 1).

Gardner (2002) summarized weather and its effect on Dall sheep in the TMA during 1990–2001. During RY01–RY03, winters were generally mild, while summers were average to dry. Effects of weather during these years are difficult to predict, but based on composition data (Table 1), the population appeared to be stable.

Population Composition

During RY01–RY03, population composition surveys were only conducted in July 2002 and 2003. Ratios of 40 lambs and 75 rams:100 ewes (counts of ewes may include some young

rams) were observed in 2002; these ratios were 32 lambs and 34 rams:100 ewes in 2003 (Table 1). Full-curl rams composed 24% of the total ram population in 2002 and 23% in 2003. The abundance of full-curl 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.

Distribution and Movements

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. During RY01–RY03 we collected no additional data on distribution and movements.

MORTALITY

Harvest

Season and Bag Limit. During the report period, 120 permits were issued in RY01 and 101 permits were issued annually in RY02 and RY03. One permit in each of RY02 and RY03 was a Governor's permit auctioned to raise funds for wildlife 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. Harvest was limited to rams that were ≥8 years old or those with at least 1 full-curl horn or both horns broken (broomed).

Alaska Board of Game Actions and Emergency Orders. No Alaska Board of Game actions were taken, and no emergency orders were issued during the report period.

Hunter Harvest. During RY01–RY03, annual harvest ranged from 34 in both RY01 and RY02 to 46 in RY03 rams ($\bar{x}$ = 38 rams). The previous 5-year mean harvest was 46 rams (Table 2). Hunter participation averaged 87% during RY01–RY03, compared to 84% during the previous 5 years. Hunter participation has generally increased since 1990, when 72% of permit recipients hunted, to 90% participation in RY03. Participation is expected to remain high because of the area's reputation for high success and few hunters.

Reduced harvest during RY01–RY02 was likely due to reduced lamb recruitment during 1992 and 1993 and to fewer permits issued in RY02. Despite only 101 permits issued in RY03, harvest increased to 46 rams. This was likely at least partly a result of favorable weather in RY03 and good lamb recruitment during 1994 and 1995.

Mean horn length during RY01–RY03 was 35.7 inches compared to the previous 5-year mean of 36.3 inches (Table 3). The number of harvested rams with horn length ≥40 inches was 1–2 and averaged 4% of the annual harvest. The previous 5-year mean was 8%. Percent of rams with horn length ≥40 inches has declined since 1995, but appears to have remained steady or increased during RY01–RY03. Average horn size has declined since the early 1990s. Small changes in horn size during the report period (Table 3) are inconclusive. Relatively high harvests during RY95–RY99 and poor horn growth due to unfavorable environmental conditions since 2000 are likely important factors in the decline. The average reported age of rams harvested during RY01–RY03 was 8.8 years, slightly younger than the previous 5-year mean of 9.1.

Hunter Residency and Success. During RY01, 2573 applicants applied for 120 permits and during RY02 and RY03, 2539 and 2882 applicants applied for 100 permits annually (3.5–4.7% chance of being drawn). Ninety-four percent of participating hunters were Alaska residents, and they took 92% of the harvested rams during RY01–RY03 (Table 4). Three to 9 nonresidents (3–8% of permittees) were drawn annually during that period. Overall, 84% of the nonresidents who drew a permit participated, compared to 86% of selected residents.

During RY01–RY03 the mean annual success rate was 42% (range 34–52%), substantially below the mean annual success rate of 58% during RY87–RY91 and somewhat lower than the previous 5-year mean of 46% (Table 4). During this report period, hunters had the greatest success in RY03 (52%) and spent 5.3 days in the field. Successful hunters were in the field 6.2 and 6.7 days during RY01 and RY02. Since RY95, success rates ≥54% were only accomplished during years hunters spent an average of 6 days hunting. The primary reason hunters spent more time hunting during certain years was favorable weather conditions, as during the RY03 hunting season.

Harvest Chronology. Since the inception of the TMA, most harvest usually occurred during the first 10 days of the sheep season (10–20 Aug). During RY01–RY03, 56% of the harvest was during the first 10 days and 21% was during the second 10 days. Hunters chose to hunt during the first week of the season because they were concerned about adverse weather later in the season, and they believed they had to be hunting on opening day to take the largest ram.

Transport Methods. Airplanes were the primary methods of transport during RY01–RY03 (Table 5). During this report period, 70% of all hunters used aircraft to access the area. For the first time, ATV use (14%) was greater than highway vehicle use (12%). Historically, ATVs were not commonly used. During RY01–RY03, the average success rate for hunters who used aircraft was 47%, while success rates for hunters who used ATVs and highway vehicles were 39% and 27%.

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 that time, it seemed that overwinter survival was high. During 1992 and 1993, weather conditions were unfavorable in terms of timing, duration, and depth of snowfall, as well as summer drought. Consequently, lamb recruitment was low, and data from collared sheep indicated high adult mortality. 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 high, resulting in low lamb recruitment. Based on numbers of sheep sighted and lamb ratios during 2002–2003 composition surveys, it appears that adult survival and lamb productivity was good during RY01–RY03.

The overall limiting effects of wolf, bear, and coyote predation on the TMA sheep population are still 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. However, we have not observed other incidences of diseased sheep in the TMA since 1990, and do not believe disease was a limiting factor to population growth during RY01–RY03. 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 Department of Natural Resources/Office of Habitat Management and Permitting 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 and 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. Results of a hunter survey in 2000 and suggestions for management actions in the TMA that are appropriate to meet the trophy quality expectations of hunters and maintain pristine hunting conditions were summarized by Gardner (2002).

CONCLUSIONS AND RECOMMENDATIONS

Most management goals and objectives were met during the report period. 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, mean horn length did not meet the management objective of a minimum of 36 inches during 2 of the 3 years of the report period. Primary reasons for the decline were likely lower numbers of older rams due to poor lamb recruitment during the early 1990s, high harvests, and possible slower horn growth during 1999–2004 due to dry summers. We expect horn size to increase as the relatively large lamb cohorts from 1994–1998 reach full-curl status. However, average horn size may still be low

due to the effects of 5 years of poor horn growth. We will continue to monitor the horn length and take corrective action if necessary.

We met our objective to prevent unacceptable increases in hunter concentration and maintain aesthetically pleasing qualities associated with sheep hunting in the TMA. We decreased the number of permits issued during RY02–RY03 to address complaints about hunter crowding. Complaints from hunters have declined since the number of permits was decreased.

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Table 1 Tok Management Area sheep composition counts from aerial surveys, 1980 through 2004

Sex/age class	1980	1994	1999[a]	2000[b]	2002	2003	2004
Legal rams[c]	148	123	38	59	85	53	65
Sublegal rams[d]	263	294	89	144	264	182	153
Unclassified rams	9	0	38	0	0	0	0
Total rams	420	417	165	199	349	235	218
Ewes[e]	922	567	352	402	466	692	593
Lambs	350	137	110	39	187	224	186
Unidentified	6	3	0	0	1	7	0
Total other sheep	1278	707	462	441	654	923	779
Total sheep	1698	1124	627	640	1003	1158	997
Legal rams:100 ewes	16.1	21.7	10.8	14.7	18.2	7.7	11.0
Sublegal rams:100 ewes	28.5	51.9	25.3	35.8	56.6	26.3	25.8
Total rams:100 ewes	45.5	73.5	46.9	49.5	74.9	34.0	36.8
Lambs:100 ewes	38.0	24.2	31.3	9.7	40.1	32.4	31.4
Lambs % of total	20.6	12.2	17.5	6.1	18.7	19.3	18.7

[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 curl but less than full curl.
[e] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 2 Tok Management Area harvest of Dall sheep rams, regulatory years 1990–1991 through 2003–2004

Hunt/area	Regulatory year	Permits issued	% Did not hunt	% Unsuccessful hunter	% Successful hunter	$\bar{x}$ Horn length	$n \geq 40$" (%)	Total harvest
DS102	1990–1991	120	28	56	44	37.0	6 (17)	36
	1991–1992	120	23	44	56	36.9	9 (17)	52
	1992–1993	120	26	58	42	37.1	6 (16)	37
	1993–1994	120	13	58	42	37.3	6 (13)	44
	1994–1995	120	28	54	46	36.9	3 (8)	39
	1995–1996	120	18	61	39	37.2	8 (13)	60
	1996–1997	120	17	44	56	36.2	5 (9)	56
	1997–1998	120	20	57	43	36.5	3 (7)	41
	1998–1999	120	13	46	54	36.2	4 (7)	56
	1999–2000	120	13	60	40	36.3	4 (10)	42
	2000–2001	121	19	66	34	36.1	3 (9)	33
	2001–2002	121	17	55	28	35.4	3 (8)	34
	2002–2003	101	13	53	34	36.2	3 (8)	34
	2003–2004	101	10	43	47	35.6	5 (11)	46

TABLE 3 Tok Management Area sheep harvest, regulatory years 1990–1991 through 2003–2004

Regulatory year	Rams	$\bar{x}$ Horn length	Sheep ≥40" (%)	$\bar{x}$ age	Ewes	Total sheep
1990–1991	36	37.0	6 (17)	9.2	0	36
1991–1992	52	36.9	9 (17)	8.9	0	52
1992–1993	37	37.1	6 (16)	8.6	0	37
1993–1994	44	37.3	6 (13)	9.0	0	44
1994–1995	39	36.9	3 (8)	9.2	0	39
1995–1996	60	37.2	8 (13)	9.4	0	60
1996–1997	56	36.2	5 (9)	8.9	0	56
1997–1998	41	36.5	3 (7)	8.9	0	41
1998–1999	56	36.2	3 (7)	9.0	0	56
1999–2000	42	36.3	4 (10)	9.5	0	42
2000–2001	33	36.1	3 (9)	9.3	0	33
2001–2002	34	35.4	2 (6)	8.7	0	34
2002–2003	34	36.2	1 (3)	8.9	0	34
2003–2004	46	35.6	2 (5)	8.7	0	46

TABLE 4 Tok Management Area sheep hunter residency and success, regulatory years 1990–1991 through 2003–2004

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	
1990–199	2	31	3	36 (44)	3	43	0	46 (56)	82
1991–199	3	47	2	52 (56)	0	38	3	41 (44)	93
1992–199	4	30	3	37 (42)	4	46	2	52 (58)	89
1993–199	3	39	2	44 (42)	6	54	1	61 (58)	105
1994–199	4	31	4	39 (46)	4	40	2	46 (54)	85
1995–199	9	44	7	60 (61)	2	37	0	39 (39)	99
1996–199	7	44	5	56 (56)	2	40	2	44 (44)	100
1997–199	3	35	3	41 (43)	8	45	1	54 (57)	95
1998–199	1	55	0	56 (54)	2	43	2	47 (46)	103
1999–199	2	39	1	42 (40)	1	58	2	61 (60)	103
2000–2001	0	29	4	33 (34)	1	63	1	65 (66)	98
2001–2002	2	27	5	34 (34)	3	60	4	67 (66)	101
2002–2003	2	30	2	34 (39)	6	47	1	54 (61)	88
2003–2004	6	38	2	46 (52)	7	33	2	42 (49)	88

TABLE 5 Tok Management Area sheep harvest percent by transport method, regulatory years 1990–1991 through 2003–2004

Regulatory year	Percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1990–1991	53	0	0	8	0	3	36	0	36
1991–1992	63	2	0	0	0	6	27	2	52
1992–1993	57	3	0	3	0	3	30	3	37
1993–1994	75	0	0	5	0	0	18	2	44
1994–1995	82	0	0	3	0	0	13	3	39
1995–1996	63	0	0	6	0	5	20	5	60
1996–1997	63	2	2	7	0	0	23	4	56
1997–1998	73	0	0	12	0	0	15	0	41
1998–1999	54	0	0	5	0	4	36	2	56
1999–2000	57	0	0	21	0	0	21	0	42
2000–2001	67	0	0	18	0	6	6	3	33
2001–2002	85	0	0	3	0	0	12	0	34
2002–2003	74	0	0	18	0	0	9	0	34
2003–2004	57	0	0	20	0	0	17	7	46

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

GEOGRAPHIC DESCRIPTION: Talkeetna Mountains and Chulitna-Watana Hills

BACKGROUND

Since statehood, sheep harvest has been restricted to adult rams in the Talkeetna Mountains and the Chulitna-Watana Hills (TCW). Sheep harvest data have been collected from hunter harvest reports since 1967. From 1967 through 1978, the mean annual harvest under a ¾-curl horn minimum regulation was 90 rams. Under a ⅞-curl horn minimum during 1979–1988, the annual harvest averaged 87 rams. In 1989 hunters were allowed to harvest only full-curl rams, and during 2001–2004 the average harvest was 65 rams. The reported harvest peaked at 118 during 1969 and again in 1986. Since then, the highest reported harvest was 109 rams taken in 1995. The low harvest of 51 rams in 2000 was surpassed in 2001, when 41 rams were harvested.

A large-scale sheep survey was first conducted in 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 historically been highest 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. By the late 1990s the TCW population estimate was approximately 1750 sheep (McDonough 2002).

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

Sheep harvest was monitored through 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, harvest success, 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 unreported is assumed to be small.

The Foundation for North American Wild Sheep provided some of the funding to conduct sex and age composition counts in limited survey areas during this reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The estimated population for sheep in TCW increased from 2000–2500 in 1994 (Masteller 1996) to 2500–3000 sheep in 1999. A severe winter in 1999–2000 decreased the overall sheep population about 40% and reduced the year's lamb recruitment by 75% (McDonough 2002). Limited surveys from 2000–01 to 2003–04 indicate that the overall sheep population has increased and is recovering from the previous decline (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The hunting season in Units 13A, 13E, 14A and 14B for regulatory years 2001–02 through 2003–04 was 1 August–20 September. The bag limit was one ram with a full-curl horn or larger.

Hunter Harvest. Hunter harvest averaged 65 rams during 2001–2004 (Table 2), much lower than the average harvest of 82 rams per year during 1990–2000. This low 3-year average is mostly due to the record low harvest of 41 rams in 2001.

With adoption of the full-curl regulation, mean horn size increased steadily from 1989 through 1996 but has remained fairly constant since the late 1990s. The 2001–04 average horn size matches the 1998–2001 average of 34.9 inches. This was also the average horn size from 1989 to 1997.

Hunter Residency and Success. The total number of hunters has decreased from the high of 534 reported in 1995 (Table 3). The success rates for all hunters were lower in 2000 and 2001 due to the large mortality of legal rams after the 1999–2000 winter (Table 3). In 2002 and 2003, success rates increased, although nonresidents continued to be more successful than residents. They accounted for 14% of hunters but took 41% of the sheep during 2001–2003 (Table 3). This higher success rate is because nonresidents are required to have a guide, and they more often use aircraft to access remote areas.

Harvest Chronology. During 2001–2003, an average proportion of 50% of the reported rams harvested were taken during the first week of the season. This reflects an increased harvest

during the first week of the season as compared to the last 15 years. For this reporting period an average proportion of 59% of the harvest occurred in the first 2 weeks (Table 4).

Transport Methods. Most successful hunters reported using aircraft or four-wheelers to access their hunting areas, and this has been the pattern for the more than 10 years (Table 5).

CONCLUSIONS AND RECOMMENDATIONS

From 2001 through 2003 the mean annual harvest of rams was 65, ranging between 41 and 79. This is below the harvest objective and is due to the population decrease after the winter of 1999–2000. The last 2 years have shown evidence of recovery in the sheep populations in the Talkeetna Mountains as reflected in the surveys, harvest numbers and success rates, although the Watana Hills have continued to decline.

Periodic surveys of the TCW sheep population to adequately assess population trends should be conducted in the count areas in Units 13 and 14 during the same summer. Surveys done every 3 years for all count areas would provide meaningful population trend information and be useful in tracking significant changes to the population and herd composition. Other means of collecting population information are limited given current budget and staff limitations, although resources provided by groups like the Foundation for North American Wild Sheep may potentially offset some of these limitations in the future.

There have continued to be a number of complaints that sheep hunting is too crowded and that more restrictions are needed to improve hunt quality. In the past, the Alaska Department of Fish and Game (ADF&G) has not supported restrictions such as changing general season hunts to drawing permit hunts or bag limit changes of 1 sheep every 3 years. It is unlikely this will change without broad public support by resident sheep hunters. However, if sheep hunting effort grows and the concern about hunt quality continues, ADF&G and the Board of Game may consider these and other potential changes to the management program in the future.

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Table 1 Talkeetna Mountains and Chulitna-Watana Hills summer aerial sheep composition counts, 1977–2004

Regulatory Year	Full Curl	(%)	Sublegal Rams[a]	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep Observed
Boulder Creek								
1977	29	9%	--	243	54	16%	--	326
1982	26	6%	42	287	104	23%	153.0	459
1994	35	11%	19	201	58	19%	125.9	313
1999	16	4%	39	286	90	21%	209.4	431
2000	5	2%	47	161	10	4%	121.6	223
2003	2	1%	40	148	53	22%	120.6	243
Chickaloon River – east								
1977	7	3%	--	183	47	20%	--	237
1982	9	5%	18	92	23	16%	68.5	142
1994	16	6%	45	146	36	15%	105.8	243
1999	8	3%	38	157	63	24%	131.2	266
2003	13	6%	28	103	28	16%	84.7	172
Hicks Creek								
1977	9	15%	--	43	9	15%	--	61
1982	6	10%	17	33	7	11%	48.5	63
1994	12	6%	32	71	25	18%	155.4	140
1999	2	1%	15	112	46	26%	211.3	175
2003	0	0%	17	89	27	20%	130.0	133
Caribou Creek								
1977	11	3%	--	329	58	15%	--	398
1982	2	1%	45	186	40	15%	80.6	273
1994	35	8%	83	237	60	15%	154.9	415
1999	36	5%	152	409	142	19%	224.3	739
2000	29	7%	77	243	36	9%	147.8	385

Table 1 continued

Regulatory Year	Full Curl	(%)	Sublegal Rams[a]	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep Observed
2002	38	6%	146	242	97	19%	78.9	523
2003	40	9%	91	187	66	17%	55.3	384
Sheep Mountain								
1977	18	17%	--	77	8	8%	--	103
1983	20	18%	19	54	19	17%	90.9	112
1994	24	19%	20	58	22	14%	79.0	124
1999	18	18%	33	36	14	14%	91.0	101
2000	8	4%	40	79	5	4%	66.7	132
2003	11	5%	48	76	14	9%	40.0	149
Watana Hills								
1977	4	3%	--	115	33	22%	--	152
1978	5	3%	--	150	34	18%	--	189
1980	9	5%	19	104	42	24%	69.6	174
1981	2	1%	37	127	43	21%	63.3	209
1982	0	0%	19	143	38	19%	---	200
1994	10	6%	28	98	23	14%	72.3	159
1999	2	2%	22	56	17	18%	44.1	97
2003	0	0%	10	33	7	14%	21.5	50
Little Susitna to King's River								
1981	19	13%	21	78	24	17%	--	142
1983	15	7%	42	131	29	13%	--	217
1986	15	6%	39	152	49	19%	--	255
1988	3	2%	44	66	18	14%	--	131
1994	4	7%	16	26	9	16%	13.4	55
1999	7	5%	29	77	24	18%	32.6	137

Table 1 continued

Regulatory Year	Full Curl	(%)	Sublegal Rams[a]	Ewes[b]	Lambs	(%)	Sheep/ Hour	Total Sheep Observed
King's River to west side Chickaloon River								
1981	12	6%	40	102	40	21%	--	194
1983	17	11%	43	77	16	10%	--	153
1986	9	3%	40	202	46	15%	--	297
1988	13	3%	77	270	90	20%	--	450
1994	12	8%	33	74	26	18%	36.2	145
1999	5	2%	58	190	66	21%	76.0	319
Sheep River – Iron Creek								
1981	11	9%	18	62	26	22%	--	117
1983	8	11%	11	48	9	12%	--	76
1986	9	25%	13	8	6	17%	--	36
1988	8	4%	47	107	39	19%	--	201
1994	10	10%	22	59	13	13%	22.6	104
1999	3	6%	13	25	8	16%	14.4	49

[a] Legal rams included under "Full curl" column. Sublegal rams include rams not identified as full curl or larger beginning in 1989. Prior to 1989, rams with ⅞-curl horns or larger were legal for sport hunting.
[b] Ewes includes yearlings of both sexes and rams of ¼ curl or less.

Table 2 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest, 1989–2003. Beginning in 1989, regulations required hunters take full-curl rams only.

Regulatory Year	Rams[a]	Average Horn Length (inches)	% ≥ 40 in.	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	51	34.4	2.0	0	51
2001–02	41	34.2	0.0	0	41
2002–03	79	35.3	3.8	0	79
2003–04	74	35.3	2.7	0	74

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

Table 3 Talkeetna Mountains and Chulitna-Watana Hills sheep hunter residency and success, 1989–2003. Beginning in 1989, regulations required hunters take full-curl rams only.

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1989–90	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
2001–02	11	9	21	41 (13)	139	104	23	266 (87)	307
2002–03	26	24	29	79 (22)	151	106	27	284 (78)	363
2003–04	33	16	25	74 (21)	138	124	22	284 (79)	358

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

Table 4 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest chronology percent by harvest period, 1989–2003. Beginning in 1989, regulations required hunters take full-curl rams only.

Regulatory year	Harvest periods						*n*
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
1989–90	35	19	9	16	11	9	76
1990–91	45	17	15	5	9	9	82
1991–92	47	19	8	9	8	9	91
1992–93	41	24	16	7	7	5	75
1993–94	38	16	19	11	7	8	82
1994–95	43	25	9	10	7	4	91
1995–96	28	26	12	7	13	13	109
1996–97	42	19	15	6	11	7	90
1997–98	44	16	10	9	10	11	81
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	51
2001–02	46	10	17	15	7	5	41
2002–03	49	11	9	13	8	9	79
2003–04	54	18	15	7	5	0	74

Table 5 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest percent by transport method 1989–2003. Beginning in 1989, regulations required hunters take full-curl rams only.

Regulatory year	Percent of harvest							*n*
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unknown	
1989–90	53	13	1	24	0	8	0	76
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	51
2001–02	51	10	0	34	0	2	2	41
2002–03	38	4	1	44	8	3	3	79
2003–04	47	4	0	45	0	4	0	74

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

GEOGRAPHIC DESCRIPTION: Delta Controlled Use Area (DCUA)

BACKGROUND

Alaska Department of Fish and Game (ADF&G) management plans for Dall sheep (ADF&G 1976; Greg Bos, personal communication, 1988) define the management goals for this species in Alaska. These goals include protection and maintenance, scientific and educational study, diversified recreational use, and commercial and subsistence uses. Federal and state subsistence laws mandate subsistence use as the highest priority of fish and wildlife when harvest is allowable. However, the Alaska Board of Game, acting in compliance with these subsistence laws, has found that historic human use of Dall sheep rarely meets the present definitions of subsistence use. Consequently, diversified human recreation is the predominant use of Dall sheep in Alaska.

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

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

In the Delta Management Area, use of motorized vehicles and pack animals for transporting hunters, hunting gear, or game was initially prohibited for the first portion of the 10 August–20 September hunting season. After 25 August, transportation restrictions were lifted and

mechanized and pack animal access was permitted. Bag limit was 1 ram with ¾-curl or larger horns.

Designation of the Delta Management Area as a walk-in-only area successfully provided walk–in-only hunting opportunity but failed to reduce harvest to the desired level or provide high-quality hunting experiences. The harvest and the quality hunting experience objectives were formally selected as consumptive use guidelines during the public planning project of the mid 1970s (ADF&G 1976). Rams in the Delta Management Area were still subjected to heavy hunting pressure resulting in excessive harvest, reduced horn size, and a great deal of hunter competition for available rams. In 1977 hunters killed 78 rams even though the desired harvest objective was 40 rams (Larson 1979).

In an effort to achieve the harvest and aesthetic quality objectives, sheep hunting in the Delta Management Area was restricted by drawing permit in 1978. Sixty permits were issued for a 10–25 August walk-in season, and 60 permits were issued for a 26 August–20 September open access season. The bag limit was 1 ram with ¾–curl horns or larger. As expected, the permit hunt reduced the hunting pressure and harvest. Harvest was reduced from 78 rams in 1977 to 31 rams in 1978, but average horn size decreased to an all-time low of 31.2 inches (Larson 1980).

In 1979 minimum horn size for legal sheep in all of Unit 20 was increased from ¾ to ⅞ curl. The 7/8–curl regulation did not affect the number of rams harvested in the Delta Management Area, but average horn size increased from 31.2 inches in 1978 to 34.6 inches in 1979 (Larson 1979).

The Delta Management Area was renamed the Delta Controlled Use Area in 1981 to more accurately reflect its classification as a controlled use area rather than a management area. In 1982 the number of drawing permits issued was increased to 75 for each portion of the drawing permit hunt.

Minimum horn size for legal sheep in Unit 20 was raised from ⅞ curl to full curl in 1984. The season and bag limit in the DCUA have not changed since 1984, with the exception of 1985, when Tier II subsistence regulations were adopted.

The size of the DCUA was reduced in July 1992 to exclude a portion of non-sheep habitat between the Richardson Highway and the Delta River. This area of non-sheep habitat is popular for hunting small game and upland game, and DCUA access restrictions unnecessarily complicated hunting in the area and confused hunters. This portion of habitat was reestablished inside the DCUA in 2002 to facilitate Macomb caribou herd management. However, access restrictions applied to only big-game hunters, rather than restricting access for all hunters as before.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

- Manage for a population of approximately 1800 sheep to provide a mean annual harvest of 35 full-curl rams with a mean horn length of more than 36 inches and mean age exceeding 8 years.

Related Management Activities

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

METHODS

Hunters selected in the permit drawing were required to report on their activities. Data contained on the permit reports were analyzed to determine hunter success, hunter residence, hunter effort, ram horn size, hunt location, transportation type, and other information. Data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY02 = 1 Jul 2002 through 30 Jun 2003).

During RY03 all hunters were mailed a sheep hunter questionnaire and asked a variety of questions about their hunt (including aesthetics) and their opinions on DCUA management (Appendix). Not all questionnaire data were summarized for this report, but we analyzed those questions related to DCUA management goals. Hunters were asked to rate satisfaction with their hunt on a scale of 10 (very satisfied) to 1 (extremely disappointed). Hunters who rated their hunt satisfaction from 6 to 10 were considered satisfied with their hunt. A mean satisfaction rating was also calculated for all hunters. Data were pooled for both drawing hunts DS203 and DS204. Also, DCUA management goals were listed in the questionnaire, and hunters were asked to answer (by yes or no) whether they agreed with the goals.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

No funds were available to complete surveys to estimate population size during this reporting period. Therefore, assessment of the population size objective was not possible.

Population Composition

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

MORTALITY

Harvest

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

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

Hunter Harvest. DCUA harvest for both hunts (DS203 and DS204) met the harvest objective in RY01–RY03 (Table 1). Harvest during RY01–RY03 averaged 55 sheep/year, which was higher than the average of 41/year for the previous 5 years. The RY01–RY03 harvest was the highest harvest reported since at least RY88.

Mean horn length for all sheep taken during this reporting period was slightly below the objective in RY01–RY02 with 35.7 and 35.6 inches respectively, but met the objective in RY03 at 36.0 inches (Table 1).

Mean age of all sheep taken in the DCUA met the management objective during RY01–RY03 (Table 1).

DCUA questionnaires were received from 74 hunters in RY03. Most hunters (81%) were satisfied with their DCUA hunt. On the rating scale of 10 (very satisfied) to 1 (extremely disappointed), the mean satisfaction rating for all hunters was 7.9 (Table 2). Twenty-nine of 74 respondents (39%) gave their hunt the highest rating possible of 10. When asked if they agreed with DCUA harvest goals, 95% of respondents answered “yes.” When asked if they agreed with DCUA aesthetic goals, 96% answered “yes” (Table 2).

Permit Hunts. The number of permit applicants continued to slowly increase to a high of 2529 in RY03 for both hunts. The number of applications for hunt DS204 continued to be slightly higher than for DS203, with 53–55% of applications in RY01–RY03 (Table 3).

Hunter Residency and Success. Most DCUA hunters continued to be Alaskan residents (Table 4).

Harvest Chronology. During hunt DS203 and DS204, most harvest occurred during the first 5 days of each hunt (Table 5).

Transport Methods. No changes in mode of transportation were detected during this reporting period. Highway vehicles were the most popular mode of transportation during hunt DS203 because most hunters walked into the DCUA from either the Richardson or Alaska Highway due to access restrictions. Aircraft and a few boats were used along the Johnson River. Airplanes and 3- or 4-wheelers were most commonly used during hunt DS204 (Table 6).

Other Mortality

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

Weather is not thought to adversely affect sheep populations in the DCUA in most years. The DCUA is located at the north end of the 2443-ft Isabel Pass through the Alaska Range, so winter storms frequently bring high winds and warm temperatures. Therefore, much of the area is either snow-free or has little snow during much of the winter. Hence, it provides suitably stable winter range for Dall sheep.

HABITAT

Assessment

Sheep habitat appears sufficient to support the population at its current level; however, we have not conducted habitat assessment surveys. The 2 greatest threats to sheep habitat in the DCUA are mining activities and military exercises on state land. Both of these activities should be monitored closely.

CONCLUSIONS AND RECOMMENDATIONS

Objectives for harvest and mean age of rams were met during this reporting period (RY01–RY03), but the horn length objective was not met in 2 of the 3 years. During the last 10 years, the horn length objective was met only 4 times, but in most other years, mean horn length was less than 1 inch short of the objective. Because the harvest objective was easily met and exceeded, the number of permits could be decreased to reduce harvest while still meeting the harvest objective, and thus allow mean horn size to increase. However, based on hunter questionnaire results, hunters appear to be satisfied with DCUA harvest results, and no reduction in the number of permits will be considered at this time.

The harvest of 51–56 sheep/year during RY01–RY03 is the highest recorded harvest since at least RY88. Without population surveys it is difficult to assess the impact of this harvest on the population. However, based on discussions with hunters and other anecdotal observations, it appears that the number of sheep in the DCUA has not declined and no effort will be made to reduce harvest at this time.

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

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TABLE 1 Delta Controlled Use Area sheep harvest data by permit hunt, regulatory years 1988–1989 through 2003–2004

Hunt/ Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest (rams)	$\bar{x}$ horn length (in)	$\bar{x}$ age (yr)	Percent ≥40"
D1103	1988–1989	75	36	47	17	13	35.4		15
	1989–1990	75	29	35	36	27	37.0		7
	1990–1991	75	32	44	20	15	34.6		0
	1991–1992	75	21	48	31	23	35.9		13
	1992–1993	75	32	43	25	19	36.0	8.4	5
DS203	1993–1994	75	33	39	28	21	36.1	8.6	14
	1994–1995	75	41	41	15	11	34.7	7.7	9
	1995–1996	75	32	48	20	15	36.7	9.0	13
	1996–1997	75	22	50	28	21	36.0	8.3	4
	1997–1998	75	13	61	25	19	35.7	9.3	10
	1998–1999	75	31	51	17	13	38.2	9.4	8
	1999–2000	75	33	40	27	20	34.7	8.6	0
	2000–2001	75	27	55	19	14	35.8	9.1	7
	2001–2002	75	24	45	31	23	36.0	9.2	17
	2002–2003	75	20	53	27	20	36.0	9.1	5
	2003–2004	75	19	49	32	24	37.0	9.8	4
D1104	1988–1989	75	23	39	39	29	36.3		3
	1989–1990	75	35	32	31	23	36.6		13
	1990–1991	75	29	52	19	13	34.8		8
	1991–1992	75	36	37	25	19	36.5		21
	1992–1993	75	23	48	30	22	35.9	8.9	14
DS204	1993–1994	75	29	45	25	19	35.6	8.4	5
	1994–1995	75	31	45	23	17	35.5	8.0	6
	1995–1996	75	32	45	23	17	34.8	8.2	0
	1996–1997	75	24	48	27	20	36.4	9.0	10
	1997–1998	75	32	40	28	21	37.0	8.3	14
	1998–1999	75	24	36	37	28	35.8	8.5	7
	1999–2000	75	29	31	40	30	36.4	8.8	10
	2000–2001	75	17	56	27	20	35.9	9.3	0

Hunt/ Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest (rams)	$\bar{x}$ horn length (in)	$\bar{x}$ age (yr)	Percent ≥40"
	2001–2002	75	15	41	44	33	35.5	8.1	0
	2002–2003	75	16	35	49	36	35.3	9.3	3
	2003–2004	75	16	45	39	29	35.0	8.7	3
Total for all permit hunts	1988–1989	150	29	43	28	42	35.9		7
	1989–1990	150	32	33	33	50	36.8		10
	1990–1991	150	31	49	20	28	34.6		4
	1991–1992	150	29	43	28	42	36.2		17
	1992–1993	150	27	45	27	41	35.9	8.7	10
	1993–1994	150	31	42	27	40	35.9	8.5	10
	1994–1995	150	36	43	19	28	35.2	7.9	7
	1995–1996	150	32	47	21	32	35.7	8.3	6
	1996–1997	150	23	49	28	41	36.4	8.6	8
	1997–1998	150	23	51	27	40	36.4	8.8	13
	1998–1999	150	27	43	27	41	36.5	8.2	12
	1999–2000	150	31	35	33	50	34.3	8.7	4
	2000–2001	150	22	55	23	34	35.8	9.3	3
	2001–2002	150	26	39	35	56	35.7	8.5	7
	2002–2003	150	18	43	37	56	35.6	9.3	4
	2003–2004	150	17	47	36	53	36.0	8.8	4

TABLE 2 Hunter satisfaction ratings with Delta Controlled Use Area (DCUA) management for Dall sheep hunts D1103/DS203 and D1104/DS204, 1993–2003

Year	% Satisfied with hunt[a]	Mean satisfaction rating	% Agree with DCUA harvest goals[b]	% Agree with DCUA aesthetic goals[c]	*n*
1993	81	6.8	86	95	63
1994	93	7.3	95	97	62
1995	81	6.7	96	90	51
1996	82	6.0	86	92	51
1997	80	6.9	92	89	64
1998[d]					
1999	84	7.4	93	95	57
2000	83	6.8	88	92	75
2001[d]					
2002[d]					
2003	81	7.9	95	96	74

[a] Based on hunters scoring satisfaction from 6 to 10 on scale of 10 (very satisfied) to 1 (extremely disappointed).
[b] Harvest Goals = Mean annual harvest of 35 full-curl rams with a mean horn size of more than 36 inches and a mean age exceeding 8 years.
[c] Aesthetic Goals = Provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means so that most hunters are satisfied with the aesthetic quality of their hunt.
[d] No data.

TABLE 3 Number of applications received for Delta Controlled Use Area Hunts DS203 (restricted access) and DS204 (unrestricted access), 1989–2003

Regulatory year	Hunt DS203	Hunt DS204	Total applications
1989–1990	514	670	1184
1990–1991	673	872	1545
1991–1992	781	846	1627
1992–1993	740	953	1693
1993–1994	677	971	1648
1994–1995	929	970	1899
1995–1996	901	994	1895
1996–1997	1000	1082	2082
1997–1998	820	954	1774
1998–1999	802	1013	1815
1999–2000	855	1156	2011
2000–2001	1011	1224	2235
2001–2002	1036	1167	2203
2002–2003	1163	1324	2487
2003–2004	1140	1389	2529

TABLE 4 Delta Controlled Use Area sheep hunter residency and success, regulatory years 1988–1989 through 2003–2004

		Successful					Unsuccessful					
Hunt	Regulatory year	Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Total hunters
D1103	1988–1989	3	10	0	0	13 (27)	19	13	1	2	35 (73)	48
	1989–1990	12	13	2	0	27 (51)	10	16	0	0	26 (49)	53
	1990–1991	6	8	1	0	15 (31)	9	22	2	0	33 (69)	48
	1991–1992	9	21	2	0	32 (39)	15	33	3	0	51 (61)	83
	1992–1993	11	8	0	0	19 (37)	15	14	2	1	32 (63)	51
	1993–1994	12	6	2	1	21 (42)	11	14	1	3	29 (58)	50
DS203	1994–1995	7	4	0	0	11 (27)	12	16	2	0	30 (73)	41
	1995–1996	1	13	1	0	15 (29)	7	25	4	0	36 (71)	51
	1996–1997	0	18	3	0	21 (36)	2	33	2	0	37 (64)	58
	1997–1998	3	15	1	0	19 (29)	6	37	3	0	46 (71)	65
	1998–1999	1	11	1	0	13 (26)	2	36	0	0	38 (75)	51
	1999–2000	1	17	2	0	20 (40)	5	21	4	0	30 (60)	50
	2000–2001	2	10	2	0	14 (26)	2	37	2	0	41 (75)	55
	2001–2002	4	17	2	0	23 (40)	2	32	1	0	35 (60)	58
	2002–2003	3	16	1	0	20 (34)	1	38	0	0	39 (66)	59
	2003–2004	3	19	2	0	24 (39)	0	33	4	0	37 (61)	61
D1104	1988–1989	13	15	1	0	29 (50)	18	11	0	0	29 (50)	58
	1989–1990	12	10	1	0	23 (49)	11	12	1	0	24 (51)	47
	1990–1991	8	4	0	0	12 (24)	19	17	1	0	37 (76)	49
	1991–1992	14	3	0	0	17 (38)	19	9	0	0	28 (62)	45
	1992–1993	11	9	2	0	22 (38)	22	14	0	0	36 (62)	58
	1993–1994	7	11	0	1	19 (36)	14	20	0	0	34 (64)	53
DS204	1994–1995	7	8	1	1	17 (35)	17	15	0	0	32 (65)	49
	1995–1996	2	15	0	0	17 (33)	9	23	2	0	34 (67)	51
	1996–1997	3	16	1	0	20 (36)	7	28	1	0	36 (64)	56
	1997–1998	4	16	1	0	21 (41)	3	24	3	0	30 (59)	51
	1998–1999	3	24	0	0	28 (51)	1	25	1	0	27 (49)	55
	1999–2000	2	26	2	0	30 (57)	3	19	1	0	23 (43)	53

Hunt	Regulatory year	Successful					Unsuccessful					Total hunters
		Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	
	2000–2001	5	15	0	0	20 (32)	8	33	1	0	42 (68)	62
	2001–2002	4	29	1	0	34 (53)	2	29	0	0	31 (48)	65
	2002–2003	3	31	2	0	36 (58)	2	24	0	0	26 (42)	62
	2003–2004	0	29	0	0	29 (47)	0	31	2	0	33 (53)	62
Total	1988–1989	16	25	1	0	42 (40)	37	24	1	2	64 (60)	106
for all	1989–1990	24	23	3	0	50 (50)	21	28	1	0	50 (50)	100
permit	1990–1991	14	12	1	0	27 (28)	28	39	3	0	70 (72)	97
hunts	1991–1992	23	24	2	0	49 (38)	34	42	3	0	79 (62)	128
	1992–1993	22	17	2	0	41 (38)	37	28	2	1	68 (62)	109
	1993–1994	19	17	2	2	40 (39)	25	34	1	3	63 (61)	103
	1994–1995	14	12	1	1	28 (31)	29	31	2	0	62 (69)	90
	1995–1996	3	28	1	0	32 (31)	16	48	6	0	70 (69)	102
	1996–1997	3	34	4	0	41 (36)	9	61	3	0	73 (64)	114
	1997–1998	7	31	2	0	40 (35)	9	61	6	0	76 (66)	116
	1998–1999	4	35	1	0	40 (38)	3	61	1	0	65 (62)	105
	1999–2000	3	43	4	0	50 (49)	8	40	5	0	53 (52)	103
	2000–2001	7	25	2	0	34 (29)	10	70	3	0	83 (71)	117
	2001–2002	8	46	3	0	57 (46)	4	61	1	0	66 (54)	123
	2002–2003	6	47	3	0	56 (46)	3	62	0	0	65 (54)	121
	2003–2004	3	48	0	0	51 (42)	0	64	6	0	70 (58)	121

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

TABLE 5 Delta Controlled Use Area sheep harvest chronology percent by month/day, regulatory years 1990–1991 through 2003–2004

Hunt	Regulatory year	Harvest chronology percent by month/day							
		8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unk	*n*
D1103[a]	1990–1991	60	27	7	--	--	--	7	15
	1991–1992	48	39	9	--	--	--	4	23
	1992–1993	63	37	0	--	--	--	0	19
DS203	1993–1994	62	33	5	--	--	--	0	21
	1994–1995	73	18	9	--	--	--	0	11
	1995–1996	60	40	0	--	--	--	0	15
	1996–1997	81	10	5	--	--	--	5	21
	1997–1998	79	21	0	--	--	--	0	19
	1998–1999	77	23	0	--	--	--	0	13
	1999–2000	85	15	0	--	--	--	0	20
	2000–2001	85	15	0	--	--	--	0	13
	2001–2002	91	4	4	--	--	--	4	23
	2002–2003	85	15	0	--	--	--	0	20
	2003–2004	63	29	4	--	--	--	4	24
D1104[b]	1990–1991	--	--	38	15	15	23	8	13
	1991–1992	--	--	42	26	11	21	0	19
	1992–1993	--	--	46	36	18	0	0	22
DS204	1993–1994	--	--	63	26	5	5	0	19
	1994–1995	--	--	41	29	18	12	0	17
	1995–1996	--	--	47	12	18	24	0	17
	1996–1997	--	--	30	40	5	25	0	20
	1997–1998	--	--	38	19	33	10	0	21
	1998–1999	--	--	32	39	7	21	0	28
	1999–2000	--	--	56	30	15	0	0	27
	2000–2001	--	--	15	35	25	25	0	20
	2001–2002	--	--	66	16	13	3	3	32
	2002–2003	--	--	53	22	14	8	3	36
	2003–2004	--	--	46	29	14	11	0	28

Hunt	Regulatory year	Harvest chronology percent by month/day							
		8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unk	*n*
Total	1990–1991	32	14	21	7	7	11	7	28
for all	1991–1992	26	21	24	12	5	10	2	42
permit	1992–1993	29	17	24	20	10	0	0	41
hunts	1993–1994	33	18	33	13	3	3	0	40
	1994–1995	29	7	29	18	11	7	0	28
	1995–1996	28	19	25	6	9	13	0	32
	1996–1997	42	5	17	20	2	12	2	41
	1997–1998	38	10	20	10	18	5	0	40
	1998–1999	24	7	22	27	5	15	0	41
	1999–2000	28	5	38	20	10	0	0	40
	2000–2001	33	6	9	21	15	15	0	33
	2001–2002	36	2	44	9	7	2	2	55
	2002–2003	30	5	34	14	9	5	3	56
	2003–2004	29	14	27	15	8	6	2	52

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

TABLE 6 Delta Controlled Use Area sheep harvest percent by transport method, regulatory years 1988–1989 through 2003–2004

Permit hunt	Regulatory year	Sheep harvest percent by transport method									
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
D1103[a]	1988–1989	10	0	4	0	0	2	79		4	13
	1989–1990	8	0	0	2	0	0	87		4	27
	1990–1991	8	0	8	0	0	0	75		8	15
	1991–1992	12	0	5	0	0	0	76		7	23
	1992–1993	5	0	5	0	0	0	84		5	19
	1993–1994	19	0	0	0	0	0	71		10	21
DS203	1994–1995	27	0	0	0	0	0	64		9	11
	1995–1996	20	0	7	0	0	0	67		7	15
	1996–1997	29	0	5	0	0	0	62		5	21
	1997–1998	5	0	0	0	0	0	90		5	19
	1998–1999	17	0	8	0	0	0	67	0	8	12
	1999–2000	15	0	0	0	0	0	80	0	5	20
	2000–2001	36	0	7	0	0	0	50	0	7	14
	2001–2002	26	0	9	0	0	0	44	22	0	23
	2002–2003	15	0	20	0	0	0	50	15	0	20
	2003–2004	25	0	0	4	0	0	67	4	0	24
D1104	1988–1989	38	0	3	12	0	14	31		2	29
	1989–1990	43	0	0	13	0	13	32		0	23
	1990–1991	38	0	0	34	0	4	24		0	13
	1991–1992	26	2	0	45	0	4	23		0	19
	1992–1993	41	0	0	41	0	5	14		0	22
	1993–1994	63	0	0	21	0	5	5		5	19
DS204	1994–1995	35	0	0	59	0	0	6		0	17
	1995–1996	41	12	0	41	0	0	6		0	17
	1996–1997	30	5	10	10	0	5	35		5	20
	1997–1998	38	0	0	43	0	5	10		5	21

Permit hunt	Regulatory year	Sheep harvest percent by transport method									
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	*n*
	1998–1999	50	0	0	39	0	11	0		0	28
	1999–2000	33	0	3	47	0	10	7	0	0	30
	2000–2001	15	0	0	65	0	5	15	0	0	20
	2001–2002	18	0	6	64	0	3	6	0	3	33
	2002–2003	31	3	0	53	0	0	14	0	0	36
	2003–2004	24	0	3	48	0	14	7	3	0	29
Total for	1988–1989	25	0	4	7	0	8	53		3	42
all permit	1989–1990	24	0	0	7	0	6	61		2	50
hunts	1990–1991	23	0	4	17	0	2	49		4	28
	1991–1992	18	1	3	20	0	2	53		4	42
	1992–1993	24	0	2	22	0	2	46		2	41
	1993–1994	40	0	0	10	0	3	40		8	40
	1994–1995	32	0	0	36	0	0	29		4	28
	1995–1996	31	6	3	22	0	0	34		3	32
	1996–1997	29	2	7	5	0	2	49		5	41
	1997–1998	23	0	0	23	0	3	48		5	40
	1998–1999	40	0	3	28	0	8	20	0	3	40
	1999–2000	26	0	2	28	0	6	36	0	2	50
	2000–2001	24	0	3	38	0	3	29	0	3	34
	2001–2002	21	0	7	38	0	2	21	9	2	56
	2002–2003	25	2	7	34	0	0	27	5	0	56
	2003–2004	25	0	2	28	0	8	34	4	0	53

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

APPENDIX Delta Controlled Use Area sheep hunter survey questionnaire

(Date)

Dear Delta Controlled Use Area Sheep Hunter:

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

Our goal for managing sheep hunters in the Delta Controlled Use Area is to 1) provide a mean annual harvest of 35 full-curl rams with a mean horn length of more than 36 inches and mean age exceeding 8 years, and 2) provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means. In other words, we want you to have a high-quality hunt.

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

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

Sincerely,

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

Enclosures

DELTA CONTROLLED USE AREA
(DATE) SHEEP HUNTER SURVEY

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

    _____

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

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

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

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

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

    _____

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

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

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

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

Very Satisfied — Extremely Disappointed — Did Not Shoot a Ram

1 2 3 4 5 6 7 8 9 10 11

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

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

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

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

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

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

Very Satisfied — Extremely Disappointed

1 2 3 4 5 6 7 8 9 10

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

Comments:_____

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

Yes No

Comments:_____

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

Thank you for your time,

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

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

BACKGROUND

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

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

Research in Unit 20A included a study comparing population and horn characteristics of sheep in Unit 20A with those in Unit 12 (Heimer and Watson 1986), a study of sheep use of the Dry Creek mineral lick, and a study of movements and seasonal ecology of sheep on Fort Greely (Spiers and Heimer 1990). More recent research included Whitten and Eagan's (1995) evaluation of sheep monitoring methods and development of a double sampling technique, Scotton's (1997) investigation of the causes and magnitude of lamb mortality, and Arthur's (2003) research on interrelationships of Dall sheep and predators.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

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

MANAGEMENT OBJECTIVES

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

METHODS

Based on harvest reports, we evaluated harvest, hunter use patterns, and characteristics of sheep taken by hunters. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY02 = 1 Jul 2002 through 30 Jun 2003).

We conducted 3 aerial surveys during RY01–RY03 to monitor population status. We surveyed Sections I–III located between the Wood and Little Delta Rivers and Section IV located south of Sections I–III between the West Fork of the Little Delta River and Buchanan Creek, and a small portion of the upper Wood River (Arthur 2003). All surveys were conducted from R-22 helicopters (Whitten and Eagan 1995). We flew contours of all sheep habitat within the survey sections. We classified sheep as lambs, yearlings, ewes, or rams based on horn size and shape and body conformation. We also classified ram horn sizes.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Composition

Dale (1999) reported the Unit 20A sheep population likely increased between 1996 and 1998, based on strong lamb:ewe and yearling:ewe ratios during those years (Table 1). However, the lower lamb:ewe and yearling:ewe ratios observed in 2000 and 2001 suggest the Unit 20A sheep population was stable between 1998 and 2001. Although lamb:ewe ratios were strong during 2002–2004 ($\bar{x}$ = 44:100), modest yearling:ewe ratios of 26:100 (range = 8:100–42:100) suggest a stable population during this reporting period. Moreover, the last 3 years we observed no noticeable declines in the annual survival rates of adult sheep radiocollared in the central mountains of Unit 20A and received no anecdotal reports of any widespread declines in sheep numbers from hunters or guides using the area.

MORTALITY

Harvest

Seasons and Bag Limit. The sheep hunting season was open 10 August through 20 September throughout RY01–RY03. The bag limit was 1 ram with a full-curl or larger horn, with both horns broken, or at least 8 years old.

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game did not change any seasons or bag limits for sheep in Unit 20A during RY01–RY03, and no emergency orders were issued. However, in 2004 the board adopted a statewide provision that required sealing by ADF&G personnel of sheep horns in most units, including Unit 20A.

Hunter Harvest. Reported harvests remained low (52–68) during RY01–RY03 (Table 2).

Mean horn length of harvested rams ranged from 34 to 35 inches since the bag limit changed from ⅞ curl to full curl in RY84 (Table 2). Less than 2% (2/122) of the rams harvested RY98–RY00 had horns ≥40 inches long compared to 4.3% (8/167) during this reporting period.

Hunter Residency and Success. Success rates remained higher for nonresidents than for resident hunters (Table 3). During RY01–RY03, nonresident success was 67–75%, while resident success was 18–24%. Overall success rates were 34–42% during RY01–RY03.

Harvest Chronology. Approximately half of the sheep harvest in Unit 20A occurred during the first 10 days of the season (Table 4). Harvest tended to taper off as the season progressed.

Transport Methods. The Wood River and Yanert Controlled Use Areas were closed to the use of motorized vehicles, except aircraft, for big game hunting and transportation throughout the sheep hunting season. These areas contain approximately half the Dall sheep range in Unit 20A. Accordingly, most of the successful sheep hunters used airplanes or horses for transportation (Table 5). Reported use of 3- or 4-wheelers by successful sheep hunters has been increasing since the mid 1980s, reaching some of the highest levels ever reported (21%) in RY01–RY03.

Natural Mortality

During late summer 2004, a localized die-off of sheep occurred in the Carlo Creek drainage. Five lambs, 1 yearling ewe, 3 adult ewes, and one 3-year-old ram were found dead and in various stages of decomposition. Necropsies were performed on 4 whole sheep (1 lamb, 2 adult ewes and one 3-year-old ram) and 1 partially decomposed sheep (lamb). A severe bronchopneumonia (*Pasteurella trehalosi*) was found in all whole, necropsied sheep, and foot rot was identified in the 3-year-old ram. Additionally, another pathogen, *Arcanobacterium pyogenes*, was involved in the pneumonia. This was the first time multiple mortalities due to *P. trehalosi* or *A. pyogenes* have been documented in a local population of Dall sheep in Alaska. Both pneumonia and foot rot have been detected in Alaska Range sheep populations, but extreme drought in summer 2004 may have exacerbated conditions favorable to the spread of the disease among sheep in the area.

HABITAT

Assessment

No significant disturbance or destruction of sheep habitat occurred in Unit 20A through RY01–RY03. During RY95–RY97, increases in mineral exploration and mining activity resulted in concerns by a local advisory committee and other users about habitat and disturbance. Although these concerns were not expressed during RY98–RY03, a local advisory committee did present concerns regarding disturbance caused by helicopter sightseeing tours.

ERA Helicopters submitted an application to the Bureau of Land Management (BLM) in 2005 for a special recreation permit to conduct helicopter-supported dog mushing tours on BLM-managed lands on the Nenana Glacier. The request included the establishment of a temporary camp and dog yard on the glacier and dogsled tours conducted on the glacier. Clients and supplies were to be flown into the camp by helicopters. The proposed designated flight path was up and down the Yanert Valley with the potential for up to 9 roundtrip flights per day during the operating season (15 May–15 Sep). The department noted that the Yanert River valley is managed by the State of Alaska as a Controlled Use Area for hunting of big game, including remote backcountry hunting experiences for Dall sheep. The public (including commercial outfitters and guides), Alaska Department of Fish and Game, and local citizen advisory committees expressed concern and/or opposition over the impacts that helicopter noise would have on hunters' experience and the natural resources (particularly Dall sheep during the lambing season) located within the Yanert Controlled Use Area. The permit application was withdrawn after ERA was informed that completion of an environmental impact statement would be required.

Usibelli Coal Mine Inc. (UCM) submitted an application to the Alaska Department of Natural Resources on 23 April 2004 for a gas only exploration license in the Healy Basin. The exploration license area consists of approximately 208,630 acres bounded by Rex Creek, Tatlanika Creek, Healy Creek, and Denali National Park and Preserve. If granted, the exploration license would give UCM exclusive rights to explore state lands within the area for natural gas for up to 10 years. Dall sheep travel through portions of the proposed license area, although areas of important sheep habitat are just north and south of the license area. A mineral lick is present in the extreme east of the license area, bounded by All Gold, Dexter, and Sheep Creeks. All other mineral licks identified in the Tanana Basin Area Plan (Department of Natural Resources) are outside the proposed license area boundary.

CONCLUSIONS AND RECOMMENDATIONS

We assumed that restricting harvest to full-curl rams achieved objectives to provide the greatest sustainable annual hunting opportunity and greatest sustainable annual harvest, but we did not specifically address these objectives during RY01–RY03. The objective to provide the opportunity to view and photograph sheep under natural conditions also was not addressed. Most of the above objectives are not quantifiable and should be changed to goals in the next 5-year plan.

Restricting harvest to full-curl rams allowed us to meet our objective to maintain naturally regulated ewe and subadult ram segments of the population. However, we probably failed to meet our population objective of 5000 sheep. As a result, current harvest was well below those sustained through the 1980s. However, this population objective seems unrealistic for a relatively small sheep population subject to occasional severe weather events and variable levels of predation. Thus, changes in seasons and bag limits are not recommended. We expect harvests to remain low as weak cohorts from the decline phase of the early 1990s mature and become legal to hunt.

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TABLE 1 Unit 20A sheep composition counts, calendar years 1994 through 2004

Calendar year	Rams:100 ewes[a]	% Full-curl rams	Lambs:100 ewes[a]	Yearlings: 100 ewes[a]	Sample size
1994[b]	59	–[c]	34		442
1995[b]	67	–[c]	44	24	586
1996[b]	59	–[c]	51	36	657
1997[b]	83	–[c]	40	44	567
1998[b]	67	21	41	24	665
1999[b]	79	12	52	28	690
2000[b]	66	6	30	24	615
2001[b]	85	15	31	21	552
2002[b]	69	11	49	8	496
2003[b]	57	22	43	42	675
2004[b]	81	17	41	29	523

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

TABLE 2 Unit 20A sheep harvest, regulatory years 1984–1985 through 2003–2004

Regulatory year	Reported harvest	Total hunters	Percent success	$\bar{x}$ Horn length (in)[a]
1984–1985	105	292	36	34.0
1985–1986	102	292	35	34.0
1986–1987	136	357	38	34.2
1987–1988	142	354	40	35.0
1988–1989[b]	154	404	38	34.7
1989–1990[c]	163	410	40	34.3
1990–1991[c]	124	379	33	34.4
1991–1992[c]	109	338	32	34.5
1992–1993	62	230	27	34.0
1993–1994	50	166	30	34.1
1994–1995	49	147	33	34.9
1995–1996	60	164	37	35.7
1996–1997	54	151	36	35.5
1997–1998	45	178	25	35.1
1998–1999	44	176	25	35.3
1999–2000	51	171	30	34.0
2000–2001	27	143	19	34.5
2001–2002	52	152	34	34.4
2002–2003	68	162	42	34.7
2003–2004	67	180	37	35.0

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

TABLE 3 Unit 20A sheep hunter residency and success, regulatory years 1984–1985 through 2003–2004

Regulatory year	Successful					Unsuccessful					Total hunters
	Unit[a] resident	Alaska[b] resident	Nonresident	Unk	Total	Unit[a] resident	Alaska[b] resident	Nonresident	Unk	Total	
1984–1985	--	78	27	0	105	--	177	7	3	187	292
1985–1986	44	65	36	1	102	143	177	10	3	190	292
1986–1987	59	90	36	10	136	141	196	13	12	221	357
1987–1988	61	80	49	13	142	100	166	9	37	212	354
1988–1989	43	72	45	37	154	125	175	3	72	250	404
1989–1990	78	110	52	1	163	158	223	19	5	247	410
1990–1991	49	73	46	5	124	167	235	12	8	255	379
1991–1992	50	76	33	0	109	146	207	15	7	229	338
1992–1993	20	35	24	3	62	102	147	20	1	168	230
1993–1994	18	26	22	2	50	66	99	15	2	116	166
1994–1995	14	22	22	5	49	59	85	3	13	101	150
1995–1996	26	31	27	2	60	75	90	13	1	104	164
1996–1997	18	29	24	1	54	76	86	10	1	97	151
1997–1998	13	20	25	0	45	88	114	17	2	133	178
1998–1999	14	19	24	1	44	84	108	23	1	132	176
1999–2000	15	26	24	1	51	81	105	14	1	120	171
2000–2001	4	12	15	0	27	64	89	26	1	116	143
2001–2002	10	18	33	1	52	62	84	16	0	100	152
2002–2003	14	22	43	3	68	59	80	14	0	94	162
2003–2004	23	30	37	0	67	52	97	14	2	113	180

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

TABLE 4 Unit 20A sheep harvest chronology percent by day/month, regulatory years 1990–1991 through 2003–2004

Regulatory year	Harvest chronology percent by day/month					
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep	Unknown	*n*
1990–1991	60	21	7	4	8	122
1991–1992	56	20	16	5	3	109
1992–1993	47	29	19	3	2	62
1993–1994	56	18	18	6	2	50
1994–1995	53	25	10	12	0	49
1995–1996	45	23	12	17	3	60
1996–1997	65	17	7	7	4	54
1997–1998	56	24	13	7	0	45
1998–1999	55	14	18	14	0	44
1999–2000	59	22	12	6	2	51
2000–2001	59	11	15	15	0	27
2001–2002	50	27	10	13	0	52
2002–2003	49	32	12	7	0	68
2003–2004	49	31	16	3	0	67

TABLE 5 Unit 20A sheep harvest percent by transport method, regulatory years 1985–1986 through 2003–2004

Regulatory year	Percent by transport method							
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unk	*n*
1985–1986	56	27	1	1	3	12	0	96
1986–1987	48	29	0	1	6	16	0	127
1987–1988	50	30	0	2	5	13	0	131
1988–1989	62	20	0	1	5	12	0	142
1989–1990	55	20	0	5	4	15	1	160
1990–1991	56	23	0	4	6	10	1	122
1991–1992	57	19	1	6	3	8	6	109
1992–1993	52	24	0	6	6	8	3	62
1993–1994	50	28	0	4	0	16	2	50
1994–1995	49	29	0	6	4	8	4	49
1995–1996	35	38	0	10	5	8	3	60
1996–1997	37	37	4	7	2	6	7	54
1997–1998	49	31	0	13	0	2	4	45
1998–1999	43	32	2	11	2	7	2	44
1999–2000	41	35	0	6	0	14	4	51
2000–2001	48	19	4	22	0	7	0	27
2001–2002	34	22	0	21	5	11	7	152
2002–2003	37	26	1	21	2	9	5	162
2003–2004	35	18	2	21	4	17	4	180

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DALL SHEEP REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

GEOGRAPHICAL DESCRIPTION: White Mountains area

BACKGROUND

Dall sheep in the White Mountains provide opportunities to view and hunt sheep relatively close to Fairbanks with access by road, air, or boat. Historically, these sheep received little attention because the population is relatively small (500–600 sheep), but hunter effort and harvest has been steadily increasing for the past 20 years to record highs in the late 1990s and early 2000s (Figure 1).

Survey data indicate the population steadily increased during the last 20 years (Figure 1). Historically, surveys were infrequent, but have increased in frequency in recent years (Table 1). They indicate a moderately high population in the early 1970s, followed by a decrease through the early 1980s, and then an increase to current numbers. Due to survey differences in area covered, date of survey, intensity, weather conditions, and pilots and observers, conclusions based on these data should be made with caution.

The number of rams classified as legal during surveys generally decreased from 1970 to 1995, largely due to changes in the definition of legal rams. From 1970 to 1978, legal rams included ¾-curl or larger rams; from 1979 to 1985, ⅞-curl rams were legal; in 1986, ⅞-curl rams were legal in Unit 25 and full-curl rams were legal in Unit 20; and only full-curl rams have been legal since 1987. Survey data from 1996 to 2000 indicate the number of legal rams increased in recent years, coincidental with an increase in the population.

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

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

MANAGEMENT DIRECTION

MANAGEMENT GOAL

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

MANAGEMENT OBJECTIVE

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

METHODS

We conducted aerial surveys in August 2002 and 2003 to estimate population size and composition. Observers classified sheep as lambs, ewes, or rams based on horn size/shape and body conformation. The ewe category included yearlings of both sexes and young rams that could not be distinguished from ewes. Rams were classified as legal (full-curl or both horns broomed) or sublegal (less than full curl). Observers searched alpine and subalpine sheep habitat by flying low-level (less than 500 ft AGL) contours and circles at 60–80 mph in Piper Super Cubs and an Aviat Husky. Survey areas included Big Bend to Windy Gap, Windy Gap to Willow Creek, Cache Mountain, Lime Peak, Mount Prindle, Mount Schwatka and Victoria Mountain. Survey intensity and coverage varied depending on weather conditions and pilot/observer availability and experience. Because sheep in this area sometimes use habitat well away from escape terrain, including timber and shrub-covered areas near mineral licks, we assumed 15% of the population was not observed during surveys.

We monitored harvest through general harvest ticket report cards. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY01 = 1 Jul 2001 through 30 Jun 2002).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The estimated sheep population during RY01–RY03 was 550–600, which is similar to the number estimated since the mid 1990s. During aerial surveys in 2002 and 2003, observers counted 485 and 524 sheep, respectively (Table 1). Because of low sightability of this sheep

population, we adjusted our estimate upward by 15% to account for sheep not observed. A survey was not completed in 2001 due to logistical constraints and poor weather conditions.

Population Composition

The lambs:100 ewes ratio was above the 1970 through 2000 mean of 27 during the 2002 (28) and 2003 (31) surveys (Table 1).

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

Distribution and Movements

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

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

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

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

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

MORTALITY

Harvest

Season and Bag Limit. The sheep hunting season was 10 August–20 September throughout RY01–RY03. The bag limit was 1 ram with full-curl horns, both horns broomed, or at least 8 years old (Table 2).

Alaska Board of Game Actions and Emergency Orders. There were no board actions or emergency orders during RY01–RY03.

Hunter Harvest. The reported annual harvest for RY01–RY03 ranged from 6 to 19 and averaged 12 (Table 3). The reported harvest of 19 sheep during fall RY03 is the highest on record. The average annual harvest of 12 sheep is double the mean annual harvest during RY84–RY00. However, sheep population survey data indicated that the increased harvest trend may be sustainable. The average percentage of legal rams in the population from 1970 to 2000 was 3.9%. In 2002 and 2003, it was 5.2% and 4.0%. This indicates that the harvest increased concurrently with the population.

The high harvest in recent years may be sustainable in sheep numbers, but trophy quality of sheep may be declining. The average horn base measurement for RY01–RY03 was 13.4 inches (Table 4), down from the RY93–RY00 average of 13.7 inches. Average horn length measurements have less meaning in this area because many are broomed (43% of all horns in the reported harvest were broomed). However, during RY01–RY03, the average horn length (32.5 inches) dropped 3 inches from the RY93–RY00 average of 35.3 inches. Reported age of harvested sheep also declined slightly from an average of 9.8 during RY93–RY00 to an average of 9.4 during RY01–RY03.

Hunter Residency and Success. Sheep in the White Mountains were mostly hunted by Alaska residents. Prior to RY95, only 2 nonresidents reported hunting sheep in the White Mountains (Table 3). Since then the number of nonresidents increased, but their success was poor. The average success rate of all hunters during RY01–RY03 was 24% (36 of 151) compared to 20% during RY84–RY00. Both successful and unsuccessful hunters reported spending an average of 5 days afield (Table 5), the same as during RY84–RY00.

Harvest Chronology. Sheep harvest shifted later in the season during RY01–RY03. Eighty percent of sheep harvested during RY84–RY00 were killed in August, compared to 71% during RY01–RY03 (Table 6).

Transport Methods. Aircraft access was at a few small airstrips in the mountains, gravel bars along the creeks, and small lakes in the area. Ground access was primarily from trails and mining roads off the Steese Highway. In 1988 BLM established off-road vehicle (ORV) restrictions throughout the WMNRA and SNCA that closed most sheep range to ORVs. However, ORVs weighing < 1500 lb were allowed in most of the area between the Steese Highway and Mount Prindle, which provided good access to sheep habitat.

During RY01–RY03, 72% of successful hunters used airplanes for transportation while 3- or 4-wheelers were the most common means of transportation for unsuccessful sheep hunters

(Table 7). This pattern has persisted for the past decade. Use of 4-wheelers for hunting has increased from an average of 3 hunters per year prior to RY91 to an average of 16 hunters per year since then. Some of this difference in success per mode of transport may be attributed to the intention of the hunters. Contact with hunters suggests that many hunters who used 4-wheelers and highway vehicles intended mainly to hunt caribou but would take sheep opportunistically. Conversely, hunters who used aircraft to hunt sheep were more focused on taking sheep.

Other Mortality

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

Little is known about predation rates or predator populations in the White Mountains. McNay (1989) estimated 87 wolves resided in Unit 25C. One radiocollared ewe was killed by wolves in winter 1983–1984. Golden eagles have been seen on Lime Peak, and coyotes are probably present (Scotton 1997).

Sheep in the White Mountains frequently travel through forested areas because sheep habitats are scattered, often at low elevations, and because of the scarcity of rugged escape terrain in the alpine areas (ADF&G 1976). Although these forested areas may provide some escape cover from eagles, they probably increase sheep susceptibility to terrestrial predators.

HABITAT

Assessment

Important features of sheep habitat include summer range, winter range, mineral licks, lambing areas, escape terrain, and travel routes between these habitats. Protecting these features is important to the long-term welfare of sheep in the White Mountains because the relatively low-elevation, discontinuous alpine areas offer limited sheep habitat. Sheep have also used caves in the White Mountains, perhaps for relief from hot weather. In 1950 L.E. Powell (ADF&G files) wrote: “A cave on the eastern slope of the White Mountains had considerable sheep sign in it. The entrance was approximately 25’ high and 14’ wide. A water hole 25’ inside the cave was inaccessible to sheep because it was sunken in shear walls below ground level. The floor of the cave was covered with an inch of old sheep droppings. No prominent or recently used trails were found in the immediate area.” In 1982, 5 rams were seen leaving a cave during a “hot and buggy day” (E. Crain, ADF&G, personal communication).

Potential threats to sheep habitat include mineral exploration; BLM's development of recreational facilities in the WMNRA and SNCA; and, in the absence of a natural fire regime, forest succession encroaching on sheep range. BLM’s facilities include trails and remote cabins intended to substantially increase human use of the area. To increase recreational

opportunity, BLM developed several trailheads and the 18-mile Nome Creek Road, which links the Steese Highway with 2 new campgrounds.

CONCLUSIONS AND RECOMMENDATIONS

Our goal to provide opportunity to hunt sheep in the White Mountains under aesthetically pleasing conditions was met. Human use of sheep in the White Mountains area was moderate, but if the increasing trend continues, the public may call for a drawing permit hunt to reduce overcrowding in hunting areas. To maintain aesthetically pleasing conditions, use of ORVs, mineral exploration, trail development, access, and cabins should be monitored and managed accordingly. Nonconsumptive use of sheep, such as viewing, will probably increase during the next few years as BLM promotes recreational use of the area.

We met our management objective to provide for sustained opportunity to harvest full-curl rams from a population of at least 250 sheep. We maintained a resident and nonresident general season from 10 August to 20 September for a full-curl ram. Our population estimate of 550–600 sheep meets our minimum population objective. No changes to season or bag limits are recommended at this time.

We also worked cooperatively with BLM and other stakeholders to protect sheep habitat. Mineral licks are important year-round use areas, and any activity that limits use of these areas by sheep should be closely examined and curtailed if necessary. Off-road vehicle users have emerged as a potential problem by rapidly expanding the existing trail system into areas where their use is both permitted and prohibited, including sheep habitat (Durtsche et al. 1990). We will continue to work closely with BLM and other stakeholders on these issues.

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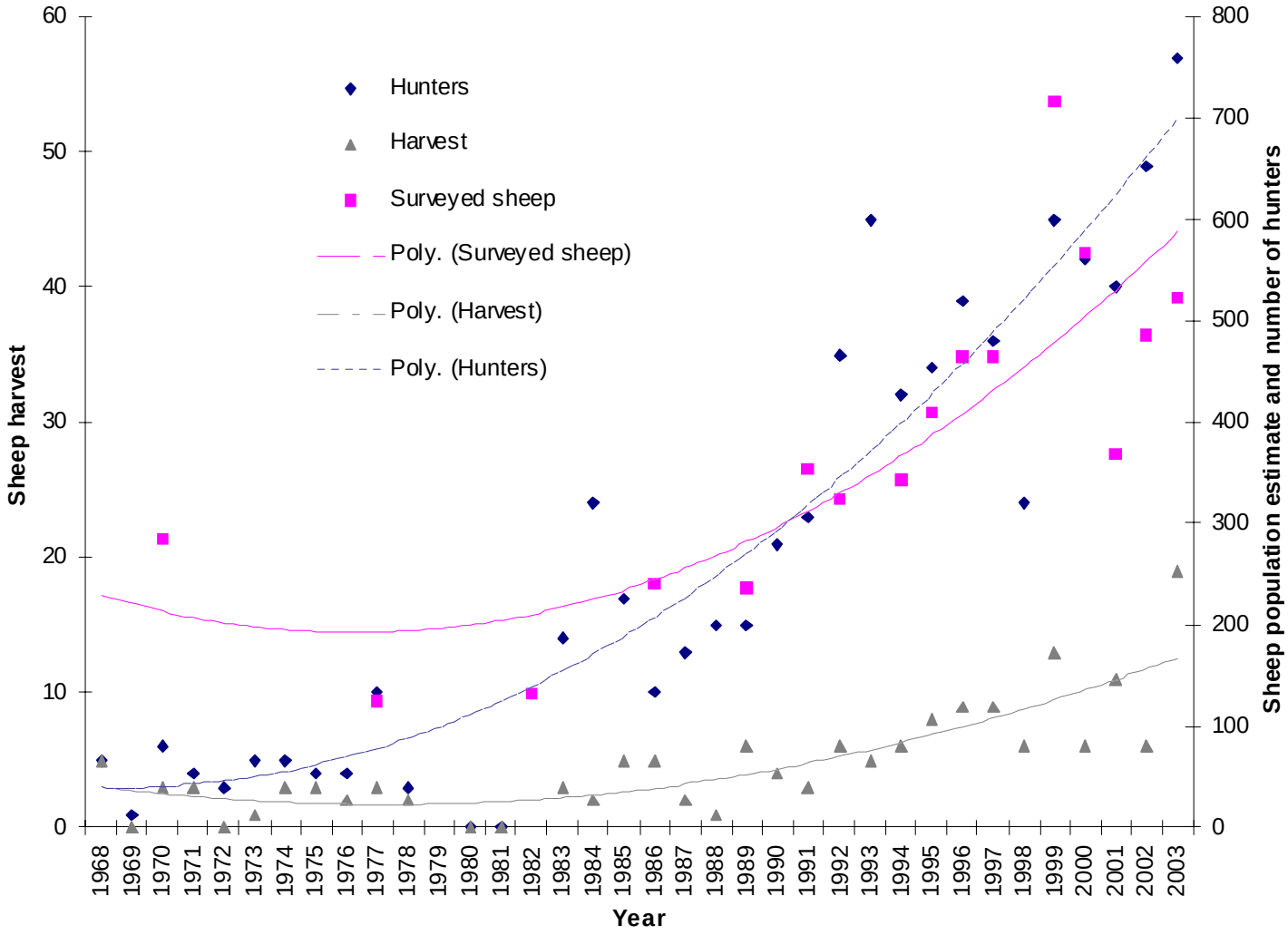

FIGURE 1 White Mountains sheep hunters, harvest, and sheep population[a,b], regulatory years 1968–1969 through 2003–2004 ([a] Data compiled from several sources including FWS, BLM, and ADF&G records; [b] Lines fitted to data points are second order polynomials [Poly]).

TABLE 1 White Mountains aerial sheep composition counts, 1970–2004

Date	Rams			Rams: 100 ewes	Ewes[c]	Lambs	Lambs:100 ewes	Total sheep[b]	Count time (hr)
	Legal[a]	Sublegal	Total[b]						
28 Aug 1970	19	25	44	26	171	70	41	285	5.9
5–8 Aug 1977	13	25	38	58	66	20	30	124	6.5
29 Jun–3 Jul 1982	15	30	45	58	77	10	13	132	9.6
17–29 Jun 1986	17	42	59	45	132	49	37	240	14.6
4–10 Aug 1989	6	50	56	42	132	31	23	237	3.6
30 Sep–3 Oct 1991	9	72	81	37	220	53	24	354	8.8
1–4 Aug 1992	8	68	76	35	215	33	15	324	11.8
4 Aug 1994[d]	8	64	72	36	201	71	35	344	10.3
1–11 Aug 1995	6	78	88	35	248	73	29	409	11.1
5–7 Aug 1996	16	90	106	39	270	88	33	464	–[e]
5 Aug 1997[f]	10	88	98	37	266	53	20	417	12.1
1–3 Aug 1999[g]	26	125	151	37	406	160	39	717	13.1
5–7 Aug 2000[g]	24	121	145	41	381	41	11	568	13.1
19 Jul 2002[g]	25	125	150	57	262	73	28	485	–[e]
Jul–Aug 2003[g]	21	70	91	29	318	99	31	524	10.9
3–5 Aug 2004[g]	19	107	126	48	262	55	21	464	14.3

[a] Legal rams = ¾ curl in 1970 and 1977, ⅞ curl in 1982 and 1986, full curl since 1987.
[b] Total numbers may include sheep that were not classified.
[c] Ewes includes unclassified young rams and yearlings of both sexes.
[d] Numbers include sheep observed during the 12–13 July 1994 ground survey of Mount Prindle, which was not surveyed in August due to severe turbulence.
[e] Total count time could not be calculated from data sheets.
[f] Victoria Mountain was not surveyed in 1997 (47 sheep were counted in this area in 1996).
[g] Big Bend to Windy Gap, Windy Gap to Willow Creek, Cake Mountain, Lime Peak, Mount Prindle, Mount Schwatka, and Victoria Mountain.

TABLE 2 White Mountains sheep seasons and bag limits, regulatory years 1983–1984 through 2003–2004

Regulatory year	Season	Bag limit	Legal horn size[a]	
			Portion in Unit 20	Portion in Unit 25
1983–1984	10 Aug–20 Sep	1 ram	⅞-curl horn or larger	⅞-curl horn or larger
1984–1985 through 1986–1987	10 Aug–20 Sep	1 ram	Full-curl horn or larger	⅞-curl horn or larger
1987–1988 through 2003–2004	10 Aug–20 Sep	1 ram	Full-curl horn or larger	Full-curl horn or larger

[a] Full-curl and ⅞-curl restrictions also allow harvest of rams with both horns broken or with 8 horn annuli present.

TABLE 3 White Mountains sheep hunter residency and success, regulatory years 1984–1985 through 2003–2004

Regulatory year	Successful hunters				Unsuccessful hunters				Total	
	Resident	Nonresident	Unspecified	Total	Resident	Nonresident	Unspecified	Total	Hunters	% Success
1984–1985	0	2	0	2	21	0	1	22	24	8
1985–1986	5	0	0	5	12	0	0	12	17	29
1986–1987	4	0	1	5	4	0	1	5	10	50
1987–1988	2	0	0	2	11	0	0	11	13	15
1988–1989	1	0	0	1	8	0	6	14	15	7
1989–1990	6	0	0	6	6	0	2	8	14	43
1990–1991	4	0	0	4	13	0	1	14	18	22
1991–1992	5	0	0	3	19	0	0	19	22	14
1992–1993	6	0	0	6	29	0	0	29	35	17
1993–1994	5	0	0	5	37	0	3	40	45	11
1994–1995	6	0	0	6	25	0	1	26	32	19
1995–1996	7	1	0	8	26	0	0	26	34	24
1996–1997	7	1	0	8	30	1	0	31	39	21
1997–1998	9	0	0	9	22	0	0	22	31	29
1998–1999	5	0	0	5	19	0	0	19	24	21
1999–2000	11	1	1	13	30	2	0	32	45	29
2000–2001	6	0	0	6	35	1	0	36	42	14
2001–2002	9	0	2	11	35	0	1	36	47	23
2002–2003	6	0	0	6	44	1	0	45	51	12
2003–2004	18	1	0	19	35	2	1	38	57	33

TABLE 4 White Mountains sheep harvest characteristics, regulatory years 1993–1994 through 2003–2004

Regulatory year	Average horn			
	Age (yr)	Broomed (%)	Length (in)	Base (in)
1993–1994	8.8	40	34.5	14.0
1994–1995	10.0	42	36.1	13.9
1995–1996	9.7	14	37.1	13.9
1996–1997	10.0	71	33.3	13.7
1997–1998	8.9	31	35.2	13.7
1998–1999	10.8	25	38.0	13.8
1999–2000	10.1	22	35.5	12.9
2000–2001	8.7	83	32.4	13.9
2001–2002	9.2	42	31.1	13.6
2002–2003	8.8	40	34.5	14.0
2003–2004	10.0	71	33.3	13.7

TABLE 5 White Mountains sheep hunter effort, regulatory years 1984–1985 through 2003–2004

Regulatory year	Successful		Unsuccessful		Total hunters[b]
	Hunters	$\bar{x}$ days[a]	Hunters	$\bar{x}$ days[a]	
1984–1985	2	8	22	7	24
1985–1986	5	6	12	4	17
1986–1987	5	9	5	6	10
1987–1988	2	6	11	4	13
1988–1989	1	2	14	4	15
1989–1990	6	3	11	4	17
1990–1991	4	5	14	4	18
1991–1992	5	5	18	6	21
1992–1993	6	6	29	4	35
1993–1994	5	4	22	6	27
1994–1995	6	6	26	5	32
1995–1996	8	4	25	4	33
1996–1997	8	5	30	6	38
1997–1998	9	4	31	4	40
1998–1999	5	4	19	5	24
1999–2000	13	4	32	4	45
2000–2001	6	6	36	5	42
2001–2002	11	5	35	5	46
2002–2003	6	5	45	6	51
2003–2004	19	4	38	4	57

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

TABLE 6 White Mountains sheep harvest chronology by day/month, regulatory years 1984–1985 through 2003–2004

Regulatory year	Harvest chronology by day/month			
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep
1984–1985	2	0	0	0
1985–1986	3	1	1	0
1986–1987	1	2	1	1
1987–1988	2	0	0	0
1988–1989	0	1	0	0
1989–1990	4	0	0	2
1990–1991	1	1	1	1
1991–1992	4	0	0	1
1992–1993	6	0	0	0
1993–1994	3	2	0	0
1994–1995	4	0	2	0
1995–1996	4	2	2	0
1996–1997	5	2	1	0
1997–1998	1	5	2	0
1998–1999	2	2	0	0
1999–2000	5	3	0	3
2000–2001	1	4	0	0
2001–2002	0	2	3	2
2002–2003	5	0	0	1
2003–2004	9	6	3	0

TABLE 7 White Mountains sheep hunter success by transport method, regulatory years 1984–1985 through 2003–2004

Regulatory year	Transport method				
	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other\Unknown
Successful					
1984–1985	2	0	0	0	0
1985–1986	5	0	0	0	0
1986–1987	3	0	1	0	1
1987–1988	2	0	0	0	0
1988–1989	1	0	0	0	0
1989–1990	5	0	0	0	1
1990–1991	4	0	0	1	0
1991–1992	3	0	0	0	1
1992–1993	5	0	0	0	1
1993–1994	4	0	1	0	0
1994–1995	5	0	0	1	0
1995–1996	7	1	0	0	0
1996–1997	6	0	0	1	1
1997–1998	7	2	0	0	0
1998–1999	4	0	0	0	0
1999–2000	10	1	0	0	0
2000–2001	4	0	0	0	0
2001–2002	4	3	0	0	0
2002–2003	5	0	0	0	1
2003–2004	14	2	0	1	2
Total	100	9	2	4	8
Unsuccessful					
1984–1985	8	6	3	2	3
1985–1986	4	1	4	3	0
1986–1987	0	1	3	1	0
1987–1988	6	2	1	0	2
1988–1989	4	1	3	2	4
1989–1990	1	1	4	3	2
1990–1991	7	8	2	1	1
1991–1992	3	15	0	4	1
1992–1993	10	10	1	5	3
1993–1994	8	17	3	5	4
1994–1995	4	12	1	4	1
1995–1996	8	13	0	4	1
1996–1997	11	13	1	3	3
1997–1998	3	18	1	5	4
1998–1999	2	6	4	1	2
1999–2000	1	18	3	6	3
2000–2001	7	17	0	5	1
2001–2002	5	20	0	7	4
2002–2003	6	19	0	9	7
2003–2004	11	15	0	6	4
Total	109	213	34	76	50

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004[a]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Tanana Hills

BACKGROUND

The Dall sheep population in the Tanana Hills comprises several small, discrete groups or subpopulations separated by areas of unsuitable habitat. These subpopulations persist at low density because the physical geography of the area provides relatively low-quality Dall sheep habitat (Kelleyhouse and Heimer 1989). The Tanana Hills were not glaciated during the most recent glacial advance and have little uplift. They are at fairly low elevation and have a rolling rather than rugged physiography that limits escape terrain.

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

Surveys conducted in the early 1980s and in 1990 suggested that sheep numbers in the Tanana Hills increased during the 1980s. Between 1991 and 1994, adverse weather conditions, and possibly predation, caused the population to decline. In 1994 the population began recovering and increased through 1997.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

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

[a] This unit report also includes data collected outside the reporting period at the discretion of the reporting biologist.

RELATED MANAGEMENT ACTIVITY

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

METHODS

The goal of providing the opportunity to hunt sheep under aesthetically pleasing conditions was maintained by requiring a drawing permit to hunt sheep in the Mount Harper complex and limiting access into Glacier Mountain under a controlled-use regulation. Access into the Seventymile and Charley Rivers was limited due to the remoteness of these areas. Harvest was monitored through drawing permit and general harvest reports. We analyzed data on harvest success, hunter participation rate, residence and effort, transportation type used to access the hunt area, and horn size and age. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY01 = 1 Jul 2001 through 30 Jun 2002).

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

Aerial surveys consisted of flying either the PA-18 or R-22 helicopter at 200–700 feet above suitable sheep habitat. Survey speed varied from 60–80 mph in the PA-18 to 30–80 mph in the R-22. A ground-based survey was conducted in 1992 and consisted of walking the entire Glacier Mountain complex during a 9-day period. All sheep were classified using a spotting scope. We closely monitored sheep movement patterns to protect against duplicating our count.

The National Park Service (NPS) estimated population composition from a helicopter within Yukon–Charley National Preserve in 1997–2002. These data will be used as a comparison for determining effects of the nonlethal wolf control program on Dall sheep in the Tanana Hills.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During RY01–RY03 we did not estimate total sheep numbers throughout the Tanana Hills. Based on population trends and composition in individual survey areas, sheep numbers likely remained stable or increased slightly (Tables 1–3) compared to the 1997 estimate of 450–500 sheep.

During the 1990s, composition data indicated the sheep population declined substantially during 1990–1993 following a series of adverse winters and springs. Lamb recruitment was

low at this time, winters were severe, and adult mortality probably was high as a result (Gardner 2002). From 1994 to 1997 the population increased due to improved lamb production and/or survival. From 1998 to 2003, the population likely remained stable or increased slightly due to continued good lamb production and/or survival.

A complete survey of this area was conducted in 1982, resulting in a population estimate of 365 sheep. The NPS conducted 4 aerial surveys for Dall sheep between 1983 and 1990 within the Yukon–Charley National Preserve (Ulvi and Knuckles 1990). Based on their data, that area's sheep population increased 5–10% annually during this period.

Population Composition

The ratios of legal and sublegal rams:100 ewes decreased from 2001 to 2002 (Tables 1–3). In Yukon–Charley National Preserve the ratio of legal rams and sublegal rams per 100 ewes decreased from 22 legal rams and 50 sublegal rams:100 ewes in 2001 to 12 legal rams and 31 sublegal rams:100 ewes in 2002 (Table 3). Similar trends were seen in the Mount Harper and Glacier Mountain surveys. However, lambs in Yukon–Charley National Preserve increased from 36:100 ewes in 2001 to 52:100 ewes in 2002 (Table 3) and from 22 to 33:100 ewes in Glacier Mountain (Table 2). In the Mount Harper survey area, the lamb ratio decreased from 40:100 ewes in 2001 to 26:100 ewes in 2002 (Table 1).

The number of legal rams may have declined due to poor lamb crops during 1992 and 1993. Surveys also show a reduced sublegal ram population, possibly indicating reduced lamb production due to unfavorable weather conditions in winters 1999–2000 and 2000–2001 and spring 2001. Decreased age of rams in the harvest ($\bar{x}$ = 9.3 during RY01–RY03 vs. $\bar{x}$ = 10.0 during RY98–RY00) may indicate that more rams were harvested the first year they became legal, as hunting pressure increased and a smaller cohort of legal rams matured.

Distribution and Movements

We found no evidence that distribution and movements were different from earlier reports by Kelleyhouse and Heimer (1990).

MORTALITY

Harvest

Season and Bag Limit. The open season for resident and nonresident hunters in the Tanana Hills in Units 20D and 20E was 10 August–20 September; the bag limit was 1 ram with full-curl or longer horns. A drawing permit was required to hunt the Mount Harper area; a harvest ticket was required for the remainder of Unit 20E. Hunters who used the Glacier Mountain Controlled Use Area (Glacier Mountain CUA) could not use motorized vehicles from 5 August through 20 September.

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game did not change seasons or bag limits for sheep in the Mount Harper area or in the remainder of Unit 20E during the report period, and no emergency orders were issued.

Hunter Harvest. During RY01–RY03, the reported general harvest ranged from 7 to 10 rams ($\bar{x}$ = 8.3; Table 4). The previous 5-year average was 6.8 rams/year. The trend of reported sheep harvest from the general season has been increasing since RY93 following removal of the permit requirements in the Charley River and Mount Sorenson areas.

During RY01–RY03, the mean horn length of the harvested rams was 34.5 inches, and the average age was 9.3 years old (Table 4). Two rams had horns ≥40 inches (6% of harvest). During the previous report period, mean horn length was 37.2 inches and mean age was 10.3 years. Decreased horn length and age are probably a reflection of fewer rams 10 years old and older in the population due to poor lamb survival in the early 1990s and to increasing annual harvest rates.

During RY01–RY03, 1–2 sheep were harvested annually in the Mount Harper drawing permit area (Table 5). Each year, 4 permits were issued and 3–4 of the recipients participated, which is comparable to the previous 10 years. Mean horn length was 35.4 inches, and no rams had horns ≥40 inches long, as was the case during RY92–RY97. During the 1999–2002 composition surveys in the Mount Harper area, 3–4 rams were observed annually that had horns estimated to be ≥40 inches (30–45% of the legal ram population).

Hunter Residency and Success. During RY01–RY03, 10 local residents, 53 nonlocal Alaska residents, and 6 nonresident hunters harvested 25 rams (36% success) during the general sheep season in Unit 20E (Table 6). The mean number of hunters per year was 23, a slight decrease from RY98–RY00, but higher than other years except RY99 and RY00. Hunter participation increased from an average of 9 hunters per year during RY90–RY94 to an average of 25 during RY98–RY00. Nonlocal Alaska residents composed most of the increase.

During the report period, 1 nonresident and 11 residents received Mount Harper permits. The nonresident and 6 of 10 Alaska residents harvested sheep (60%). Average success since RY90 has been 61%.

Harvest Chronology. Historically, the timing of sheep harvest varied annually in the area, because many hunters also hunted caribou and did not begin their hunt until the caribou were accessible. During RY01–RY03, 88% of the harvest occurred in August during the first 3 weeks of the season. The most common times for harvest were during the first week when 52% of the harvest occurred and at the end of August (the third week of the season) when 28% of the harvest occurred. If the hunter participation rate continues to increase and if most hunters choose to hunt the first week of the season, the goal of uncrowded hunting will not be met. The primary area of concern is the Charley River. We do not believe we need to change management to address these concerns at this time but will monitor trends and evaluate public satisfaction during the next report period.

Transport Methods. Except for the Glacier Mountain CUA and the lower Charley River, terrain features and landownership restrictions limit sheep hunters to using aircraft to access sheep habitat. A few hunters (6% during RY01–RY03) drove riverboats up the Charley River. In the Glacier Mountain CUA, all successful hunters reported using highway vehicles, although they had to walk into the area to reach sheep habitat. During the 1980s, hunting by

horseback was common among successful hunters; however, since 1992 no hunters have used horses to access this area.

Other Mortality

Most Dall sheep mortality in the Tanana Hills is likely due to natural factors. However, we do not know the primary limiting factor(s) to population growth. Wolf, grizzly bear, and golden eagle predation has been observed (Gardner 2002). Escape terrain is limited, increasing predator effectiveness. We have no data on the limiting effects of accidents, disease, or winter habitat.

We have documented that at least 7 wolf packs reside in the Mount Harper and Glacier Mountain sheep areas. To document the effects of the Fortymile nonlethal wolf control program on Dall sheep, we monitored sheep numbers and composition within the Glacier Mountains and Mount Harper complexes. Wolf control was not found to be effective in causing short-term increases in sheep numbers in the Alaska Range (Gasaway et al. 1983). However, Gardner (2002) hypothesized that sheep in these 2 areas would benefit from an 80% reduction in wolf population size. This prediction was based on the theory that wolf predation is a more important limiting factor in the Tanana Hills compared to the Alaska Range, because of the lack of escape terrain in the Tanana Hills. Surveys conducted during summers 2000–2002 indicate a moderate increase in lamb:ewe ratios, but no change in population size could be determined. We will continue annual surveys and present the data in the next Tanana Hills sheep management report.

HABITAT

Assessment

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

Portions of the Tanana Hills included in the Yukon–Charley National Preserve are protected from most human disturbance. Mount Harper is known to have mineral potential and has been subjected to mining operations in the past. Currently there is renewed interest in the area; much land has once again been claimed for mining activity, and more mineral exploration is expected. Any full-scale development of the area should include sufficient measures to minimize disturbance of sheep or destruction of sheep escape cover and winter range. ADF&G/Division of Wildlife Conservation biologists will coordinate with Department of Natural Resources/Office of Habitat Management and Permitting staff to ensure that sheep habitat is protected during future development.

More than 30 years of wildfire suppression has caused lower elevation winter ranges and travel routes to become cloaked in spruce forest. Implementation of the Alaska Interagency Fire Management Plan—Fortymile Area should result in a near-natural fire regime throughout this area, possibly benefiting the sheep population.

CONCLUSIONS AND RECOMMENDATIONS

It appears sheep numbers stabilized in the Tanana Hills by 1998 and were stable to slightly declining until 2001. During RY01–RY03 the number of rams decreased, perhaps due to poor lamb crops during 1992 and 1993. However, surveys indicated a reduced sublegal ram population as well, possibly indicating continued poor lamb production due to unfavorable weather conditions in winters 1999–2000 and 2000–2001 and spring 2001. Decreased age of rams in the harvest ($\bar{x}$ = 9.3 during RY01–RY03 vs. $\bar{x}$ = 10.0 during RY98–RY00) may indicate that more rams were harvested the first year they became legal, as hunting pressure increased.

The Tanana Hills sheep population tends to be widely dispersed, often below tree line. The area has few trails or suitable landing sites. However, currently there is renewed mining interest in the area. Any full-scale development of the area should include sufficient measures to minimize disturbance of sheep or destruction of sheep escape cover and winter range.

We met our management goals to 1) protect, maintain, and enhance the sheep population and its habitat in concert with other components of the ecosystem and 2) provide an opportunity to hunt sheep under aesthetically pleasing conditions. Harvests have been low for the past 20 years, with little effect on the population. Hunter participation decreased slightly between RY01–RY03 and the previous report period, but increased by 212% since RY90–RY94. If hunter use continues to increase, crowding will occur in several areas and harvest will probably initially increase. However, it appears that hunter participation has leveled off. If so, our management goal of maintaining aesthetically pleasing hunting conditions will continue to be met. During the next report period, management objectives will be to 1) maintain a full-curl harvest strategy and 2) maintain fewer than 50 hunters per season in the Tanana Hills.

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TABLE 1 Mount Harper Dall sheep composition counts from aerial surveys, 1982–2002

Sex/age class	1982[a]	1993[a]	1997[b]	2000[b]	2001[a]	2002[a]
Legal rams[c]	18	11	13	7	9	5
Sublegal rams[d]	22	15	16	19	23	20
Unclassified rams				0	0	0
Total rams	40	26	29	26	32	25
Ewes[e]	39	30	40	25	30	35
Lambs	8	4	9	9	12	9
Yearlings			5	9		
Unidentified				0	0	
Total other sheep	47	34	54	43	42	44
Total sheep	87	60	83	69	74	69
Legal rams:100 ewes	46	37	33	28	30	14
Sublegal rams:100 ewes	56	50	40	76	77	57
Total rams:100 ewes	103	87	73	104	107	71
Lambs:100 ewes	21	13	23	36	40	26
% Lamb	9	7	11	13	16	13

[a] Super Cub survey.
[b] Helicopter survey.
[c] Full curl or larger.
[d] Greater than ¼ curl but less than full curl.
[e] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 2 Glacier Mountain Dall sheep composition counts from a ground survey in 1993 and aerial surveys during 1998–2002

Sex/age class	1993	1998	1999[a]	2000	2001	2002
Legal rams[b]	3	6	4	6	7	2
Sublegal rams[c]	29	17	16	27	18	14
Unclassified rams			1	0	0	0
Total rams	32	23	21	33	25	16
Ewes[d]	42	54	40	61	50	46
Lambs	10	20	15	6	11	15
Yearlings						
Unidentified			0	0	0	0
Total other sheep	52	74	55	67	61	61
Total sheep	84	97	76	100	86	77
Legal rams:100 ewes	7	11	10	10	14	4
Sublegal rams:100 ewes	69	31	43	44	36	30
Total rams:100 ewes	76	43	53	54	50	34
Lambs:100 ewes	24	37	38	10	22	33
% Lamb	12	21	20	6	13	16

[a] Partial survey.
[b] Full curl or larger.
[c] Greater than ¼ curl but less than full curl.
[d] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 3 Yukon–Charley Rivers National Preserve Dall sheep composition counts, 1997–2002[a]

Sex/age class	1997	1998	1999	2000[b]	2001	2002
Legal rams[c]	18	24	24	7	27	18
Sublegal rams[d]	37	53	46	25	60	48
Unclassified rams	0	0	0	0	0	0
Total rams	55	77	70	32	87	66
Ewes[e]	156	116	149	54	121	154
Lambs	63	63	65	18	43	80
Yearlings	35	26	45	16	39	30
Unidentified					0	0
Total other sheep	254	205	259	88	203	264
Total sheep	309	282	329	120	290	330
Legal rams:100 ewes	12	21	16	13	22	12
Sublegal rams:100 ewes	24	46	31	46	50	31
Total rams:100 ewes	35	66	47	59	72	43
Lambs:100 ewes	40	54	44	33	36	52
% Lamb	20	22	20	15	15	24

[a] Yukon–Charley Rivers National Preserve data, John Burch, NPS, unpublished data.
[b] Partial survey.
[c] Full curl or larger.
[d] Greater than ¼ curl but less than full curl.
[e] Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 4 Tanana Hills sheep harvest, regulatory years 1990–1991 through 2004–2005

Regulatory year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Ewes	Total sheep	Hunters
1990–1991[a]	1	36.0	11.0	0	1	4
1991–1992[a]	3	33.7	8.3	0	3	13
1992–1993[a]	1	33.0	10.0	0	1	5
1993–1994[b]	5	34.0	8.8	0	5	11
1994–1995[b]	3	33.7	8.0	0	3	8
1995–1996[b]	8	36.3	9.1	0	8	16
1996–1997[b]	5	35.0	9.4	0	5	16
1997–1998[b]	9	35.3	10.5	0	9	23
1998–1999[b]	5	35.6	10.0	0	5	15
1999–2000[b]	10	36.9	10.8	0	10	28
2000–2001[b]	5	37.4	9.8	0	5	31
2001–2002[b]	7	37.3	10.2	0	7	20
2002–2003[b]	8	30.7	8.9	0	8	25
2003–2004[b]	10	34.8	9.6	0	10	24
2004–2005[b,c]	3	35.5	9.0	0	3	13

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

TABLE 5 Mount Harper drawing permit sheep harvest, regulatory years 1990–1991 through 2004–2005

Regulatory year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	$\bar{x}$ Horn length	$\bar{x}$ Age	Total harvest
1990–1991	4	2	1	1	39.8		1
1991–1992	4	1	1	2	37.0		2
1992–1993	4	2	0	2	34.5		2
1993–1994	4	0	3	1	32.5	8.0	1
1994–1995	4	1	3	0			0
1995–1996	4	0	0	4	37.0	8.0	4
1996–1997	4	1	1	2	35.6	10.5	2
1997–1998	4	2	0	2	34.8	10.0	2
1998–1999	4	1	2	1	40.0	10.0	1
1999–2000	4	0	1	3	37.0	8.8	3
2000–2001	4	1	1	2	35.0	7.0	2
2001–2002	4	0	1	2	35.6	8.7	2
2002–2003	4	0	2	2	35.0	8.5	2
2003–2004	4	1	2	1	36.0	7.0	1
2004–2005[a]	4	3	1	0			0

[a] Preliminary data.

TABLE 6 Tanana Hills sheep hunter residency and success[a], regulatory years 1993–1994 through 2004–2005

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Total	(%)	Local resident	Nonlocal resident	Nonresident	Total	(%)	
1993–1994	0	2	3	5	(45)	1	4	1	6	(55)	11
1994–1995	0	2	1	3	(38)	2	1	2	5	(62)	8
1995–1996	2	5	1	8	(50)	1	6	1	8	(50)	16
1996–1997	1	2	2	5	(31)	3	7	1	11	(69)	16
1997–1998	0	6	3	9	(41)	3	10	0	13	(59)	22
1998–1999	2	3	0	5	(33)	1	7	2	10	(67)	15
1999–2000	0	7	2	10[b]	(36)	8	10	0	18	(64)	28
2000–2001	0	3	2	5	(16)	3	23	0	26	(84)	31
2001–2002	1	4	2	7	(35)	1	12	0	13	(65)	20
2002–2003	1	5	2	8	(32)	3	14	0	17	(68)	25
2003–2004	2	7	1	10	(42)	2	11	1	14	(58)	24
2004–2005[c]	1	2	0	3	(23)	1	9	0	10	(77)	13

[a] Excludes hunters in permit hunts.
[b] Total includes hunters of unknown residency.
[c] Preliminary data.

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

GEOGRAPHIC DESCRIPTION: Western Brooks Range

BACKGROUND

Dall sheep are indigenous to northwest Alaska. For centuries, Inupiat residents hunted sheep for subsistence (Georgette and Loon 1991). For many years resident and nonresident hunters living outside Unit 23 also hunted sheep recreationally in this unit. We think there are 3 relatively discrete populations of sheep within Units 23 and 26A that inhabit the following areas: the area west of Howard Pass that is north of the Noatak River and Kiyak Creek including the Wulik Peaks ("De Long Mountains"; the area south and east of the Noatak River and west of the Cutler and Redstone Rivers ("Baird Mountains"); and the area east of Howard Pass and the Cutler and Redstone Rivers ("Schwatka Mountains"). Although there is likely some exchange of sheep between the Baird and De Long Mountains, we think it is minimal. Sheep also occur in the Lisburne Hills, although it is unclear whether they move into this area seasonally from the Wulik Peaks or remain in the Lisburne Hills year-round. This report will cover only the De Long and Baird Mountain sheep populations. The Schwatka Mountain population will be included in the report for Unit 24.

Sheep in Units 23 and 26A are at the northwestern margin of their range in Alaska. Consequently, these populations may be more prone to fluctuations in population size because of adverse weather than populations inhabiting areas with better and more stable range conditions. In addition, long-term local residents report wolf abundance substantially affects sheep numbers and distribution. Wolf numbers are thought to have fluctuated widely during the last 50 years in response to hunting, disease, and availability of prey (Ballard 1993). The Western Arctic Caribou Herd has numbered >400,000 individuals since about 1990, and large numbers of caribou have moved through sheep habitat throughout Units 23 and 26A during spring, summer, and fall. Caribou have likely affected the availability of food for sheep through direct competition and trampling.

In Units 23 and 26A, sheep are at low density compared to other areas in the state (Singer 1984). Beginning in 1990, high natural mortality reduced sheep numbers dramatically in Units 23 and 26A. In response, the ADF&G and the National Park Service (NPS) closed or shortened recreational and subsistence sheep hunting in most of these units during 1991–2004. Limited hunting was reestablished in 1998.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Baird Mountains

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

De Long and Schwatka Mountains

- Census sheep in both ranges prior to 2006.
- Maintain a minimum of 7–10 ⅞-curl-and-larger rams:100 "ewes" in each area; ewe includes female sheep and males with ewe-like horns (1-to-2-year-old rams)
- Establish criteria to regulate recreational and subsistence hunts.

Units 23 and 26A

- Monitor harvests through the harvest ticket system, permit hunts, community-based harvest assessments, public contacts, and field observations.

METHODS

In 2000–2003 the NPS conducted Baird Mountain sheep surveys in conjunction with a sheep research project. For the first time since 1999, ADF&G staff assisted the NPS with sheep surveys in the Baird Mountains during July 2004 using techniques previously described (Dau 1992). The De Long Mountain (Kugururok River/Trail Creek area) and Wulik Peaks sheep trend count areas have not been surveyed since 1999 because movements of sheep appeared to confound estimates of total number and ram:ewe ratios. We monitored harvests in the De Long Mountains through state registration permits; additionally, the NPS provided summaries of sheep taken under federal regulations in the Baird and De Long Mountains. Federal summaries did not include information about unsuccessful hunters, sex of sheep, horn length or diameter. For this report, the term "lamb" includes sheep <12 mos old; "ewe" includes female sheep and males with ewe-like horns (1-to-2-year-old rams); "small ram" includes rams <⅞ curl; and "large ram" includes rams ≥⅞ curl.

RESULTS AND DISCUSSION

POPULATION SIZE, STATUS AND TREND

Population Size

Baird Mountains. We think the Baird Mountain trend count area (roughly 700 mi^2) contains 85–90% of that sheep population. Small groups of sheep regularly occur outside the trend count area in portions of the Squirrel River drainage. For many years we assumed sheep surveys conducted by Super Cubs with locally experienced pilot/observer teams observed 80–90% of the sheep in the count area under favorable weather conditions. Movements of sheep

in and out of the survey area and weather undoubtedly affected sheep survey results (e.g., in 1996 and 1997). However, we think these effects were small in most years.

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

De Long Mountains and Wulik Peaks. We think sheep population dynamics in the De Long Mountains and Wulik Peaks are similar to those in the Baird Mountains. The density of sheep in these areas has generally appeared to be lower than in the Baird Mountains. Although mountainous habitat occurs continuously from the western portion of the Wulik Peaks to the eastern end of the De Long Mountains (i.e., Howard Pass), sheep occur only in pockets of this mountain range.

Population Composition

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

MORTALITY

Harvest

State Seasons and Bag Limits (identical for Units 23 and 26A).

2001–2002, 2002–2003, 2003–2004

Bag Limit	Hunt Type	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
Unit 23, that portion south and east of the Noatak River and west of the Cutler and Redstone Rivers (Baird Mountains)			
Resident hunters: One sheep by	R	10 Aug–30 Apr	No open season

2001–2002, 2002–2003, 2003–2004

Bag Limit	Hunt Type	Resident Open Season (Subsistence and General Hunts) (Subsistence hunt)	Nonresident Open Seasons
registration permit only			
All hunters One ram with full-curl horn or larger by drawing permit only provided that the harvestable surplus is >47 sheep		10 Aug–20 Sep	10 Aug–20 Sep
Unit 23, that portion north of Rabbit Creek, Kiyak Creek, and the Noatak River, and west of the Aniuk River (De Long Mountains)			
Resident hunters One sheep by registration permit only; quota is 5 sheep	R	10 Aug–30 Apr (Subsistence hunt)	
All hunters One ram with full-curl horn or larger by drawing permit only, provided that the harvestable surplus is >9 sheep in combination with that portion of Unit 26A, west of the Etivluk River	D	10 Aug–20 Sep	10 Aug–20 Sep
Remainder of Unit 23 (Schwatka Mountains)			
Resident hunters Three sheep by registration permit only	R	1 Aug–30 Apr	

2001–2002, 2002–2003, 2003–2004

Bag Limit	Hunt Type	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
All hunters 1 ram with full-curl horn or larger	H	10 Aug–20 Sep	10 Aug–20 Sep
Unit 26A, that portion west of the Etivluk River			
Resident hunters One sheep by registration permit only	R	10 Aug–30 Apr (subsistence hunt)	10 Aug–20 Sep
All hunters One ram with full-curl horn or larger by drawing permit only, provided that the harvestable surplus is greater than 9 in combination with that portion of Unit 23 in the De Long Mountains	D	10 Aug–20 Sep	10 Aug–20 Sep
Unit 26A, that portion east of the Etivluk River			
Resident hunters Three sheep by registration permit only	R	1 Aug–30 Apr	
All hunters One ram with full-curl horn or larger	H	10 Aug–20 Sep	10 Aug–20 Sep

Board of Game Actions and Emergency Orders. In 1998 ADF&G and NPS negotiated an informal agreement to cooperatively manage sheep in the future for Units 23 and 26A. The basic elements of this agreement are:

1. All sheep hunting in the Baird Mountains of Unit 23 will be administered through federal regulations.

2. Sheep hunting in the De Long Mountains of Units 23 and 26A will be administered jointly under state and federal regulations. A single harvest quota will be allocated between the NPS and ADF&G.

    A. If the total harvest quota is ≥20 sheep:

        a. The NPS will issue federal registration permits. This federal harvest could be divided between fall and spring hunts. Federal permits would allow use of aircraft and be valid only for federally qualified users on federal public lands.

        b. ADF&G will issue up to 11 drawing hunt permits to resident and nonresident hunters for hunt DS384. These permits would be valid within the Noatak National Preserve, and the bag limit would be 1 full-curl ram. The department would also issue registration permits under hunt RS388. Registration permits would be valid within the Noatak National Preserve, and the bag limit would be 1 sheep.

        c. ADF&G and NPS will each close its hunt when the overall quota is reached, regardless of how many sheep are taken under state or federal regulations.

    B. If the harvest quota is <20 sheep:

        a. NPS and ADF&G will each administer a portion of the quota.

        b. The state will close drawing hunt DS384 to ensure an adequate number of sheep are available for subsistence hunters under RS388.

During the 2001–2002 regulatory year, the combined state-federal quota for the De Long Mountains was 10 full-curl rams with half to be administered under federal regulations and half under state regulations. Because the amount necessary for subsistence is 9 sheep from the De Long Mountains, the state drawing permit was closed by Emergency Order 05-06-2001. This emergency order did 3 things in Units 23 and 26A:

1) It closed the nonresident drawing permit sheep hunt (DS384) in those portions of Units 23 and 26A north of Rabbit Creek, Kiyak Creek and the Noatak River, and west of the Etivluk and Aniuk Rivers (De Long Mountains).

2) It closed all sheep hunting in that portion of Unit 23 south of Rabbit Creek, Kiyak Creek and the Noatak River, and west of the Cutler and Redstone Rivers (Baird Mountains).

3) It closed the season for all but full-curl horn rams in the De Long Mountain registration permit subsistence hunt (RS 388) in Units 23 and 26(A).

During 2002–2003 and 2003–2004, hunt DS384 was not advertised in the hunt supplement because the combined state-federal quota was 20 sheep with half administered under each regulatory system.

Hunter Harvest. As with moose and caribou harvest data, we think sheep harvest data is incomplete for hunters who reside within Units 23 and 26A. This is probably most problematic for the Baird Mountains because that is where most residents of Unit 23 hunt sheep. Before 1991–1992, when sheep hunting in the Baird and De Long Mountains was closed or restricted, roughly 60% of the total reported harvest was taken in the Baird Mountains (Figure 1). During this time, residents of Unit 23 harvested more sheep in the Baird Mountains than nonresident or nonlocal resident hunters (Figure 2). In contrast, nonresidents harvested most sheep in the De Long Mountains (Figure 3). Ewes composed <3% of the reported harvest in the Baird and De Long Mountains prior to the restrictions imposed in 1991–1992; however, this is probably very conservative given the low reporting rate for residents of Unit 23.

Using survey data from 1986–1990 (before regulations were significantly restricted) and assuming 80% sightability, hunters took an average 37% (range 18–52%) of the large rams and 11% (range 6–13%) of all rams annually from the Baird Mountains. During this time, the ram:ewe ratio declined from 35 to 23 rams:100 ewes, and the ratio of ⅞+ curl rams declined from 11 to 7 rams:100 ewes. In 1991, the year seasons were closed, ram:ewe ratios roughly doubled to 45 rams:100 ewes and 15 large rams:100 ewes. In 2004, following 3 years of limited hunting under federal regulations since 1998–1999, there were 23 rams:100 ewes and 9 large rams:100 ewes.

Median horn length in the Baird Mountain harvest decreased from 34.5 inches during 1983–1984 (n=13 rams) to 32.0 inches during 1990–1991 (n=18 rams). Information regarding horn length was not available for sheep taken under federal regulations. During 1983–1984 through 1993–1994 there was no temporal trend in median horn length for sheep taken in the De Long Mountains and the overall median length was 34.0 inches.

Other Mortality

The primary predators of sheep are wolves and golden eagles. Large rams appear more vulnerable to wolves than other segments of the population based on carcasses and skeletons I've observed in low-lying areas far from escape terrain. Lambs are most vulnerable to golden eagles; however, I received a report of an eagle that attacked a ¾-curl ram near Atigun Gorge during the late 1980s. The eagle was on top of the ram and was working its talons deeply into its back. The ram appeared exhausted and had lost a substantial amount of blood. Unfortunately, the observers inadvertently frightened the eagle away while attempting to photograph this struggle, so it is unknown whether the eagle could have killed its prey through shock or loss of blood. The effects of predators and disease on Unit 23 sheep populations have not been quantified.

CONCLUSIONS AND RECOMMENDATIONS

The Baird and probably De Long Mountain sheep populations are approaching pre-crash population levels. Since 1991 ADF&G and NPS have worked with Advisory Committees, the Northwest Arctic Regional Advisory Council, and members of the public to gradually resume sheep hunting in Unit 23. The cooperative regulatory arrangement negotiated between NPS and ADF&G in 1998 should be continued.

During June 2005, NPS initiated a 2-yr project to estimate sheep numbers in the entire Brooks Range west of the Dalton Highway. The department assisted with this project in 2005 and should continue to provide support in 2006.

It is unlikely federal subsistence needs will ever be met in the Baird Mountains; therefore, the state should not publish sheep hunts for this area.

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Table 1 Number of Dall sheep observed during aerial surveys in the Baird Mountains, Unit 23, 1989–2004

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2004[c]
Rams ½+	162	105	108	130	123	93	90	75	114	116	86	107	145	157	123
Rams ⅞+	51	32	35	42	37	1	23	56	72	70	28	25	50	79	51
Ewes[a]	574	466	239	267	256	204	166	169	314	289	243	317	389	381	343
Lambs	170	133	17	59	47	20	95	58	83	72	77	101	73	118	91
Unknown	75	14	36	0	0	0	0	0	0	0	0	0	9	26	41
Total Sheep	981	718	400	456	426	317	351	302	511	477	406	525	616	682	598
Total Adults[b]	736	571	347	397	379	297	256	244	428	405	329	424	534	538	466
Lambs:100 Ewes	30	29	7	22	18	10	57	34	26	25	32	32	19	31	27
Rams:100 Ewes	28	23	45	49	48	46	54	44	36	40	35	34	37	41	36
Rams ⅞+:100 Ewes	9	7	15	16	14	20	14	33	23	24	12	8	13	21	15
Adults/mi^2	1.03	0.80	0.49	0.56	0.53	0.42	0.36	0.34	0.60	.57	.46	.60	.75	.80	.63

[a] Ewes defined as adult females, yearling of either sex, and ¼-curl rams.
[b] Adult defined as all sheep excluding lambs and unknowns.
[c] No survey completed in 2003.

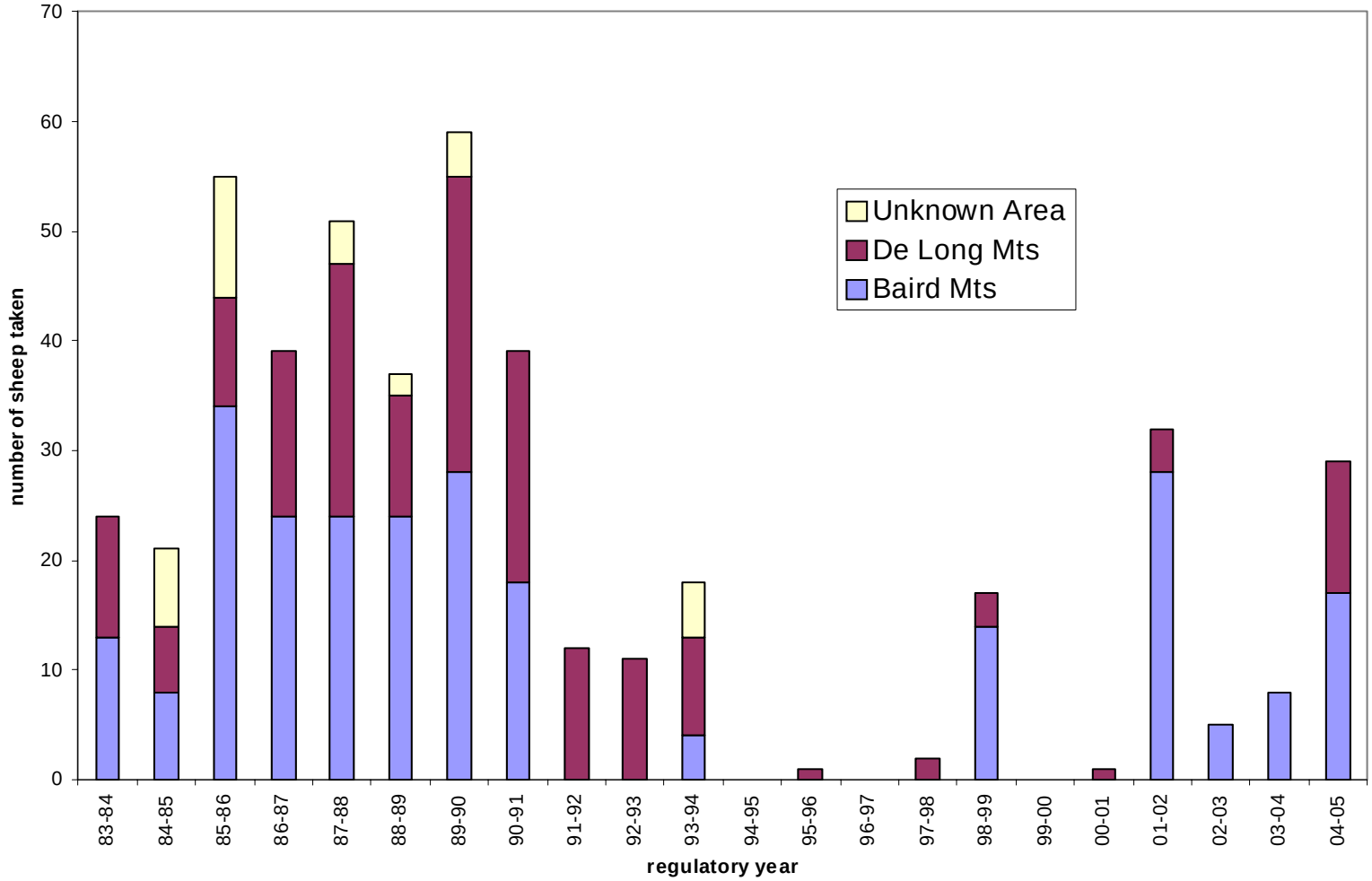

Figure 1 Number of sheep harvested in Game Management Unit 23 by area (data includes best information available for federal harvests)

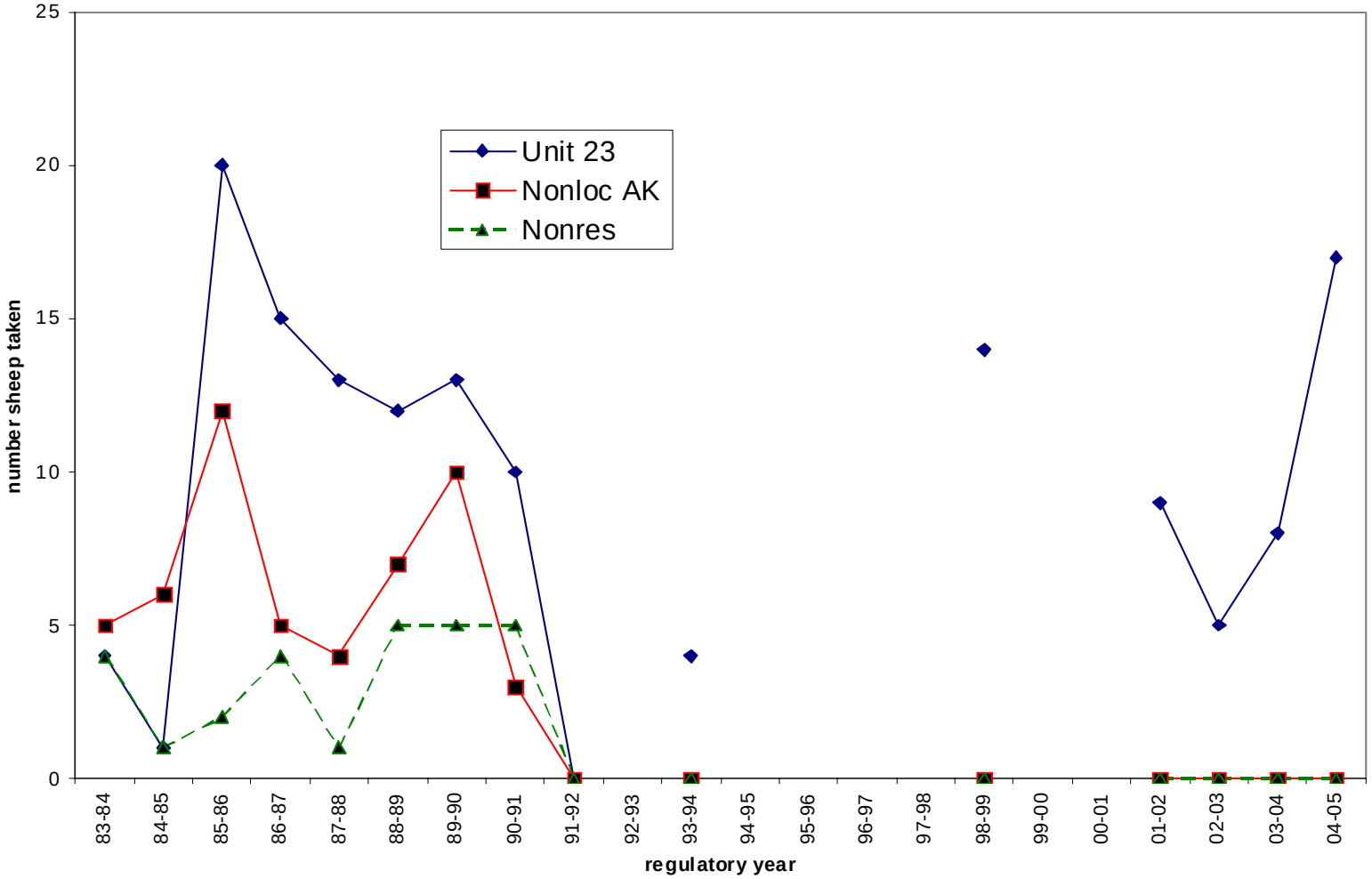

Figure 2 Baird Mountain sheep harvest in relation to hunter residence (data includes best information available for federal harvests)

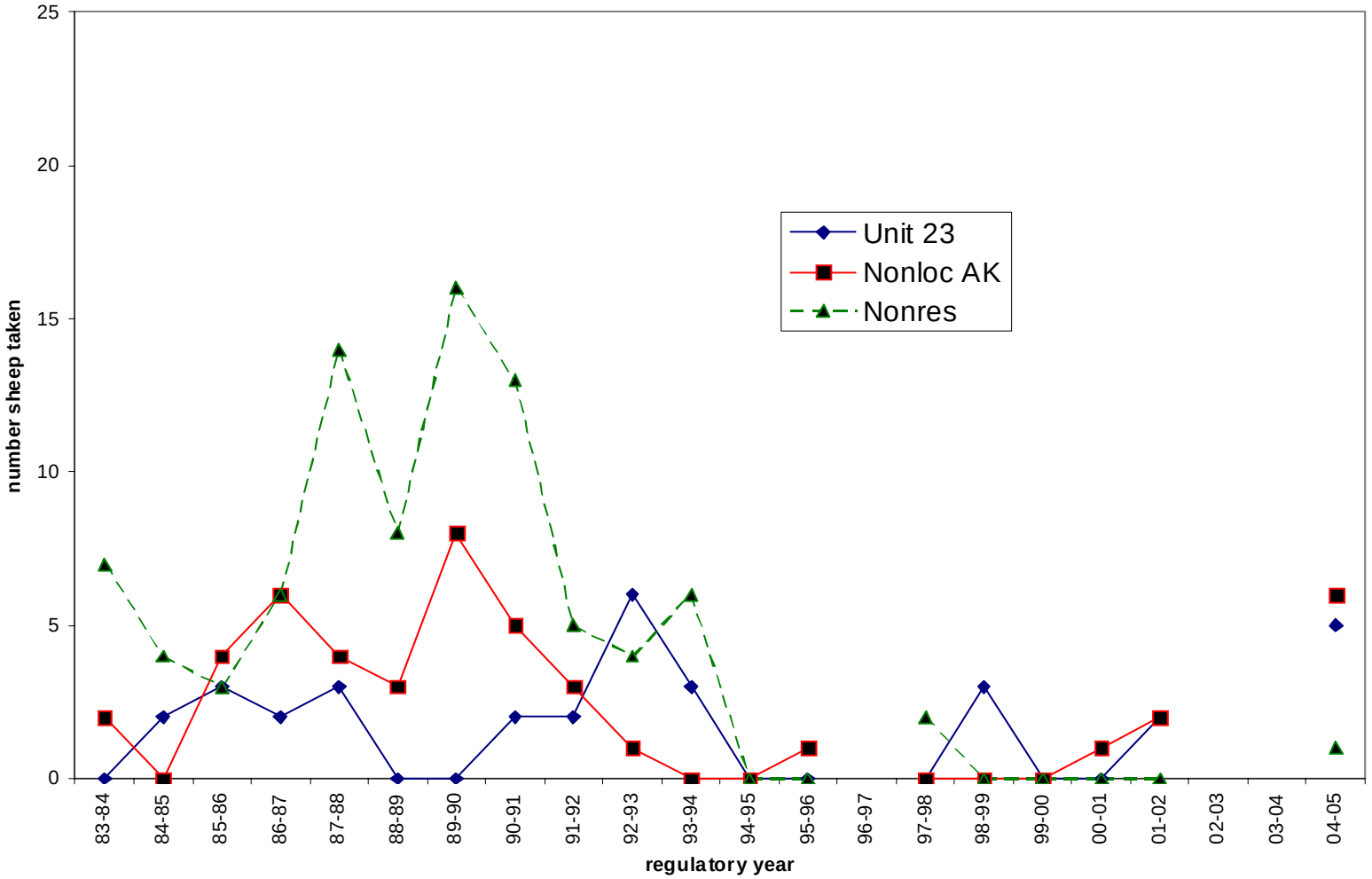

Figure 3 De Long Mountain sheep harvest in relation to hunter residence (data includes best information available for federal harvests)

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

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

BACKGROUND

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

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

Prior to expansion of GAAR in 1981, all of Unit 24 and those portions of Units 23 and 26A included in this report were open to general sheep hunting. The average annual total harvest (reported and estimated unreported) was 50 rams. The take by Nunamiut hunters (inland Inupiat Eskimos) was unrecorded but was likely ≤50 per year (Osborne 1996). During the 1980s, hunting regulations for this area changed substantially, and general sheep hunting was

closed in GAAR. Recently, harvest in the state general hunt has been low (7–10), probably partially due to scarcity of full-curl rams because of poor lamb production in the early 1990s (cohorts that would currently be full curl). Reported harvest in GAAR has declined since regulatory year (RY) 2000 (RY = 1 July through 30 June; e.g., RY00 = 1 July 2000 through 30 June 2001).

MANAGEMENT DIRECTION

MANAGEMENT GOAL

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

MANAGEMENT OBJECTIVE

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

Activity

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

METHODS

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

POPULATION STATUS

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

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

A subsample of the 1996 population survey area was surveyed during 1998–2002 in June or July by staff from GAAR using a fixed-wing Super Cub aircraft (Lawler 2004). Sheep were classified as rams, ewe-like, and lambs, similar to the 1996 surveys except that rams smaller than ½ curl were included in the ewe-like category.

As part of a sheep survey encompassing the western portion of the eastern Brooks Range, 2 count areas in the Central Brooks Range (sample units 13A and 13B) were surveyed during 22–24 June 2004 by staff from ADF&G and Alaska Bureau of Wildlife Enforcement (ABWE) using a fixed-wing Super Cub aircraft. Sheep were classified as rams, ewe-like, and lambs. Yearlings and rams smaller than ¼ curl were included in the ewe-like category.

Harvest

During 1988–1997, ADF&G staff monitored the federal subsistence harvest in GAAR by conducting personal interviews with hunters, issuing permits, and sending out questionnaires to registered hunters after the close of the hunt. Sex, date of kill, and location of kill were recorded. During this period, we collected subsistence harvest data from the following villages in Unit 24: Anaktuvuk Pass, Wiseman, Bettles, Coldfoot, and Allakaket. In Unit 23 subsistence data was collected from Ambler. In 1997 GAAR implemented a community harvest quota for Anaktuvuk Pass (60 sheep, not to exceed 10 ewes), and GAAR personnel assumed responsibility for collecting harvest data from that village. In addition, beginning in 1992, BLM administered another federal subsistence hunt along the DHMCA for residents of Unit 24 north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia. Three agencies are involved in collecting subsistence harvest data on federal lands, which creates substantial confusion for local residents. Because GAAR does not allow hunting other than by residents of Unit 24 who live north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia, ADF&G staff are not directly involved in collecting these data. However, we will continue to cooperate with GAAR staff to summarize the federal subsistence harvest data and the state general harvest data collected by ADF&G through the statewide harvest ticket system. Harvest ticket reports were required from all hunters not qualified to hunt under the federal system. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year. Harvest data for the DHCMA and east of the DHCMA obtained through the statewide harvest ticket system and the BLM registration hunt were reported in the eastern Brooks Range sheep report.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Little data concerning historical population trends or age/sex composition have been collected in the Central Brooks Range. The few population estimates since the early 1980s were from within the GAAR. Sheep numbers were somewhat high and increasing in the early 1980s and stable between 1984 and 1987 (Table 1; Singer 1984; Adams 1988; Whitten 1997). However, by the early 1990s, sheep numbers had decreased substantially. During 1993 and 1996 there was some indication that the decline in sheep numbers decelerated (Osborne 1996; Whitten 1997), and during 1996–2002, the population was considered stable, albeit at lower densities than observed during the 1980s (Lawler 2004).

In 1982–1984, Singer (1984) estimated 10,939 sheep existed in GAAR (10,132 mi^2 of sample units; density = 1.1 sheep/mi^2). In 1996 a population of 2758 ±8% (90% CI) sheep was estimated over an area of 2242 mi^2, with densities ranging from 0.3–1.6 sheep/mi^2 among survey units (Whitten 1997; Brubaker and Whitten 1998). This estimate was substantially lower than the 4605 Dall sheep counted in the same area in 1982 (densities ranged 1.1–2.8 sheep/mi^2), providing substantial evidence that the sheep abundance was markedly lower than observed in the early 1980s.

Although different portions of the GAAR were surveyed during 1982–1996, some of the same sample units (Singer 1984; sample units 1, 2, and 5) were surveyed in 1982, 1984, 1987, and 1996. In these sample units, 882 sheep were counted in 1982, 1079 were counted in 1984, 1043 were counted in 1987 (Singer 1984; Adams 1988). These counts provided some evidence that sheep numbers increased during the 1980s. By 1996, 358 sheep were estimated in the same sample units, suggesting that a substantial decline had occurred (Table 1; Whitten 1997; Brubaker and Whitten 1998). Consequently, Whitten (1997) suggested that sheep increased 11% per year between 1982 and 1984, were stable during 1984–1987, and declined 66% by 1996 (Table 1). There was some indication that the sheep population level changed little during 1993–1996. Osborne (1996) counted 617 sheep in an 817–mi^2 area in 1993, and in 1996 Whitten (1997) counted 618 sheep in almost the same area using a less efficient aircraft, but longer search times. There were more lambs and fewer adults in the 1996 survey. However, comparisons of population levels among years should be done cautiously because search intensity and methods varied. Nonetheless, Brubaker and Whitten (1998) and Whitten (1997) suggested that the decrease in sheep numbers from 1982 to 1996 could not be explained by search intensities. Thus, sheep were far less abundant in the mid 1990s compared with the 1980s. This trend also was observed in the eastern Brooks Range and the Alaska Range (Osborne 1996; Scotton 1997; Whitten 1997; Gardner 1999; Arctic National Wildlife Refuge, FWS, unpublished data). The decline in sheep populations across all these areas appeared to be correlated with severe, deep snowfall during winters between 1988 and 1993 (Whitten 1997). In the Central Brooks Range, snowfall during 1988 through 1993 was above a 42-year average of 90 inches (range: 95–170 inches, Bettles, Alaska airport), except in 1991 when snowfall was approximately 53 inches. During RY94, snowfall was

approximately 90 inches and was low in RY95 (56 inches). This low snowfall year preceded the 1996 sheep survey in which a higher proportion of lambs were observed (Whitten 1997).

During 1998–2002, sheep numbers in count areas surveyed by GAAR staff west of Anaktuvuk Pass ranged from 169 to 460 (Table 2). In some years, not all count areas were flown (Table 2). The low value during the 1999 survey was influenced by high winds and poor visibility. Whitten (1997) suggested the population was increasing in 1996 because the ratio of lambs was high (Table 1). However, recent surveys indicated that there was no consistent trend from 1996 to 2002 (Lawler 2004). In addition, surveys in the upper Chandalar River region (779 mi^2) also found no evidence of a population trend between 2002 and 2004 (Stephenson 2005).

In 2004, 2 count areas on the eastern border of GAAR and south of the Brooks Range (sample units 13A and 13B) were surveyed as part of a sheep survey encompassing portions of the central and eastern Brooks Range (1792 mi^2 of sheep habitat). These count areas were similar to count area 13 surveyed by Singer (1984) in 1983 (485 mi^2), with the 2004 count area containing a slightly larger area (521 mi^2). In 2004, we counted 386 sheep (density = 0.74 sheep/mi^2) in 9 hours. In 1983, Singer (1984) counted 507 sheep (density = 1 sheep/mi^2). Different aircraft type and methodologies may have been used between the 2 surveys.

Population Composition

Population composition varies from year to year depending on lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting (Heimer 1988). Although it is difficult to directly compare population numbers across years because of varied methods, the data can be valuable to evaluate trends in composition. Whitten (1997) indicated that the sheep population was probably stable between 1984 and 1987, and percent lambs and the lamb:100 ewe ratios support this suggestion. In the same 3 count areas in 1982, 1984, and 1987, percent lambs were 18%, 19%, and 18%, respectively, and the lamb:100 ewe ratios was 45, 51, and 47 (Table 1; Singer 1984; Adams 1988). In 1993, the percent lambs was 17% and the observed lamb:ewe ratio was 29:100 (not the same count areas as surveyed during 1982–1987). Yearlings and young rams are included in the "ewe" category in the 1993 survey; an actual lamb:ewe ratio was probably 12–18% higher than the observed lamb:ewe ratio, or about 32–34:100 (W. Heimer, ADF&G, personal communication). In 1996, occurrence of lambs increased to 24%, and the lamb:ewe ratio increased to 45:100 in an area similar to that of the 1993 surveys, which indicated that reproductive success had increased, and the population might have been growing. Yearlings and young rams were not included the "ewe" category in 1996; thus, the lamb:ewe ratio is likely more accurate. In addition, for the entire 1996 survey with helicopter classification only, the percent lambs was 22% and the lamb:ewe ratio was estimated at 47:100 ±8% (90% CI) (Table 1; Whitten 1997; Brubaker and Whitten 1998).

To compare the data from 1998–2002 to the 1996 surveys, Lawler (2004) used classification from the surveys conducted by fixed-wing aircraft in 1996, which used the same method as surveys conducted during 1998–2002. In addition, classification of ewes conducted by fixed-wing aircraft in 1996 and 1998–2002 included rams smaller than ½ curl (ewe-likes.) The ratio for 1996 was 38 lambs:100 ewe-like, with 24% lambs. This ratio was similar to

estimates obtained for the entire 1996 survey in which only helicopter classification data was used to estimate lamb:ewe ratios and percent lambs. From 1998 to 2002, percent lambs ranged from 11 to 22% and lambs:100 ewe-likes ranged from 17 to 34 (Table 2). The low number of lambs observed in 2001 may have been related to high snowfall during winter 2000–2001 (111 inches). During 1998–2002 the actual lamb:ewe ratio was likely higher than observed because of the inclusion of young rams in the ewe-like category. Thus, the actual ratio may have been consistently greater than 30 lambs:100 ewes, except for 2001. This suggests a stable to increasing population. However, according to the trend count areas, population numbers did not increase from 1996 to 2002 (Table 2). Mortality of radiocollared adult ewes during 1998–2001 ranged from 17 to 29% annually (n = 14–18; Jim Lawler, GAAR, personal communication) and may have slowed or prevented a population increase.

Rams were classified differently during 1982–2002. Singer (1984) combined ram statistics for surveys that occurred during 1982–1984 and reported that GAAR had 28% rams, and only 8% of those rams were ⅞ curl or larger. Adams (1988) determined that within the area he surveyed, the population contained 35% rams with 50% of those rams full curl or larger. The proportion of rams and large rams observed in the 3 sample units surveyed in 1982, 1984, and 1987 was similar to the trend observed in the complete surveys for those years (See Table 1). Prior to 1982, sheep hunting within GAAR was open to both residents and nonresidents (Osborne 1996). During 1982–1984 only residents of Anaktuvuk Pass were allowed to hunt sheep within GAAR (Singer 1984). The increase in percent rams greater than or equal to full curl observed in 1987 may have been influenced by changes in hunting regulations, although differences in sizes of cohorts produced during the period also may have contributed. In 1993, Osborne (1996) reported 26% rams and 39% greater than or equal to full curl. (Table 1; Note: Osborne [1996] calculated 39% by including 7 rams in the total that were not classified. By using only classified rams, the percent of rams greater than or equal to full curl was 41%). By 1996, percent rams was estimated at 22%, and the percent of rams greater than or equal to full curl was 33% in the same area as the 1993 surveys (although not the exact same portions of the count areas were flown in both years [Table 1]). The decrease in proportion of rams observed, particularly full curl and greater, may have been influenced by deep snows that occurred during 1988–1993, which probably reduced survival of lambs born during these years. These lambs would have become full-curl rams during 1994–2000. Furthermore, if larger cohorts were produced beginning in 1994, there would be more young rams included in the "ewe-like" category, which would further reduce the perceived proportion of rams in the population. In addition, hunting regulations varied little during the 1990s. The classification from helicopter for the entire 1996 survey was 20% rams, with 29% of those rams greater than or equal to full curl (Whitten 1997). Because classification of rams differed between previous surveys and those conducted during 1998–2002, it is difficult to compare ram statistics for these periods. Percent rams ranged 15–20% during 1998–2002, with the lowest number of rams observed in 2002.

MORTALITY

Harvest

Season and Bag Limit (RY98–RY04). Only state regulations are listed below, although federal subsistence regulations do apply on federal lands within the area.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Units 24, 26A and 26B, that portion within the Gates of the Arctic National Park on private lands.		
RESIDENT HUNTERS: 3 sheep.	1 Aug–30 Apr	No open season
Remainder of Unit 24.		
RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep
Units 23 (Schwatka Mountains) and 26A, east of the Cutler, Redstone, Aniuk, and Etivluk Rivers.		
RESIDENT HUNTERS: 3 sheep by registration permit only (RS389).	1 Aug–30 Apr (Subsistence hunt only)	
RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep

Alaska Board of Game Actions and Emergency Orders.

The Board of Game made no changes and no emergency orders were issued during this report period. A history of board of game actions since RY95 can be found in Lenart (2002).

Hunter Harvest. The combined harvest from the GAAR and the state general hunt declined somewhat during the past 5 years ($\bar{x}$ = 19; RY99–RY03) compared to the previous 5 years ($\bar{x}$ = 28; RY94–RY98; Table 3). Most of the decline in this harvest occurred in the general hunt, but recently some decline in the GAAR subsistence hunt also occurred (Table 3). In addition, GAAR hunters usually harvested most of the sheep ($\bar{x}$ = 56%; range: 42–81%; RY90–RY03; Table 3).

The general harvest for the Central Brooks Range (excluding GAAR) averaged 8 sheep during the past 5 years (range: 7–12; RY99–RY03; Table 4) compared to 10 the previous 5 years (RY94–RY98; Table 4). The decline in harvest actually began in RY96 and may be related to availability of full-curl rams after 1996. Poor lamb crops during the late 1980s and early 1990s may have reduced the number of full-curl rams in the population during the mid to late 1990s. However, some of the lower harvest was also probably related to fewer hunters in the field as numbers of hunters also began to decrease in RY96 (Table 4). In RY00 and RY01, harvest increased slightly and may have been a reflection of higher survival and larger cohorts produced during the mid 1990s. However, harvest was very low in RY03 (Table 5). Individuals reporting on the general harvest reports hunted primarily in the Alatna, John, and Wild River drainages. The mean age and horn length could not be used to make generalizations about the harvest or population due to the small sample size (Table 5).

Permit Hunts. The reported federal subsistence harvest from GAAR during the last 5 years averaged 10 sheep (range: 5–18; RY99–RY03; Table 3). This harvest declined substantially compared with the previous 5 years ($\bar{x}$ = 19; range: 9–26; Table 3). Most of the sheep harvested were adults, and rams usually made up 75% or greater of the harvest (Table 6). Where local residents should report harvest has been confusing since 1997 when GAAR personnel assumed responsibility for collecting harvest data from Anaktuvuk Pass. Problems incurred were duplication of reporting between the federal and state systems and/or lack of reporting. In most subsistence hunts we believe some sheep are taken and not reported, but confusion about where to report also may have influenced recent reporting. In addition, some ewe harvest probably was not reported.

Hunter Residency and Success. In the state general harvest, the 5-year average success rate for the area was 39% (range: 26–52%; RY99–RY03). Success rates were higher for nonresident hunters (range: 37–87%) compared with resident hunters (range: 7–50%). Nonresident hunters primarily used guides. The percent of nonresident and resident hunters was variable during RY99–RY03, but usually over 50% were resident hunters (Table 4). However, in Unit 26A almost all hunters were nonresidents. In general, most hunting occurred in Unit 24 and little or no hunting occurred in Unit 23.

Hunters from Anaktuvuk Pass harvested most of the sheep taken during the subsistence hunt in GAAR. Residents of Wiseman were the other primary local sheep hunters. Success rates were difficult to determine because reporting by unsuccessful hunters can be inconsistent and recently there was no attempt to obtain information about hunter effort. However, in RY01 only 5 sheep were harvested compared to a mean of 17 sheep for the previous 5 years (Table 6). A small harvest also occurred during RY02 (8) and RY03 (9 sheep). These smaller harvests could be related to weather and traveling conditions or confusion about where to report. In addition, it may be more difficult for federal subsistence hunters to find sheep in GAAR.

Harvest Chronology. Highest harvest of sheep in the Central Brooks Range in the state general hunt usually occurred during the first 10 days of the season during RY93–RY03 (Table 7), although in some years, more harvest occurred during the second 10 days. Timing of harvest was probably related to weather and the desire of hunters to be in the field before a great deal of hunting has occurred, causing sheep to become more wary.

Federal subsistence hunters who hunted in GAAR in Units 24 and 26A took sheep in both fall (Aug and Sep) and spring (Mar and Apr). The season in which most sheep were taken was variable during RY90–RY03. The main factors affecting sheep hunting were weather and traveling conditions (i.e., snow).

Transportation Methods. In the RY93–RY03 state general hunts, aircraft were the major transportation means because access by other means is limited (Table 8). Boats, primarily out of Bettles, were the second most used means of transportation. Federal subsistence hunters who hunted in GAAR mainly used ATVs in the fall and snowmachines in the winter and spring.

Other Mortality

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

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in the Central Brooks Range appeared to be stable during RY98–RY02 (Table 2). According to the GAAR surveys, lamb production was good. The average percent lambs was 18% and lambs:100 ewe-likes remained ≥29, except in 2001 when there was a late spring. However, mortality of radiocollared adult ewes was high and may have prevented an increase in the population. Sheep surveys directly east of the Central Brooks Range also indicated little change in population numbers during RY01–RY03 (Stephenson 2005). It is possible that the population has been stable for the past 7 years, although at much lower densities than observed in the 1980s. The combined reported harvest from the GAAR subsistence hunt and the state general hunt remained <30 with rams as the largest proportion of the harvest. Because the harvest was low and predominantly older rams, this likely had little effect on the sheep population. However, if more ewes were harvested and not reported, this could affect the population. Since RY95 the number of hunters (<25) and sheep harvested (≤12) in the state general hunt remained small (Table 4).

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

The goal of providing opportunity for a subsistence harvest in all portions of the Central Brooks Range was met as evidenced by subsistence hunter participation. There was no long-term decline in the number of sheep taken by subsistence hunters, and no apparent declines in sheep populations attributable to harvest. The goal of providing an opportunity for a general harvest outside of GAAR was met as there was a season and bag limit.

The objective of maintaining a general harvest of full-curl rams in the Wild, Alatna, and John River drainages in addition to federal subsistence hunts was met. Seasons and bag limits did not change for GAAR hunters, thus allowing them ample opportunity to harvest sheep. In the general hunt, seasons and bag limits also remained the same, providing opportunity to harvest full-curl rams. The number of hunters has changed little since RY96 (range: 19–23; except in RY98 when it was 30) and success rates were good during RY99–RY03 ($\bar{x}$ = 39%; Table 4), except success rates in RY03 were lower (26%).

We will continue to work with staff from GAAR to summarize harvest data. We suggest a cooperative effort between the 2 agencies to continue existing sheep surveys already conducted by GAAR staff and expanding the surveys to the east.

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TABLE 1 Aerial (fixed-winged/helicopter) composition counts of Dall sheep in Gates of the Arctic National Park and Preserve (for years 1982, 1984, 1987, 1993, and 1996)

Year	Lambs (%)[a]	Ewe-likes[b] (%)[a]	Lamb: 100 Ewes	Yearlings (%)[a]	Rams (%)[a]	Rams:100 Ewes	% Rams ≥ full curl[a]	Unk adults	Total sheep
(Singer 1984 count areas 1, 2, and 5)									
1982	162 (18)	359 (42)	45	105 (12)	229 (27)	64	10	27	882
1984	204 (19)	400 (38)	51	127 (12)	322 (30)	80	13	26	1079
1987	192 (18)	406 (39)	47	114 (11)	328 (31)	81	48	3	1043
1996[c]									358
(Singer 1984 count areas 1, 2, 3, and 6)[d]									
1993	102 (17)	356[e] (58)	29		159 (26)	45	41	0	617
1996[f]	85 (24)	191 (54)	45		80 (22)	42	33	0	356

[a] When calculating percent ratios, unknown classified animals were subtracted from total.
[b] Ewe-likes included ewes, yearlings, and rams smaller than ¼ curl.
[c] The 1996 survey for total sheep was an estimate, not a count.
[d] Not the exact same portions of the count areas were flown both years.
[e] In Osborne 1996, Table 1, the number reported is 393, but this was a typographical error.
[f] Data from ADF&G unpublished files (memo to Glenn Stout from Ken Whitten).

TABLE 2 Aerial surveys of Dall sheep in Gates of Arctic National Park and Preserve (Jun–Jul), 1996–2002 (Data source: Lawler 2004)

Year	Lambs (%)	Ewe-like[a]	Lambs:100 Ewe-like	Rams (%)	Unk adults	Total sheep	Area survey (mi^2)	Survey time (min)
1996	108 (24)		38		337	445	475	1008
1998	66 (17)	228	29	61 (15)	31	386	475	1126
1999[b]	38 (22)	110	34	21 (12)	0	169	422	995
2000[c]	93 (20)	278	33	89 (19)	0	460	323	762
2001[d]	32 (11)	193	17	57 (20)	0	282	308	774
2002	76 (19)	260	29	56 (14)	0	392	475	1053

[a] Ewe-like includes adult ewes, yearlings, and rams smaller than ½ curl.
[b] Poor survey conditions; high winds and poor visibility.
[c] Wind, new snow and fog were somewhat problematic.
[d] Late spring; snow and fog were problematic.

TABLE 3 Central Brooks Range sheep harvest, regulatory years 1993–1994 through 2003–2004

Regulatory year	Unit[a] 23 GAAR[b]	23 Other[c]	24 West GAAR	24 West Other	26A GAAR	26A Other	Total harvest GAAR	Total harvest Other	Total harvest Combined	(% GAAR)
1990–1991							22	28	50	(44)
1991–1992							23	32	55	(42)
1992–1993							22	15	37	(59)
1993–1994	4	0	6	9	5	6	15	15	30	(50)
1994–1995	0	0	13	6	13	11	26	17	43	(60)
1995–1996	0	0	7	6	2	4	9	10	19	(47)
1996–1997	0	0	17	3	5	2	22	5	27	(81)
1997–1998	2	0	12	3	5	6	19	9	28	(68)
1998–1999	2	0	8	5	8	3	18	8	24	(67)
1999–2000	0	0	10	4	8	4	18	8	26	(69)
2000–2001	0	0	6	6	6	1	12	7	19	(63)
2001–2002	0	0	3	7	2	3	5	10	15	(33)
2002–2003	0	0	4	9	4	2	8	11	19	(42)
2003–2004	0	0	5	2	4	3	9	5	14	(64)

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

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

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

TABLE 4 Central Brooks Range (excluding Gates of the Arctic National Park) hunter residency and success, regulatory years 1993–1994 through 2003–2004

	Successful						Unsuccessful						
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Total hunters (% Nonresident)
1993–1994	0	7	8	0	15	(31)	5	21	6	1	33	(69)	48 (29)
1994–1995	0	6	11	0	17	(44)	0	17	5	0	22	(56)	39 (41)
1995–1996	2	3	5	0	10	(36)	3	13	2	0	18	(64)	28 (25)
1996–1997	0	2	3	0	5	(26)	2	8	3	1	14	(74)	19 (32)
1997–1998	0	1	8	0	9	(47)	0	6	4	0	10	(53)	19 (63)
1998–1999	0	2	6	0	8	(27)	0	17	5	0	22	(73)	30 (37)
1999–2000	0	1	7	0	8	(35)	0	14	1	0	15	(65)	23 (35)
2000–2001	0	2	5	0	7	(35)	1	4	8	0	13	(65)	20 (65)
2001–2002	0	2	7	1	10	(48)	1	8	2	0	11	(52)	21 (43)
2002–2003	1	6	5	0	12	(52)	0	7	4	0	11	(48)	23 (39)
2003–2004	0	2	3	0	5	(26)	0	9	5	0	14	(74)	19 (42)

[a] Local residents includes residents of Ambler, Shungnak, and Kobuk in Unit 23; Wiseman, Bettles, and Coldfoot in Unit 24; and Anaktuvuk Pass in Unit 26A. Most of the local residents harvest sheep under the federal system.

TABLE 5 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park), regulatory years 1993–1994 through 2003–2004

Regulatory year	$\bar{x}$ Horn length	% Over 40 in.	$\bar{x}$ Age	Total rams
1993–1994	33.8	7	10.6	15
1994–1995	34.8	0	10.0	17
1995–1996	34.3	0	9.8	10
1996–1997	35.3	0	9.4	5
1997–1998	35.4	11	9.3	9
1998–1999	34.5	0	9.1	8
1999–2000	34.8	0	9.5	8
2000–2001	37.2	14	10.0	7
2001–2002	36.9	20	11.0	10
2002–2003	35.4	9	9.0	11
2003–2004	36.7	0	9.8	5

TABLE 6 Gates of the Arctic National Park subsistence sheep harvest, regulatory years 1989–1990 through 2003–2004

Regulatory year	Harvest				
	Rams	Ewes	Yearlings	Unknown	Total
1989–1990	19	8	0	0	27
1990–1991	18	2	2	0	22
1991–1992	20	3	0	0	23
1992–1993	16	4	2	0	22
1993–1994	15	0	0	0	15
1994–1995	6	5	0	15	26
1995–1996	9	0	0	0	9
1996–1997	20	2	0	0	22
1997–1998	15	2	0	2	19
1998–1999	10	6	0	2	18
1999–2000	14	4	0	0	18
2000–2001	4	7	1	0	12
2001–2002	3	2	0	0	5
2002–2003	6	2	0	0	8
2003–2004	2	7	0	0	9

TABLE 7 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park) chronology percent by month/day, regulatory years 1993–1994 through 2003–2004

	Harvest chronology percent by month/day				
Regulatory year	8/10–8/20 (*n*)	8/21–8/31 (*n*)	9/1–9/10 (*n*)	9/11–9/20 (*n*)	*N*
1993–1994	60 (9)	27 (4)	7 (1)	7 (1)	15
1994–1995	82 (14)	6 (1)	12 (2)	6 (1)	17
1995–1996	30 (3)	50 (5)	20 (2)	0 (0)	10
1996–1997	80 (4)	20 (1)	0 (0)	0 (0)	5
1997–1998	78 (7)	22 (2)	0 (0)	0 (0)	9
1998–1999	25 (2)	63 (5)	12 (1)	0 (0)	8
1999–2000	88 (7)	12 (1)	0 (0)	0 (0)	8
2000–2001	43 (3)	43 (3)	14 (1)	0 (0)	7
2001–2002	70 (7)	30 (3)	0 (0)	0 (0)	10
2002–2003	17 (2)	58 (7)	17 (2)	8 (1)	12
2003–2004	60 (3)	40 (2)	0 (0)	0 (0)	5

TABLE 8 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park) percent by transport method, regulatory years 1993–1994 through 2003–2004

	Harvest percent by transport method					
Regulatory year	Airplane (*n*)	Boat (*n*)	Snowmachine (*n*)	Horses (*n*)	Unknown (*n*)	*N*
1993–1994	80 (12)	20 (3)	0 (0)	0 (0)	0 (0)	15
1994–1995	94 (16)	0 (0)	0 (0)	0 (0)	6 (1)	17
1995–1996	60 (6)	40 (4)	0 (0)	0 (0)	0 (0)	10
1996–1997	80 (4)	20 (1)	0 (0)	0 (0)	0 (0)	5
1997–1998	78 (7)	22 (2)	0 (0)	0 (0)	0 (0)	9
1998–1999	37 (3)	63 (5)	0 (0)	0 (0)	0 (0)	8
1999–2000	63 (5)	37 (3)	0 (0)	0 (0)	0 (0)	8
2000–2001	71 (5)	29 (2)	0 (0)	0 (0)	0 (0)	7
2001–2002	70 (7)	20 (2)	0 (0)	10 (1)	0 (0)	10
2002–2003	83 (10)	8 (1)	8 (1)	0 (0)	0 (0)	12
2003–2004	100 (5)	0 (0)	0 (0)	0 (0)	0 (0)	5

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DALL SHEEP MANAGEMENT REPORT

From: 1 July 2001
To: 30 June 2004

LOCATION

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

GEOGRAPHIC DESCRIPTION: Eastern Brooks Range

BACKGROUND

Dall sheep are found throughout the mountains of the eastern Brooks Range. Highest densities are in the northern drainages, where weather and habitat conditions provide the most favorable winter range. Sheep were generally abundant during the last several decades. Although surveys have been sporadic in most areas, available data and observations by hunters familiar with the area indicated that relatively high populations existed during the 1980s. Numbers declined during the 1990s, apparently as a result of severe winters, and appear to have stabilized at lower levels in recent years.

Survey data and anecdotal reports from the public indicate that sheep numbers declined during the late 1980s and early 1990s. The most likely cause of the decline was severe weather, which reduced recruitment and may have increased predation. Heimer (1985) estimated there were 13,000 sheep in the eastern Brooks Range in 1985. Numbers declined by approximately 40% since the mid 1980s in the Hulahula drainage in Unit 26C, and similar declines appear to have occurred elsewhere in the area. Anecdotal reports suggest that sheep populations continued to be relatively low in most of the eastern Brooks Range.

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

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

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVE

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

RELATED MANAGEMENT ACTIVITIES

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

METHODS

The eastern Brooks Range includes that portion of Unit 24 in the Dalton Highway Corridor Management Area (DHCMA) and east of the DHCMA, Unit 25A, Unit 26B, and Unit 26C. Harvest and survey data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY03 = 1 Jul 2003–30 Jun 2004). Surveys in this area generally included annual ground-based composition counts in Atigun Gorge in Unit 26B (Table 1), the Hulahula drainage in Unit 26C, and the Chandalar drainage in Unit 25A (Table 2). Standardized routes were surveyed in June. Surveys were conducted in the Atigun area in RY01, RY03 and RY04 and in the Hulahula drainage in RY00, RY03 and RY04. Although no ground surveys were conducted in the Chandalar drainage during RY01–RY04, aerial surveys were completed in late June in the area west of Chandalar Lake in RY01, RY02, and RY03. These surveys involved 2 or more PA-18 Super Cub aircraft, each carrying an experienced pilot and observer. The main survey area included 779 mi^2, and an additional 1247-mi^2 area was surveyed in RY03 (Table 3, Fig. 1). Sheep were classified as lambs, "ewes" (which included ewes, yearlings and young rams), and legal and sublegal rams. Survey time varied among years: 2002, 14 hr 5 min; 2003, 11 hr 32 min; and 2004, 16 hr 41 min. The reduced time spent surveying sheep in 2003 was related to high winds in some areas and fewer sheep that were observed and classified.

During 1992–1995 a helicopter was used to complete composition surveys. Subsequent surveys in the Atigun area were conducted using a highway vehicle to survey sheep east of the Dalton Highway from Atigun Pass to Atigun Gorge. Surveys in the Hulahula and Chandalar areas were accomplished by observers on foot, who hiked standardized survey routes and classified sheep with the aid of spotting scopes. The Hulahula trend area includes the entire drainage within the mountains. The Chandalar trend area includes the region west of the East Fork from Gilbeau Pass southwest to Crow Nest Creek (F. Mauer, former FWS wildlife biologist, personal communication).

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

Three agencies were involved in managing sheep hunting in the eastern Brooks Range—ADF&G, Bureau of Land Management (BLM), and ANWR. People were confused about which agency to report hunting and harvest to and often reporting was duplicated among the different agencies. Beginning in 1992, BLM administered 2 federal subsistence hunts along the DHMCA: RS424 in Unit 24 was for residents of Unit 24 north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia; RS699 in Unit 26B was for rural residents of Unit 26B and residents of Anaktuvuk Pass, Wiseman, and Point Hope. Nonfederally qualified hunters also were allowed to hunt in the DHCMA under more restrictive state regulations. ANWR administered a hunt in Unit 26C (RS799) for residents of Unit 26, Anaktuvuk Pass, Arctic Village, Chalkyitsik, Fort Yukon, Point Hope, and Venetie. RS799 is similar to the state registration sheep hunt RS595. ANWR also administered a hunt for the Arctic Village Sheep Management Area in Unit 25A for residents of Arctic Village, Venetie, Fort Yukon, Kaktovik, and Chalkyitsik. Harvest ticket reports were required from all hunters not qualified to hunt under the federal system. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year. Data obtained from BLM hunts (RS424 and RS699) were analyzed with data obtained from the statewide harvest ticket system because season and bag limits were similar to the state hunt.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Total population size during this reporting period was unknown. To estimate population trend in the upper Chandalar survey area, we compared sheep numbers and composition from the part of the 2004 survey that included the same geographical area as surveyed in 2002 and 2003. In 2004, 1460 sheep were observed in this 779-mi^2 area in the upper Chandalar drainage, compared with 989 in 2003 and 1539 in 2002 (Table 3). We initially believed that the lower number of sheep observed in 2003 compared to 2002 was a result of a combination of factors, such as winter mortality of adults and low survival of lambs to 1 year of age, redistribution of sheep, sheep missed during the survey, and one creek not being surveyed. Because a 30% reduction in all age classes had occurred with the largest proportional declines in lambs and young rams, we thought that this was consistent with the theory that there was

high winter mortality due to deep snow. However, based on the new data acquired in 2004, it seems unlikely that the sheep population experienced a substantial decline in 2003. Instead, the lower number of sheep observed was probably a result of poorer survey conditions (high winds and direct sunlight) in 2003. Sheep movements in and out of the survey area may also have played a role. With only 3 years of data, it is still difficult to determine a trend; however, there is no evidence of a major change in the sheep population during 2002–2004 in the upper Chandalar survey areas.

Population Composition

During RY00, RY02, and RY03, surveys in the Atigun drainage indicated lamb:ewe ratios of 33, 25, and 16:100, respectively. These data indicate relatively low lamb survival during this report period (Table 1). Ratios of 26 and 35 lambs:100 ewes were observed in the Hulahula drainage in June of 2003 (RY02) and 2004 (RY03), respectively (Table 2). Composition surveys show considerable variation in occurrence of lambs among areas and years. Poor lamb survival is generally associated with severe winters and cold spring weather. Heavy snowfalls occurred on the south slope of the Brooks Range during RY99, RY00, RY02, and RY04. This may have both short- and long-term effects on sheep numbers in Unit 25A. However, no surveys were completed in this area during this report period, and surveys in the upper Chandalar area were not initiated until 2002. Snow conditions may account in part for the modest lamb survival observed in this area, but other factors including fluctuations in golden eagle populations and predation probably play an important role as well. Survey data indicate the proportion of full-curl rams in the population in some areas increased after the full-curl regulation passed in 1993. Hunter reports and survey results indicated that large rams were fairly well represented in most parts of the eastern Brooks Range (Tables 1–5).

The proportion of full-curl rams in the upper Chandalar survey area was fairly stable among years (range: 2.9–3.4%; Table 3), suggesting that the number of mature rams that survived each hunting season during this report period was fairly consistent. Percent lambs was slightly lower in 2003 (11%) and 2004 (12%) compared with 2002 (14%). This was also reflected in the ratio of lambs:100 “ewe-like,” sheep with 25, 18, and 20:100 in 2002, 2003, and 2004, respectively. Interpreting lamb:ewe-like ratios should take into account previous levels of recruitment. For example, lamb:ewe ratios following a good reproductive year (e.g., 2002) can appear lower for the next 2 years because of larger numbers of immature ewes and rams in the population. In addition, the lower lamb:ewe-like ratio observed in 2003 may have been influenced by poorer condition of the ewes in the spring because of relatively deep snows and less windblown habitat during the previous winter. In contrast, snow cover was relatively light and higher elevations were more windblown during winter 2003–2004, which probably contributed to reduced overwinter mortality and increased reproductive success in 2004.

In 2004, ratios observed in a larger survey in Unit 25A and 24 were similar to those in the smaller survey area (Fig. 1). The percent of legal rams for the larger area was slightly higher (4.3%) compared to the smaller area (2.9%). Previous surveys did not include units in GAAR where restrictions on sheep hunting occur. Thus, we suggest that hunting restrictions in GAAR influenced the number of legal rams observed in the total 2004 survey area because the percent of legal rams in the survey units in GAAR was 10% (n = 386). The percent lambs

in the larger survey was the same (12%) in both the upper Chandalar and the total survey areas, and the lamb:ewe-like ratio was 21:100 compared to 20:100 in the smaller survey area.

Distribution and Movements

No studies of sheep distribution and movement were done in the current report period. Studies of radiomarked sheep during 1988–1992 showed that major drainages inhibited sheep movements, resulting in discrete subpopulations north and south of the Junjik River and east and west of the East Fork Chandalar and Hulahula Rivers. Sheep home range size was generally similar to that observed in the Alaska Range. However, movements of sheep near the East Fork Chandalar River were relatively extensive, perhaps because of less stable weather patterns and resulting changes in forage availability (Heimer et al. 1994).

MORTALITY

Harvest

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

Alaska Board of Game Actions and Emergency Orders. There were no regulatory changes or emergency orders during RY01–RY03. In March 2002 the Alaska Board of Game extended the vehicle restrictions for the DHCMA to the Prudhoe Bay Closed Area. This regulation will curtail snowmachine access to areas outside the DHCMA. The board considered, but did not pass, proposals for an expanded archery-only sheep hunting area in the Atigun and adjacent drainages east and west of the DHCMA and a drawing permit for nonresident sheep hunting in western Unit 25A. In March 2000 the board rejected a proposal to change the bag limit for the winter registration hunt from 3 sheep to 2 rams. The last major regulatory change for the eastern Brooks Range occurred in 1993, when the board established a full-curl regulation.

The Federal Subsistence Board (FSB) established the Arctic Village Sheep Management Area (AVSMA) in 1991 in response to concerns raised by Arctic Village residents. Villagers felt nonlocal hunters interfered with hunting by local residents. The regulation closed the area to nonlocal hunters. In 1995 the FSB extended the original boundary of the AVSMA at Cane Creek northward to include the Red Sheep Creek drainage. An effort to monitor aircraft and hunting activity near the Red Sheep Creek airstrip was initiated by FWS in August 1995. The results indicated that hunting activity by nonlocal residents would not interfere with hunting by local residents, but did not influence the status of federal regulations. The AVSMA continues to be a source of public concern. In 2005 the federal Office of Subsistence Management reviewed the status of the AVSMA and recommended that revisions to the existing regulation should be considered in view of the limited use of the area and lack of reported harvest. The issue will be discussed at the spring 2006 meeting of the FSB.

Hunter Harvest. The number of sheep taken in Units 24 East, 25A, 26B, and 26C ranged from 94 to 144 annually during RY01–RY04 (Table 4). The eastern Brooks Range experienced a long-term increase in the number of hunters and harvest that began in the early 1970s and ended in RY90. Harvest was stable or increased slightly during the last few years, and hunter participation was nearly stable. From RY86 to RY91 the total reported harvest exceeded 200 sheep each year. Harvest declined beginning in RY92 and was stable since RY97 with an average of 126 sheep reported taken during the last 8 years. Hunters and guides familiar with the area reported that legal rams were common, but continue to be less abundant than during the 1980s. Average horn size apparently increased somewhat following establishment of the full-curl regulation in 1993 and has since been relatively stable (Table 5).

Permit Hunts. Participation in sheep registration hunt RS595 has been open to all Alaska residents since RY90. Nineteen permits were issued during the reporting period, and 2 sheep were reported taken. Reporting by local residents was limited, but interviews with residents of Kaktovik and Arctic Village indicated local residents took 30–40 sheep each year in the late 1980s. Permit holders reported taking 2–14 sheep annually from RY90 to RY93, approximately 50% of which were ewes. The reported harvest has generally declined since then, probably because of limited demand and poor reporting. However, it increased in RY00 after a small number of hunters found a way to access hunting areas in Unit 26C with snowmachine by initiating travel from the Prudhoe Bay Closed Area and traveling around the northern end of the Dalton Highway corridor (Table 6). Regulation changes in 2002 made this practice illegal.

Limited data was available for the AVSMA federal hunt, RS596. No permits were issued in 2001, 2 permits (1 hunter) were issued in RY02, and 4 permits (2 hunters) were issued in RY03. No harvest reports were returned in RY02 or RY03, but verbal reports from 1 hunter in each year indicated no animals were harvested.

Hunter Residency and Success. Most sheep hunters using the eastern Brooks Range were Alaska residents, although a large number of nonresidents also use the area (Table 4). Nonresident hunters continued to have a higher success rate, reflecting the advantage of having a guide (Golden 1990). Hunter success was 35–48% during RY01–RY04, representing a continuation of the lower success rates observed during the 1990s, which compare to rates

of 60–67% in the late 1980s (Table 4). Harvest reports show that hunter success varied considerably in the eastern Brooks Range. During the last few years, success was lower in areas adjacent to the Dalton Highway than in less accessible areas to the east.

Harvest Chronology. Most sheep hunting in the eastern Brooks Range continued to occur during August, when weather was most favorable. Eighty to 90% of the sheep harvest occurred before 1 September (Table 7). Most of the remaining harvest occurred in September, with a few sheep reported taken in October.

Transport Methods. Aircraft were the primary means of transportation for most hunters (Table 8). They were used in 80–90% of successful hunts. The remaining harvest involved the use of horses, boats, and in the Dalton Highway area, highway vehicles.

CONCLUSIONS AND RECOMMENDATIONS

Management goals providing for subsistence use, viewing and photography, an opportunity to hunt under aesthetically pleasing conditions, and protection of sheep populations and habitat were met. Objectives relating to monitoring population status and the effects of the full-curl regulation, managing for the harvest of large rams, and cooperatively managing subsistence harvest were generally met. However, declines in sheep numbers and availability of legal rams led to reductions in the number of hunters, success rates, and harvest during the past decade or more. The goal of maintaining and enhancing sheep populations was not met. The full-curl regulation appears to be working as intended, with the general decline in harvests being attributable to the overall decline in sheep numbers rather than the increase in minimum legal horn size. However, there are growing concerns that unregulated guiding of nonresident hunters on state land is resulting in excessive hunting pressure. The only area where this issue affects sheep management in the eastern Brooks Range is in the middle and north forks of the Chandalar River. Recent population surveys in this area have improved our understanding of the situation, and indicate that the sheep population is not being jeopardized by the relatively high hunting pressure. The staff of ANWR played a major role in annual population monitoring and provided valuable support for management efforts. Continued cooperative efforts will be important to future success in conducting composition and trend surveys.

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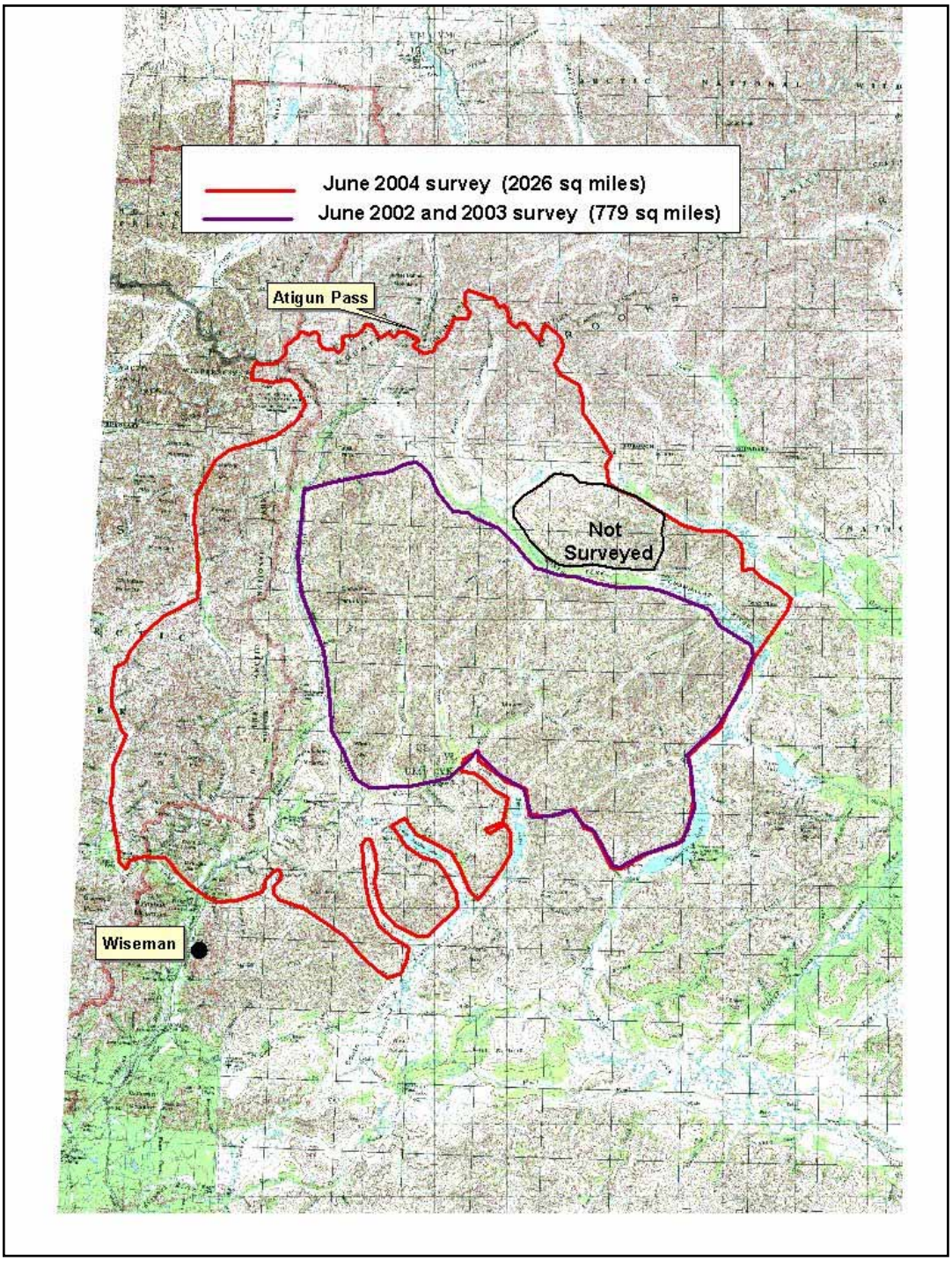

Figure 1 Areas surveyed in late June 2002, 2003, and 2004 in the Central/Eastern Brooks Range

TABLE 1 Atigun Gorge (Unit 26B) ground–based sheep composition counts, 1986–2004. Surveys occurred in June of the year indicated (source: FWS, ANWR).

	Rams							
Year[a]	Full curl	¾–Full curl	½–¾ curl	<½ curl	Ewes[b]	Lambs (%)	Lambs:100 ewes	Total sheep observed
1986	1	10	18	18	165	42 (17)	25	254
1987	0	19	20	13	137	47 (20)	34	236
1988	3	16	29	11	221	80 (22)	36	360
1989	0	19	37	15	253	40 (11)	16	364
1990	0	18	23	8	165	69 (24)	42	283
1991	2	22	19	10	318	122 (25)	38	493
1992	0	12	15	7	309	39 (10)	13	382
1993	1	19	22	5	206	24 (9)	12	277
1994	5	16	21	10	225	89 (24)	39	366
1995	0	9	18	5	247	28 (9)	11	307
1996[c]	0	2	6	11	114	49 (27)	43	182
1997	0	11	8	21	91	16 (11)	18	147
1998	0	2	12	11	141	70 (30)	50	236
1999	0	7	8	17	140	40 (19)	29	212
2001[d]	0	7	7	17	133	44 (21)	33	208
2003	1	11	13	10	276	68 (18)	25	379
2004	3	9	16	11	210	34 (12)	16	283

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

[b] Includes adult females, yearlings and 2-year-olds of both sexes and rams of ¼ curl or less.

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

[d] No surveys were conducted in 2000 or 2002.

TABLE 2 Hulahula (Unit 26C) and East Fork Chandalar (Unit 25A) River drainages ground–based sheep composition counts, 1992–2004. Surveys occurred in June of the year indicated (source: F. Mauer, ANWR).

	Rams								
Area/year	Full curl (%)		¾–Full curl	½–¾ curl	<½ curl	Ewes[a]	Lambs (%)		Lambs:100 ewes	Total sheep observed
Hulahula										
1992	1	(0.2)	28	26	4	318	10	(3)	3	387
1993[b]	12	(1.0)	242	87	40	709	171	(14)	24	1261
1994[b]	6	(0.7)	99	47	18	595	99	(12)	17	864
1995[b]	25	(2.2)	160	111	24	631	179	(16)	28	1130
1996[c]										
1997[c]										
1998[d]	10	(2.9)	34	36	47	190	61	(16)	32	378
1999[c]										
2000[b]	7	(1.9)	40	32	34	219	20	(6)	9	352
2001[c]										
2003	9	(2.8)	15	27	25	191	50	(16)	26	317
2004	9	(2.8)	12	10	10	201	71	(23)	35	313
East Fork Chandalar										
1992	4	(1.8)	17	6	0	155	34	(16)	22	216
1993	20	(5.6)	37	29	6	219	45	(13)	21	356
1994	16	(8.1)	24	23	13	121	0	(0.0)	0	197
1995	15	(9.5)	25	7	5	89	17	(11)	19	158
1996[c] thru 2004[c]										

[a] Includes adult females, yearlings, 2-year-olds and ¼-curl rams.
[b] Helicopter surveys over most of the drainage.
[c] No survey conducted.
[d] Ground survey: upper Hulahula only.

TABLE 3 Sheep surveys in the upper Chandalar River drainage (779 mi^2), June 2002[a], 2003[b], and 2004[c]

Year	Legal (%)	Sublegal	"Ewe-like"	Lambs	% Lambs	Lamb:100 "ewes"	Unk rams	Total
2002	50 (3.2)	380	884	221	14	25	4	1539
2003	34 (3.4)	207	621	114	11	18	13	989
2004	43 (2.9)	320	908	180	12	20	9	1460

[a] Survey time in 2002 was 14 hr 5 min.
[b] Survey time in 2003 was 11 hr 32 min.
[c] Survey time in 2004 was 16 hr 41 min.

TABLE 4 Units 25A, 26B, and 26C and eastern Unit 24 sheep hunter[a] residency and success, regulatory years 1985–1986 through 2004–2005

Regulatory year	Successful hunters					Unsuccessful hunters					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1985–1986	2	109	80	4	195 (62.5)	1	98	13	5	117 (37.5)	312
1986–1987	0	126	79	9	214 (60.0)	2	120	14	7	143 (40.0)	357
1987–1988	0	156	104	14	274 (67.1)	0	116	10	8	134 (32.9)	408
1988–1989	1	109	99	35	244 (63.2)	0	107	18	17	142 (36.8)	386
1989–1990	5	154	114	4	277 (59.8)	1	157	24	4	186 (40.2)	463
1990–1991	13	138	115	16	282 (55.5)	3	200	16	7	226 (44.5)	508
1991–1992	3	138	102	8	251 (53.3)	2	192	25	1	220 (46.7)	471
1992–1993	7	90	86	3	186 (45.0)	7	199	20	4	230 (55.0)	416
1993–1994[c]	2	89	46	0	137 (36.2)	1	218	21	2	242 (63.8)	379
1994–1995	1	78	43	1	123 (41.5)	0	155	16	2	173 (58.4)	296
1995–1996	1	90	51	2	144 (39.8)	2	180	30	6	218 (60.2)	362
1996–1997	2	72	37	8	119 (43.3)	2	130	19	5	156 (56.7)	275
1997–1998	2	61	57	9	129 (49.6)	1	111	17	2	131 (50.3)	260
1998–1999	2	73	58	1	134 (44.6)	6	140	20	0	166 (55.3)	300
1999–2000	9	51	66	0	126 (42.0)	6	141	27	0	174 (58.0)	300
2000–2001	3	56	59	2	120 (37.6)	1	165	33	0	199 (62.4)	319
2001–2002	1	70	71	2	144 (46.0)	0	132	30	7	169 (54.0)	313
2002–2003	0	36	54	4	94 (35.2)	2	116	52	3	173 (64.8)	267
2003–2004	1	52	72	0	125 (42.4)	1	124	43	2	170 (57.6)	295
2004–2005	0	55	76	2	133 (48.0)	1	117	23	3	144 (51.6)	277

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

TABLE 5 Units 24 East, 25A, 26B, and 26C[a] mean Dall ram horn length, regulatory years 1985–1986 through 2004–2005

Regulatory year	*n*	$\bar{x}$ Horn length (inches)	% ≥40 in.
1985–1986	170	34.9	n/a
1986–1987	185	35.4	n/a
1987–1988	223	34.8	n/a
1988–1989	208	35.1	n/a
1989–1990	258	35.0	10
1990–1991	265	34.6	9
1991–1992	234	34.3	7
1992–1993	174	34.1	2
1993–1994	122	34.6	2
1994–1995	122	34.3	4
1995–1996	135	35.1	2
1996–1997	102	34.6	0
1997–1998	115	34.8	2
1998–1999	134	33.8	4
1999–2000	125	35.3	6
2000–2001	114	35.1	5
2001–2002	144	35.3	1
2002–2003	94	35.5	3
2003–2004	125	35.2	4
2004–2005	136	35.5	6

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

TABLE 6 Units 25A and 26C sheep harvest data by permit hunt, regulatory years 1985–1986 through 2003–2004

Regulatory year	Hunt[a]	Permits issued	% Did not hunt	% Unsuccessful hunters	% Successful hunters	Rams	Ewes (%)	Unk	Total harvest[b]
1985–1986	1195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12–30
1986–1987	1195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12–30
1987–1988	1195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30–40
1988–1989	1195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30–40
1989–1990	1195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30–40
1990–1991	1195	69	46	67	33	7	6 (46)	1	14
1991–1992	1195	9	n/a	n/a	n/a	1	1 (50)	0	2
1992–1993	1195	n/a	n/a	n/a	n/a	3	1 (25)	4	8
1993–1994	1195	16	75	25	75	3	3 (50)	1	7
	RS799(F)	3		33	66	4	1 (20)		5
1994–1995	1195	7	100	n/a	n/a	n/a	n/a	n/a	0
	RS799(F)								0
1995–1996	RS595	10	50	80	20	1	0 (0)	0	1
	RS799(F)	4	n/a	75	25	1			1
1996–1997	RS595	4	100	n/a	n/a	n/a	n/a	n/a	0
	RS799(F)	2	n/a	0	100	3	2 (40)		5
1997–1998	RS595	10	70	67	33	1	0 (0)	0	1
	RS799(F)	1		100					0
1998–1999	RS595	6	33	75	25	1	0 0	0	1
	RS799(F)	1	n/a		100	0	2		2
1999–2000	RS595	9	89	0	100	1	0 0	0	1
	RS799(F)	1	n/a	0	100	2			2
2000–2001	RS595	16	37	56	44	8	0 0	0	8
	RS799(F)	2	n/a	0	100	6			6
2001–2002	RS595	8	50	50	50	2	0 0	0	2
	RS799(F)[c]	9	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2002–2003	RS595	5	60	100	0	00	0 0	0	0
	RS799(F)[c]	12	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 6 continued

Regulatory year	Hunt[a]	Permits issued	% Did not hunt	% Unsuccessful hunters	% Successful hunters	Rams	Ewes (%)		Unk	Total harvest[b]
2003–2004	RS595	6	83	100	0	0	0	0	0	0
	RS799(F)	0	n/a	n/a	n/a	n/a	n/a		n/a	n/a

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

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

[c] No harvest reports returned.

TABLE 7 Units 24 East, 25A, 26B, and 26C sheep harvest[a] chronology percent by harvest month/day, regulatory years 1985–1986 through 2004–2005

Regulatory year	Harvest chronology percent by month/day									*n*
	8/1–8/4[b]	8/5–8/11	8/12–8/18	8/19–8/25	8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29[b]	
1985–1986	8.8	38.3	22.3	16.5	6.7	4.7	1.0	0.5	1.0	191
1986–1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1987–1988	0.0	0.0	41.0	20.9	19.8	7.5	7.5	1.5	1.5	261
1988–1989	0.4	35.9	26.4	18.2	6.5	7.3	3.0	0.8	0.8	223
1989–1990	0.4	23.0	27.4	24.4	12.8	6.2	2.5	1.8	0.4	268
1990–1991	1.2	17.8	42.2	18.2	12.0	6.2	1.9	0.0	0.4	258
1991–1992	0.0	23.5	35.4	18.9	12.7	4.1	2.4	2.8	1.2	243
1992–1993	0.0	20.7	35.1	18.6	14.4	5.3	0.5	2.7	1.1	188
1993–1994	0.0	22.0	41.6	13.9	12.4	3.6	2.2	0.0	4.4	137
1994–1995	0.8	22.8	53.7	8.1	7.3	0.8	2.4	1.6	2.4	123
1995–1996	0.0	29.9	29.2	13.9	18.7	5.5	0.0	1.4	0.0	144
1996–1997	0.0	20.5	52.1	10.2	9.4	5.9	0.0	0.0	0.0	117
1997–1998	0.0	27.5	40.1	15.0	6.3	6.3	3.1	1.6	0.0	127
1998–1999	0.0	11.6	40.3	23.2	10.8	6.2	6.2	0.8	0.0	129
1999–2000	0.0	19.8	29.4	26.2	13.5	1.6	6.3	3.2	0.0	126
2000–2001	0.8	23.9	29.9	15.4	14.5	10.2	3.4	1.7	0.0	117
2001–2002	0.0	17.0	31.2	25.5	18.4	4.3	1.4	2.1	0.0	141
2002–2003	0.0	5.4	31.2	30.1	19.4	6.5	3.2	4.3	0.0	93
2003–2004	0.0	17.2	39.3	23.8	13.9	3.3	1.6	0.8	1.6	122
2004–2005	0.7	21.0	38.8	20.1	11.9	5.2	2.2	0.0	0.0	134

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

TABLE 8 Units 24 East, 25A, 26B, and 26C sheep harvest[a] percent by transport method, regulatory years 1985–1986 through 2004–2005

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	*n*
1985–1986	82.6	3.6	1.0	1.0	0.0	0.5	5.6	5.6	195
1986–1987	89.7	3.3	0.5	1.5	0.0	0.0	2.3	2.8	214
1987–1988	85.6	2.0	0.8	0.0	0.0	0.0	6.0	5.6	250
1988–1989	85.4	3.3	1.2	0.0	0.0	0.0	6.2	3.7	240
1989–1990	86.0	3.6	1.8	0.0	0.0	0.0	7.6	1.1	277
1990–1991	80.8	3.9	1.8	0.0	3.5	0.0	7.4	2.5	282
1991–1992	81.3	4.4	1.2	0.0	0.0	0.0	10.0	3.2	251
1992–1993	83.0	1.6	0.5	0.0	0.0	0.0	13.3	1.6	188
1993–1994	80.3	3.6	1.5	0.0	0.0	2.2	12.4	0.0	137
1994–1995	91.9	0.8	0.0	0.0	0.0	0.0	4.9	2.4	123
1995–1996	83.3	2.0	0.0	0.0	0.0	0.0	12.5	2.0	144
1996–1997	82.3	1.7	2.5	0.0	0.0	0.0	13.4	0.0	119
1997–1998	82.9	7.9	0.0	0.0	0.0	0.0	9.3	0.0	129
1998–1999	83.6	2.2	2.2	0.0	0.0	0.0	11.9	0.7	134
1999–2000	76.2	5.5	3.2	0.0	0.0	0.0	13.5	1.6	126
2000–2001	79.2	10.0	0.8	0.0	0.0	0.0	8.3	1.6	120
2001–2002	88.2	4.9	0.0	0.0	0.0	0.0	6.9	0.0	144
2002–2003	84.0	4.3	3.2	0.0	0.0	0.0	8.5	0.0	94
2003–2004	80.0	8.0	3.2	0.0	0.0	0.0	7.2	1.6	125
2004–2005	83.1	8.1	0.0	0.0	0.0	0.0	8.1	0.7	136

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

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge and attitudes for responsible hunting.

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