

**Dall Sheep  
Management Report**  
of survey-inventory activities  
1 July 2004–30 June 2007

**Patricia Harper, Editor**  
**Alaska Department of Fish and Game**  
**Division of Wildlife Conservation**



**Photo by Stephen Arthur**

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**Cover Photo:** A full-curl ram in the Saint Elias Mountains. *Photo by Stephen Arthur*

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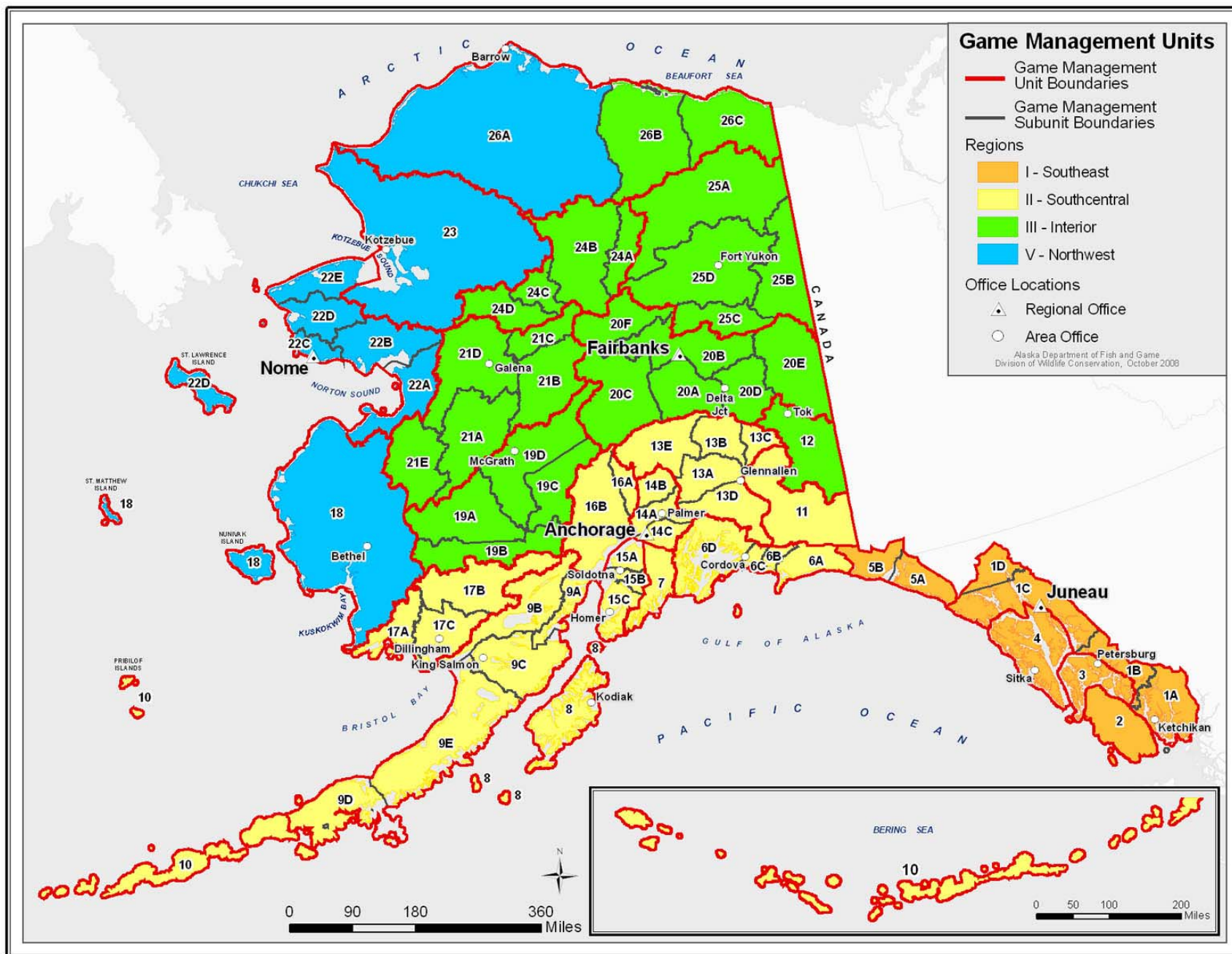
# DALL SHEEP MANAGEMENT REPORT

From: 1 July 2004

To: 30 June 2007

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## **DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007

### **LOCATION**

**GAME MANAGEMENT UNIT:** 7 and 15 (8397 mi<sup>2</sup>)

**GEOGRAPHICAL DESCRIPTION:** Kenai Mountains

### **BACKGROUND**

The Kenai Mountains are 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 been conducted only in 1968 and 1992.

### **MANAGEMENT DIRECTION**

#### **MANAGEMENT OBJECTIVES**

- Adequately monitor population trends and allow for hunting opportunities with a sustainable harvest.

### **METHODS**

We conducted aerial surveys of selected count areas in the Kenai Mountains in conjunction with mountain goat surveys. Sheep were classified into the following categories: legal rams (full-curl or larger); sublegal rams (less than full-curl); lambs; ewes and yearling rams; and unidentified sheep. Yearling rams are difficult to distinguish from ewes and, therefore, they are summarized together.

### **RESULTS AND DISCUSSION**

#### **POPULATION STATUS AND TREND**

##### *Population Size and Population Composition*

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 was 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 are lower than levels found in the early 1970s (Table 1).

#### *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, and south of Trail Creek and west of the Seward Highway from Upper Trail Lake to Six Mile Creek.

No sheep have ever been radio collared on the Kenai Peninsula to study movements or other questions, due to budgetary constraints.

### **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 1 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, 1 for ewes (DS154) and 1 for full-curl rams (DS156), started in the Crescent Lake area in 1999 (Table 2). A drawing hunt for Round Mountain rams (DS150) started in 2004 (Table 2).

Board of Game Actions. There were no Board of Game actions during the reporting period.

Hunter Harvest, Residency, and Success. The harvest has averaged 17 rams over the last 5 seasons (Table 3). The number of general season hunters has averaged 139 over the past 5 seasons, and a majority of both successful and unsuccessful hunters were local residents of the Kenai Peninsula (Table 3).

Harvest Chronology. Chronology of harvest followed similar patterns over the past five years; most of the harvest occurred during the first 2 weeks of the season (Table 4).

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

### **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**

The Alaska Department of Fish and Game (ADF&G) will hire a regional sheep biologist in 2008. This is the first dedicated position focusing on sheep research in the region since the last position dissolved in the mid 1980s. We are sanguine that this position will include research on

Kenai Peninsula populations. The Crescent Lake and Grant Lake regions are good replicate areas to compare varied harvest strategies and other questions.

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 Aerial sheep composition counts, Units 7 and 15, 2002–2006

Regulatory year	Rams		Ewes and yearling rams	Unclassified sheep	Lambs	Total sheep observed <sup>a</sup>	Estimated population size
	Full-curl	< Full-curl or unclassified rams					
2002–03	3	77	205		43	328	1000–1700
2003–04	4	86	165		42	297	1000–1700
2004–05	4	52	161	1	43	261	1000–1700
2005–06	2	21	50		18	91	1000–1700
2006–07	6	92	240	40	66	444	1000–1700

<sup>a</sup> The amount of area surveyed varies each year.

TABLE 2 Results of drawing permit hunt, Units 7 and 15, 2002–2006

Hunt	Regulatory year	Nr of permits issued	Nr of hunters	Harvest	Percent success
Rount Mt. Ram <sup>a</sup> (DS 150)	2002–03	0			
	2003–04	0			
	2004–05	3	2	0	
	2005–06	3	3	0	
	2006–07	3	2	1	
Rount Mt. Ewe (DS 152)	2002–03	20	17	5	29
	2003–04	20	18	7	39
	2004–05	0			
	2005–06	0			
	2006–07	0			
Crescent Lake Ewe (DS 154)	2002–03	10	7	3	43
	2003–04	10	10	5	50
	2004–05	10	7	3	43
	2005–06	10	3	3	100
	2006–07	10	6	0	0
Crescent Lake Ram (DS 156)	2002–03	10	9	1	11
	2003–04	10	7	2	29
	2004–05	6	4	1	25
	2005–06	6	3	1	33
	2006–07	6	5	0	0

<sup>a</sup> Hunt was initiated in 2004

TABLE 3 Sheep hunter residency and success in the general season, Units 7 and 15, 2002– 2006

Regulatory year	Successful					Unsuccessful				Total hunters
	Local <sup>a</sup> resident	Nonlocal resident	Non- resident	Total <sup>b</sup>	Percent success	Local <sup>a</sup> resident	Nonlocal resident	Non- resident	Total <sup>b</sup>	
2002–03	12	7	0	19	12	70	57	8	135	154
2003–04	10	7	1	18	9	102	68	2	172	190
2004–05	11	9	0	21	19	43	44	0	91	112
2005–06	10	2	2	14	12	46	50	1	99	113
2006–07	10	3	0	13	11	51	53	7	111	124

<sup>a</sup> Residents of Units 7 and 15.<sup>b</sup> Includes unspecified residency.

TABLE 4 Sheep harvest chronology (percent of harvest) in the general season, Units 7 and 15, 2002– 2006

Regulatory year	Harvest Periods						Harvest
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
2002–03	47	11	5	5	11	21	19
2003–04	44	11	11	11	6	17	18
2004–05	57	19	5	5	10	5	21
2005–06	64	7	21	7	0	0	14
2006–07	38	8	38	15	0	0	13

TABLE 5 Transport methods used (percent of harvest) during the general season for sheep, Units 7 and 15, 2002– 2006

Regulatory year	3/4 wheel- ATV	Airplane	Boat	Highway vehicle	Horse	ORV	Unknown	Harvest
2002–03	5	32	32	26	5	0	0	19
2003–04	0	56	17	22	6	0	0	18
2004–05	0	62	19	19	0	0	0	21
2005–06	0	0	71	14	7	0	7	14
2006–07	0	15	15	38	31	0	0	13

## **DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

### **LOCATION**

**GAME MANAGEMENT UNIT:** Portions of 9B, 16B, 17B, 19B and 19C (4600 mi<sup>2</sup>)

**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 is relatively close to Anchorage, the state's largest population center. Aircraft transportation is the main 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.

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).

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, Szepanski (2005) stated that the number of sheep observed during aerial surveys and reported harvest of rams declined between RY98 and RY03.

### **MANAGEMENT DIRECTION**

#### **MANAGEMENT GOALS**

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

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

- 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**

No surveys were conducted during the reporting period (RY04–RY06). Plans for a survey during summer 2006 were not carried out because a pilot was not available.

#### **HARVEST**

Harvest by hunters, effort, location, transportation, age, and horn characteristics of harvested rams were monitored using harvest reports submitted by hunters and sealing data summarized by regulatory year.

### **RESULTS AND DISCUSSION**

#### **POPULATION STATUS AND TREND**

The current status of the ARW sheep population is unknown, although the population reportedly was declining when the most recent survey was completed in 2003 (Szepanski 2005).

#### **MORTALITY**

##### *Harvest*

Alaska Board of Game Actions. The Alaska Board of Game did not change seasons or bag limits for sheep in the ARW during RY04–RY06, and no emergency orders were issued. However, in 2004 the board adopted a statewide provision that required sealing 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 at least 8 years of age, or with both horns broomed. The full-curl regulation has been in effect since RY89. Before RY89 the minimum horn size requirement was a  $\frac{7}{8}$  curl, and prior to RY79 it was  $\frac{3}{4}$  curl or larger.

Harvest by Hunters. Reported harvest of sheep in ARW is high and illegal or unreported take is believed to be low. Annual harvests were 81, 75, and 74 rams during RY04, RY05, and RY06, respectively (Table 1), which were similar to harvests during the previous reporting period, but substantially lower than annual harvests prior to RY97 (Szepanski 2005). From RY90 to RY97,

an average of 139 full-curl rams were harvested annually in ARW. From RY98 to RY04, average annual harvest was 82 full-curl rams. The total number of hunters using the ARW also has declined markedly since RY97 (Szepanski 2005). The average number of sheep hunters declined from 251 hunters per year during RY90–RY97 to 181 per year during RY98–RY04 (Szepanski 2005), and declined further to an average of 166 hunters per year during RY04–RY06.

The average horn length of rams harvested during RY02–RY06 was 35.4 inches (Table 1). Average age of rams harvested during RY02–RY06 was 8.9 years (Table 1). In general, average horn length and age are influenced by the full-curl regulation because most rams become full-curl at 6–8 years of age and usually have a horn length  $\geq 34$  inches (Heimer and Smith 1975).

During RY90–RY97, 7% of legal rams harvested were  $\geq 40$  inches and during RY98–RY04, 4% were  $\geq 40$  inches (Szepanski 2005). The downward trend in the number of large rams taken continued during this reporting period and only 1% of rams taken in ARW from RY04 to RY06 were  $\geq 40$  inches. Reasons for reductions in the number of legal rams available, fewer total hunters, and smaller mean horn length since RY97 are unknown at this time.

Permit Hunts. A federal subsistence hunt has occurred in Unit 9B since RY95. A total of 31 sheep have been harvested during this hunt over its history with 0 rams taken in RY04, 5 in RY05, and 2 in RY06.

Hunter Residency and Success. Resident hunters outnumbered nonresidents, but nonresidents were more likely to be successful than residents (Table 2). Average success for residents and nonresidents during RY02–RY06 was 38% and 62%, respectively. During the report period nonresident success was 65% while resident success was 33%.

Success rates for nonresidents likely were higher than those for resident hunters because nonresidents typically were accompanied by licensed guides. Numbers of resident hunters remained stable from RY02–RY06, while the number of nonresidents declined (Table 2).

Harvest Chronology. As in previous reporting periods, a majority of the sheep harvest in ARW occurred during the first week of the 6-week season (Table 3). During RY02–RY06, an average of 42% of the harvest occurred during 10–16 August.

Transport Methods. Aircraft were used by the majority of successful sheep hunters during RY04–RY06 (Table 4). 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 by a small percentage of sheep hunts.

#### *Other Mortality*

Winter weather, wolves, coyotes, golden eagles and bears are all sources of mortality, but the effects of predation are unknown.

## **MANAGEMENT PROBLEMS–NEEDS**

The number of guide–outfitters operating in the ARW was not limited during RY04–RY06 or previous reporting periods, and crowded hunting conditions may have reduced the quality of the sheep hunting experience in several of the most accessible drainages. The Big Game Commercial Services Board, consisting of members appointed by the governor of Alaska and confirmed by the legislature, oversees guide, outfitter, and transporter activities and is currently considering regulations to create exclusive guide use areas. If this occurs, the level of hunting activity in the ARW is likely to change because all nonresidents are required to use a guide.

## **CONCLUSIONS AND RECOMMENDATIONS**

Aerial surveys have not been conducted since 2003 and the current status of the ARW sheep population is unknown at this time. Harvest reporting data show a decrease in the number of nonresident hunters, however hunter numbers overall remained relatively stable from RY02 to RY06. While harvest continued to be lower than in the 1990s, it was comparable to reported harvest in the last report period (Szepanski 2005).

We met our management goal of providing a sustained opportunity to harvest Dall sheep rams from a naturally regulated population during RY04–RY06. With regard to the full-curl harvest, we met this objective with an average of 76 full-curl rams harvested annually from RY04 through RY06. Average horn length was greater than 35 inches and average age was greater than 8 years.

Reports of crowded conditions continue 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” are subjective and this goal will be omitted for the next report period.

We recommend the following goal and objective for the next report period:

### **MANAGEMENT GOAL**

- Provide an opportunity for sustainable harvest of Dall sheep rams.

### **MANAGEMENT OBJECTIVE**

- Using a full curl harvest strategy, maintain harvest of rams averaging  $\geq 8$  years old.

#### *Activities:*

1. Monitor hunter harvest and assess age of the harvest through harvest tickets and horn sealing.
2. Assess population trend, age, and composition through annual aerial surveys.



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TABLE 1 Alaska Range West sheep harvest, horn length, and age, regulatory years 2002–2003 through 2006–2007

Regulatory year	Rams harvested	$\bar{x}$ Horn length (inches)	% $\geq 40$ inches	$\bar{x}$ Age
2002–2003	76	35.2	0.0	8.7 <sup>a</sup>
2003–2004	75	35.0	1.3	8.4 <sup>a</sup>
2004–2005	81	35.5	2.6	8.9 <sup>b</sup>
2005–2006	75	35.4	0.5	9.8 <sup>b</sup>
2006–2007	74	35.8	0.5	8.9 <sup>b</sup>

<sup>a</sup> Hunter estimate of age.

<sup>b</sup> ADF&G sealing officer estimate of age.

TABLE 2 Alaska Range West sheep hunter residency and success, regulatory years 2002–2003 through 2006–2007

Regulatory year	Successful				Unsuccessful				Total hunters
	Resident	Nonresident	Unk	Total (%)	Resident	Nonresident	Unk	Total (%)	
2002–2003	21	51	4	76 (41)	75	29	4	108 (59)	184
2003–2004	22	53	0	75 (45)	61	28	1	90 (55)	165
2004–2005	35	46	0	81 (52)	55	18	2	75 (48)	156
2005–2006	32	39	4	75 (46)	62	25	1	88 (54)	163
2006–2007	32	39	3	74 (41)	81	24	1	106 (59)	180

TABLE 3 Alaska Range West sheep harvest chronology percent by month/day, regulatory years 2002–2003 through 2006–2007

Regulatory year	Harvest chronology percent by month/day						Unk	<i>n</i>
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20		
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
2005–2006	51	17	9	9	4	8	1	75
2006–2007	36	16	26	8	5	7	1	74
Average	42	13	15	10	11	8	2	76

TABLE 4 Alaska Range West sheep harvest percent by transport method, regulatory years 2002–2003 through 2006–2007

Regulatory year	Harvest percent by transport method						Unk	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle		
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
2005–2006	89	3	1	1	3	0	3	75
2006–2007	92	0	0	3	0	1	4	74

**WILDLIFE  
MANAGEMENT REPORT**

**Alaska Department of Fish and Game  
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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007

**LOCATION**

**GAME MANAGEMENT UNIT:** 11 (12,784 mi<sup>2</sup>) Wrangell Mountains

**GEOGRAPHIC DESCRIPTION:** East of the Copper River

**BACKGROUND**

Dall sheep inhabit most alpine and subalpine areas of the Wrangell Mountains and have a long hunt history in Unit 11. The Wrangell Mountains, which cross the Alaska-Canada border, are well-known for trophy-sized rams. Sheep harvests were not monitored prior to 1962. Since then however, harvest reports have provided managers with harvest numbers and trends.

In late 1978, the Wrangell Mountains and the eastern Chugach Mountains in Unit 11 were designated as National Monument lands. In 1980, the Alaska National Interest Lands and Conservation Act (ANILCA) permanently designated the lands as the Wrangell St. Elias National Park and Preserve (WRST). Very little state and private land remain within Unit 11.

The harvest of sheep on Park lands is 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 on Preserve lands. State hunting regulations provide opportunity for residents and nonresidents to hunt sheep on Preserve lands, as well as on state and private land in Unit 11. All state and federal sheep hunting in Unit 11 during the regular season is reported under the state harvest ticket system.

Sheep numbers in the Wrangell Mountains are unavailable prior to the 1950s. While sheep surveys were done during the late 1950s and 1960s, 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 aerial surveys were conducted to determine sex and age composition and population trends of sheep in selected trend count areas within Unit 11. All hunters were required to submit posthunt harvest ticket reports which provided information on the location, timing, and magnitude of effort and harvest. Rams harvested during the state hunt were sealed, and detailed horn measurements and genetic samples were taken.

## **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. The National Park Service (NPS) estimated 25,972 sheep  $\pm$  6233 (95% CI) within the entire WRST in 1990, 27,972 sheep  $\pm$  6448 (95% CI) in 1991, and 17,455  $\pm$  3883 sheep in 1993 (Strickland et al. 1993). The entire area has not been surveyed since that time.

Following surveys in the early 1990s, the NPS, through extrapolation, estimated 5071 ( $\pm$  137) sheep for the southern portion of the Wrangell Mountains from Mount Drum southeast to the Canadian border (McDonald et al. 1990, 1991; Strickland et al. 1993). Extrapolations from department fixed-wing surveys of specific count areas during this reporting period indicated a minimum of 3000 sheep inhabiting this area, similar to the previous reporting period.

#### *Population Trends*

Data for selected sheep trend count areas surveyed in Unit 11 are presented in Table 1. The limited surveys conducted during this reporting period do not indicate any unitwide trends, although sheep numbers in some areas continue to be well below those observed during the 1980s and early 1990s. The most recent surveys included count area (CA) 3 West located on the Upper Copper River, CA 11 and CA 12 between the Dadina and Kuskulana rivers, CA 14 Crystalline Hills, CA 21 MacColl Ridge, CA 22 between Canyon Creek and Barnard Glacier, and CA 23 West Barnard Glacier to the Park/Preserve boundary.

The north Wrangell Mountains within the Upper Copper River drainage (CA 3 West) fall within Park boundaries. Although nonresidents and nonlocal residents are excluded from this area, it is utilized by local subsistence hunters using 4-wheelers for access. An aerial survey in 2001 in this area indicated a minimum population of 502 sheep. A recent 2007 survey indicated a similar overall population size with 565 sheep observed.

Survey areas in the southwest Wrangells include CA 10 (Mt. Drum), CA 11 (Dadina River to Long Glacier), CA 12 (Long Glacier to Kuskulana River), and CA 14 (Crystalline Hills). Though CA 10 has not been flown consistently, the population has declined dramatically since 1992 when nearly 500 sheep were observed. While surveys in the early 1980s indicated approximately 200 sheep in the area, the most recent count of 87 in 2002 was the lowest recorded.

Within Unit 11, CA 11 and CA 12 have the longest running count histories. Sheep in CA 11 declined steadily from the early 1980s through 2002. The population has remained relatively stable since then. The lowest recorded sheep count occurred in 2006 when only 164 sheep were observed.

Up until 2000, CA 12 had fairly stable numbers of sheep, with count observations ranging 449-601. Since then, sheep numbers have declined substantially. During the 2006 survey, a record low of 113 sheep were observed. Movement may have been an issue in 2006, as 208 sheep were observed the following year. In 2008, 180 sheep were observed.

In CA 14, an isolated mountain block adjacent to the McCarthy Road, sheep numbers have declined markedly since 1980 when 209 sheep were observed. About 70 sheep have been counted annually in this area since the mid 1990s; ram numbers remain extremely low.

The southeast Wrangell Mountains are monitored by surveying CA 21 (MacColl Ridge), CA22 (Canyon Creek to Barnard Glacier), and CA23 (Barnard Glacier to Anderson Glacier) in the Upper Chitina River drainage. Sheep in CA 21 were last surveyed in 2005. Numbers appear relatively stable at about 200 since the mid 1990s, slightly below the average of 280 observed during the early 1980s. In CA 22, total sheep numbers since the early 1980s have ranged from 197 to 305 (ave. = 255). Counts were elevated somewhat in the mid 1990s averaging 294, though the most recent count of 238 in 2005 was similar to the 1980s.

While total CA 23 sheep numbers have remained relatively stable over time, the survey data has been separated into CA 23 West (Preserve area) and CA 23 East (Park area) due to the different hunting regulations for these areas. The Preserve area is managed under State hunting regulations, where there are no residency or access restrictions. The Park area is managed under Federal Subsistence hunting regulations, where only local residents can hunt (aircraft are not allowed, and there is no 4-wheeler access). Sheep numbers in the Preserve area declined from an average of 269 during the early 1980s to an average of 128 since 2001. Surveys have not been flown as often in the Park area. The only early count was conducted in 1982, when only 79 sheep were observed. Since 2001, the area has averaged 216.

### *Population Composition*

Composition data for selected sheep trend count areas surveyed in Unit 11 are presented in Table 1. In CA 3 West in the north Wrangells between 2001 and 2007, total sheep numbers increased only slightly, though the population composition changed markedly. Ewe observations increased by 10%, while ram observations decreased by 32%. Of the total rams, the percentage of full-curls increased slightly from 46% to 50%. In 2007, 32 lambs:100 ewes were observed.

Sheep numbers in CA 11 in the western Wrangell Mountains, while stable over the last few years, are considerably lower than during the early 1980s. The ram to ewe ratio has varied annually, and no long-term composition trends are evident in this area. The most recent survey in 2007 found a ratio of 18 rams:100 ewes, slightly below the long-term average of 27 rams:100 ewes for this area. Of the total rams, 52% were full-curl or greater in 2007. Summer lamb counts in this area are consistently moderate, averaging 30 lambs:100 ewes since 2002.

In CA 12, sheep numbers held up until the late 1990s. Since then, rams and ewes have declined at similar rates. Over the past 10 years, the average ratio has been 53 rams:100 ewes. Of the total rams observed in 2007, 49% were full-curl or greater. The most noticeable factor in this area is the highly variable lamb to ewe ratio. Over the past 10 years, the observed range has been 11 to 37 lambs:100 ewes, averaging 24 lambs:100 ewes.

The Crystalline Hills (CA 14) have had low sheep numbers since the mid 1990s. Lamb to ewe ratios are highly variable year to year, ranging 14 to 43 lambs:100 ewes since 1996. Though not surveyed since 2005, this area consistently has low ram numbers. In 2005, only 4 rams:100 ewes were observed.

The MacColl Ridge area (CA 21) has had relatively stable sheep numbers over time, although counts are intermittent. During the most recent count in 2005, 21 rams:100 ewes and 33 lambs:100 ewes were observed. Of the total rams, 31% were full-curl or greater, down slightly from 38% in 1994.

From Canyon Creek to the Barnard Glacier (CA 22) sheep numbers have remained relatively stable since 2000. During the most recent count in 2005, 40 rams:100 ewes and 32 lambs:100 ewes were observed. Of the total rams, only 29% were full-curl or greater. In this area, the ram to ewe ratio has increased from the average of 24 rams:100 ewes observed during the late 1990s. The percentage of rams full-curl or greater remained relatively stable during this period, averaging 28%.

East of Barnard Glacier (CA 23) sheep numbers have been relatively stable over time. Due to the land status, this count area is surveyed in two units: CA 23 West (WRST Preserve land) and CA 23 East (WRST Park land). In the western count area, the ram to ewe ratios are consistently low to moderate, averaging 25 rams:100 ewes since 2001. The eastern area receives much less hunting pressure due to aircraft and residency restrictions, and is reflected in the average 64 rams:100 ewes since 2001. The percentage of rams classified as full-curl or greater follows a similar pattern with 23% in the west and 41% in the east for the same time period.

### *Distribution and Movement*

Sheep are well distributed throughout the Wrangell Mountains in Unit 11. The area south of the Chitina River is considered eastern Chugach Mountains, and while this area has sheep, the distribution is inconsistent and the density is much lower than north of the river. Information on movements of sheep inhabiting Unit 11 is limited. Movement studies of sheep have not been conducted in this area, although field observations indicate sheep move to wind-blown, snow-free areas in the winter and to areas of new growth in the spring.

During this reporting period, Gretchen Roffler, a wildlife biologist with the U.S. Geological Survey, began a research project in Unit 11 to document sheep genetic diversity in relation to geological features and barriers. Genetic samples were collected from swabs of fresh fecal pellets as well as from swabs from the flesh of hunter-killed sheep. Data from this project should provide some insight as to historical stocking levels and movement patterns of sheep.



## **MORTALITY**

### *Harvest*

Seasons and Bag Limit. The state season for all sheep hunters is 10 August-20 September. Prior to 1979, the Unit 11 bag limit was 1 ram with  $\frac{3}{4}$ -curl or larger horns for all hunters. Beginning in 1979 the minimum horn size was increased to  $\frac{7}{8}$ -curl or larger.

In 1989, the bag limit was changed to 1 sheep for state subsistence hunters, and 1 ram with full-curl or larger horns for other hunters (nonlocal resident and nonresident hunters).

Up through 1989, subsistence hunters for state hunts were defined as rural Alaska residents that have a customary and traditional use of a particular species of game in a particular area. Late that year, the rural priority was struck down in a decision on the McDowell appeal.

Due to the discrepancy between state and federal law pertaining to rural subsistence priority, the Federal Subsistence Board implemented federal subsistence hunting regulations for local rural residents on federal lands beginning in 1990. The general federal subsistence sheep season in Unit 11 is 10 August-20 September, and the bag limit is 1 sheep. While the bag limit is considered liberal, federal regulations prohibit the use of aircraft for hunting on park lands, severely limiting access to and the harvest of sheep from many once popular sheep hunting areas.

Between 1991 and 2000, the state bag limit for resident hunters was 1 sheep through 2000. Due to declining sheep numbers, the regulation was changed to 1 ram in 2001, and then to  $\frac{3}{4}$ -curl or larger in 2003. The nonresident bag limit has remained full-curl or larger since 1989; guides are required.

In 1998, the Federal Subsistence Board implemented an additional federal season for hunters over the age of 60. The season for this hunt is 21 September-20 October; the bag limit is 1 sheep. This hunt is administered through a federal registration permit system, while all other Unit 11 sheep hunts are administered through the state harvest ticket system.

Board of Game Actions and Emergency Orders. In March 2004, the Board of Game (BOG) passed a regulation requiring all rams harvested in areas with curl-restrictions to have their horns sealed by ADF&G or the Alaska State Troopers. This regulation became effective July 2004. During the first year of the sealing process, a plastic seal was affixed to the skull or the sheep cape. Using numbered plugs provided by the Foundation for North American Wild Sheep (FNAWS), sealers now permanently mark ram horns.

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 describe “full-curl” in this area.

The reported sheep harvest has declined steadily in Unit 11 since the peak harvest of 146 rams in 1991. During this reporting period, the total harvest declined 36% from 99 in 2004 to 63 in 2006 (Table 2). The average horn size for all harvested rams >28 inches steadily increased through the

1980s and mid 1990s, peaking at 36.4 inches in 1997. The average horn length then declined until 2004, when it bottomed out at 34.7 inches.

Ironically, the number of large rams harvested ( $\geq 38$  inches) peaked in 2005, with 21 harvested (28% of all rams taken). The total number of large rams harvested annually ranged from 15 to 21 (20% to 28% of the total ram harvest) over this reporting period. The number of rams  $\geq 40$  inches harvested annually ranged from 7 to 10 (7% to 16% of the total ram harvest). While the number of large rams harvested in recent years is considerably lower than during the early 1990s, the percentage of large rams harvested is up slightly since the low in 2002, when only 9% of rams taken had horns  $\geq 38$  inches.

The number of ewes harvested during this period is also presented in Table 2. On average, 3 ewes were harvested annually during this reporting period. Since 2001 ewes have been legal only under federal subsistence regulations.

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 averaging 50%. The success rate slowly declined until it hit a low of 30% in 1994. Success rates varied from 32% to 45% through 2004, though have declined since then due to reduced sheep numbers.

Sheep hunting effort, presented in Table 4, has steadily declined since the early 1990s. In 1993 and again in 1994, record numbers of hunters pursued sheep in Unit 11 (371 and 362 respectively). During this reporting period the average number of hunters per season was 211. Hunter effort by resident and nonresident hunters has declined.

During the early 1990s local residents took an average of 32 sheep per year, nonlocal residents averaged 93 per year, and nonresidents averaged 27 per year. During this reporting period, the average harvests were 21, 45, and 16 respectively. While lower than in past years, nonresident success remained relatively high during this reporting period, averaging 61%. Nonresidents remain the most successful group of hunters in Unit 11. Nonlocal hunter success rates averaged 33%, also slightly lower than previous years. Alternatively, local hunter success rates averaged 41%, slightly up from previous years. This discrepancy is likely due to the lower hunting pressure in the park areas of Unit 11, where local residents have an exclusive right to hunt under federal subsistence regulations.

As reported in Table 4, the average number of days hunted annually by successful hunters ranged from 4.2 to 4.8 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 5.2 to 5.9 days and averaged 5.6 days.

Harvest Chronology. Harvest chronology data for sheep taken in Unit 11 are presented in Table 5. During the early 1990s, the majority of the harvest was spread across the first two weeks of the season. Since 1997, the majority of the harvest has shifted to the first week of the season. During this reporting period, the largest percentage of the harvest, 40% occurred during the first week of the season.

Transportation Methods. For the first time, 4-wheelers have replaced aircraft as the primary mode of transportation for sheep hunters in Unit 11. The use of all-terrain vehicles (ATVs) has continued to increase since 3-wheelers entered the hunting scene during the 1980s. They have since been replaced by the safer, more popular 4-wheeler. During this reporting period, an annual average of 78 hunters (38%) used ATVs while only 65 (32%) used aircraft. Aircraft has however remained the primary mode of transportation of successful hunters (Table 6). During this reporting period, an annual average of 26 successful hunters (34%) used ATVs, though 28 successful hunters (36%) used aircraft.

While ATV access is quite limited across most of Unit 11, the few available access points into and across the park areas of Unit 11 have grown in popularity with sheep hunters. Specific trail closures in the northern portion of Unit 11 across park lands have also recently and indefinitely limited the use of ATVs during summer and fall months pending further review of environmental impacts (NPS 2008). These types of trail closures, if permanent, may severely impact sheep hunting opportunity in future years.

#### *Other Mortality*

No studies of natural mortality of sheep in Unit 11 have been conducted. Predation by coyotes and golden eagles on Dall sheep lambs has been documented in the Alaska Range (Scotton 1997), and has been observed in the Wrangell Mountains as well. Reports by local residents also suggest lambs are pursued by wolverines, and black and grizzly bears; however, species specific predation rates have not been estimated in Unit 11.

Other sources of natural mortality common to sheep populations include accidents and starvation during periods of deep snow and icing conditions. Severe winter conditions have the potential to increase adult mortality and impact lamb production and survival. Prior to 1993, snow depths were only available from two sites, Sanford River and Dadina Lake in the western Wrangell Mountains. In 1993, three additional locations in the southern Wrangells were added: Lost Creek, Chokosna, and May Creek.

Unit 11 snow surveys have shown increased variability between sites since 2000-01, particularly in the southern portion of the unit. The Sanford and Dadina sites in the western Wrangells showed consistent snow conditions through this reporting period, with April 1 snow depths of 22 inches and 27–29 inches respectively. In the southern Wrangells, April 1 snow depths ranged 9–29 inches at the Chokosna site, 7–18 inches at the Lost Creek site, and 18–23 inches at the May Creek site. The 2006–07 winter had some of the lowest snow depths on record, which may have been a factor in slight increases in sheep numbers in 2007 across the unit.

#### **HABITAT**

Only one sheep habitat assessment study has been done in the Wrangell Mountains. In 2005, Miranda Terwilliger completed her Master of Science thesis titled “Population and Habitat Analyses for Dall’s sheep (*Ovis dalli*) in Wrangell–St. Elias National Park and Preserve.” This work focused on historical trend count data in relation to Geographical Information System (GIS) derived habitat characteristics such as escape terrain, terrain ruggedness, percentage of south and west facing slopes, and relative greenness or NDVI (normalized difference vegetation

index). No clear habitat model emerged which would explain more than half of the variation in either horn growth or population density (Terwilliger 2005).

## **CONCLUSION AND RECOMMENDATIONS**

Annual sheep surveys have been difficult to maintain in Unit 11 due to the large size of the unit as well as budget and time constraints. Many of the surveys flown during the early 1990s were funded by the NPS; the most recent surveys have been funded by a combination of NPS and ADF&G funds. In the future, an emphasis should be placed on maintaining annual counts of at least 3 count areas to provide yearly recruitment and survival estimates for lambs in various regions of the Wrangell Mountains.

In addition to annual summer trend counts between June and July, early summer trend counts in May would be useful to document early lamb production prior to losses due to predation. Identifying specific predators and other factors associated with early lamb losses would only be possible through a neonatal mortality research project; however, documenting lamb production and the timing of lamb losses would enhance our knowledge of recruitment trends across the unit.

Sheep population trends appear stable across Unit 11 during this reporting period. The northern Wrangell Mountains within Unit 11 appear to have a moderately high density of sheep that is holding steady. While hunting occurs in this area mostly by local residents who qualify for the federal subsistence priority, sheep hunting pressure is considered moderate due to the 4-wheeler accessible terrain. Although the sheep population composition has changed somewhat since 2001, the population appears well structured with 32 rams:100 ewes. The percentage of rams full-curl or greater also appears very strong at 50%, well above levels observed in surrounding heavily hunted areas. Given the recent changes in sheep hunting regulations in the Chugach Mountains, effects of the any sheep bag limit in this area are worth monitoring over the next several years.

While sheep numbers in the western Wrangell Mountains have declined markedly since the early 1980s, the population seems to have leveled out in recent years. While the sheep density is very low, there are adequate numbers of mature rams to sustain the population with 52% being full-curl or larger in CA 11 and 49% in CA12. As expected, sheep hunting has become very difficult in these areas due to the low sheep density, and hunter numbers are not expected to rebound until some increase in recruitment is realized.

Recent surveys in the south Wrangell Mountains also indicate stabilization of population numbers. Ram to ewe ratios in the heavily hunted areas such as CA 21, 22, and 23 West are considered low to moderate ranging 21–40 rams:100 ewes, and lamb to ewe ratios appear healthy ranging from 32–33 lambs:100 ewes. With only 18% of observed rams being full-curl or greater in CA 23 West, there is some concern that if the number of mature rams declines any further, the population in this area could face adverse impacts in future years. Over the next several years, the population composition should be monitored closely in the south Wrangells, particularly in the most heavily hunted areas.

Nonlocal Alaska residents continued to take the most sheep from Unit 11 during this reporting period (ave = 45/year), followed by local residents (ave = 21/year), then nonresidents (ave = 16/year; Table 3). Due to the lower numbers of sheep in the Wrangells, many nonlocal residents have already shifted hunting pressure to other mountain ranges such as the Brooks Range. Local residents are expected to continue hunting in Unit 11 due to the subsistence priority under federal regulations, as are nonresidents due to the exclusive guide use regulations in the preserve. Unless sheep numbers increase, the overall sheep hunter numbers are expected to remain relatively low in Unit 11.

The number of large rams harvested in Unit 11 has declined dramatically since the early 1990s. Although the total harvest has also declined over the same time period, the percentage of large rams harvested has begun to noticeably follow an approximate 10-year cycle in Unit 11, remarkably similar to what Hik and Carey found in the Yukon (2000). While no specific factor could be linked to the pattern, the authors suggest some large-scale regional weather pattern may be responsible. These patterns should be addressed in more detail in coming years, particular in light of ongoing questions pertaining to the impact of different harvest strategies for Dall sheep.

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TABLE 1 Unit 11 summer aerial sheep composition counts, 1973–2008

Regulatory Year	% Rams				Lambs	Rams:	Lambs:	Total Sheep
	Full <sup>a</sup> Curl	Full <sup>a</sup> Curl	< Full Curl	Ewes <sup>b</sup>		100 Ewes	100 Ewes	
CA 3W – UPPER COPPER RIVER								
2001	75	46%	89	314	24	52	8	502
2007	56	50%	55	344	110	32	32	565
CA 10 – MT. DRUM								
1973 <sup>a</sup>	Unk	Unk	Unk	150	23		15	208
1980 <sup>a</sup>	4	11%	31	107	59	33	55	201
1992	Unk	Unk	Unk	273	83		30	481
2001	11	35%	20	65	13	48	20	109
2002	8	38%	13	53	13	40	25	87
CA 11 – DADINA RIVER TO LONG GLACIER								
1982 <sup>a</sup>	24	33%	48	359	126	20	35	557
1984 <sup>a</sup>	12	17%	59	283	60	25	21	414
1987 <sup>a</sup>	52	42%	71	330	106	37	32	559
1990	28	54%	24	231	78	23	34	361
1993	25	41%	36	172	35	35	20	268
1994	18	46%	21	197	85	20	43	321
1995	9	33%	18	237	83	11	35	347
1996	8	21%	31	169	46	23	27	254
1997	8	16%	41	198	50	25	25	297
1998	7	14%	42	109	26	45	24	184
1999	17	33%	35	160	44	33	28	256
2000	11	28%	29	161	38	25	24	239
2001	16	37%	27	147	32	29	22	222
2002	7	15%	41	100	27	48	27	175
2003	14	35%	26	128	41	31	32	209
2004	14	48%	15	113	36	26	32	178
2005	10	34%	19	127	36	23	28	192
2006	10	45%	12	110	32	20	29	164
2007	11	52%	10	118	37	18	31	176
2008	8	33%	16	132	47	18	36	203

(table continued next page)

TABLE 1 continued

Regulatory Year	Full <sup>a</sup> Curl	%Rams Full <sup>a</sup> Curl	< Full Curl	Ewes <sup>b</sup>	Lambs	Rams: 100 Ewes	Lambs: 100 Ewes	Total Sheep
CA 12 – LONG GLACIER TO KUSKULANA RIVER								
1981 <sup>a</sup>	26	33%	52	359	129	22	36	566
1983 <sup>a</sup>	60	55%	49	341	64	32	19	514
1984 <sup>a</sup>	65	49%	67	290	68	46	23	490
1993	36	35%	67	426	39	24	9	568
1996	37	25%	113	346	105	43	30	601
1998	36	27%	96	242	75	55	31	449
1999	34	23%	113	250	59	59	24	456
2000	27	22%	98	173	31	72	18	329
2001	23	30%	54	185	26	42	14	288
2002	23	26%	64	139	33	63	24	259
2003	25	37%	42	121	34	55	28	222
2004	23	61%	15	109	12	35	11	159
2005	19	50%	19	105	28	36	27	171
2006	25	63%	15	58	15	69	26	113
2007	27	49%	28	112	41	49	37	208
2008	29	53%	26	90	35	61	39	180
CA 14 – CRYSTALLINE HILLS								
1981 <sup>a</sup>	2	1%	5	142	60	5	42	209
1993	13	10%	8	85	18	25	21	124
1994	5	6%	12	56	6	30	11	79
1996	5	7%	14	44	13	43	30	76
1999	5	5%	10	57	19	26	33	91
2001	1	2%	10	43	6	26	14	60
2002	0	0%	0	39	11	0	28	50
2003	0	0%	2	43	15	5	35	60
2004	3	4%	8	52	11	21	21	74
2005	0	0%	2	49	21	4	43	72
CA 21 – MACCOLL RIDGE								
1982 <sup>a</sup>	25	51%	24	187	69	26	37	305
1983 <sup>a</sup>	27	53%	24	186	39	27	21	276
1984 <sup>a</sup>	23	44%	29	157	43	33	27	252
1985 <sup>a</sup>	26	Unk	Unk	Unk	41	Unk	Unk	250
1994	8	38%	13	161	22	13	14	204
1999	Unk	Unk	Unk	157	19	Unk	12	192
2005	9	31%	20	136	45	21	33	210

(table continued next page)



TABLE 1 continued

Regulatory Year	Full <sup>a</sup> Curl	%Rams Full <sup>a</sup> Curl	< Full Curl	Ewes <sup>b</sup>	Lambs	Rams: 100 Ewes	Lambs: 100 Ewes	Total Sheep
CA 22 – CANYON CREEK TO BARNARD GLACIER								
1981 <sup>a</sup>	27	49%	28	143	51	38	36	249
1984 <sup>a</sup>	33	49%	34	125	43	54	34	235
1993	20	39%	31	190	63	27	33	304
1996	14	24%	44	165	54	35	33	277
1998	21	47%	24	213	47	21	22	305
1999	1	2%	45	179	66	26	37	291
2000	8	21%	30	143	16	27	11	197
2001	12	22%	43	176	20	31	11	251
2002	15	27%	41	142	45	39	32	243
2004	11	26%	31	119	50	35	42	211
2005	16	29%	39	139	44	40	32	238
CA 23W – BARNARD GLACIER EAST TO PARK/PRESERVE BOUNDARY								
1981 <sup>a</sup>	26	65%	14	158	49	25	31	247
1982 <sup>a</sup>	20	47%	23	194	66	22	34	303
1984 <sup>a</sup>	21	45%	26	168	41	28	24	256
2001	4	24%	13	105	10	16	10	132
2003	7	27%	19	78	12	33	15	116
2007	4	18%	18	86	28	26	33	136
CA 23E – PARK/PRESERVE BOUNDARY EAST TO ANDERSON GLACIER								
1982 <sup>a</sup>	26	57%	20	26	7	177	27	79
2001	46	52%	42	129	26	68	20	243
2003	25	33%	50	117	25	64	21	217
2007	23	37%	39	103	22	60	21	187

<sup>a</sup> Prior to 1989, the “Full Curl” column included rams 7/8 curl and larger.

<sup>b</sup> Includes yearlings of both sexes and rams of 1/4 curl or less.

TABLE 2 Unit 11 sheep harvest, 2002-2007

Regulatory Year	Rams			Ewe Harvest	Total <sup>b</sup> Sheep Harvest
	Total Ram Harvest	Average Horn Length (in) <sup>a</sup>	Large Rams ≥ 38 in.		
2002	90	35.6	8	2	92
2003	81	35.1	16	0	82
2004	96	34.7	19	3	99
2005	76	35.7	21	5	82
2006	63	36.1	15	0	63
2007	46	35.4	12	5	51

<sup>a</sup> Excluding subsistence rams ≤ 28".<sup>b</sup> Includes sheep of unknown sex.

TABLE 3 Unit 11 sheep hunter residency and success, 2002-2007

Regulatory year	Successful				Unsuccessful				Total <sup>b</sup> hunters
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%) <sup>b</sup>	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%) <sup>b</sup>	
2002–03	11	59	19	92 (32)	51	130	13	197 (68)	289
2003–04	16	50	16	82 (37)	25	100	11	140 (63)	222
2004–05	24	57	18	99 (44)	28	90	6	124 (56)	223
2005–06	14	51	17	82 (40)	30	84	9	123 (60)	205
2006–07	24	26	12	63 (31)	30	95	16	143 (69)	206
2007–08	13	28	9	51 (26)	32	97	14	145 (74)	196

<sup>a</sup> Local means residents of Unit 11 and 13.

<sup>b</sup> Total may exceed sum because some hunters fail to report residency.

TABLE 4 Unit 11 sheep hunting effort, 2002–2007<sup>a</sup>

Regulatory Year	Successful hunters			Unsuccessful hunters			Total hunters		
	No. hunters	Total days	Average days	No. hunters	Total days	Average days	No. hunters	Total days	Average days
2002–03	92	411	4.5	196	1,084	5.5	288	1,495	5.2
2003–04	79	390	4.9	138	784	5.7	217	1,174	5.4
2004–05	98	454	4.6	122	633	5.2	220	1,087	4.9
2005–06	80	337	4.2	119	703	5.9	199	1,040	5.2
2006–07	63	302	4.8	142	804	5.7	205	1,106	5.4
2007–08	51	231	4.5	144	880	6.1	195	1,111	5.7

<sup>a</sup> Includes only those hunters reporting numbers of days hunted on their report.

TABLE 5 Unit 11 sheep harvest chronology percent by harvest periods, 2002–2007<sup>a</sup>

Regulatory year	Harvest periods						<i>n</i> <sup>a</sup>
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
2002–03	38	10	14	11	8	19	88
2003–04	37	19	11	14	14	6	81
2004–05	56	7	8	12	6	11	99
2005–06	41	16	10	15	4	15	82
2006–07	24	21	19	10	11	15	62
2007–08	53	27	10	8	2	0	49

<sup>a</sup> Includes only those hunters reporting date of kill on their report.

TABLE 6 Unit 11 sheep harvest percent by transport method, 2002–2007<sup>a</sup>

Regulatory year	Percent of harvest							<i>n</i> <sup>a</sup>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	
2002–03	40	2	3	35	0	4	12	91
2003–04	44	3	6	41	0	0	6	80
2004–05	34	3	10	37	0	0	13	97
2005–06	44	0	14	25	0	1	15	81
2006–07	27	3	22	38	0	2	8	60
2007–08	41	2	20	25	0	2	10	51

<sup>a</sup> Includes only those hunters reporting method of transportation on their report.

## **DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007

### **LOCATION**

**GEOGRAPHIC DESCRIPTION:** Chugach Mountains

**GAME MANAGEMENT UNITS:** This single report combines separate reports on game management unit areas that fall within the Chugach Mountains. Three separate sections address these unit areas: southern Unit 11 and Unit 13D, Unit 14A, and Unit 14C.

### **SOUTHERN 11 (5332 mi<sup>2</sup>) and 13D (5745 mi<sup>2</sup>)**

### **BACKGROUND**

The northern Chugach Mountains between the Copper River and the Canadian border are encompassed by Unit 11. This eastern-most portion of the Chugach range is almost entirely within the park portion of the Wrangell–St. Elias National Park and Preserve (WRST). Historically, this area has had a very low density (McDonald et al. 1991), high quality sheep population.

The northern Chugach Mountains between the Coal Creek drainage and the Copper River are encompassed by subunit 13D. While this area has been a popular sheep hunting destination since the early 1900s, very limited sheep composition or harvest data prior to the 1970s are available.

During the early 1970s the eastern Chugach range in Unit 11 averaged 16 hunters per year, while the more popular central Chugach range in 13D averaged 152 hunters per year. In 1975 a 644 mi<sup>2</sup> portion of 13D (east of the Richardson highway and north of the lower Tiekkel River) was changed to a walk-in only hunt area and designated as the Tonsina Controlled Use Area (TCUA). This restriction was implemented to reduce harvest pressure and let more rams mature to trophy size. Ground access to the remainder of sheep habitat in 13D is limited by distance, rough terrain, and river crossings. Aircraft has consistently been the most common method of transportation for the majority of sheep hunters in the central Chugach Mountains.

The Antiquities Act in 1979 closed the eastern Chugach Mountains as well as the majority of the Wrangell Mountains in Unit 11 to hunting for all but local area residents. At the time, managers worried that the change would lead to increased hunting pressure in adjacent areas such as 13D, and management recommendations included possible permit hunts for the entire Chugach range. In 1980 the WRST was established. The park lands retained the local residency requirement, though preserve areas were reopened to all hunters.

Despite concerns about the displacement of sheep hunters, sheep harvests stayed relatively consistent in 13D until 1986, when hunter numbers increased significantly. This increase was likely due to aircraft access restrictions imposed in 1985 by the National Park Service (NPS) in the park portion of the WRST in Units 11 and 12 which stopped subsistence hunters from using aircraft to access hunt areas.

Throughout the 1960s and 1970s, the sheep bag limit for all of Unit 13 was one  $\frac{3}{4}$ -curl ram, similar to the rest of southcentral Alaska. In 1979 it was changed to  $\frac{7}{8}$ -curl. For a few years during the late 1980s (1985, 1986, and 1989) Unit 13 also had a  $\frac{7}{8}$ -curl subsistence sheep season for local residents only. In 1989, the Unit 13 bag limit was changed to full-curl.

Perhaps the most important regulation change impacting sheep hunting patterns in the central Chugach range occurred in the fall of 1988, when the State's exclusive guide use area system was invalidated by the Owsicheck Supreme Court decision. Since that time, an unlimited number of guides have had the ability to book sheep hunting clients in 13D.

Although the total number of sheep hunters and harvest in 13D remained relatively stable through the 1990s, hunting patterns, such as the chronology of harvest and hunter residency over time, have changed significantly in this area.

## **MANAGEMENT DIRECTION**

### **MANAGEMENT OBJECTIVE**

Maintain a minimum harvest of 120 full-curl or larger rams throughout the entire Chugach Mountain Range.

## **METHODS**

Activities accomplished for regulatory years (RY) 2004–2006 included conducting summer aerial sex and age composition surveys and monitoring the number, horn size, and location of harvested sheep. Harvested rams were also sealed. Annual sheep surveys are flown from the Glennallen Alaska Department of Fish and Game (ADF&G) office. Due to time and fiscal restraints, surveys are rotated between the surrounding mountain ranges. No aerial sex and age composition surveys were flown in subunit 13D in 2004 or 2005, though since 2006 surveys have been flown each year.

## **RESULTS AND DISCUSSION**

### **POPULATION STATUS AND TREND**

#### *Population Size*

Given the size of subunit 13D, it is difficult to estimate the sheep population for the entire area in any given year. Annual count data are presented in Table 1.

Count areas (CA) 1, 2, 16, 17, and 18 cover western subunit 13D (Coal Creek drainage to the Tazlina Glacier). The highest count of sheep in this area was 1028 in 1976. Subsequent surveys

since then have fluctuated between 430 and 600 observed sheep. The most noticeable trend in this area has been in CA 16 and 17, between the Matanuska and Nelchina glaciers. While observers in 1976 documented 475 sheep in this area, the most recent counts of 91 in 2007 and 138 in 2008 indicate a decline of more than 70% over the past 3 decades. The count of 539 sheep for all 5 count areas in 2008 indicated an increase in sheep numbers from 2007, although the largest number of observations were in the Coal Creek drainage on the border of subunit 14A. Tracks indicate that sheep do pass between these two management areas, creating some difficulty in monitoring population trends.

Count areas 3, 4, 5, 7, and 9 cover east-central subunit 13D (Tazlina Glacier to the Richardson Highway), one of the most popular sheep hunting areas in Unit 13. Based on periodic surveys in this area, the highest sheep numbers here likely occurred in 2003 when 419 sheep were observed in CA 3, 4, and 5 (between Tazlina and Klutina lakes). Periodic surveys from CA 7 and 9 (between Klutina and Tonsina lakes) suggest these areas could have between 200 and 400 additional sheep. During the most recent surveys (CA 4 and 5 in 2006 and 3, 7, and 9 in 2007), 573 total sheep were observed.

Count areas 11, 12, and 13 cover the walk-in TCUA. The observed number of sheep in the TCUA increased from a low of 148 in 1976 to a high of 312 in 1992. Periodic surveys since then indicated a steady decline to 156 sheep in 2006. In 2008, 171 sheep were observed, suggesting the population may have stabilized.

Minimal survey data exists for the eastern Chugach Mountains in Unit 11, CA 25–31. In 1991, two areas were surveyed by the NPS; 73 sheep were observed in CA 27 (Nelson Mountain area), and 27 sheep were observed in CA 31 (south Logan Glacier). At the time, the remainder of the area was similarly classified as low density (McDonald et al. 1991). This area is almost entirely park land and is only hunted by a small number of local federal subsistence hunters; ADF&G does not survey the area because there are no state administered hunts in the area.

### *Population Composition*

Since 2002, the percentage of full-curl and larger rams observed in subunit 13D has ranged from 2 to 6% of all observed sheep. The percentage of lambs has ranged from 18 to 23% (Table 1). While the percentage of full-curl rams for 13D is lower than in adjacent areas, the lamb numbers are consistently high, indicating good production and initial survival.

The sheep composition for all 5 count areas in western 13D averaged 40 rams:100 ewes and 38 lambs:100 ewes (22% lambs) in recent years. Of the sheep observed in 2007, 92 were rams and only 10% of those were judged  $\geq$  full-curl. In 2008, 124 rams were observed and 24% were judged  $\geq$  full-curl. As for the significant decline documented between the Matanuska and Nelchina glaciers, it is important to note the declines in ram and ewe numbers were similar. This pattern suggests that the cause(s) of the decline affected both sex classes as opposed to over hunting which can lead to a larger decline in rams.

In east-central 13D, the sheep composition for all five count areas averaged 37 rams:100 ewes and 34 lambs:100 ewes (20% lambs) for 2006 and 2007. Of the sheep observed in 2006, 132

were rams and 14% of those were judged  $\geq$  full-curl. In 2007, 131 rams were observed and 10% were judged  $\geq$  full-curl.

The sheep composition in the walk-in TCUA averaged 22 rams:100 ewes and 36 lambs:100 ewes for 2006 and 2008. Of the sheep observed in 2006, 24 were rams and 67% of those were judged  $\geq$  full-curl. In 2008, 22 rams were observed and 27% were judged  $\geq$  full-curl.

No composition data is available for the eastern Chugach range in Unit 11.

### *Distribution and Movements*

Sheep distribution and movements in 13D during the summer months have been documented by aerial surveys, although little is known about important rutting, wintering, and lambing areas. Sheep have been observed from 2000–7500 ft elevation during summer months, and concentration areas vary greatly. Predation risk and weather patterns influence sheep distribution year-round. Similar to other known sheep wintering areas, sheep in this area require relatively snow-free windblown ridges during the winter months.

## **MORTALITY**

### *Harvest*

Seasons and Bag Limits. During this reporting period, the general hunt sheep season in subunit 13D was 10 August–20 September. The bag limit was 1 ram with full-curl horn or larger. In the Chugach portion of Unit 11, only local federally qualified hunters were able to sheep hunt under limited access regulations. The federal subsistence season was 10 August–20 September with a bag limit of 1 sheep.

Board of Game Actions and Emergency Orders. In March 2004, the Board of Game (BOG) passed a regulation requiring all rams harvested in hunts with horn curl restrictions be sealed by ADF&G or the Alaska State Troopers. This regulation became effective July 2004. During the first year of the sealing process, a plastic seal was affixed to the skull or the sheep cape. Using numbered plugs provided by the Foundation for North American Wild Sheep (FNAWS), sealers now permanently mark ram horns.

In March 2007, the BOG passed a regulation changing the general hunt in 13D west of the Richardson Highway to drawing permit only. Two hunt areas were established, east and west of the Tazlina Glacier. For each hunt area two hunts were established, 1 for residents and 1 for nonresidents. After reviewing the history of hunter residency for 13D, the BOG allocated 80% of the permits for each hunt area to residents and the remaining 20% to nonresidents. The bag limit for the western area was set at 1 ram, while the bag limit for the eastern area remained 1 full-curl ram. The BOG also added the requirement of a guide–client agreement for nonresident guided hunters. These hunts were first offered during the November 2007 drawing period, for the 2008–09 hunt season.

Hunter Harvest. The sheep harvest from the Chugach portion of Unit 11 continues to be very low. For this reporting period, the average number of sheep hunters in this area was 4.3 per year, and the average harvest was 2.3 sheep per year (100% rams).



Sheep harvest numbers for subunit 13D are reported in Table 2. The annual ram harvests for this reporting period range 34–69 (ave = 51/year), down slightly from the previous reporting period (ave = 59/year). The 2006 take of 34 rams was the lowest ever recorded for this subunit. Preliminary harvest data for 2007 show virtually no increase in the harvest.

The harvest of trophy class rams peaked in the mid 1990s in 13D, with 35 rams  $\geq$  38 inches taken in 1994, and 14 rams  $\geq$  40 inches taken in 1995. During this reporting period, the number of large rams taken annually was considerably lower, averaging 18 and 6 respectively. In 2006, only 9 rams  $\geq$  38 inches were harvested, and of those, 5 were  $\geq$  40 inches.

Permit Hunts. No permit hunts were conducted during this reporting period. For the 2008–09 season, the first year of the drawing hunts, permit numbers were set conservatively. For the western drawing area, 8 permits were allocated for residents (DS160) and 2 permits were allocated for nonresidents (DS260). For the eastern drawing area, 33 permits were allocated for residents (DS165) and 8 permits were allocated for nonresidents (DS265).

Hunter Residency and Success. Hunter residency data for 13D are reported in Table 3. In recent years, while overall hunter numbers in 13D have declined, the percentage of nonresident hunters and the percentage of rams harvested by those nonresidents have increased. During this reporting period, the percent of 13D sheep hunters that were nonresidents averaged 30%, and the percentage of rams harvested by those hunters averaged 58%. This reflects a dramatic departure from the 15% of 13D sheep hunters that were nonresidents during the early 1980s, and the 30% of total sheep harvested by those hunters.

Over the past 20 years compared to adjacent sheep hunting areas, 13D as a whole has had the highest percentage of nonresident hunters (27%); much higher than the 10% nonresidents hunting in the Chugachs in 14A, 11% in the Talkeetnas in 13A, and 13% in the Wrangells in Unit 11.

Of the 13D hunt areas, the walk-in TCUA has consistently had the lowest percentage of nonresident hunters. Over the past decade, the nonresident percentage of TCUA hunters has averaged only 13%. Of those hunters, they took an average of 27% of the total number of rams harvested annually.

Harvest Chronology. Chronology data for sheep harvested in 13D are reported in Table 4. Harvest patterns have changed dramatically over time in 13D. Through the mid 1990s it was common to see rams harvested throughout the entire six-week season. Since 1996 the percentage of the harvest occurring in the first week of the season has increased significantly from an average of 20% (1987-96) to 47% (1997–2006). During this reporting period, an average of 52% of the harvest occurred during the first week of the season.

The harvest chronology in the walk-in TCUA has remained more consistent. The harvest during the first week of the season however, has always been fairly high, averaging 56% for the 10 years prior to 1996, and 55% since. With low total harvests ranging from 3–15 rams per year in this area, the chronology of the harvest can be highly variable year to year.

Transport Methods. Aircraft has consistently been the most popular and successful method of transportation for 13D hunters outside the walk-in area. During this reporting period an average of 53% of all 13D hunters used an aircraft, followed by 25% who hunted from a highway vehicle. Of the successful hunters (Table 5), 72% used an aircraft and 16% hunted from their highway vehicle. Of successful western 13D sheep hunters, 80% used aircraft during this reporting period; 81% used aircraft in eastern 13D (to the Richardson Highway).

#### *Other Mortality*

Though no studies have been conducted in 13D addressing Dall sheep mortality factors, predation on lambs by wolves, coyotes, and golden eagles is thought to affect annual recruitment significantly in this area. Black bears, grizzly bears, and wolverines are also present, and have been observed pursuing sheep in this area, although their impacts on sheep population dynamics have not been documented.

During this reporting period snow depth in the Copper River basin was well above average in only 1 year, 2004–05. Thought to be a major factor in population dynamics in western portions of the Chugach Mountains and the Talkeetna Mountains, deep snow (estimated from relatively low elevation snow course sites) does not seem to have the same obviously detrimental impact on sheep in the central Chugach range.

Another weather factor of interest is the frequency of midwinter freeze–thaw events (November through February). Warm temperatures promoting the freeze–thaw cycle result in icing conditions thought to be harmful to sheep by causing deep snow to settle and develop ice layers which make foraging difficult; any partially exposed vegetation could be coated with ice as well. From 2000–01 to 2005–06, the Gulkana Airport recorded a winter average of 20 days when the maximum temperature met or exceeded 32° F. This is significantly higher than the average of 10 days for the previous 6-year period (1994–95 through 1999–2000;  $P = 0.028$ ). While there does not appear to be a significant long-term trend evident (1943 to 2006), annual fluctuations in this weather parameter likely have important consequences for Dall sheep.

While no large scale Dall sheep mortality events have been documented in this area, general reports of sickly and dead sheep seem to be increasing in recent years. In 2006, a member of the public reported watching a sickly lamb while hunting in east-central 13D. The lamb died soon after, and photos of the lamb were submitted to ADF&G. The photos indicated contagious ecthyma, a viral-caused condition not uncommon to Dall sheep in Alaska. Staff observed a sickly lamb in the same area during sheep surveys in July of 2007; it was collected and necropsied. Outward appearances were similar to the hunter-observed lamb, both having a noticeably gross condition of contagious ecthyma. The necropsy report indicated a severe case of pneumonia, though the cause was unclear. While the report indicated a potentially low level of copper when compared to domestic sheep, there are no published data describing healthy levels of copper in Dall sheep. Finally, there were no indications of any *Pasteurella* bacteria, a common precursor to pneumonia in big-horn populations.

During a sheep survey in western 13D in July of 2008, staff observed a dead lamb, still attended by the ewe. Then in the TCUA in August of 2008, staff observed a dead lone sheep. The sheep was small bodied and thought to be a lamb or yearling. No obvious signs of predation or other

cause of mortality could be seen from the fixed-wing aircraft. Neither of these carcasses could be collected. Additional observations reported by hunting guides in 13D in 2007 of lethargy and coughing suggest some adult sheep across the area may suffer from pneumonia.

In east-central 13D, counts between 2002 and 2006 showed a decline in ram numbers of 25%, but only a 3% decline in ewe numbers. In the TCUA, counts between 2003 and 2006 indicated a decline in ram numbers of 41%, but only 26% in ewes. Unlike predation, weather, and disease, which usually impact both sexes similarly, this pattern suggests there are other factors such as over hunting, that may be causing the differential demographic declines in these areas.

## **HABITAT**

### *Assessment*

Though habitat is not currently monitored in this area, lamb numbers in recent years have been sufficiently high to suggest adequate habitat quality and quantity for reproduction. Snow depth, snow density, and icing conditions, rather than vegetation quality or quantity, may be the primary determinants of winter sheep habitat in this area. Summer range quality may be similarly influenced by the timing of early snow melt, as well as precipitation and temperature throughout summer months.

## **CONCLUSIONS AND RECOMMENDATIONS**

The Dall sheep population in the central Chugach Mountains in subunit 13D covers such a large area that monitoring population trends as well as the driving factors have proven difficult with a limited budget and unpredictable summer weather. Total sheep numbers in east-central 13D as well as the TCUA appear to have declined considerably during the past 5 years. Lamb numbers across these areas vary tremendously, indicating lamb production and/or early survival in some areas may have played a role in the decline. Sheep numbers in some portions of western 13D are substantially lower than in years past; however, there are no clear responsible factors. Healthy lamb numbers in recent counts in all these areas is a positive sign for population recovery.

Composition data from 2006 and 2007 indicate a low percentage of full-curl rams in 13D outside the TCUA. Considering these surveys are conducted prior to the hunting season, very few large mature rams are surviving in these areas to breed each year. While a small part of this may be due to reduced recruitment of rams following deep snow winters in 1999–2000 and 2000–01, this is a highly unnatural situation compared to the population structure in areas with less or no hunting pressure.

The changing harvest patterns in 13D may also help to explain the low number of large mature rams in recent years. The exceptionally high number of guided nonresident sheep hunters in this area is particularly worth addressing. Since exclusive guide-use areas were dissolved in 1989, guiding on state land has changed tremendously. Due to the remoteness and ruggedness of sheep habitat in 13D, this area has become very popular with sheep guides over time. In the early 1980s only 15% of 13D sheep hunters were nonresidents; that percentage has since doubled to 30%.

In addition to an increasing percentage of nonresident hunters, there continues to be a large disparity between resident and nonresident success. During this reporting period, an average of 19% of resident hunters were successful, compared to 60% of nonresidents. In 2007, the preliminary resident success rate was the lowest ever, at 9%, while nonresident success remained high at 69%. These patterns help to explain why the number of resident hunters in 13D dropped from an average of 153 per year during the 1990s to 107 per year during this reporting period.

The Chugach range, particularly eastern 13D, has been known to produce highly desirable heavy-horned fast-growing rams. Three of the top 10 Boone and Crockett Dall sheep have come from the Chugach range. This trophy potential has likely provided much of the impetus for the increased guide activity and high price of hunts in this area. Given the effort and planning involved with nonresident guided hunts, many guides are booked years ahead of time, and do not have the flexibility to take hunters elsewhere when ram numbers are down. Also, the cost of a guided sheep hunt has increased tremendously in recent years, furthering the incentive to sell hunts. This continued harvest pressure by the most successful group of hunters has helped to push the number of large mature rams in this area to record lows.

Continued heavy harvest pressure under the full-curl general hunting regulation will keep the trophy potential of the area from being realized, and may negatively impact the long-term genetic health of the population. The rams most desired by hunters are being harvested before they have the chance to breed regularly, while less desirable rams, some of which may never reach full-curl, are left to reproduce. With lower harvest pressure, the fastest growing 5–7 year old rams will have a better chance of surviving to breed instead of being systematically removed as soon as they reach full-curl.

The harvest objective of 120 full-curl rams for the Chugach Mountains has remained virtually unchanged for more than 20 years, and very little in the way of management objectives have ever been specified. Subunit 13D has historically accounted for more than half of the objective 120 full-curl rams. The average annual 13D harvest was only 52 rams during this reporting period; clearly indicating the objective is no longer being met. Additionally, the 2006 harvest of 34 rams, and the preliminary harvest of 36 rams in 2007 suggest the situation is deteriorating.

Future Dall sheep management in the central Chugach Mountains should reflect the historical trophy value of the area, as well as the current reality of hunting pressure trends. Due to the difficulty involved in hunting the walk-in TCUA, this portion of the range may be the only area that can sustain a full-curl general season hunt. As originally intended, this area should continue to provide a quality experience as well as the continued opportunity to take a trophy class ram, while maintaining the genetic diversity of the population.

For the remainder of 13D (west of the Richardson Highway), we recommend future management objectives mirror those of the TCUA. Given the history of the central Chugach range, we believe sheep hunters who invest such a large amount of time, money, and effort in a hunt in this area expect to have a reasonable opportunity to harvest a trophy class ram. Continued heavy hunting pressure by an unlimited number of hunters would be expected to further degrade the hunt quality once associated with this area. With the majority of sheep harvested during the first week of the 6-week season, crowding has become more of a problem for those hunters hoping to have

the first shot at a legal ram. The trend of resident hunters leaving this hunt area would also be expected to continue.

Many options have been considered to help improve the situation. Considering aircraft is the main mode of transportation for sheep hunters in this area due to geographic limitations, aircraft restrictions would unnecessarily eliminate access to most sheep habitat. Given the low number of sheep available to hunters, reducing the season length would have little to no effect on the exploitation of existing rams. Establishing a bag limit of 1 ram every 4 years would reduce hunting pressure by a small number of resident hunters, though the most effective guided nonresident hunters would be largely immune. Many additional options have been explored, though few would have the ability to effect positive change.

The establishment of drawing hunts appears to be the best solution to effectively reduce harvest pressure in this area. Conservative harvests for a few years will be necessary to return the population structure to a more natural state, at least to the point where a sufficient number of large mature rams will survive the hunting season to breed. This scenario should lead to a more orderly rut, with less energy expended during mating. By having an adequate number of older and desirable mature rams participating in rutting activities, we can also be assured that learned behaviors as well as valuable genetic traits will be passed along to the next generation.

While some hunting opportunity will be sacrificed, it will be replaced by an inherently high quality hunt where the sheep population as well as future sheep hunters will benefit. Considering western 13D has so few rams, this is the ideal place to institute a permit hunt with a bag limit of any ram. This will immediately help relieve pressure on the small number of remaining older rams, as well as help select against those rams that will never reach full curl. Having a bag limit of any ram will allow hunters the choice as to what a trophy is to them. No ram would ever be shot and left due to appearing sublegal on close evaluation, eliminating the most prevalent sheep enforcement concern. A bag limit of any ram under a permit system should theoretically provide a more natural age distribution in the ram segment of the population, allowing natural selection to function at its best. In east-central 13D there seem to be enough rams to justify a permit hunt with a full-curl bag limit. By having different bag limits in adjacent hunts, we will be better prepared to evaluate the effectiveness of the any ram bag limit. Under this scenario, the management objective of providing a quality experience as well as the continued opportunity to take a trophy class ram, while maintaining the genetic diversity of the population should be attainable for all of 13D.

Under this recommended management strategy, the total number and the sustainable harvest of rams in 13D should increase over the next several years. For the purpose of evaluating these management actions, we recommend the long-term annual harvest objectives of 20 rams in western 13D, 30 rams in east-central 13D, and 8 rams in the TCUA.

In addition to re-evaluating management and harvest objectives, we also need to focus research activities on potential factors relating to the low population numbers and increasing reports of sickly and dead sheep in this area. Documenting baseline health parameters as well as monitoring sheep productivity and survival will be essential in understanding all the underlying factors behind the population dynamics in the area. If funds and time permit, annual weather parameters as well as basic genetic diversity should also be evaluated more closely in an effort to

understand the ability of this sheep population to withstand extreme weather and perhaps even changing climate patterns.

## **UNIT 14A**

### **BACKGROUND**

Sheep harvest has been limited to adult rams in the 14A portion of the Chugach Mountains. Sheep harvest data have been collected from hunter harvest reports since 1967. From 1967 through 1978, sheep were managed under a  $\frac{3}{4}$ -curl horn minimum size regulation and a  $\frac{7}{8}$ -curl horn minimum size from 1979 through 1988. In 1989 hunters were allowed to harvest only full-curl rams. The average harvest between 1990 and 2000 was 22 rams.

Historically, 14A sheep surveys have been inconsistently funded and conducted when adequate funding, appropriate weather and staff were available. The first formal sheep surveys in the unit were done in 1973 (Didrickson 1977). During the last 10 years, more effort has been made to fly on a more frequent basis. More recently, sheep surveys in the unit have been conducted in 3 of the last 5 years.

Increasing guided hunting pressure through the 1990s and 2000s had been demonstrated by the trend in a higher proportion of nonresident hunters and increased nonresident hunter success. As indicated in the section of this report on GMU 13D, the Owsichuk decision of the Alaska Supreme Court in 1988 invalidated the State of Alaska's exclusive guide use area system, resulting in increased guide use of some areas. This was possibly the most important regulation change impacting sheep management strategies in the unit over the last 20 years.

During the last 2 reporting periods, concerns have been raised by resident hunters, some guides, and a few transporters regarding the increasingly crowded hunting conditions, number of legal rams available, and overall sheep numbers.

### **MANAGEMENT DIRECTION**

#### **MANAGEMENT OBJECTIVE**

- Maintain a minimum harvest of 120 full-curl or larger rams throughout the entire Chugach Mountain Range.

### **METHODS**

Sheep harvest was monitored through sheep sealing and 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, and transportation used were noted on the reports. The number of sheep killed but unreported was assumed to be small.

Mandatory sheep sealing began in the 2004–05 season. Horns were measured, age was noted, and a permanent plug was placed in one of the horns. Plans are to begin collecting additional data on sheep horn growth and age starting in 2007. These additional sheep horn measurements

will be taken to evaluate size, mass, and annual growth characteristics relative to age and location of harvest.

Aerial surveys were conducted in two of the three years during the reporting period. Surveys were conducted when most of the previous winter's snow has melted and prior to the sheep hunting season (Aug.10). In most years, this occurs in July.

## **RESULTS AND DISCUSSION**

### **POPULATION STATUS AND TREND**

#### *Population Size*

The sheep population in the 14A portion of the Chugach Mountains was estimated to be about 700–800 during the reporting period. The number of sheep counted during aerial surveys decreased from 907 in 1998 to 644 sheep in 2006. The two surveys conducted during the reporting period show a general decline in the population. (Table 6). Surveys conducted in July 2007 (outside of this reporting period) indicate that the overall sheep population has stabilized or has begun to recover.

### **MORTALITY**

#### *Harvest*

Season and Bag Limit The hunting season in Unit 14A Chugach for regulatory years 2004–05 through 2006–07 was 10 August–20 September. The bag limit was 1 ram with a full-curl horn or larger.

Board of Game Actions and Emergency Orders. In March 2004, the Board of Game (BOG) passed a regulation requiring all rams harvested in areas with curl restrictions to have their horns sealed by ADF&G or the Alaska State Troopers. This regulation became effective July 2004.

During the March 2007 BOG meeting the 14A portion of the Chugach Range was changed from a general season hunt to a drawing hunt. In addition the bag limit was changed from 1 full-curl ram to any ram. The BOG allocated 10% of the available permits to nonresidents and 90% to residents. Nonresidents were required to provide a guide-client agreement or the name of the 2<sup>nd</sup> degree kindred relation that would accompany them on their hunt at the time of application. The regulation changes would first take place in the 2008–2009 hunting season.

Hunter Harvest. Hunter harvest averaged 31 rams during 2004–2006 (Table 7), higher than the average harvest of 20 rams per year during 2001–2003 (Coltrane 2005).

The 2004–2006 average horn size increased slightly from the 1997–2003 average (36.2 vs. 35.7 inches). The percentage of horns greater than 40 inches has increased from the 1997–2003 average over the reporting period (5.4% vs. 5.7%; Table 7).

Hunter Residency and Success. The total number of hunters has changed little over the past 10 years (Table 8). The success rate was higher during the reporting period than during the 2001–2003 period (25% vs 20%). Nonresidents continued to be more successful than residents. They

accounted for 24% of hunters but took 57% of the sheep during 2004–2006 (Table 8). 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 2004–2006, an average of 52% of the reported rams harvested were taken during the first week of the season, compared to 40% for the 2001–2003 period. For this reporting period an average of 67% of the harvest occurred in the first two weeks (Table 9).

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 10).

## **CONCLUSIONS AND RECOMMENDATIONS**

Until recently, the sheep population in the Chugach Mountains portion of subunit 14A was largely ignored except for occasional aerial surveys when budget and time allowed. Monitoring the harvest and the population on an annual basis was not essential under the general season full-curl management strategy. This strategy was considered “self-regulating” and as such didn’t require the close monitoring necessary for other big game species and/or management programs. When managers evaluated the difference between observed legal rams from recent survey data and reported harvest, the data showed full curl rams have been harvested at a very high rate for years. This fact combined with improved overall budgets resulted in increased funding for sheep surveys and coincidentally more interest in sheep management in the Chugach Mountains by hunters and guides

Concerns regarding legal ram availability, crowded hunting conditions, and total sheep numbers resulted in several proposals submitted to the Board of Game in March 2007 to allow sheep hunting by drawing permit only in the 14A portion of the Chugach Mountains. The Board approved limited drawing permit hunts for the Chugach portions of GMU’s 14A and 13D to begin with the 2008–09 hunting season. Most of the rationale for these proposed new drawing hunts was discussed in the earlier chapter on subunit 13D in this report.

To provide better distribution of hunters and hunting pressure in the 14A portion of the Chugach Range, we recommend the area be divided into 3 drawing areas within the subunit. Each area would have an early and a late season. This will result in 6 different hunts. The hunts can further be divided into resident and nonresident drawings, allowing for up to 12 separate drawing permit hunts. This will redistribute hunting pressure (real and perceived) and harvest, allowing the department to maximize the number of drawing permits possible for the subunit without concentrating hunters in time and space, which will be beneficial given the limited number of access points. The result should be fewer overcrowding complaints and reduction of guide and transporter conflicts at the same access points.

It has been difficult to maintain a harvest of 120 full-curl or larger rams in the Chugach Range in recent years and this level of harvest most likely will not be possible anytime soon under the draw hunt scenario. Therefore the appropriate option is to abandon the hard target goal of 120 full curl or larger rams per year for the entire Chugach Range. Instead management efforts should establish harvest objectives for each subunit within the Chugach drawing areas (subunits 13D, 14A, and 14C). We recommend a harvest objective of 20 rams for subunit 14A.



Additionally, we are considering objective language that allows for no more than 50 percent of the rams harvested to be full curl or larger. This will address the concern about excessive harvest pressure on the oldest age class rams. It will also allow for flexibility within the harvest objective to adjust permit levels for harvest of the oldest rams based on the most recent survey information.

Based on the earlier discussion of future management objectives in the subunit 13D chapter, we recommend similar standards relative to recent management issues, public comments, and proposed solutions to sheep management in the central Chugach Mountains. For subunit 14A we recommend a future management objective of providing a quality sheep hunting experience with opportunity to take a trophy ram while maintaining the genetic diversity of the population. This is a desirable objective given the recent discussions of those interested in sheep management in subunits 13D and 14A. Also, this should be a realistic and attainable management objective that will provide the basis for future management strategies that are implemented in subunit 14A.

## **UNIT 14C**

### **BACKGROUND**

Large numbers of miners, railroad workers, and market hunters probably significantly reduced 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<sup>2</sup> 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 20<sup>th</sup> 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 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  $\frac{3}{4}$ -curl rams was further restricted to  $\frac{7}{8}$ -curl rams in 1979. This regulation remained in effect for 10 years. Because of increasing demand for sheep hunting in Unit 14C, a drawing permit was instituted in 1982 to maintain the number of large rams and aesthetic 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. Since 1996, the bag limit for non-archery drawing permit hunts have allowed the taking of either a full-curl ram or ewe, or have been ewe-only hunts.

## **MANAGEMENT DIRECTION**

### **MANAGEMENT OBJECTIVE**

Maintain a minimum harvest of 120 full-curl or larger rams throughout the entire Chugach Mountain Range.

## **METHODS**

Activities accomplished for regulatory years (RY) 2004–2006 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 2004 only.

Mandatory sheep sealing began in the 2004–05 season. Horns were measured, age was noted, and a permanent plug was placed in one of the horns. Plans are to begin collecting additional data on sheep horn growth and age starting in 2007. These additional sheep horn measurements will be taken to evaluate size, mass, and annual growth characteristics relative to age and location of harvest.

## **RESULTS AND DISCUSSION**

### **POPULATION STATUS AND TREND**

#### *Population Size*

The sheep population in Unit 14C has declined steadily since the late 1990s, from an estimated high of 2400 sheep in 1998 to a low of 1201 sheep counted in 2004 (Table 11). The overall population decline during the reporting period has been primarily attributed to severe snow and ice conditions for several consecutive winters. Notably, the winters of 2003–04 and 2006–07 were characterized by deep snow and severe ice, respectively, which may have significantly impacted sheep survival.

### *Population Composition*

Since 2002, the percentage of full-curl and larger rams observed in Unit 14C increased from 5 to 8% of all observed sheep (Table 11). However, it is important to note that the number of full-curl rams reported is a minimum count. When conducting aerial composition counts, full-curl rams are reported conservatively. Therefore, some of the rams reported as being less than full curl were probably full curl under the regulatory definition.

The percentage of lambs has ranged from 9 to 14%, which probably reflects inclement winter conditions. Numbers of ewes and yearling rams remain relatively high, slightly over one-half of the total population. However, since no surveys were conducted during 2005 and 2006, it is difficult to further assess the current population trend.

### *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. Closed areas in Unit 14C, such as the Anchorage Hillside, and areas with very little hunting pressure (i.e. no more than 2 permits a year), including Falls and Indian Creek drainages, support the highest sheep densities, followed by Ship Creek 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.

## **MORTALITY**

### *Harvest*

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

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

Board of Game Actions and Emergency Orders. In 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. In March 2005, with Board approval, the department exercised its discretionary authority to create an additional hunt for either 1 full curl or 1 ewe by drawing permit only. This new hunt area encompassed three areas, including the west side of Indian Creek drainage, the south side of Eagle River Valley, and Ram Valley on the north side of Eagle River.

Hunter Harvest. Total harvests of sheep in Unit 14C for this reporting period were: 70 (2004–05), 56 (2005–06), and 46 (2006–07; Table 12). The number of hunters has ranged from 229–256 in Unit 14C during the reporting period (Table 13). Illegal harvest is unknown; however, due to the popularity of Unit 14C for many user groups, it is unlikely that much illegal harvest occurs.

Permit Hunts. During this reporting period, between 344 and 375 drawing permits, including 135 archery-only drawing permits, were issued annually in Unit 14C (Table 12). The number of permits issued was reduced to 344 in 2005–06, 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 2004 to 2006 ranged from 20% to 27%. Total annual harvest has declined since the beginning of the reporting period; however, this decline is a direct result of permit reduction in 2005 (Table 6).

Hunter Residency and Success. During the reporting period, nonresident hunters took 37 sheep (21%) out of 173 harvested in Unit 14C (Table 13). Sixty-five percent (113 of 173) of successful hunters in Unit 14C were local residents.

Transport Methods. The primary method of transport used by sheep hunters in Unit 14C was highway vehicle, due to motorized access restrictions in Chugach State Park and proximity of roads (Table 14).

#### *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.

## **CONCLUSIONS AND RECOMMENDATIONS**

The sheep population in Unit 14C ranged from 2200–2600 during the mid 1990s and early 2000s, reaching a population high in 1998. Since 2002, sheep numbers in 14C have been declining steadily. This decline has been attributed primarily to several severe winters; however, other variables undoubtedly impact the population as well. An incomplete population survey conducted in 2007 resulted in only 904 total sheep counted, compared to 1343 sheep counted in the same areas in 2004. Although no surveys were conducted in 2008, it is probable that the population numbers are currently more depressed due to various melt-freeze cycles during the

winter of 2007–08. As a result of this apparent decline, we have systematically been reducing ewe hunt permits since 2005. For the upcoming 2009–10 regulatory year, we have used our discretionary authority to eliminate all ewe hunts within Unit 14C. We see this as a prudent measure to reduce overall mortality and to bolster production in the 14C sheep population. It is our intent to reestablish ewe hunts when we feel the population can again sustain them.

Due to declines in sheep numbers in Units 14A and 13, the majority of hunting for these areas has been converted to drawing hunts. A harvest objective for the entire Chugach Mountain range of 120 full curl rams is no longer sustainable. We recommend new independent management objectives for Units 14C, 14A, and 13D. For Unit 14C, we recommend the following management objective: To maintain a harvest in Unit 14C of at least 30 full curl rams. This harvest objective is based on available full-curl sheep and the need to address hunter overcrowding issues. Prior to 2005, hunter overcrowding significantly reduced hunt quality and success rates.

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TABLE 1 Chugach Mountains, Unit 13D sheep composition counts and estimated population size, 2002–2008

Regulatory year	Rams		Ewes <sup>b</sup>	Lambs (%)	Total sheep observed	Minimum estimated population size <sup>i</sup>
	Full curl (%) <sup>a</sup>	Sublegal				
2002–03 <sup>c</sup>	38 (6)	105	357	140 (22)	640	1581
2003–04 <sup>d</sup>	29 (5)	113	355	108 (18)	605	1581
2004–05 <sup>e</sup>						
2005–06 <sup>e</sup>						
2006–07 <sup>f</sup>	42 (4)	141	597	228 (23)	1008	1415
2007–08 <sup>g</sup>	21 (2)	190	584	184 (19)	979	1163
2008–09 <sup>h</sup>	36 (5)	110	401	163 (23)	710	1283

<sup>a</sup> Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed.

<sup>b</sup> Includes yearlings of both sexes and some rams ¼-curl or less.

<sup>c</sup> Count Areas 16–18 and the TCUA (count areas 11, 12, and 13).

<sup>d</sup> Count Areas 1–5.

<sup>e</sup> No survey conducted.

<sup>f</sup> Count Areas 1–5, 7, 9, and the TCUA.

<sup>g</sup> Count Areas 1–3, 7, 9, and 16–18.

<sup>h</sup> Count Areas 1, 2, 16–18, and the TCUA.

<sup>i</sup> These minimum population estimates reflect the sum of the most recent counts for every count area; sightability correction factors not applied. No extrapolations were made for the small portion of the subunit not included in count areas.

TABLE 2 Chugach Mountains, Unit 13D sheep harvest, 2002–2007

Regulatory year	Rams	Average horn length (in) of rams	% of horn length $\geq 40$ in	Ewes	Total sheep
2002–03	57	35.2	4	0	57
2003–04	73	36.6	8	0	73
2004–05	69	36.4	10	0	69
2005–06	52	37.5	13	0	52
2006–07	34	37.1	15	0	34
2007–08	36	36.3	11	0	36

TABLE 3 Chugach Mountains, Unit 13D sheep hunter residency and success, 2002–2007

Regulatory year	Successful				Unsuccessful				Total <sup>b</sup> hunters
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%) <sup>b</sup>	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%) <sup>b</sup>	
2002–03	2	26	28	57 (31)	12	98	17	128 (69)	185
2003–04	4	27	41	73 (38)	12	93	12	119 (62)	192
2004–05	3	27	35	69 (38)	14	76	16	112 (62)	181
2005–06	2	18	31	52 (34)	7	72	19	99 (66)	151
2006–07	0	13	20	34 (24)	12	78	20	110 (76)	143
2007–08	0	13	22	36 (20)	14	121	10	146 (80)	182

<sup>a</sup> Local means residents of Unit 13.<sup>b</sup> Total may exceed sum because some hunters fail to report residency.



TABLE 4 Chugach Mountains, Unit 13D sheep harvest chronology percent by harvest period, 2002–2007

Regulatory year	Harvest periods						<i>n</i>
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
2002–03	46	16	12	16	5	5	57
2003–04	42	13	13	13	13	8	72
2004–05	39	16	20	9	13	3	69
2005–06	52	15	17	8	0	8	52
2006–07	64	15	15	3	3	0	33
2007–08	40	23	11	11	6	9	35

25 TABLE 5 Chugach Mountains, Unit 13D sheep harvest percent by transport method, 2002–2007

Regulatory year	Percent of harvest							<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	
2002–03	40	16	13	13	0	0	18	55
2003–04	66	7	7	5	0	0	15	73
2004–05	72	4	7	3	0	1	12	67
2005–06	79	2	6	6	0	0	8	52
2006–07	67	0	6	0	0	0	27	33
2007–08	69	0	3	11	0	0	17	36

TABLE 6 Chugach Mountains, 14A sheep composition counts and estimated population size, 1999–2007

Regulatory Year	Full Curl(%) <sup>a</sup>	Sublegal	Ewes <sup>b</sup>	Lambs(%)	Total sheep observed	Estimated population size
1999-00 <sup>c</sup>						
2000-01 <sup>c</sup>						
2001-02 <sup>c</sup>						
2002-03 <sup>c</sup>	19(2)	257	469	121(14)	866	900-1000
2003-04 <sup>c</sup>						
2004-05 <sup>d</sup>	15 (3)	120	262	105 (21)	502	
2005-06 <sup>c</sup>						
2006-07 <sup>c</sup>	26(4)	141	338	139(22)	644	700-800

<sup>a</sup> Does not include an unknown number of legal rams at least 8 years old with less than full curl horns or with both horn tips broomed.

<sup>b</sup> Ewes include yearlings of both sexes and rams of ¼ curl or less.

<sup>c</sup> No survey conducted.

<sup>d</sup> Only a partial survey conducted.

TABLE 7 Chugach Mountains, Unit 14A sheep harvest, 1997–2007

Regulatory Year	Average	Total Rams <sup>a</sup>	Horn Length (inches)	% $\geq$ 40 in.	Ewes	sheep
1997–98		22	37.2	22.7	0	22
1998–99		21	34.9	0.0	0	21
1999–00		24	35.6	0.0	0	24
2000–01		21	35.8	0.0	0	21
2001–02		19	35.8	10.5	0	19
2002–03		20	34.5	0.0	0	20
2003–04		22	35.9	4.5	0	22
2004–05		32	36.1	3.1	0	32
2005–06		27	36.6	11.1	0	27
2006–07		35	36.0	2.9	0	35

<sup>a</sup> Includes only rams for which horn length was reported.

TABLE 8 Chugach Mountains, Unit 14A sheep hunter residency and success, 1997–2006

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident <sup>a</sup>	Nonlocal resident	Nonresident	Total (%)	Local resident <sup>a</sup>	Nonlocal resident	Nonresident	Total (%)	
1997–98	14	1	8	23 (21)	82	0	3	85 (79)	108
1998–99	13	1	8	22 (18)	91	4	3	98 (82)	120
1999–00	14	1	8	23 (19)	90	1	6	97 (81)	120
2000–01	16	1	3	20 (18)	84	4	3	91 (82)	111
2001–02	11	0	7	18 (18)	74	2	6	82 (82)	100
2002–03	15	1	4	22 (21)	76	2	6	84 (79)	106
2003–04	12	1	9	22 (21)	76	0	5	81 (79)	103
2004–05	15	3	13	31 (28)	76	0	4	80 (72)	111
2005–06	9	1	19	29 (28)	63	0	11	74 (72)	103
2006–07	5	3	16	24 (19)	83	0	17	100 (81)	124

<sup>a</sup> Local means residents of game management unit 14.

TABLE 9 Chugach Mountains Unit 14A sheep harvest chronology percent by harvest period, 1997–2006

Regulatory year	Harvest periods						<i>n</i>
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
1997–98	48	5	14	10	5	19	21
1998–99	38	19	19	14	5	5	21
1999–00	33	17	13	21	4	13	24
2000–01	60	5	15	0	5	15	20
2001–02	58	11	0	5	11	16	19
2002–03	30	15	10	35	0	10	20
2003–04	32	18	14	14	9	14	22
2004–05	56	19	3	9	3	9	32
2005–06	44	15	7	19	7	7	27
2006–07	57	9	13	9	13	0	23

TABLE 10 Chugach Mountains Unit 14A sheep harvest percent by transport method 1997–2006

Regulatory year	Percent of harvest							<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unknown	
1997–98	59	5	5	23	0	9	0	22
1998–99	43	0	29	5	0	19	5	21
1999–00	38	0	17	17	4	25	0	24
2000–01	14	10	10	24	14	29	0	21
2001–02	44	6	17	17	0	11	6	18
2002–03	55	0	5	30	0	10	0	20
2003–04	68	5	9	14	0	5	0	22
2004–05	59	3	3	25	0	9	0	32
2005–06	70	7	4	7	4	7	0	27
2006–07	64	5	9	23	0	0	0	22

TABLE 11 Chugach Mountains, Unit 14C aerial sheep composition counts, 2002–2007

Regulatory year	Rams		Ewes <sup>a</sup>	Lambs (%)	Total sheep observed <sup>b</sup>
	≥ full curl (%)	<full curl			
2002–03	85 (5)	475	865	153 (9)	1654
2003–04	126 (7)	487	970	274 (14)	1892
2004–05	92 (8)	307	635	149 (12)	1201
2005–06 <sup>c</sup>					
2006–07 <sup>c</sup>					

<sup>a</sup> Includes yearlings of both sexes and rams of ¼ curl or less.

<sup>b</sup> Total includes unclassified sheep.

<sup>c</sup> No survey conducted.

TABLE 12 Chugach Mountains, Unit 14C sheep harvest data by permit hunt, 2002–2007

Hunt Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Rams	Horn length (inches) <sup>a</sup>	% Rams $\geq$ 40 in.	Ewes (%)	Unk	Total harvest
57	DS121-122, 124-129	2002–03	71	24	74	26	36.3	0	4 (29)	0	14
		2003–04	46	43	62	38	37.9	20	5 (50)	0	10
	Northeast, East Eklutna	2004-05	46	32	65	32	38.1	29	3 (30)	0	10
		2005-06 <sup>a</sup>	22	32	87	13	38.7	50	0	0	2
		2006-07	22	45	67	33	37.9	0	0	0	4
	DS111-112, 130-135	2002–03	86	15	71	29	35.1	0	5 (23)	0	21
		2003–04	70	20	67	33	35.8	10	8 (44)	0	18
	Northwest, Upper Eagle River	2004-05	70	23	54	46	35.9	0	12 (48)	0	25
		2005-06	66	24	62	38	35.4	0	13 (68)	0	19
		2006-07	66	24	86	14	33.6	0	4 (57)	0	7
	DS117-118, 136-138	2002–03	53	8	57	43	36.0	8	8 (38)	0	21
		2003–04	53	20	60	40	36.8	10	7 (41)	0	17
	Southwest	2004-05	53	17	64	36	35.5	10	6 (38)	0	16
		2005-06	50	28	56	44	38.0	13	5 (31)	0	16
		2006-07	50	24	61	39	35.6	0	7 (47)	0	15
	DS119-120, 139 <sup>g</sup>	2002–03	70	33	77	23	35.8	0	4 (36)	0	11
		2003–04	70	27	69	31	37.0	0	10 (63)	0	16
	West (late season --rifle)	2004-05	70	27	78	22	38.2	20	6 (55)	0	11
		2005-06	70	26	75	25	36.5	11	2 (15)	0	13
		2006-07	70	19	75	23	36.6	10	2 (15)	0	13
	DS140 West (late season --archery)	2002–03	100	28	89	11	28.5	0	1 (13)	0	8
		2003–04	100	37	87	13	28.1	0	0	0	8
		2004-05	100	52	88	10	28.3	0	1 (20)	0	5
		2005-06	100	34	89	9	33.6	0	1 (17)	0	6
		2006-07	100	55	93	7	35	0	1 (33)	0	3

TABLE 12 continued

Hunt Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters <sup>b</sup>	Percent successful hunters	Rams	Horn length (inches) <sup>a</sup>	% Rams $\geq$ 40 in.	Ewes (%)	Unk	Total harvest
DS141	2002–03	35	29	80	20	4	35.2	0	1 (20)	0	5
West Eklutna (archery)	2003–04	35	43	95	5	1	36.3	0	0	0	1
	2004–05	35	26	92	8	1	35.9	0	1 (50)	0	2
	2005–06	35	46	95	0	0	---	---	0	0	0
	2006–07	35	34	87	9	2	37.1	0	0	0	2
Governor's Permit	2002–03	1	0	0	100	1	35.8	0	0	0	1
	2003–04	1	100	--	--	--	--	--	--	--	--
	2004–05	1	0	0	100	1	42.6	100	0	0	1
	2005–06	1	0	100	0	0	---	---	0	0	0
	2006–07	1	0	0	100	1	41.8	100	0	0	1
DS123	2006–07	1	0	0	100	1	38.3	0	0	0	1
Total all hunt areas	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
	2004–05	375	32	72	27	41	35.8	12	29 (41)	0	70
	2005–06	344	31	76	23	35	36.4	11	21 (38)	0	56
	2006–07	345	34	79	20	32	36.4	9	14 (30)	0	46

<sup>a</sup> No permits issued for DS121 and DS122.

<sup>b</sup> Sum of percent successful and unsuccessful hunters may not equal 100% because some hunters fail to report.

TABLE 13 Chugach Mountains, Unit 14C sheep hunter residency and success, 2002–2007

Regulatory year	Successful				Unsuccessful				Total hunters
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%) <sup>b</sup>	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%) <sup>b</sup>	
2002–03	61	8	12	81 (25)	200	32	9	241 (75)	322
2003–04	60	5	6	71 (28)	165	13	5	186 (72)	257
2004–05	48	6	16	70 (27)	152	27	7	186 (73)	256
2005–06	43	8	5	56 (24)	150	26	6	182 (76)	238
2006–07	22	9	16	47 (20)	143	27	12	182 (80)	229

<sup>a</sup> Local means residents of Unit 14C.<sup>b</sup> Total may exceed sum because some hunters fail to report residency.

TABLE 14 Chugach Mountains, Unit 14C sheep harvest percent by transport method, 2002–2007

Regulatory year	Percent of harvest									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	
2002–03	6	5	4	10	0	2	60	10	2	81
2003–04	4	6	1	8	0	1	70	4	4	71
2004–05	4	6	0	9	0	0	73	7	1	70
2005–06	9	5	0	4	0	0	48	34	0	56
2007–08	4	9	2	4	0	0	60	21	0	47



**WILDLIFE  
MANAGEMENT REPORT**

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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNIT:** Portions of 12 (10,000 mi<sup>2</sup>)

**GEOGRAPHIC DESCRIPTION:** Mentasta, Nutzotin, and northern Wrangell Mountains

**BACKGROUND**

The Dall sheep population in the northern Wrangell, Mentasta, and Nutzotin (WMN) Mountains 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, by maintaining the general hunt structure using a full-curl harvest strategy.
- Annually harvest most of the legal rams available throughout the area.
- Provide for diversified recreational uses of wildlife, including the opportunity to view and photograph Dall sheep under natural conditions.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

## **RELATED MANAGEMENT ACTIVITY**

- Monitor harvest through hunter contacts and harvest reports.

## **METHODS**

We monitored harvest by analyzing data from general harvest reports including harvest success, hunt area, hunter participation rate, residence, effort, transportation type used to access the hunt area, horn size, and ram age. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY04 = 1 Jul 2004 through 30 Jun 2005).

We estimated population composition by conducting aerial surveys in the Wrangell–St Elias Preserve between the Nabesna and Chisana Rivers south of Cooper and Notch Creeks (Count areas 4W and 4E), between the Nabesna and Chisana Rivers north of Cooper and Notch Creeks (Count Areas 5W and 5E), east of Snag and Carl Creeks to the Yukon, Canada border north of Beaver Creek (Count Areas 7W and 7E), and in the Nutzotin Mountains south of Beaver Creek to the White River and east of Solo and Flat Creeks to the Yukon, Canada border (Count Area 9) (Fig. 1). Additional results from surveys in the Nutzotin and Mentasta Mountains preceding this report period (Tables 1 and 2) were included to better analyze population and composition trends in Unit 12. Piper Super Cubs were used to conduct all surveys. We classified sheep as rams, ewes, or lambs based on horn size and body conformation. Ewes included young rams ( $\leq 1/2$ -curl) that could not be distinguished from ewes. Rams were also classified as either legal (full curl or both horns broomed) or sublegal ( $> 1/2$ -curl but less than full curl).

## **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. From 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 (Tables 1 and 3). Aerial surveys in the Nutzotin Mountains between the Chisana River and the Canada border suggest a local decline in sheep numbers and lamb production from 2002 to 2005 (Table 2). Investigators, guides, and local, long-term residents also believe the number of Dall sheep in Unit 12 has declined since the late 1990s.

The role of predators as a limiting factor during RY04–RY06 is unknown, but based on studies conducted elsewhere, it may have been significant. Coyotes are important predators on lambs (Scotton 1998), and local residents have observed coyotes killing older sheep. A Dall sheep mortality study 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<sup>2</sup> but were not found to be a significant predator (Sumanik 1987).

Relatively mild climate conditions during 1994 and 1995 and incidental sightings (Gardner 1999) indicated that lamb production was as high as 25 lambs:100 ewes. Surveys 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 then stabilized or declined and remained relatively low despite mild winters during RY04–RY06 (Table 2).

### *Population Composition*

Composition data are not directly comparable between years because different areas were sampled each year (Tables 1–3). Lamb abundance was low (9–19 lambs:100 ewes) during 1990–1993, 2001 and 2002 in many count areas, and moderate to high in all areas during 1997 and 1998. During RY04–RY06, lamb abundance appeared to be high and varied between 24 and 43 lambs:100 ewes among areas surveyed.

No adult mortality data have been collected in this area. The number of legal rams was low, possibly due to low lamb survival in RY99 and RY00. However, the abundance of sublegal rams in the population suggests that this phenomenon was short-lived. Survey data collected in the eastern Wrangell Mountains (Table 2) indicate that the number of ewes was reduced between 1981 and 2001, but we do not know when the decline occurred. Ewe numbers increased in the only count area (7W) surveyed in 2002, but then declined in this area by 2005. Comparison of population composition data in the Nutzotin Mountains (Count Area 9) indicates that total sheep counted, percent lambs, and lambs:100 ewes were lower in 2002 and 2005 than in 1981. However, the ratios of legal and sublegal rams:100 ewes were substantially higher (Table 2). This suggests that harvest rates of legal sheep and/or lamb productivity were low during the report period.

Weather, predation, and harvest management directly influence annual population composition (Heimer 1988). During RY04–RY06, we observed ratios of 6–19 legal rams:100 ewes, 24–43 lambs:100 ewes, and 14–23% lambs in the portions of the population counted.

Based on survey and harvest data, weather is the primary factor limiting lamb production, ram numbers, and population growth. During the early 1980s, winters were mild and lamb production was high ( $\geq 30$  lambs:100 ewes; Table 1). Survey data collected during 1998–2002 show relatively high numbers of sublegal rams, indicating those lamb cohorts had a high survival rate. However, a subsequent increase in the numbers of legal rams was not observed in 2005.

The effects of predation on sheep composition in the WMN Mountains are unknown. Incidental sightings indicate coyote predation can be important when coyote numbers are high. Based on trapper reports, coyote numbers increased substantially during 1997–2000 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 (C. L. Gardner, ADF&G unpublished data, Fairbanks), 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). Snowshoe hare populations in Unit 12 may again be at peak levels. Although coyote predation may not have been a significant factor limiting the sheep population in RY02 and RY03, it may become increasingly important as hare numbers peak and crash in the near future.

### *Distribution and Movements*

Information on distribution and movements of Dall sheep within Unit 12 are limited. Kelleyhouse and Heimer (1989) reported that Dall sheep occur in steep terrain throughout the WMN Mountains primarily near *Dryas*-dominated feeding areas at 4000 to 7000 ft elevation. Although small mineral licks occur throughout the area, 3 large mineral licks located in Lost Creek, Sonya Creek, and East Fork Snag Creek concentrate sheep during summer months. During winter, most sheep concentrate on windswept alpine ridges, but snow accumulation occasionally forces sheep to brush fields at lower elevations. There are no data to indicate distribution and movements have changed since that time.

## **MORTALITY**

### *Harvest*

Season and Bag Limit. The sheep hunting season for residents and nonresidents was 10 August–20 September with a bag limit of 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 passed a proposal requiring sheep horns to be sealed in most areas of the state. Starting in RY06, horns of all Dall sheep legally harvested in Unit 12 have been sealed using a uniquely numbered aluminum plug. No emergency orders were issued during RY04–RY06.

Harvest by Hunters. During RY04–RY06, 287–353 hunters ( $\bar{x} = 316$ ) reported taking 125–152 sheep ( $\bar{x} = 140$ ; Tables 4 and 5), a slight increase from RY01–RY03 in both hunter participation and harvest. Since RY92, harvest has declined 21% and hunter participation declined by 23%. 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 RY93 to RY01, which resulted in declining hunter success and interest. Based on surveys (Table 2), the number of legal rams increased during RY01–RY03 but may have decreased slightly during RY04–RY06. Additional surveys in the same areas each year are needed to fully assess the effects of harvest on numbers of legal rams and the population composition in the WMN Mountains.

Mean horn length was 34.7 inches during RY04–RY06. Mean horn size has changed little since RY96, and both the 5- and 10-year averages were 34.6 inches (Table 5). During RY04–RY06, 7 rams had horns  $\geq 40$  inches (1.7%). The mean reported age of harvested rams was 8.4 years during RY04–RY06. The previous 3-year average was 8.6 years. In comparison, in the Tok Management Area just north of the WMN Mountains, the percentage of the harvested rams with horns  $\geq 40$  inches normally exceeds 10%, and the average annual age of harvested rams ranges between 8.9 and 10 years.

Similar to previous reporting periods, areas within the WMN Mountains that produced the largest rams ( $\geq 38$  inches) were along the Nabesna Glacier, Cheslina River, Snag Creek, and the upper Tetlin River. The Tetlin River is within Tetlin Native Corporation lands and was closed to most hunting, except by Tetlin Native Corporation shareholders. The other areas were difficult to access.

Hunter Residency and Success. The overall success rate of 45% during RY04–RY06 was similar to the average of 46% in RY01–RY03, and a slight improvement over the 40% success reported in RY98–RY00 (Table 4). Nonresident success rates (76–79%) were much higher than resident success rates (30–35%) during RY04–RY06. The primary reasons nonresidents had higher success rates were that most nonresidents were guided and hunted in the highest density sheep areas in 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 RY04–RY06, nonresidents made up an average of 26% of the sheep hunters and were responsible for taking an average of 46% of the annual harvest.

Harvest Chronology. Most sheep were taken early in the hunting season (Table 6). During RY04–RY06, 33–44% ( $\bar{x} = 37\%$ ) of the harvest was taken during the first week of the season. Harvest decreased dramatically to an average of 15% during the next 3 weeks, 6% during the fifth week, and 9% of rams were harvested during the final week of the season.

Transport Methods. During RY04–RY06, airplanes and horses were used by 64–83% of successful hunters (Table 7). The average success rates for hunters who used aircraft and horses were 51% and 87%, respectively. Success rates for nonresidents were much higher than residents who used these methods (airplanes 72% vs. 40%; horses 90% vs. 71%) because most nonresidents were guided and hunted the better quality areas. Eighty-one percent of successful hunters who used horses were nonresidents. Annually during RY04–RY06, 14–30% of successful hunters used 4-wheelers, other ORVs, or highway vehicles to access sheep habitat. Hunters who used 4-wheelers and other ORVs averaged 23% success, and hunters who used highway vehicles averaged 31% success. These transportation methods were primarily used by resident hunters ( $\bar{x} = 94\%$ ).

### *Other Mortality*

We did not conduct studies during RY04–RY06 to determine changes in the rate or type of natural mortality compared to those reported by Kelleyhouse and Heimer (1989), who noted predation by golden eagles, coyotes, and wolves. Predation is likely the greatest source of natural mortality operating on this population, but it does not appear to have been responsible for any measurable decline in Dall sheep numbers within Unit 12.

## **HABITAT**

### *Assessment*

The WMN Mountains are glaciated and offer steep, rugged terrain with excellent escape cover near feeding areas dominated by *Dryas* species. 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 continued to be the most hunted unit in the state for sheep, and both the number of hunters and total harvest increased slightly during RY04–RY06. Hunters in many areas of Unit 12 harvested most of the legal rams available. Increased harvests in the WMN Mountains during report periods RY04–RY06 and 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 these cohorts aged, a greater number of legal rams likely became available to hunters during RY01–RY06. However, aerial surveys conducted in 2005 in the Nutzotin Mountains suggest possible declines in sheep numbers and lamb production. Consistent surveys in regular survey areas are needed to better understand local population fluctuations.

Both numbers of hunters participating in Dall sheep hunts in Unit 12 and their success rates have been reasonably stable during the last 10 years (Fig. 2).

For the next reporting period, the management objective will be:

- Maintain an average horn size on harvested rams of  $\geq 34$  inches during the report period.

Because most of the legal rams available in Unit 12 are harvested each year, monitoring horn size will help determine the possible population level effects of regularly removing all fast growing, large horned rams from the population. No changes in the season or bag limits will be necessary to meet these objectives.

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 offer trips to wildlife viewers.

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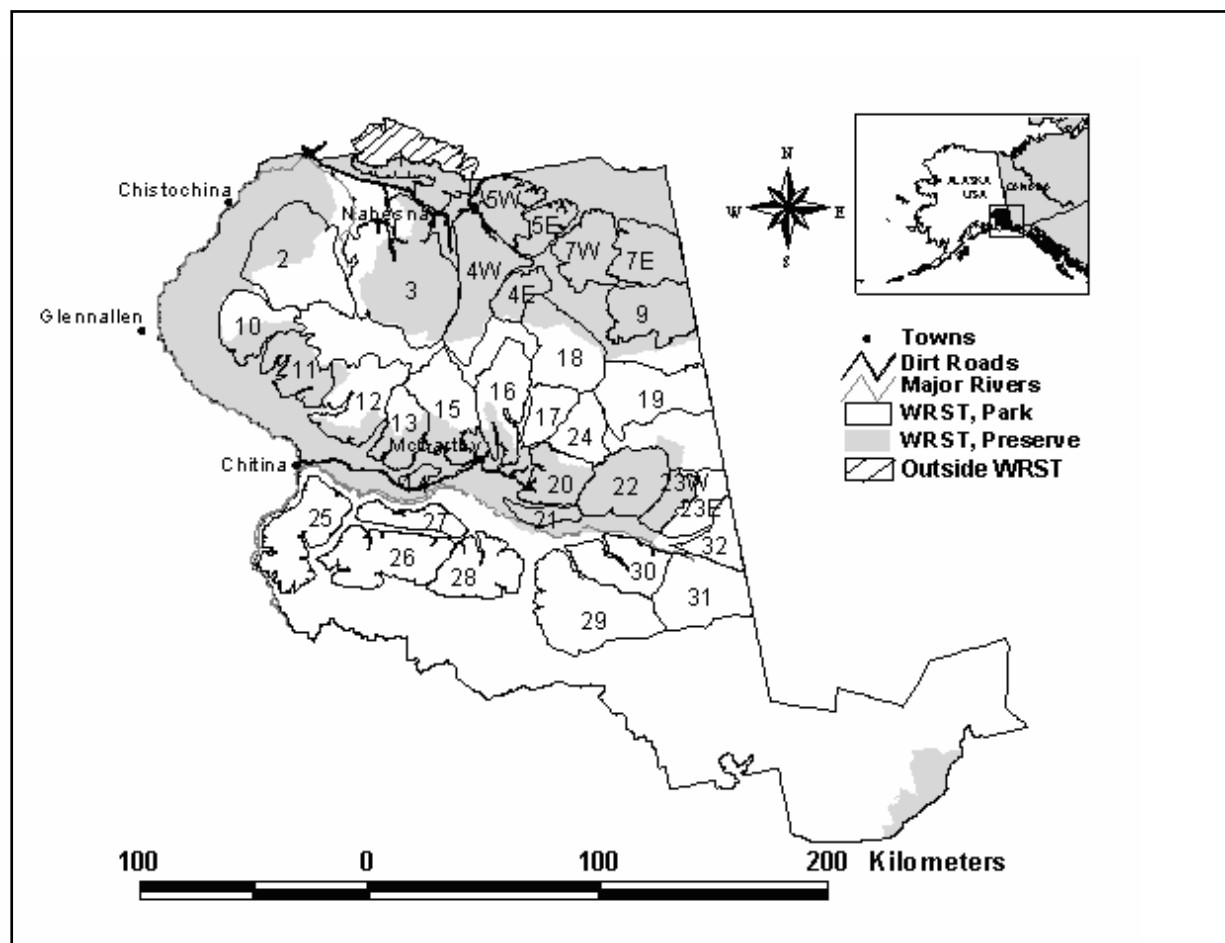


FIGURE 1 Locations of Unit 12 Dall sheep aerial survey units 4E, 4W, 5E, 5W, 7E, 7W, and 9, within Wrangell–St Elias National Park and Preserve (Terwilliger 2005)



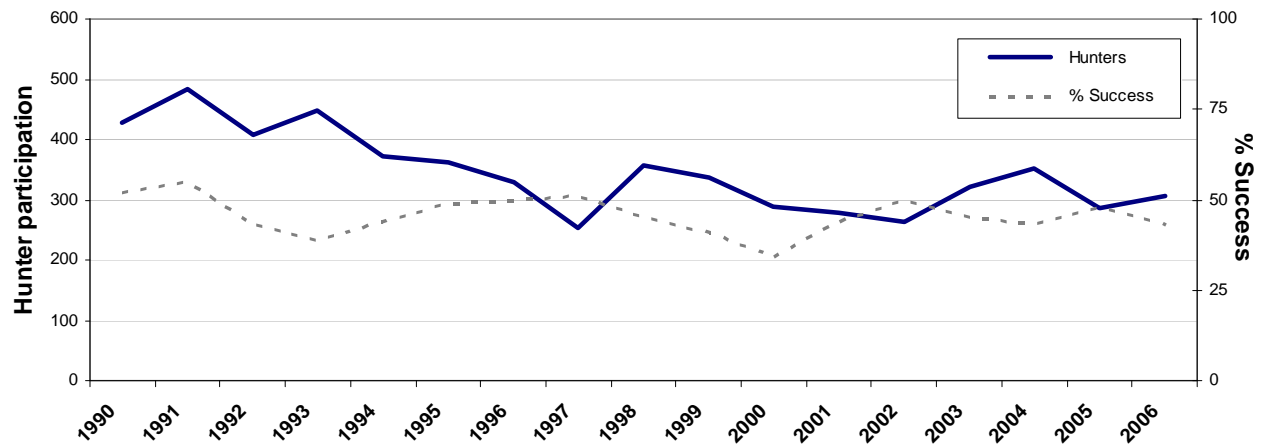


FIGURE 2 Total number of hunters participating in Unit 12 Dall sheep hunts during RY90–RY06, including hunter success rate for each year determined from harvest report cards

TABLE 1 Unit 12 Dall sheep aerial composition counts in the Mentasta Mountains, 1971–1997

Sex/age class	1971 <sup>a</sup>	1973 <sup>a</sup>	1980 <sup>a</sup>	1997 <sup>b, d</sup>	1997 <sup>c, d</sup>
Legal rams	78	141	112	70	47
Sublegal rams <sup>e</sup>	10	106	185	97	246
Unclassified rams	22	19	10	0	0
Total rams	110	266	307	167	293
Ewes <sup>f</sup>	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	2	20	25	14	30
Total rams:100 ewes	20	50	41	24	36
Lambs:100 ewes	25	8	47	28	27
Lambs % of total <sup>g</sup>	17	4	23	19	17

<sup>a</sup> Legal size ram is  $\geq 3/4$  curl.

<sup>b</sup> Subset of total area surveyed in 1997 to be consistent with counts conducted during 1971–1980.

<sup>c</sup> Counts reflect sheep observed in entire 1997 survey area.

<sup>d</sup> Legal ram is  $\geq$  full curl.

<sup>e</sup> Greater than  $1/4$  curl but less than legal size.

<sup>f</sup> Ewe classification also includes yearlings of both sexes and rams of  $1/4$  curl or less.

<sup>g</sup> Percentage of total of all sheep.

TABLE 2 Unit 12 Dall sheep aerial composition counts in the Wrangell Mountains and Nutzotin Mountains, 1981, 2001, 2002, 2005, 2006, and 2007

	Year	Legal rams <sup>a</sup>	Sublegal rams <sup>b</sup>	Unclassified rams	Total rams	Ewes <sup>c</sup>	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 Area 4E	2006	7	24	0	31	65	25	0	90	121	11	37	48	38	21
Count Area 4W	2006	42	89	3	134	315	136	0	451	585	13	28	43	43	23
Count Area 5W	2007	40	83	0	123	209	66	0	275	398	19	40	59	32	17
Count Area 5E <sup>d</sup>	1981	84	243	0	327	698	234	0	932	1259	12	35	47	34	19
	2001	54	207	0	261	516	90	0	606	867	11	40	51	17	10
Count Area 7W <sup>d</sup>	1981	15	210	21	246	511	140	51	702	948	3	41	48	27	15
	2001 <sup>e</sup>	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
	2005	26	100	0	126	260	63	0	323	449	10	38	48	24	14
Count Areas 5E and 7W combined <sup>d</sup>	1981	99	453	21	573	1209	374	51	1634	2207	8	38	47	31	17
	2001	79	295	0	374	669	123	0	792	1166	12	44	56	18	11
Count Area 7E	2007	14	87	1	102	248	62	0	310	412	6	35	41	25	15
Count Area 9 <sup>f</sup>	1981	9	110	136	255	682	249	0	931	1186	1	16	37	37	21
	2002	40	194	0	234	358	125	18	501	735	11	54	65	35	17
	2005	30	179	5	214	436	107	0	543	757	7	41	49	25	14

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

TABLE 3 Unit 12 Dall sheep aerial composition counts<sup>a</sup> within Wrangell–St Elias National Preserve, 1991–1998

Sex/age class	1991	1992	1993	1998 (East)	1998 (West)
Legal rams <sup>b</sup>		31	111	22	34
Sublegal rams <sup>c</sup>		140	544	110	117
Unclassified rams		30	0	0	0
Total rams	174	201	655	132	151
Ewes <sup>d</sup>	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

<sup>a</sup> Data from National Park Service.

<sup>b</sup> Full curl or larger.

<sup>c</sup> Greater than ¼ curl but less than full curl.

<sup>d</sup> Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 4 Unit 12 sheep hunter residency and success, regulatory years 1990–1991 through 2006–2007

Regulatory year	Successful				Unsuccessful				Total hunters <sup>b</sup>
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total <sup>b</sup> (%)	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total <sup>b</sup> (%)	
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	1	83	62	152 (43)	19	156	20	201 (57)	353
2005–2006	3	65	69	138 (48)	19	109	21	149 (52)	287
2006–2007	3	66	61	131 (43)	14	145	16	176 (57)	307

<sup>a</sup> Resident of Unit 12.<sup>b</sup> Total hunters includes hunters who did not report residency.

TABLE 5 Unit 12 sheep harvest, regulatory years 1990–1991 through 2006–2007

Regulatory year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Total sheep <sup>a</sup>	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	152	34.5	8.2	152	353
2005–2006	134	34.7	8.4	138	287
2006–2007	125	34.9	8.6	131	307

<sup>a</sup> Total sheep includes illegal ewe harvest and unknown sex.

TABLE 6 Unit 12 sheep harvest chronology percent by time period, regulatory years 1990–1991 through 2006–2007

Regulatory year	Harvest chronology percent by time period						<i>n</i>
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
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	42	17	9	14	8	9	144
2004–2005	44	11	16	11	11	7	149
2005–2006	33	26	9	16	5	11	136
2006–2007	33	22	15	12	9	8	130

TABLE 7 Unit 12 sheep harvest percent by transport method, regulatory years 1990–1991 through 2006–2007

Regulatory year	Harvest percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1990–1991	53	21	2	9	0	2	12	1	266
1991–1992	56	22	4	5	0	2	9	3	272
1992–1993	62	27	1	2	0	2	6	1	177
1993–1994	62	24	2	5	0	1	5	2	173
1994–1995	59	20	6	9	0	0	5	1	167
1995–1996	50	27	4	10	0	1	8	1	179
1996–1997	53	26	3	7	0	3	8	0	164
1997–1998	55	23	4	5	0	0	12	1	129
1998–1999	54	25	6	6	0	1	8	0	160
1999–2000	48	26	8	9	0	1	7	1	137
2000–2001	59	20	7	3	0	1	10	0	99
2001–2002	57	20	6	9	0	2	4	2	126
2002–2003	45	23	9	9	0	0	14	1	133
2003–2004	43	31	5	8	0	1	11	1	146
2004–2005	41	23	5	14	0	1	15	1	152
2005–2006	47	27	1	10	0	1	11	2	138
2006–2007	55	28	3	8	0	0	6	0	131





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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNITS:** Portions of Units 12, 13C, and 20D (1500 mi<sup>2</sup>)

**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 (Alaska Department of Fish and Game [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. Low hunter density prevented hunter crowding and competition and resulted in an abundance of legal rams, including rams with horns  $\geq 40$  inches. This management strategy also allowed ADF&G to maintain unrestricted methods of access to the area and for other components of a high-quality hunting experience. A more complete history of management in the TMA is available in Kelleyhouse (1989).

**MANAGEMENT DIRECTION**

**MANAGEMENT GOALS**

- Provide for diversified recreational uses of wildlife.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

- 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.
- Using a full curl harvest strategy, 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 whether the management goals and objectives were met. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY06 = 1 Jul 2006 through 30 Jun 2007).

Population composition and productivity have been periodically estimated in the TMA using aerial or ground survey techniques (Gardner 2002). Aerial composition surveys were conducted in a 990-mi<sup>2</sup> portion of the TMA from mid July through early August in 2006 and 2007 to determine population and composition trends. This area makes up about two-thirds of the available sheep habitat in the TMA and was a considerable increase from the 580-mi<sup>2</sup> surveyed in 2002, 2003, and 2004. Because of differences in the areas surveyed between years, population trends must be viewed with caution.

### **RESULTS AND DISCUSSION**

#### **POPULATION STATUS AND TREND**

##### *Population Size*

We did not obtain a sheep population estimate for the TMA during RY04–RY06. 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 1994–2003 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 survival of Dall sheep lambs in the TMA during 1990–1999. Following favorable weather conditions throughout Interior Alaska from 1994 to 1999 the sheep population in the TMA appeared to increase. However, during winter and spring 1999–2000, weather conditions were severe and sheep numbers stabilized or decreased slightly. From 2001 to 2006, winters were generally mild, while summers were average to dry. However, during winter 2004–2005, deep snow and crusting in late winter and early spring may have impacted sheep and limited population growth in the eastern TMA. Effects of weather are difficult to predict, but based on composition data (Table 1), the overall population appeared to be stable. A more consistent monitoring regime is needed to better understand limiting factors in this population.

### *Population Composition*

Population composition surveys were conducted in July and early August 2004, 2006, and 2007 (Table 1). During RY04–RY06, lamb survival was high and varied between 31–36 lambs:100 ewes (counts of ewes may include some young rams) and lambs composed an average of 20% of the population over these years. High lamb production during RY04–RY06 and the previous report period follows the 30-year low of 10 lambs:100 ewes observed in 2000. During 2000 and 2001, severe winter weather with deep snow prevailing into the lambing period preceded shorter than average growing seasons, which affected sheep populations regionwide. The proportion of the total ram population composed of full-curl rams has been stable since 2002, and averaged 25% during RY04–RY06. Composition data collected during the 1980s indicated that full-curl rams composed  $\geq 36\%$  of the ram population. Despite a reduction in the numbers of permits issued to hunters in 2002, the abundance of full-curl rams has remained relatively low, due to poor overwinter survival in RY99 and RY00, but may increase as rams born in RY01 reach full-curl.

### *Distribution and Movements*

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. During RY04–RY06 we collected no additional data on distribution and movements.

## **MORTALITY**

### *Harvest*

Season and Bag Limit. One-hundred one permits were issued annually in the TMA during RY04–RY06. One permit each year was a Governor’s permit auctioned to raise funds for wildlife research and management in Alaska. The hunting 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  $\geq 8$  years old or those with at least 1 full-curl horn or both horns broken (broomed).

Alaska Board of Game Actions and Emergency Orders. Increasing numbers of nonresident applications, and a larger proportion of permits allocated to nonresident hunters resulted from the ability of applicants to apply on the Internet. In 2006 the Alaska Board of Game (board) passed a proposal which took effect in RY07 that limits the number of nonresident permits issued in the TMA to a maximum of 10%. This ensures that resident hunters continue to have a good chance of receiving these highly valued permits, and addressed concerns of overharvest due to the disproportionately high success rates of guided nonresident hunters.

The board also passed a proposal requiring horns from sheep harvested in most areas of the state to be sealed. Since RY06 all legally harvested Dall sheep horns in the TMA have been sealed with a uniquely numbered aluminum plug. No emergency orders were issued during RY04–RY06.

Harvest by Hunters. During RY04–RY06, annual harvest ranged from 41 to 47 rams ( $\bar{x}$  = 44 rams). The previous 5-year mean harvest was 38 rams (Table 2). Hunter participation averaged 82% during RY04–RY06, compared to 86% during the previous 5 years. Hunter participation has generally increased since 1990, when 72% of permit recipients hunted, to a high of 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 and has since remained high. This was likely a result of favorable weather in RY03 and good lamb recruitment during 1994–1999.

Mean horn length during RY04–RY06 was 36.5 inches compared to the previous 5-year mean of 35.9 inches (Table 3). The average percentage of rams with horn length  $\geq 40$  inches was 14% ( $n = 4-9$ ) of the annual harvest, compared to the previous 5-year mean of 9.2%. Percent of harvested rams with horn length  $\geq 40$  inches was low from RY95 to RY03, but increased during RY04–RY06 to a record high of 22% in RY06. However, no rams with horns  $\geq 43$  inches were taken during RY04–RY06, and average horn size has declined since the early 1990s. Small changes in horn size during RY04–RY06 (Table 3) are inconclusive. Relatively high harvests during RY95–RY99 and poor horn growth due to unfavorable environmental conditions since 2000 may be important factors in the decline. The average reported age of rams harvested during RY04–RY06 was 8.8 years, slightly younger than the previous 5-year mean of 9.0.

Hunter Residency and Success. During RY04, RY05, and RY06, 2931, 2955, and 3426 applicants applied for 100 permits (2.9–3.4% chance of being drawn). Eighty-three percent of participating hunters were Alaska residents, and they took 71% of the harvested rams during RY04–RY06 (Table 4). Eight to 16 nonresidents (9–19% of permittees) were drawn annually during this period compared to the 3–9 hunters (3–8% of permittees) drawn during RY01–RY03. Overall, 95% of the nonresidents who drew a permit participated, compared to 81% of selected residents.

During RY04–RY06 the mean annual success rate was 54% (range 49–59%), substantially above the previous 5-year mean annual success rate of 40% and closer to the mean success rate of 52% seen during RY94–RY98 (Table 4). During RY04–RY06, hunters had the greatest success in RY04 (59%) and spent 3.9 days in the field. On average, successful hunters were in the field 4.3 and 5.0 days during RY05 and RY06, respectively. Favorable weather is frequently the primary reason hunters spend more time hunting during certain years, and more time in the field increases their chance of successfully harvesting a sheep.

Harvest Chronology. Since the inception of the TMA, most sheep harvest occurred during the first 10 days of the hunting season (10–20 Aug). During RY04–RY06, 57% 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 believed they had to be hunting on opening day to take the largest ram.

Transport Methods. Airplanes were the primary means of transport during RY04–RY06 (Table 5). During this report period, 74% of successful hunters used aircraft to access the area and ATV use (10%) was greater than highway vehicle use (9%). Historically, ATVs were not commonly used, but have generally exceeded use of highway vehicles since RY01. During RY04–RY06, the average success rate for hunters who used aircraft was 57%, while success rates were 41% for hunters who used ATVs or highway vehicles.

### *Other Mortality*

Severe winter weather and predation are the most important natural mortality factors for Dall sheep (Murie 1944; Heimer and Watson 1986; Heimer 1988). 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. Consequently, lamb recruitment was low, and data from radiocollared 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 2002–2006 composition surveys, it appears that adult survival and lamb productivity was good during RY01–RY03 as well as RY04–RY06.

The overall limiting effects of wolf, bear, coyote, and golden eagle predation on the TMA sheep population are not known. Dall sheep are not normally a preferred prey of wolves; however, the area's wolf population has increased since 1989 due to increased numbers of caribou during winter. The impacts of this larger population of wolves in the TMA could affect the sheep population, especially when caribou migrate out of the area. Both coyote and golden eagle predation can be important when these predator numbers are high. Based on trapper reports, coyote numbers increased substantially during 1997–2000 due to an increasing snowshoe hare population, but have since declined (Gross 2004). Golden eagle numbers are unknown. 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). Snowshoe hare populations in the TMA are again approaching peak levels. Although coyote predation may not have been a significant factor limiting the sheep population during RY04–RY06, it may become important as coyote numbers increase.

We have not monitored the effects of disease on the TMA population since 1990. At that time, disease was not a limiting factor (K. Beckmen, ADF&G, unpublished data, Fairbanks). One ram killed by a hunter in RY98 and another in RY07 had signs of pneumonia. Severe lung inflammation associated with lungworm was found in one hunter-killed ram in RY05. 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 RY04–RY06. 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 sheep in the TMA. Currently the habitat condition in the TMA is not well understood. Additional studies of possible changes in forage quality and availability are needed to address their potential impact on Dall sheep within the TMA.

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. Mining exploration is ongoing 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 ADF&G's Habitat Division to minimize impacts.

## **NONREGULATORY MANAGEMENT PROBLEMS AND NEEDS**

The TMA was created in 1974 to provide a limited number of Dall sheep hunters the opportunity to harvest large-horned, trophy rams. Trophy sheep were not defined, but the objectives to 1) maintain an average harvest of rams with horns between 36 and 37 inches, and 2) maintain a minimum percentage of rams with horns  $\geq 40$  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). Differences were found between user groups in both the philosophies and definitions of trophy rams and what was acceptable hunting opportunity and hunter crowding. However, over 90% of survey respondents generally supported the current management objectives for maintaining the limited number of drawing permits, limiting harvest to benefit trophy ram management, and preventing hunter crowding. Ninety-eight percent of TMA applicants supported maintaining uncrowded hunting conditions. In 2002 the number of permits offered was reduced from 120 to 101 sheep, to ensure that management objectives continue to be met.

## **CONCLUSIONS AND RECOMMENDATIONS**

Management goals and objectives were met during RY04–RY06. Age of harvested rams and the percentage of harvested rams with horns  $\geq 40$  inches met the minimum harvest management objectives. Although average horn size has declined since the early 1990s, a record number of rams with horns measuring over 40 inches were harvested in RY06. Average horn size during RY04–RY06 was greater than during the previous 5 years, but less than during the early 1990s. The absence of exceptionally large rams harvested in RY04–RY06 may indicate that few rams survived beyond 8 years at the current harvest level. We will continue monitoring both the horn length and public opinion of what constitutes a trophy ram, and will take corrective action if necessary. Although the TMA sheep population generally appears to be stable, greater consistency in areas surveyed are needed for precise estimates of population status and trends.

We met our objective to prevent unacceptable increases in hunter concentration and maintain aesthetically pleasing qualities associated with sheep hunting in the TMA. The number of

permits was reduced in 2002 to address complaints about hunter crowding. This may have also increased the number of full-curl rams over 40 inches, by reducing harvest of younger rams and permitting them to grow larger horns. The number of permits offered was held at 101 throughout this report period, and complaints from hunters were lower in RY04–RY05 than in RY02 when the number of permits was reduced. In RY06 informal complaints about trophy quality and hunter crowding again increased. This resulted in changes to seasons and limits on the number of nonresident hunters beginning in RY08. However, public opinion on trophy quality and the aesthetic importance of an uncrowded hunt have not been adequately quantified since 2000. We recommend surveys of public opinion to reassess the desires of sheep hunters following recent changes in sheep management. In the next report period the objectives will be:

- Using a full-curl harvest strategy, maintain a population that produces a harvest of 30–45 rams with mean horn sizes of at least 36 inches and a mean age greater than 8 years.
- Maintain an average of at least 7% rams with 40-inch or greater horns in the harvest.
- Maintain at least 60% hunter satisfaction with aesthetically pleasing, uncrowded, hunting conditions.

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TABLE 1 Tok Management Area sheep composition counts from aerial surveys, 1980 through 2007

Sex/age class	1980	1994	1999 <sup>a</sup>	2000 <sup>b</sup>	2002	2003	2004	2006	2007
Legal rams <sup>c</sup>	148	123	38	59	85	53	65	56	54
Sublegal rams <sup>d</sup>	263	294	89	144	264	182	153	179	196
Unclassified rams	9	0	38	0	0	0	0	0	0
Total rams	420	417	165	203	349	235	218	235	250
Ewes <sup>e</sup>	922	567	352	402	466	692	593	580	683
Lambs	350	137	110	39	187	224	186	207	245
Unidentified	6	3	0	0	1	7	0	27	0
Total other sheep	1278	707	462	441	654	923	779	814	928
Total sheep	1698	1124	627	644	1003	1158	997	1049	1178
Legal rams:100 ewes	16.1	21.7	10.8	14.7	18.2	7.7	11	9.7	7.9
Sublegal rams:100 ewes	28.5	51.9	25.3	35.8	56.6	26.3	25.8	30.9	28.7
Total rams:100 ewes	45.5	73.5	46.9	49.5	74.9	34	36.8	40.5	36.6
Lambs:100 ewes	38.0	24.2	31.3	9.7	40.1	32.4	31.4	35.7	35.9
Lambs % of total	20.6	12.2	17.5	6.1	18.7	19.3	18.7	19.7	20.8

<sup>a</sup> Surveyed the Robertson and Johnson River drainages only.

<sup>b</sup> Surveyed portions of the Tok River drainage and all of the Front Range from the Glenn Highway to Robertson River.

<sup>c</sup> Full curl or larger.

<sup>d</sup> Greater than 1/4 curl but less than full curl.

<sup>e</sup> Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

TABLE 2 Tok Management Area harvest of Dall sheep rams, regulatory years 1990–1991 through 2006–2007

Hunt no.	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)	38
	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	66	34	35.4	3 (9)	34
	2002–2003	101	13	61	39	36.2	3 (9)	34
	2003–2004	101	10	48	52	35.6	4 (9)	46
	2004–2005	101	21	41	59	36.5	5 (11)	47
	2005–2006	101	16	47	53	36.1	4 (9)	45
	2006–2007	101	17	51	49	36.8	9 (22)	41

TABLE 3 Tok Management Area sheep harvest, regulatory years 1990–1991 through 2006–2007

Regulatory year	Rams	$\bar{x}$ Horn length	Sheep $\geq 40''$ (%)	$\bar{x}$ 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 (14)	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	4 (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	3 (9)	8.7	0	34
2002–2003	34	36.2	3 (9)	8.9	0	34
2003–2004	46	35.6	4 (9)	8.7	0	46
2004–2005	47	36.5	5 (11)	8.4	0	47
2005–2006	45	36.1	4 (9)	8.6	0	45
2006–2007	41	36.8	9 (22)	9.4	0	41

TABLE 4 Tok Management Area sheep hunter residency and success, regulatory years 1990–1991 through 2006–2007

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident <sup>a</sup>	Nonlocal resident	Nonresident	Total (%)	Local resident <sup>a</sup>	Nonlocal resident	Nonresident	Total (%)	
1990–1991	2	31	3	36 (44)	3	43	0	46 (56)	82
1991–1992	3	47	2	52 (56)	0	38	3	41 (44)	93
1992–1993	4	30	3	37 (42)	4	46	2	52 (58)	89
1993–1994	3	39	2	44 (42)	6	54	1	61 (58)	105
1994–1995	4	31	4	39 (46)	4	40	2	46 (54)	85
1995–1996	9	44	7	60 (61)	2	37	0	39 (39)	99
1996–1997	7	44	5	56 (56)	2	40	2	44 (44)	100
1997–1998	3	35	3	41 (43)	8	45	1	54 (57)	95
1998–1999	1	55	0	56 (54)	2	43	2	47 (46)	103
1999–2000	2	39	1	42 (41)	1	58	2	61 (59)	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 (48)	88
2004–2005	0	42	5	47 (59)	0	31	2	33 (41)	80
2005–2006	0	32	13	45 (53)	0	37	3	40 (47)	85
2006–2007	2	27	12	41 (49)	1	41	1	43 (51)	84

<sup>a</sup> Local resident includes residents of Units 12, 13, 20E or 20D.

TABLE 5 Tok Management Area sheep harvest percent by transport method, regulatory years 1990–1991 through 2006–2007

Regulatory year	Percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
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
2004–2005	85	0	0	4	0	0	6	4	47
2005–2006	80	0	2	4	0	0	9	4	45
2006–2007	56	0	7	15	2	5	12	2	41

## **DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007

### **LOCATION**

**GAME MANAGEMENT UNIT:** 13A, 13E, 14A (north), and 14B (14,849 mi<sup>2</sup>)

**GEOGRAPHIC DESCRIPTION:** Talkeetna Mountains and Chulitna-Watana Hills

### **BACKGROUND**

Sheep harvest is limited 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 7⁄8-curl horn minimum during 1979–1988 the annual harvest averaged 87 rams. Since 1989 hunters were allowed to harvest only full-curl rams, In the 3 year period of 2004–2007 the average harvest was 55 rams, down from 65 during 2001 – 2004. 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 42 rams in 2006 was similar to the low harvest of 2001, when 41 rams were harvested.

The first large-scale sheep survey was 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 in the count areas surrounding 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, and transportation used were noted on the reports. Mandatory sheep sealing began in the 2004–05 season. Horns were measured and age was noted and a permanent plug was placed on the horns. The number of sheep killed but unreported is assumed to be small.

Aerial surveys were conducted in at least some areas of the TCW during the 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). Surveys from 2000–01 to 2003–04 indicate that the overall sheep population has increased and was recovering from the previous decline. However, surveys conducted during the reporting period again show a general decline in the population (Table 1).

### MORTALITY

#### *Harvest*

Season and Bag Limit. The hunting season in Units 13A, 13E, 14A and 14B for regulatory years (RY) 2004 through 2006 was 20 August–20 September (regulatory years begin 1 Jul and end 30 Jun; e.g., RY04 = 1 Jul 2004 through 30 Jun 2005). The bag limit was 1 ram with a full-curl horn or larger.

Hunter Harvest. Hunter harvest averaged 55 rams during 2004–2007 (Table 2), lower than the average harvest of 65 rams per year during 2001–2003 and much lower than the average of 82 rams from 1990–2000.

The 2004–06 average horn size increased slightly from the 1998–2003 average (35.5 vs. 34.9 inches). The percentage of horns greater than 40 inches has decreased over the last 10 years (Table 2)

Hunter Residency and Success The total number of hunters has decreased steadily over the past 10 years (Table 3). The success rate was lower during this reporting period than during the 2001–2003 period (16% vs 19%). Nonresidents continued to be more successful than residents. They accounted for 14% of hunters but took 47% of the sheep during 2004–2006 (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 2004–2007, an average proportion of 43% of the reported rams harvested were taken during the first week of the season. This reflects a decrease in percent harvested during the first week of the season compared to 50% for the 2001–2003 period. For this reporting period an average proportion of 59% of the harvest occurred in the first two 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 2004 through 2006 the mean annual harvest of rams was 55, a decrease of 10 over the previous reporting period. This continues to be below the harvest objective. The potential recovery reported by Kavalok (2005) appears to not be the case as population and harvest has shown a decline over the past 3 years.

Periodic surveys of the TCW sheep population to adequately assess population trends should be conducted in the count areas in Units 13 and 14 on a more consistent basis. 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.

During the Spring 2007 meeting of the Board of Game much of the Chugach Range hunting season was changed from general harvest to a draw hunt. This may result in increased hunting pressure on the TCW in the future and an increase in complaints about crowding that some hunters have experienced in the TCW. Hunter numbers and success rates should be monitored closely to determine if restrictions need to be placed on hunting in the TCW.

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TABLE 1 Talkeetna Mountains and Chulitna-Watana Hills summer aerial sheep composition counts, 1999–2007

Regulatory Year	Full Curl	(%)	sublegal Rams <sup>a</sup>	Ewes <sup>b</sup>	Lambs	(%)	Sheep/ Hour	Total Sheep Observed
Boulder Creek								
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
2007	6	2%	22	189	56	21%	109.2	273
Chickaloon River – east								
1999	8	3%	38	157	63	24%	131.2	266
2003	13	6%	28	103	28	16%	84.7	172
2007	9	5%	25	106	38	21%	93.7	178
Hicks Creek								
1999	2	1%	15	112	46	26%	211.3	175
2003	0	0%	17	89	27	20%	130.0	133
2007	10	9%	21	61	24	21%	96.7	116
Caribou Creek								
1999	36	5%	152	409	142	19%	224.3	739
2000	29	7%	77	243	36	9%	147.8	385
2002	38	6%	146	242	97	19%	78.9	523
2003	40	9%	91	187	66	17%	55.3	384
2006	16	6%	38	134	72	28%	74.3	260
2007	16	7%	39	146	44	18%	72.1	245
Sheep Mountain								
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
2007	11	8%	4	32	13	22%	75.0	60

TABLE 1 continued

Regulatory Year	Full Curl	(%)	Sublegal Rams <sup>a</sup>	Ewes <sup>b</sup>	Lambs	(%)	Sheep/ Hour	Total Sheep Observed
Watana Hills								
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								
1999	7	5%	29	77	24	18%	32.6	137
King's River to west side Chickaloon River								
1999	5	2%	58	190	66	21%	76.0	319
2006	7	5%	20	96	31	20%	33.2	154
Sheep River – Iron Creek								
1999	3	6%	13	25	8	16%	14.4	49

<sup>a</sup> 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  $\frac{7}{8}$ -curl horns or larger were legal for sport hunting.

<sup>b</sup> Ewes include yearlings of both sexes and rams of  $\frac{1}{4}$  curl or less.

TABLE 2 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest, 1997–2006

Regulatory Year	Rams <sup>a</sup>	Average Horn Length (inches)	% $\geq$ 40 in.	Ewes	Total sheep
1997–98	81	34.5	5.1	0	81
1998–99	76	36.1	6.4	0	76
1999–00	85	34.3	2.6	0	85
2000–01	51	34.4	1.3	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	2.6	0	74
2004–05	64	34.9	1.3	0	64
2005–06	59	35.4	5.2	0	59
2006–07	42	36.0	5.1	0	42

<sup>a</sup> Includes only rams for which horn length was reported.

TABLE 3 Talkeetna Mountains and Chulitna-Watana Hills sheep hunter residency and success, 1997–2006

Regulatory year	Successful				Unsuccessful				Total hunters
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%)	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Total (%)	
1997–98	23	20	37	80 (19)	180	161	9	350 (81)	430
1998–99	22	13	39	76 (18)	164	159	20	343 (82)	419
1999–00	32	18	34	85 (19)	190	153	29	372 (81)	457
2000–01	11	12	28	51 (13)	170	135	25	330 (87)	381
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
2004–05	24	12	28	64 (17)	153	130	20	303 (83)	367
2005–06	14	14	31	59 (16)	126	112	28	266 (84)	325
2006–07	16	8	18	42 (13)	151	102	24	277 (8)	319

<sup>a</sup> 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, 1997–2006

Regulatory year	Harvest periods						<i>n</i>
	8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	
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
2004–05	59	16	13	8	6	2	63
2005–06	41	22	17	10	3	7	59
2006–07	29	10	17	14	7	24	42

TABLE 5 Talkeetna Mountains and Chulitna-Watana Hills sheep harvest percent by transport method 1997–2006

Regulatory year	Percent of harvest							<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unknown	
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
2004–05	46	3	0	48	0	3	0	63
2005–06	66	2	0	22	0	10	0	59
2006–07	43	0	0	40	2	14	0	42

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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNIT:** Portions of 13B, 20A, and 20D (1680 mi<sup>2</sup>)

**GEOGRAPHIC DESCRIPTION:** Delta Controlled Use Area

**BACKGROUND**

Alaska Department of Fish and Game (ADF&G) management plans for Dall sheep (ADF&G 1976; G. Bos, ADF&G, 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 (G. Bos, personal communication) 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.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

When the Delta Management Area was created, use of motorized vehicles and pack animals for transporting hunters, hunting gear, or game was initially prohibited for the first 15 days of the 10 August–20 September hunting season. After 25 August, transportation restrictions were lifted and mechanized and pack animal access were permitted. Bag limit was 1 ram with  $\frac{3}{4}$ -curl or larger horns.

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

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

In 1979 the minimum horn size for legal sheep in the Delta Management Area was increased from  $\frac{3}{4}$  to  $\frac{7}{8}$  curl. The  $\frac{7}{8}$ -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  $\frac{7}{8}$  curl to full curl in 1984. The season and bag limit in the DCUA have not changed since 1984, with the exception of 1985, when Tier II subsistence regulations were adopted for that year only.

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 was popular for hunting small game and upland game, and DCUA access restrictions unnecessarily complicated hunting in the area and confused hunters. This area was again included in the DCUA beginning 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 GOAL

- 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 OBJECTIVE

- 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., RY04 = 1 Jul 2004 through 30 Jun 2005).

I surveyed the DCUA in a Piper PA-18 Super Cub. Surveys were timed to avoid turbulence by conducting flights in the early morning, generally starting about 0530 hours, or evening, starting about 1900 hours. Survey altitude was 300–700 feet above ground level. Data and search times were recorded in reference to major drainages and recorded on 1:250,000 scale USGS topographic maps. In addition, the latitude and longitude of each observation were recorded. Sheep were classified as lambs, rams  $\geq \frac{1}{2}$  curl, and others. Full-curl rams were noted when possible. Photographs were taken of aggregations that were difficult to observe from the air (i.e., in a steep canyon, too windy, etc.) and classified from the photographs. Photographs were taken with a digital single lens reflex camera and a 70–300 mm image stabilized lens, using ISO 400–800 depending on light conditions. Photographs were also taken of many ram aggregations to compare ram horn size from visual observations to the photographs.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

#### *Population Size and Composition*

RY06. Aerial surveys were flown from 6–27 July 2006 for 22.3 hours of survey time from the east bank of the Johnson River to and including the Jarvis Creek drainage. This area was 357.3 mi<sup>2</sup> (62% of the DCUA). Suitable weather for surveys occurred infrequently, with numerous days having high winds and low ceilings. Total flight time was 28.3 hours for a cost of \$5094.

During the 2006 survey, 1714 sheep were observed, compared to 844 observed in the same portion of the DCUA during the last survey of this area in 1995. This included 240 lambs, 427 rams  $\geq \frac{1}{2}$  curl (including 83 full curl [19.4% of rams]), and 1047 other sheep (Table 1). Twenty-three percent of observed sheep were lambs, and 41% were rams. Density of sheep in the survey area was 4.8 sheep/mi<sup>2</sup>.

RY07. Aerial surveys were flown 4–12 July 2007 for 10.9 hours of survey time in the DCUA west of the Jarvis Creek drainage. Total flight time was 16.5 hours for a cost of \$3053. A total of 473 sheep were observed, including 98 lambs, 98 rams  $\geq \frac{1}{2}$  curl (including 8 full-curl rams [8.2% of rams]), and 277 other sheep (Table 1).

Combining results from the RY06 and RY07 surveys resulted in an estimate of 2187 sheep in the entire DCUA, including 338 lambs, 525 rams  $\geq \frac{1}{2}$  curl (including 91 full-curl rams), and 1324 other sheep. Composition ratios were 26% lambs and 40% rams, and 17% of rams were full curl. The last sheep survey of the entire DCUA was in 1995, when 1285 sheep were observed and the population was estimated to be 1673 (1436–1910) when a 1.3 sightability correction factor was applied.

### 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 10–25 August. Motorized vehicles and pack animals were not permitted for transport of 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 Alaska 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 improve management of the Macomb caribou hunt by incorporating the area between the Richardson Highway and the Delta River into the DCUA so that caribou hunting in this area would have DCUA access restrictions.

Harvest by Hunters. DCUA combined harvest for hunts DS203 and DS204 met the harvest objective in RY04–RY07 (Table 2) and averaged 52 sheep/year.

Mean horn length for all sheep taken during RY04–RY07 was slightly below the objective each year, ranging from 35.1 inches (RY04) to 35.5 inches (RY05 and 06; Table 2).

Mean age of all sheep taken in the DCUA met the management objective each year during RY04–RY07 ranging from 8.1 (RY07) to 8.9 years (RY06; Table 2).

Permit Hunts. The number of permit applicants continued to slowly increase to 3596 in RY07 for both hunts combined. From RY04–RY07, the number of applications averaged 1458 for hunt DS203 and 1747 for DS204 (Table 3).

Hunter Residency and Success. Most DCUA hunters continued to be Alaska residents, although the number of nonresidents increased to an average of 16 per year (9%) during RY04–RY07, compared to 8 per year (4%) during the previous 4 years (Table 4). Residents were 43% successful and nonresidents were 67% successful, compared to the previous 4 years when success was 39% and 47% for residents and nonresidents.

Harvest Chronology. During hunts DS203 and DS204, the largest percentage of the harvest generally occurred during the first 5 days of each hunting season (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 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

The DCUA harvest objective was met during RY04–RY07, but the horn length objective was not. The last time the horn length objective was met for the total annual DCUA harvest was RY03. Because the harvest objective was 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, this would decrease hunting opportunity. Because hunters are not complaining about smaller horn size, this objective will be monitored but no reduction in the number of permits will be considered at this time.

The combined RY06 and RY07 DCUA population estimate of 2187 sheep exceeds the population objective. However, it is not possible to determine the current population trend at this time because there were no surveys conducted between RY95 and RY06.

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TABLE 1 Aerial survey data for sheep seen in the Delta Controlled Use Area during 2006 and 2007

Drainage	Lambs	Rams ≥1/2 curl	Full curl	Total rams	Others	Total	Survey minutes	Survey hours
<i>2006</i>								
Johnson River	32	36	9	45	103	180	161	2.7
Spur Creek	31	34	15	49	136	216	146	2.4
Boulder Creek	21	26	1	27	77	125	91	1.5
Gerstle River	37	9	12	21	213	271	251	4.2
Granite Mountains–Bradford Creek	14	70	11	81	73	168	157	2.6
Southern McCumber, Morningstar	4	51	8	59	81	144	50	0.8
Northern McCumber, Granite Mountains	24	73	14	87	106	217	235	3.9
Riley Creek	20	4	0	4	69	93	45	0.8
Pegmatite, Little Gerstle, Sheep Creek	18	0	0	0	65	83	60	1.0
Jarvis Creek	29	27	12	39	97	165	130	2.2
Little Gold Creek	10	14	1	15	27	52	11	0.2
Subtotal	240	344	83	427	1047	1714	1337	22.3
<i>2007</i>								
Ruby–Flood Creek	56	45	2	47	129	232	142	2.4
Pillsbury–McGinnis Creek	7	0	0	0	41	48	80	1.3
Castner Glacier	12	13	2	15	25	52	78	1.3
Eel Glacier	0	3	1	4	0	4	33	0.6
Canwell Glacier	0	6	2	8	0	8	35	0.6
Augustana–S Black Rapids	2	0	0	0	4	6	50	0.8
N Black Rapids	21	23	1	24	78	123	135	2.3
Subtotal	98	90	8	98	277	473	553	9.2
2006–2007 Total	338	434	91	525	1324	2187	1890	31.5

TABLE 2 Delta Controlled Use Area sheep harvest data by permit hunt, regulatory years 1993–1994 through 2007–2008

Hunt/ Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Ram Harvest	$\bar{x}$ Horn length (in)	$\bar{x}$ Age (yr)	Percent ≥40"
DS203	1993–1994	75	33	39	28	21	36.1	8.6	14
	1994–1995	75	40	43	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
	2004–2005	75	25	39	35	26	34.9	8.5	4
	2005–2006	75	21	43	33	25	36.2	8.8	8
	2006–2007	75	29	41	28	21	35.2	8.1	5
	2007–2008	75	27	45	28	21	35.7	8.2	0
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
	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
	2004–2005	75	19	43	37	28	35.3	8.6	4
	2005–2006	75	26	35	36	27	35.0	8.4	0
	2006–2007	75	24	37	39	29	35.7	9	3
	2007–2008	75	21	39	39	29	35.0	8.0	4

Hunt/ Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Ram Harvest	$\bar{x}$ Horn length (in)	$\bar{x}$ Age (yr)	Percent $\geq 40$ "
Total	1993–1994	150	31	42	27	40	35.9	8.5	10
for all	1994–1995	150	36	43	19	28	35.2	7.9	7
permit	1995–1996	150	32	47	21	32	35.7	8.3	6
hunts	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	28	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
	2004–2005	150	22	41	36	54	35.1	8.5	4
	2005–2006	150	24	39	35	52	35.5	8.6	4
	2006–2007	150	27	39	33	50	35.5	8.9	4
	2007–2008	150	24	42	33	50	35.3	8.1	2

TABLE 3 Number of applications received for Delta Controlled Use Area Hunts DS203 (restricted access) and DS204 (unrestricted access), regulatory years 1989–1990 through 2007–2008

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
2004–2005	1299	1525	2824
2005–2006	1324	1538	2862
2006–2007	1590	1944	3534
2007–2008	1617	1979	3596



TABLE 4 Delta Controlled Use Area sheep hunter residency and success, regulatory years 1994–1995 through 2007–2008

Hunt	Regulatory year	Successful					Unsuccessful					Total hunters
		Local <sup>a</sup> resident	Nonlocal resident	Nonres	Unk	Total (%)	Local <sup>a</sup> resident	Nonlocal resident	Nonres	Unk	Total (%)	
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
	2004–2005	1	24	1	0	26 (47)	2	27	0	0	29 (53)	55
	2005–2006	4	16	5	0	25 (44)	4	28	0	0	32 (56)	57
	2006–2007	0	17	4	0	21 (41)	2	24	5	0	31 (61)	51
	2007–2008	0	16	5	0	21 (38)	2	30	2	0	34 (62)	55
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	25	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
	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
	2004–2005	4	21	3	0	28 (47)	2	29	1	0	32 (53)	60
	2005–2006	2	20	5	0	27 (51)	6	19	1	0	26 (49)	53
	2006–2007	4	24	1	0	29 (51)	1	26	1	0	28 (49)	57
	2007–2008	2	24	3	0	29 (50)	1	24	4	0	29 (50)	58

Hunt	Regulatory year	Successful					Unsuccessful					Total hunters
		Local <sup>a</sup> resident	Nonlocal resident	Nonres	Unk	Total (%)	Local <sup>a</sup> resident	Nonlocal resident	Nonres	Unk	Total (%)	
Total	1994–1995	14	12	1	1	28 (31)	29	31	2	0	62 (69)	90
for all	1995–1996	3	28	1	0	32 (31)	16	48	6	0	70 (69)	102
permit	1996–1997	3	34	4	0	41 (36)	9	61	3	0	73 (64)	114
hunts	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
	2004–2005	5	45	4	0	54 (47)	4	56	1	0	61 (53)	115
	2005–2006	6	36	10	0	52 (47)	10	47	1	0	58 (53)	110
	2006–2007	4	41	5	0	50 (45)	3	50	6	0	59 (54)	110
	2007–2008	2	40	8	0	50 (44)	3	54	6	0	63 (56)	113

<sup>a</sup> Local is a hunter who resides in Unit 20D.

TABLE 5 Delta Controlled Use Area sheep harvest chronology percent by month/day, regulatory years 1993–1994 through 2007–2008

Hunt	Regulatory year	Harvest chronology percent by month/day							<i>n</i>
		8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unknown	
DS203 <sup>a</sup>	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
	2004–2005	81	19	0	--	--	--	0	26
	2005–2006	88	13	0	--	--	--	0	24
	2006–2007	100	0	0	--	--	--	0	17
	2007–2008	67	24	--	--	--	--	10	21
DS204 <sup>b</sup>	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
	2004–2005	--	--	56	30	4	11	0	27
	2005–2006	--	--	63	22	7	7	0	27
	2006–2007	--	--	43	18	21	14	4	28
	2007–2008	--	--	41	30	22	7	4	27

Hunt	Regulatory year	Harvest chronology percent by month/day							<i>n</i>
		8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20	Unknown	
Total	1993–1994	33	18	33	13	3	3	0	40
for all	1994–1995	29	7	29	18	11	7	0	28
Permit	1995–1996	28	19	25	6	9	13	0	32
Hunts	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
	2004–2005	39	9	28	15	2	6	0	53
	2005–2006	41	6	33	12	4	4	0	51
	2006–2007	43	0	24	10	12	8	2	49
	2007–2008	29	10	23	17	13	4	4	48

<sup>a</sup> Season open from 10 August to 25 August.

<sup>b</sup> Season open from 26 August to 20 September.

TABLE 6 Delta Controlled Use Area sheep harvest percent by transport method, regulatory years 1994–1995 through 2007–2008

Permit hunt	Regulatory year	Sheep harvest percent by transport method									<i>n</i>
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	
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
	2004–2005	23	0	0	2	0	2	58	15	4	26
	2005–2006	36	0	4	0	0	0	48 <sup>a</sup>	12	0	25
	2006–2007	14	0	10	0	0	0	67 <sup>a</sup>	10	0	21
	2007–2008	24	0	0	0	0	0	67 <sup>a</sup>	10	0	21
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
	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
	2004–2005	21	0	14	54	0	7	12	0	4	28
	2005–2006	48	0	0	26	0	11	15	0	0	27
	2006–2007	21	0	0	62	0	10	7	0	0	29
	2007–2008	31	0	0	41	0	10	7	10	0	29
Total for	1994–1995	32	0	0	36	0	0	29		4	28

Permit hunt	Regulatory year	Sheep harvest percent by transport method									<i>n</i>
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	
all permit	1995–1996	31	6	3	22	0	0	34		3	32
Hunts	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
	2004–2005	22	0	0	28	0	4	35 <sup>a</sup>	7	4	54
	2005–2006	40	0	2	13	0	11	29 <sup>a</sup>	5	0	55
	2006–2007	18	0	4	37	0	6	33 <sup>a</sup>	4	0	49
	2007–2008	29	0	0	25	0	6	29 <sup>a</sup>	6	4	48

<sup>a</sup> Transportation mode of “foot” is combined with “highway vehicle” on the assumption that hunters did not walk to the departure point, but used a highway vehicle to get there.

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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNIT:** 20A (6796 mi<sup>2</sup>)

**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 have 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 (Heimer 1974), 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

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

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., RY06 = 1 Jul 2006 through 30 Jun 2007).

We conducted 3 aerial surveys during RY04–RY06 to monitor population status. We surveyed Sections I–III located between the Wood and Little Delta Rivers, Section IV south of Sections I–III between the West Fork Little Delta River and Buchanan Creek, and a small portion of the upper Wood River (Arthur 2003). We reported only on Sections I–III to be consistent with historical surveys. All surveys were conducted from R-44 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. 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. Modest lamb:ewe and yearling:ewe ratios observed in 2000 and 2001 suggest the Unit 20A sheep population was stable between 1998 and 2001 (Table 1). Strong lamb:ewe ( $\bar{x}$  = 43:100; range 41–44) and yearling:ewe ratios (30:100; range = 27:100–42:100) suggest a stable or increasing population during 2003–2007.



## MORTALITY

### *Harvest*

Seasons and Bag Limit. The sheep hunting season was open 10 August through 20 September throughout RY04–RY06. 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 RY04–RY06, and no emergency orders were issued. However, in 2004 the board adopted a statewide provision that required sealing by Alaska Department of Fish and Game (ADF&G) personnel of sheep horns in most units, including Unit 20A.

Harvest by Hunters. Reported harvests increased from a 3-year average of 62 (range 52–68) rams during RY01–RY03 to 72 (range 51–85) rams during RY04–RY06 (Table 2).

Mean horn length of harvested rams has ranged from 34 to 36 inches since the bag limit changed from  $\frac{7}{8}$  curl to full curl in RY84 (Table 2). There has been no apparent trend in the percentage of  $\geq 40$ -inch rams in the harvest over the past 9 years. The proportion of rams harvested with horns  $\geq 40$  inches long was 1.6% during RY98–RY00 compared to 4.8% (8 of 167) during RY01–RY03 and 1.9% (4/216) during RY04–RY06.

Hunter Residency and Success. Success rates remained higher for nonresidents than for resident hunters (Table 3). During RY04–RY06, nonresident success was 63–72%, while Alaska resident success was 12–32%. Overall success rates were 27–45% during RY04–RY06.

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 ( $\bar{x}$  = 20%; range 17–23%) during RY04–RY06.

### *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 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. Because most seeps at higher elevations were dry, sheep were forced to water at the few remaining active seeps, which increased exposure to the pathogen.

## **HABITAT**

### *Assessment*

No significant disturbance or destruction of sheep habitat occurred in Unit 20A through RY04–RY06. 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) 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. 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 Usibelli Coal Mine Inc. 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 RY04–RY06. 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. This population objective seems unrealistic for a relatively small sheep population subject to occasional severe weather events and variable levels of predation. In the absence of predator control, we would expect harvests to remain below those sustained in the mid- to- late 1980s ( $\bar{x}$  = 134 rams, 1984–1989). Conversely, we would also expect harvests to remain above those experienced following the steep population decline precipitated by the harsh winter of 1991–1992 ( $\bar{x}$  = 49 rams, 1992–2001), until another severe weather event causes a similar population setback. Until that time, no changes in seasons and bag limits are likely to be recommended.

The following management objectives are not quantifiable so will be eliminated as objectives for the next reporting period: 1) Provide the greatest sustainable annual opportunity to hunt Dall sheep; 2) Provide the greatest sustainable annual harvest of Dall sheep; 3) Provide the opportunity to view and photograph Dall sheep under natural conditions; and 5) Maintain naturally-regulated ewe and subadult ram segments of the population. Management objectives for the next reporting period will be as follows: 1) Manage for a Dall sheep population of approximately 5000 sheep; and 2) Using a full-curl harvest strategy, maintain an average harvest of rams  $\geq 8$  years old.

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TABLE 1 Unit 20A sheep composition counts, calendar years 1998 through 2007

Calendar year	Rams:100 ewes <sup>a</sup>	% Full-curl rams	Lambs:100 ewes <sup>a</sup>	Yearlings:100 ewes <sup>a</sup>	Sample size
1998	67	21	41	24	665
1999	79	12	52	28	690
2000	66	6	30	24	615
2001	85	15	31	21	552
2002	69	11	49	8	496
2003	57	22	43	42	675
2004	81	17	41	29	523
2005	61	21	43	27	543
2006	83	19	44	27	717
2007	46	20	44	27	752

<sup>a</sup> Counts of ewes likely include some young rams.

TABLE 2 Unit 20A sheep harvest, regulatory years 1997–1998 through 2006–2007

Regulatory year	Reported harvest	Total hunters	Percent success	$\bar{x}$ Horn length (in) <sup>a</sup>
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
2004–2005	51	187	27	35.0
2005–2006	81	180	45	35.0
2006–2007	85	196	43	35.1

<sup>a</sup> Includes broomed horns.

TABLE 3 Unit 20A sheep hunter residency and success, regulatory years 1997–1998 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Unk	Total	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Unk	Total	
1997–1998	13	7	25	0	45	88	26	17	2	133	178
1998–1999	14	5	24	1	44	84	24	23	1	132	176
1999–2000	15	11	24	1	51	81	24	14	1	120	171
2000–2001	4	8	15	0	27	64	25	26	1	116	143
2001–2002	10	8	33	1	52	62	22	16	0	100	152
2002–2003	14	8	43	3	68	59	22	14	0	95	163
2003–2004	23	7	37	0	67	52	45	14	2	113	180
2004–2005	13	3	33	2	51	58	56	19	3	136	187
2005–2006	21	17	42	1	81	53	29	16	1	99	180
2006–2007	15	18	51	1	85	64	25	21	1	111	196

<sup>a</sup> Includes all of Unit 20.

TABLE 4 Unit 20A sheep harvest chronology percent by day-month, regulatory years 1997–1998 through 2006–2007

Regulatory year	Harvest chronology percent by day-month				Unknown	<i>n</i>
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep		
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
2004–2005	69	12	14	4	2	51
2005–2006	53	28	14	4	1	79
2006–2007	44	23	18	15	0	84

TABLE 5 Unit 20A sheep harvest percent by transport method, regulatory years 1997–1998 through 2006–2007

Regulatory year	Percent by transport method						Unknown	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle		
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	38	38	0	13	2	2	6	52
2002–2003	39	39	0	14	0	7	1	70
2003–2004	41	25	0	18	1	12	3	68
2004–2005	46	29	0	17	2	4	2	52
2005–2006	40	23	2	23	1	6	4	81
2006–2007	42	28	4	19	2	1	4	85

**WILDLIFE**  
**MANAGEMENT REPORT**

**Alaska Department of Fish and Game**  
**Division of Wildlife Conservation**  
(907) 465-4190 PO Box 115526  
Juneau, AK 99811-5526

**DALL SHEEP REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNIT:** Portions of 20B, 20F, and 25C (534 mi<sup>2</sup>)  
**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 (200–600 sheep). However, hunter effort and harvest have steadily increased since 1980, and reached record highs in the late 1990s and early 2000s (Fig. 1).

Survey data indicate the population also increased during the last 20 years (Fig. 1). Historically, surveys were infrequent, but have increased in frequency in recent years (Table 1). The population was moderately high in 1970, declined through the early 1980s, then increased during the 1990s, and is currently stable or decreasing. Due to survey differences in area covered, date and intensity of survey, 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, but this was largely due to changes in the definition of legal rams. From 1970 to 1978, legal rams included those with  $\frac{3}{4}$  curl or larger horns; from 1979 to 1985, the legal minimum was  $\frac{7}{8}$  curl; in 1986, the minimum was  $\frac{7}{8}$  curl in Unit 25 and full curl in Unit 20; and only full-curl rams have been legal throughout the area since 1987. Full-curl and  $\frac{7}{8}$ -curl restrictions also allowed harvest of rams with both horns broken (broomed) or with 8 horn annuli present. During surveys, rams with both horns broken were considered legal. Survey data from 1996 to 2000 indicated the number of legal rams increased coincident 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 the Alaska Department of Fish and Game (ADF&G) cooperated on a study of 10 radiocollared sheep to identify distribution, movements, and seasonal use areas (Durtsche et al.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.



1990). Sheep in the White Mountains were found in small, widely scattered groups throughout approximately 534 mi<sup>2</sup> of alpine habitat in the vicinity of Victoria Mountain, Mount Schwatka, Mount Prindle, and Lime Peak (Rocky Mountain). Durtsche et al. (1990) speculated that these sheep may have a relatively unique gene pool 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 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 2004, 2005, and 2006 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 above ground level) 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 at least 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., RY06 = 1 Jul 2006 through 30 Jun 2007).

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

#### *Population Size*

The estimated sheep population during RY04–RY06 was 500–600. This estimate is similar to previous estimates since the late 1990s, except for the peak of over 700 in 1999. During aerial surveys in 2004, 2005, and 2006, observers counted 443, 513, and 483 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.

#### *Population Composition*

The mean ratio of lambs:100 ewes was 27 during 1970 through 2002. This ratio was lower during the 2004 (21:100), 2005 (20:100), and 2006 (12:100) 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 lamb mortality during summer affects lamb:ewe ratios, and 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 likely contained some 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 before and during rut, then returning to their traditional areas after 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 occurred, 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 (Fossil Peak), 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 RY04–RY06. 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 that addressed the White Mountains sheep population during RY04–RY06. However, in 2004 the board adopted a statewide provision that required sealing by ADF&G personnel of sheep horns in areas with full-curl regulations, including the White Mountains.

Harvest by Hunters. The reported annual harvest for RY04–RY06 ranged from 6 to 16 and averaged 11 (Table 3). The reported harvest of 19 sheep during fall RY03 is the highest on record. The average annual harvest of 11 sheep is 69% higher than the mean annual harvest during RY84–RY03. Based on the increasing number of hunters and a decreasing sheep population (Fig. 1), this harvest level may result in reduced hunt quality due to lower success rates and crowding in the near future. The average percentage of legal rams in the population from 1970 to 2003 was 4.7%. In 2004, 2005, and 2006, this percentage was 4.3%, 4.9%, and 4.3%, respectively. This indicates that the current harvest level may be sustainable.

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 RY04–RY06 was 13.4 inches (Table 4), down from the RY93–RY03 average of 13.7 inches. Average horn length measurements have less meaning in this area because many are broomed (41% of all horns RY93–RY06). However, during RY04–RY06, the average horn length (32.0 inches) was 2.3 inches less than the RY93–RY03 average of 34.3 inches. Reported age of harvested sheep also declined from an average of 9.6 during RY93–RY03 to an average of 8.4 during RY04–RY06. However, 5 of the 32 rams shot during RY04–RY06 had too much of their horns broken off to accurately determine age. Since these broken horned rams are often quite old, the mean age of harvested rams during RY04–RY06 was likely higher than represented by the data.

Hunter Residency and Success. Most sheep hunters in the White Mountains were Alaska residents. During RY84–RY94, only 2 nonresidents reported hunting sheep in the White Mountains (Table 3). Since then the number of nonresidents has increased. The average success rate of all hunters during RY04–RY06 was 23% (32 of 142) compared to 21% during RY84–RY03. Hunters seem to be spending less time in the field. During RY84–RY03, both successful and unsuccessful hunters reported spending an average of 5 days afield (Table 5). In RY04–

RY06, successful hunters spent an average of 3 days afield and unsuccessful hunters spent 4 days.

Harvest Chronology. Sheep harvest shifted earlier in the season during RY04–RY06. Fifty-one percent of sheep harvested during RY84–RY03 were taken during the first 10 days of the season, compared to 59% during RY04–RY06 (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 RY04–RY06, 75% 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 15 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 winter 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. Other potential predators include golden eagles and coyotes (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, Fairbanks) described a cave on the eastern slope of the White Mountains that had considerable sheep sign in it. The entrance was approximately 25 ft high and 14 ft wide. A water hole 25 ft 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. Use of ORVs, mineral exploration, trail development, access, and cabins should be monitored and managed to maintain aesthetically pleasing conditions. Nonconsumptive use of sheep, such as viewing, will probably increase during the future 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 500–600 sheep met 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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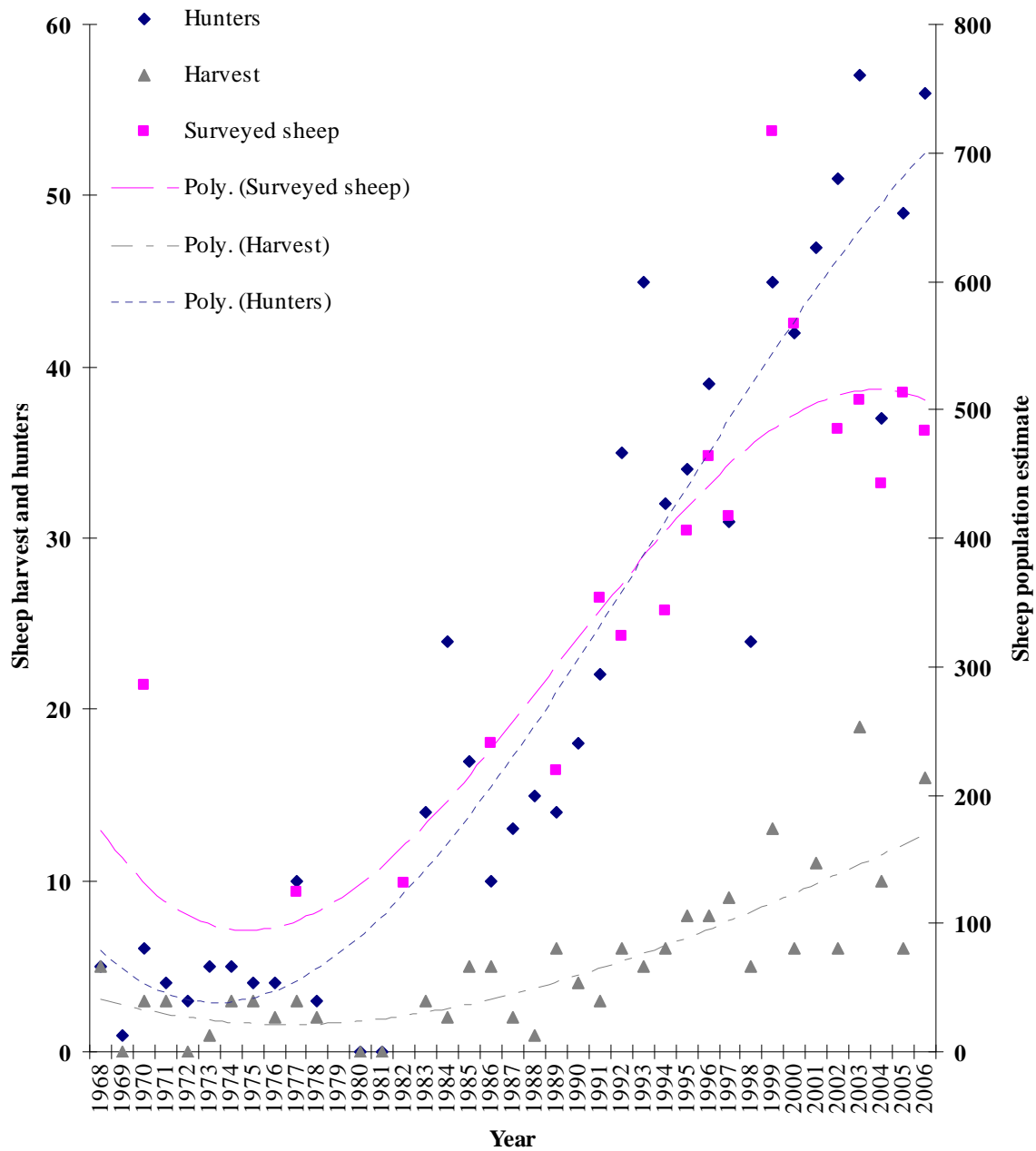


FIGURE 1 White Mountains sheep hunters, harvest, and sheep population<sup>a,b</sup>, regulatory years 1968–1969 through 2006–2007 (<sup>a</sup> Data compiled from several sources including FWS, BLM, and ADF&G records; <sup>b</sup> Lines fitted to data points are third order polynomials [Poly]).

TABLE 1 White Mountains aerial sheep composition counts, 1970–2006

Date	Rams			Rams: 100 ewes	Ewes <sup>c</sup>	Lambs	Lambs:100 ewes	Total sheep <sup>b</sup>	Count time (hr)
	Legal <sup>a</sup>	Sublegal	Total <sup>b</sup>						
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	219	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 <sup>d</sup>	8	64	72	36	201	71	35	344	10.3
1–11 Aug 1995	6	78	88	35	248	73	29	405	11.1
5–7 Aug 1996	16	90	106	39	270	88	33	464	— <sup>e</sup>
5 Aug 1997 <sup>f</sup>	10	88	98	37	266	53	20	417	12.1
1–3 Aug 1999 <sup>g</sup>	26	125	151	37	406	160	39	717	13.1
5–7 Aug 2000 <sup>g</sup>	24	121	145	41	381	41	11	567	13.1
19 Jul 2002 <sup>g</sup>	25	125	150	57	262	73	28	485	— <sup>e</sup>
Jul–Aug 2003 <sup>g</sup>	21	70	91	29	318	99	31	508	10.9
3–5 Aug 2004 <sup>g</sup>	19	107	126	48	262	55	21	443	14.3
1–4 Aug 2005 <sup>g</sup>	25	107	132	42	317	64	20	513	14.9
2–5 Aug 2006 <sup>g</sup>	21	102	123	38	321	39	12	483	13.2

<sup>a</sup> Legal rams =  $\frac{3}{4}$  curl in 1970 and 1977,  $\frac{7}{8}$  curl in 1982 and 1986, full curl or both horns broken since 1987.

<sup>b</sup> Total numbers may include sheep that were not classified.

<sup>c</sup> Ewes includes unclassified young rams and yearlings of both sexes.

<sup>d</sup> 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.

<sup>e</sup> Total count time could not be calculated from data sheets.

<sup>f</sup> Victoria Mountain was not surveyed in 1997 (47 sheep were counted in this area in 1996).

<sup>g</sup> 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 2006–2007

Regulatory year	Season	Bag limit	Legal horn size <sup>a</sup>	
			Portion in Unit 20	Portion in Unit 25
1983–1984	10 Aug–20 Sep	1 ram	$\frac{7}{8}$ -curl horn or larger	$\frac{7}{8}$ -curl horn or larger
1984–1985 through 1986–1987	10 Aug–20 Sep	1 ram	Full-curl horn or larger	$\frac{7}{8}$ -curl horn or larger
1987–1988 through 2006–2007	10 Aug–20 Sep	1 ram	Full-curl horn or larger	Full-curl horn or larger

<sup>a</sup> Full-curl and  $\frac{7}{8}$ -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 2006–2007

Regulatory year	Successful hunters				Unsuccessful hunters				Total	
	Resident	Nonresident	Unspecified	Total	Resident	Nonresident	Unspecified	Total	Hunters	% Success
1984–1985	0	2	0	2	21	0	1	22	24	8
1985–1986	5	0	0	5	12	0	0	12	17	29
1986–1987	4	0	1	5	4	0	1	5	10	50
1987–1988	2	0	0	2	11	0	0	11	13	15
1988–1989	1	0	0	1	8	0	6	14	15	7
1989–1990	6	0	0	6	6	0	2	8	14	43
1990–1991	4	0	0	4	13	0	1	14	18	22
1991–1992	3	0	0	3	19	0	0	19	22	14
1992–1993	6	0	0	6	29	0	0	29	35	17
1993–1994	5	0	0	5	37	0	3	40	45	11
1994–1995	6	0	0	6	25	0	1	26	32	19
1995–1996	7	1	0	8	26	0	0	26	34	24
1996–1997	7	1	0	8	30	1	0	31	39	21
1997–1998	9	0	0	9	22	0	0	22	31	29
1998–1999	5	0	0	5	19	0	0	19	24	21
1999–2000	11	1	1	13	30	2	0	32	45	29
2000–2001	6	0	0	6	35	1	0	36	42	14
2001–2002	9	0	2	11	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
2004–2005	10	0	0	10	26	1	0	27	37	27
2005–2006	6	0	0	6	40	3	0	43	49	12
2006–2007	14	1	1	16	38	1	1	40	56	29

TABLE 4 White Mountains sheep harvest characteristics, regulatory years 1993–1994 through 2006–2007

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	60	35.2	14.4
1999–2000	9.7	46	34.3	13.3
2000–2001	10.8	25	38.0	13.8
2001–2002	10.1	22	35.5	12.9
2002–2003	8.7	83	32.4	13.9
2003–2004	9.2	44	31.1	13.6
2004–2005	8.1	35	29.1	13.6
2005–2006	8.0	33	34.5	13.2
2006–2007	8.8	44	32.9	13.4

TABLE 5 White Mountains sheep hunter effort<sup>a</sup>, regulatory years 1984–1985 through 2006–2007

Regulatory year	Successful		Unsuccessful		Total hunters
	Hunters	$\bar{x}$ days	Hunters	$\bar{x}$ days	
1984–1985	2	8	22	7	24
1985–1986	5	6	12	4	17
1986–1987	5	9	5	6	10
1987–1988	2	6	11	4	13
1988–1989	1	2	14	4	15
1989–1990	6	3	11	4	17
1990–1991	4	5	14	4	18
1991–1992	3	5	18	6	21
1992–1993	6	6	29	4	35
1993–1994	5	4	22	6	27
1994–1995	6	6	26	5	32
1995–1996	8	4	25	4	33
1996–1997	8	5	30	6	38
1997–1998	9	4	31	4	40
1998–1999	5	4	19	5	24
1999–2000	13	4	32	4	45
2000–2001	6	6	36	5	42
2001–2002	11	5	35	5	46
2002–2003	6	5	45	6	51
2003–2004	19	4	38	4	57
2004–2005	10	2	27	5	37
2005–2006	6	2	43	4	49
2006–2007	16	4	40	4	56

<sup>a</sup> This table includes only hunters who reported the number of days they hunted and does not include all hunters.

TABLE 6 White Mountains sheep harvest chronology by day-month, regulatory years 1984–1985 through 2006–2007

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
2004–2005	7	2	0	1
2005–2006	3	0	1	2
2006–2007	9	4	3	0

TABLE 7 White Mountains sheep hunter success by transport method, regulatory years 1987–1988 through 2006–2007

Regulatory year	Transport method				
	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other\Unknown
<u>Successful</u>					
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
2004–2005	8	1	0	0	1
2005–2006	5	0	0	1	0
2006–2007	11	5	0	0	0
Total	114	15	1	5	8
<u>Unsuccessful</u>					
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
2004–2005	9	9	0	2	7
2005–2006	5	14	2	13	9
2006–2007	7	16	1	10	6
Total	118	244	27	95	69

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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNIT:** Portions of Units 20B, 20D, and 20E (1641 mi<sup>2</sup>)

**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 the 1990s 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.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

## MANAGEMENT OBJECTIVES

- Maintain a full-curl harvest strategy.
- Limit hunters in the Tanana Hills to fewer than 50.

## 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., RY05 = 1 Jul 2005 through 30 Jun 2006).

We monitored population status by conducting aerial surveys from a Piper Super Cub PA-18 aircraft. Sheep were classified as rams, ewes, or lambs based on horn size and body conformation. Young rams that could not be distinguished from ewes were classified as ewes. Rams were also classified as either legal (full curl or both horns broomed) or sublegal. Aerial surveys were flown 300–700 feet above ground level in suitable sheep habitat at airspeeds of 60–80 mph.

## RESULTS AND DISCUSSION

### POPULATION STATUS AND TREND

#### *Population Size and Composition*

Mount Harper. During RY04–RY05, Mount Harper sheep surveys were flown at low intensity and without a standardized survey area to collect composition and sheep survival data for evaluation of wolf control activities in Unit 20E (Table 1). Therefore, no population size or trend comparisons are made. No survey was conducted in RY06.

In July 2007 we flew a population estimation and composition survey in the Mount Harper area. This survey included all sheep habitat in the DS206 drawing sheep hunt area and included that portion of Unit 20D north of the Alaska Highway, and that portion of Unit 20E within the Middle Fork of the Fortymile River drainage north and west of the north bank upstream from and including the Joseph Creek drainage. In addition, sheep habitat adjacent to the DS206 area was surveyed in the headwaters of the Charley River in Unit 20E and the adjacent portion of Unit 20B in the Salcha River drainage between Camp Creek and Stone Boy Creek.

Portions of the 2007 Mount Harper survey were flown on 6, 12, and 16 July. Poor survey conditions precluded the survey from being completed in consecutive days. Survey time totaled



7.4 hr. One hundred eight sheep were seen, including 20 rams (of which 9 were full curl), 21 lambs, and 67 ewe-like sheep. Ewe-like sheep included adult females plus yearlings and 2-year-olds of both sexes. Resulting composition ratios are 13 rams:100 ewe-like sheep, 31 lambs:100 ewe-like sheep, and 19% lambs in the population (Table 1).

Glacier Mountain. Glacier Mountain aerial surveys were flown in 2004 and 2005. The 2004 survey was flown on 27 July for 1.5 hr. Ninety-eight sheep were observed, with ratios of 54 lambs:100 ewes and 50 rams: 100 ewes. The 2005 survey was flown on 20 July for 1.5 hr. This survey found 108 sheep, with ratios of 22 rams:100 ewes and 28 lambs:100 ewes (Table 2).

#### *Distribution and Movements*

No sheep movement data were collected during this reporting period.

### **MORTALITY**

#### *Harvest*

Season and Bag Limit. The open season for resident and nonresident hunters in the Tanana Hills in Units 20B, 20D and 20E was 10 August–20 September; the bag limit was 1 ram with full-curl or longer horns, with both horns broken, or at least 8 years old. A drawing permit was required to hunt the Mount Harper area; a harvest ticket was required for the remainder of Unit 20E and the portion of Unit 20B surveyed. 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 adopted proposal 37 at their spring 2008 meeting, which redefined the Mount Harper drawing permit hunt (DS206) to state “Unit 20D, that portion north of the Alaska Highway, and that portion of Unit 20E within the Middle Fork Fortymile River drainage north and west of the north bank upstream from and including the Joseph Creek drainage.” In 2004 the board adopted a statewide provision that required sealing by ADF&G personnel of sheep horns in most areas, including Units 20B, 20D, and 20E.

Harvest by Hunters. Hunter harvest is analyzed for the Mount Harper DS206 drawing permit hunt separately. All other harvest is classified as Tanana Hills (includes portions of Units 20B and 20E).

*Mount Harper* — During RY04–RY07, harvest was low with no sheep killed in RY04 or RY07, and 2 sheep killed each year in RY05 and RY06 (Table 3). In RY05, average horn size of sheep killed was 35.25 inches and average age was 6.5 years. In RY06, average horn size of sheep killed was 35.75 inches and average age was 8.5 years (Table 3).

*Tanana Hills* — During RY04–RY07, Tanana Hills sheep harvest averaged 5 sheep/year (range 3–8; Table 4). Average horn length ranged from 35.5 inches in RY04 to 37.25 in RY06. Average age of sheep harvested ranged from 9.0 years in RY04 to 10.0 years in RY07 (Table 4).

### Hunter Residency and Success.

*Mount Harper* — Most hunters in the Unit 20D Mount Harper DS206 drawing permit hunt continue to be nonlocal residents. No nonresidents reported hunting in this area during RY04–RY07 (Table 5).

*Tanana Hills* — Most hunters in the Tanana Hills continued to be Alaska residents. No nonresidents reported hunting in this area during RY04–RY07 (Tables 5 and 6).

### Harvest Chronology.

*Mount Harper* — All 4 sheep killed in the Mount Harper DS206 drawing permit hunt during RY04–RY07 were killed from 11 to 14 August.

*Tanana Hills* — Harvest dates during RY04–RY07 were highly variable, with 8 sheep killed during August and 10 killed during September.

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.

*Mount Harper* — All sheep taken in DS206 during RY04–RY07 were taken by hunters using aircraft for access.

*Tanana Hills* — In the Glacier Mountain Controlled Use Area hunt, 4 of 6 successful hunters used highway vehicles to access the hunt area while 2 hunters reported using horses. In the remainder of the Tanana Hills, 11 of 13 hunters reported using aircraft to access their hunt area, while 1 reported using a highway vehicle and 1 reported using a boat.

### *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.

## **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 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. The Alaska Department of Fish and Game (ADF&G), Division of Wildlife Conservation biologists will coordinate with ADF&G, Division of Habitat 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* (Alaska Wildland Fire Coordinating Group 1998) should result in a near-natural fire regime throughout this area, possibly benefiting the sheep population.

## CONCLUSIONS AND RECOMMENDATIONS

We met our management objectives to 1) maintain a full-curl harvest strategy and 2) maintain fewer than 50 hunters per season in the Tanana Hills. No change in management is recommended at this time. However, in order to more easily determine whether the objectives are met, the first objective will be changed for the next reporting period to:

- Using a full-curl harvest strategy, maintain a harvest of rams averaging  $\geq 8$  years old.

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.

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TABLE 1 Mount Harper Dall sheep composition counts from aerial surveys, 2003–2007

Sex/age class	2003	2004	2005	2007
Legal rams <sup>a</sup>	10	8	5	9
Sublegal rams <sup>b</sup>	29	16	8	11
Unclassified rams	0	0	0	0
Total rams	39	24	13	20
Ewes <sup>c</sup>	35	32	27	67
Lambs	4	12	9	21
Yearlings	0	0	0	
Unidentified	0	0	0	0
Total other sheep	39	44	36	88
Total sheep	78	68	49	108
Legal rams:100 ewes	29	25	19	13
Sublegal rams:100 ewes	83	50	30	16
Total rams:100 ewes	111	75	48	30
Lambs:100 ewes	11	38	33	31
% Lamb	5	18	18	19

<sup>a</sup> Full curl or larger.<sup>b</sup> Greater than ¼ curl but less than full curl.<sup>c</sup> Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 2 Glacier Mountain Dall sheep aerial survey data 2001–2005

Sex/age class	2001	2002	2003	2004	2005
Legal rams <sup>a</sup>	7	2	5	5	5
Sublegal rams <sup>b</sup>	18	14	10	19	11
Unclassified rams	0	0	0	0	0
Total rams	25	16	15	24	16
Ewes <sup>c</sup>	50	46	37	48	72
Lambs	11	15	12	26	20
Yearlings					
Unidentified	0	0	0	0	0
Total other sheep	61	61	49	74	92
Total sheep	86	77	64	98	108
Legal rams:100 ewes	14	4	14	10	7
Sublegal rams:100 ewes	36	30	27	40	15
Total rams:100 ewes	50	35	41	50	22
Lambs:100 ewes	22	33	32	54	28
% Lamb	13	19	19	27	19

<sup>a</sup> Full curl or larger.<sup>b</sup> Greater than ¼ curl but less than full curl.<sup>c</sup> Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

TABLE 3 Mount Harper drawing permit sheep harvest, regulatory years 1990–1991 through 2007–2008

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	3	35.6	8.7	3
2002–2003	4	0	2	2	35.0	8.5	2
2003–2004	4	1	2	1	36.0	7.0	1
2004–2005	4	3	1	0			0
2005–2006	4	1	1	2	35.25	6.5	2
2006–2007	4	2	0	2	35.75	8.5	2
2007–2008	4	2	2	0			0

TABLE 4 Tanana Hills sheep harvest, regulatory years 1990–1991 through 2007–2008

Regulatory year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Ewes	Total sheep
1990–1991 <sup>a</sup>	1	36.0	11.0	0	1
1991–1992 <sup>a</sup>	3	33.7	8.3	0	3
1992–1993 <sup>a</sup>	1	33.0	10.0	0	1
1993–1994 <sup>b</sup>	5	34.0	8.8	0	5
1994–1995 <sup>b</sup>	3	33.7	8.0	0	3
1995–1996 <sup>b</sup>	8	36.3	9.1	0	8
1996–1997 <sup>b</sup>	5	35.0	9.4	0	5
1997–1998 <sup>b</sup>	9	35.3	10.5	0	9
1998–1999 <sup>b</sup>	5	35.6	10.0	0	5
1999–2000 <sup>b</sup>	10	36.9	10.8	0	10
2000–2001 <sup>b</sup>	5	37.4	9.8	0	5
2001–2002 <sup>b</sup>	7	37.3	10.2	0	7
2002–2003 <sup>b</sup>	8	30.7	8.9	0	8
2003–2004 <sup>b</sup>	10	34.8	9.6	0	10
2004–2005 <sup>b</sup>	3	35.5	9.0	0	3
2005–2006 <sup>b</sup>	8	35.7	9.8	0	8
2006–2007 <sup>b</sup>	2	37.3	9.5	0	2
2007–2008 <sup>b</sup>	7	37.1	10.0	0	7

<sup>a</sup> Includes the Glacier Mountain Controlled Use Area only.<sup>b</sup> Includes the old 1107 and 1108 permit areas (Unit 20E UCUs 101, 102, 103, 104, 303, 304, and 305) and Glacier Mountain Controlled Use Area.



TABLE 5 Tanana Hills, Unit 20D, sheep hunter residency and success<sup>a</sup>, regulatory years 1993–1994 through 2007–2008

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident <sup>b</sup>	Nonlocal resident	Nonresident	Total (%)	Local resident <sup>b</sup>	Nonlocal resident	Nonresident	Total (%)	
1993–1994	0	1	0	1 (25)	0	3	0	3 (75)	4
1994–1995	0	0	0	0 (0)	0	3	0	3 (100)	3
1995–1996	0	3	1	4 (100)	0	0	0	0 (0)	4
1996–1997	0	1	1	2 (67)	0	1	0	1 (33)	3
1997–1998	0	2	0	2 (100)	0	0	0	0 (0)	2
1998–1999	0	1	0	1 (33)	0	2	0	2 (67)	3
1999–2000	0	3	0	3 (75)	0	1	0	1 (25)	4
2000–2001	0	1	1	2 (67)	0	1	0	1 (33)	3
2001–2002	0	2	1	3 (75)	0	1	0	1 (25)	4
2002–2003	0	2	0	2 (50)	0	2	0	2 (50)	4
2003–2004	0	1	0	1 (33)	0	2	0	2 (67)	3
2004–2005	0	0	0	0 (0)	0	1	0	1 (100)	1
2005–2006	0	2	0	2 (50)	0	2	0	2 (50)	4
2006–2007	0	2	0	2 (50)	0	2	0	2 (50)	4
2007–2008	0	0	0	0 (0)	0	2	0	2 (100)	2

<sup>a</sup> Excludes hunters in permit hunts.<sup>b</sup> Residents of Unit 20D.

TABLE 6 Tanana Hills, Unit 20E, sheep hunter residency and success<sup>a</sup>, regulatory years 1993–1994 through 2007–2008

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident <sup>b</sup>	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	9 (33)	8	10	0	18 (67)	27
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	1	4	0	5 (31)	1	10	0	11 (69)	16
2005–2006	0	8	0	8 (73)	0	3	0	3 (27)	11
2006–2007	0	2	0	2 (13)	0	13	0	13 (87)	15
2007–2008	0	7	0	7 (47)	0	8	0	8 (53)	15

<sup>a</sup> Excludes hunters in permit hunts.<sup>b</sup> Residents of Unit 20E.

## **SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007

### **LOCATION**

**GAME MANAGEMENT UNITS:** 23 (44,000 mi<sup>2</sup>) and 26A (53,000 mi<sup>2</sup>)

**GEOGRAPHIC DESCRIPTION:** Western Brooks Range

### **BACKGROUND**

The Brooks Range, with indigenous populations of Dall sheep, extends into northwest Alaska and occupies portions of Unit 23 and Unit 26A. For centuries, Inupiat residents hunted sheep for subsistence (Georgette and Loon 991). For many years, resident and nonresident hunters living outside Unit 23 also hunted sheep recreationally in this unit. Within Units 23 and 26A there are three relatively discrete populations of sheep 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, it is likely 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 is 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 of vegetation.

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 Alaska Department of Fish and Game (ADF&G, the department) and the National Park Service (NPS) closed recreational and subsistence sheep hunting in one or both areas from 1991 until 1995. Limited hunting was reestablished in 1995. When hunting resumed in the Baird Mountains in 1995, it was administered by the NPS as a federal subsistence hunt and remains as such.

## **MANAGEMENT DIRECTION**

### **MANAGEMENT GOALS AND OBJECTIVES**

#### *Baird Mountains*

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

#### *De Long Mountains*

- Maintain a minimum ratio of 7 to 10 large rams (with  $\geq \frac{7}{8}$ -curl) per 100 “ewes” in each area.

#### *Units 23 and 26A*

- Census sheep within each area at least once within each 3-year reporting period.
- Monitor harvests through the harvest ticket system, permit hunts, community-based harvest assessments, public contacts and field observations.

## **METHODS**

The NPS has continued to conduct sheep surveys in the Western Brooks Range as part of a sheep monitoring program (Udevitz *et al.* 2006). Department staff assisted with these surveys in 2005 and 2006. Harvests in the De Long Mountains are monitored through state registration permits; additionally, the NPS provided summaries of sheep taken under federal regulations in the Baird and De Long Mountains. For this report, the term “lamb” includes sheep <12 months old; “ewe” includes female sheep and males with ewe-like horns (1- 2-year-old rams); “small ram” to include rams < $\frac{7}{8}$  curl; and “large ram” to include rams  $\geq \frac{7}{8}$  curl.

## **RESULTS AND DISCUSSION**

### **POPULATION SIZE, STATUS AND TREND**

#### *Population Size*

Baird Mountains. We think the Baird Mountain trend count area (roughly 700 mi<sup>2</sup>) 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. Movements of sheep in and out of the survey area and weather can affect sheep survey results (e.g. in 1996 and 1997). However, we think these effects were small in most years.

The number of sheep observed since 1989 is shown in Table 1; however, survey data for all years after 2001 represent varying levels of incomplete survey coverage, making comparisons between years problematic. The Baird Mountain sheep population last peaked in 1989 prior to severe winters in 1989–1990 and 1990–1991 that initiated a 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 reached its lowest level 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. Sheep population dynamics in the De Long Mountains and Wulik Peaks appear similar to those in the Baird Mountains although the density of sheep in these areas tends to be lower. 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. The lack of lambs is reflected in the decline in the number of small rams (2 to 6-years-old) through 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 has increased in most years since 1996. Current trends in numbers of large rams and in the ratio of large rams:100 “ewes” in the Baird Mountains are partial and should not be used in analysis.

### **MORTALITY**

#### *Harvest*

##### State Seasons and Bag Limits

Seasons and bag limits were identical for Units 23 and 26A for regulatory years 2004–2006. A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY 2004 = 1 Jul 2004–30 Jun 2005).

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")			

Bag Limit	Hunt Type*	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
Resident hunters: 1 sheep by registration permit only	R	10 Aug–30 Apr (subsistence hunt)	No open season
All hunters: 1 ram with full-curl horn or larger by drawing permit only provided that the harvestable surplus is >47 sheep	R	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: 1 sheep by registration permit only; quota is 5 sheep	R	10 Aug-30 Apr (Subsistence hunt)	
All hunters: 1 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 (“Schwotka Mountains”)			
Resident hunters: 3 sheep by registration permit only	R	1 Aug-30 Apr	

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:			
1 sheep by registration permit only	R	10 Aug-30 Apr (subsistence hunt)	10 Aug-20 Sep
All hunters:			
1 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:			
3 sheep by registration permit only	R	1 Aug-30 Apr	
All hunters:			
1 ram with full curl horn or larger	H	10 Aug-20 Sep	10 Aug-20 Sep

\* Hunt Type: R = registration hunt; D = drawing hunt; H = harvest ticket

Board of Game Actions and Emergency Orders. In 1998 the department and NPS negotiated an informal agreement to cooperatively manage sheep in the future for Units 23 and 26A. The basic elements of this on-going agreement are listed here:

- I. All sheep hunting in the Baird Mountains of Unit 23 will be administered through federal regulations (federal land only).

II. Sheep hunting in the De Long Mountains of Units 23 and 26A will be administered jointly under state and federal regulations (state and federal land). A single harvest quota will be established with allocation for state and federal harvest.

A. If the total harvest quota is  $\geq 20$  sheep:

1. The NPS will issue federal registration permits where federal harvest can 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.
2. The department 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.
3. The department and NPS will each close their respective hunts 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:

1. The NPS and department will each administer a portion of the quota.
2. The state will close drawing hunt DS384 to ensure an adequate number of sheep are available for subsistence hunters under RS388.

Hunter Harvest. As with moose and caribou harvest data, it is likely that sheep harvest data are incomplete for hunters who reside within Units 23 and 26A. This is probably most problematic for the Baird Mountains where most unit-residents hunt sheep. Before 1991–1992, when season restrictions or closures were initiated in the Baird and De Long Mountains, roughly 60% of the total reported harvest was taken in the Baird Mountains (Fig 1), where residents of Unit 23 harvested more sheep than nonresident or nonlocal resident hunters (Fig 2). In contrast, nonresidents harvested the most sheep in the De Long Mountains (Fig 3). “Ewes” comprised  $< 3\%$  of the reported harvest in the Baird and De Long Mountains prior to the restrictions imposed in 1991–1992; however, the number of “ewes” is probably under-estimated due to 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  $\geq 7/8$  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.” The season remained closed until 1995, when limited hunting was allowed as administered by the NPS. From 1995–1999, the average rams: 100 “ewes” was 42 and average large rams:100 “ewes” was 21. From 2000



through 2002, the last year with complete survey data, the average ram:100 “ewes ” was 37 and average large rams: 100 “ewes” was 14.

Median horn length of harvested sheep is not available for sheep taken under federal regulations. Therefore, there is no trend information about horn lengths in the Baird Mountains since 1993. Harvest trends from sheep taken in the state managed hunt in the De Long Mountains show an increase in horn length from a low of 32.63 inches (n=7) to a high of 36.78 inches (n=4) in 2006.

#### *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 observed in low-lying areas far from escape terrain. 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 the department and NPS have worked with advisory committees, the Northwest Arctic Regional Advisory Council and members of the public to gradually resume sheep hunting in Unit 23. The cooperative regulatory arrangement negotiated between the NPS and department in 1998 should be continued.

The NPS has initiated a sheep monitoring program for the entire Brooks Range west of the Dalton Highway. The department assisted with this project in 2005 and 2006 and should continue to provide support in future years.

It is unlikely federal subsistence needs will ever be met in the Baird Mountains; therefore, the state will not plan 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, 1989–2007

Sex/Age class	Year																	
	89	90	91	92	93	94	95	96	97	98	99	00	01	02	04 <sup>ab</sup>	05 <sup>b</sup>	06 <sup>b</sup>	07 <sup>b</sup>
Rams 1/2+	162	105	108	130	123	93	90	75	114	116	86	107	145	157	123	149	60	64
Rams 7/8+	51	32	35	42	37	41	23	56	72	70	28	25	50	79	51	29	13	14
“Ewes” <sup>c</sup>	574	466	239	267	256	204	166	169	314	289	243	317	389	381	343	307	223	306
Lambs	170	133	17	59	47	20	95	58	83	72	77	101	73	118	91	55	55	110
Unknown	75	14	36	0	0	0	0	0	0	0	0	0	9	26	41	0	0	0
Total Sheep	981	718	400	456	426	317	351	302	511	477	406	525	616	682	598	511	338	480
Total Adults <sup>d</sup>	736	571	347	397	379	297	256	244	428	405	329	424	534	538	466	456	283	370
Lambs:100 “Ewes”	30	29	7	22	18	10	57	34	26	25	32	32	19	31	27	18	25	36
Rams:100 “Ewes”	28	23	45	49	48	46	54	44	36	40	35	34	37	41	36	49	27	21
Rams 7/8+:100 “Ewes”	9	7	15	16	14	20	14	33	23	24	12	8	13	21	15	9	6	5
Adults/mi <sup>2</sup>	1.03	0.80	0.49	0.56	0.53	0.42	0.36	0.34	0.60	0.57	0.46	0.60	0.75	0.76	0.40	0.75	0.80	1.02

<sup>a</sup> No survey completed in 2003.<sup>b</sup> Partial surveys completed. Detailed information is available from NPS or ADF&G.<sup>c</sup> Ewes defined as adult females, yearling of either sex, and 1/4 curl rams.<sup>d</sup> Adult defined as all sheep excluding lambs and unknowns.

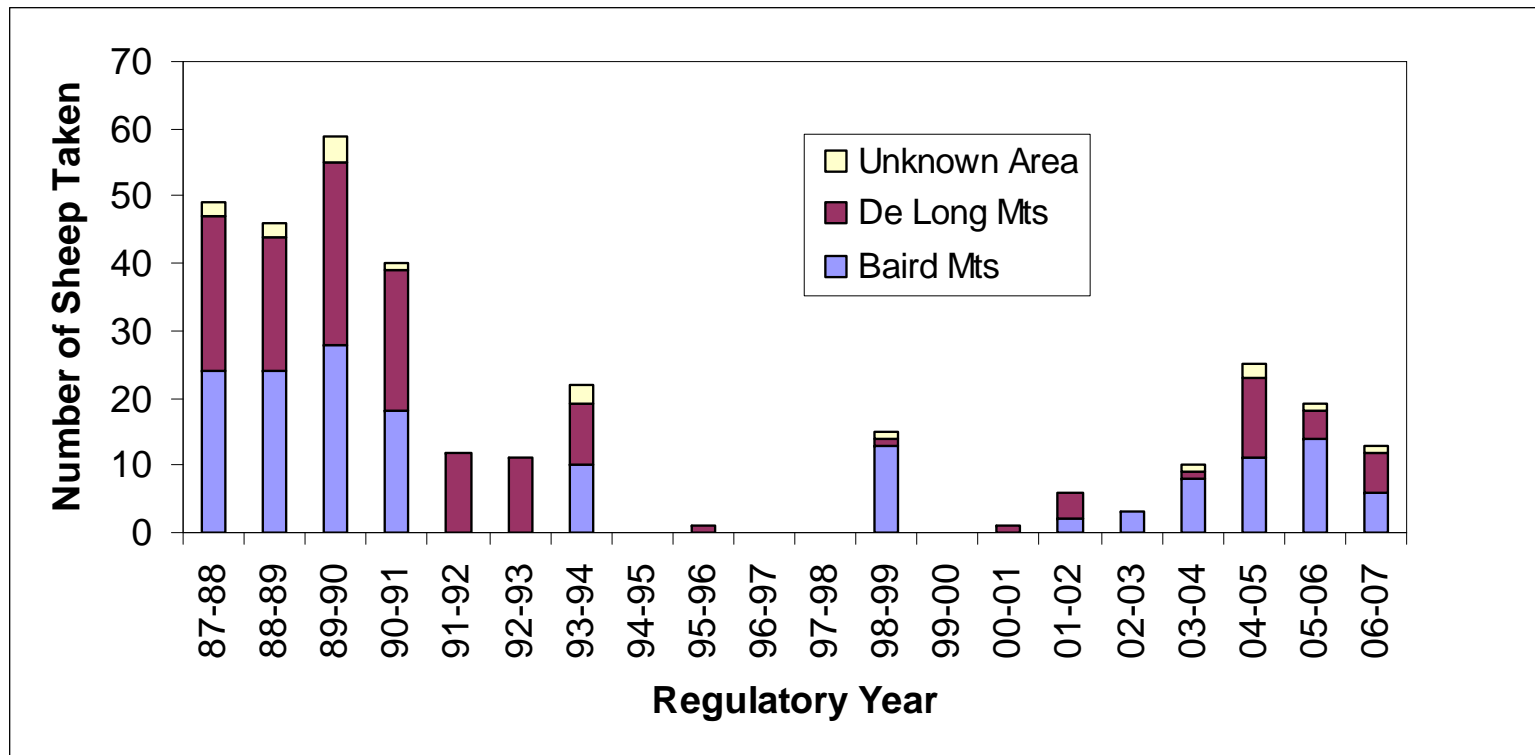


FIGURE 1 Number of sheep harvested in Game Management Unit 23 by area (data includes best information available for federal harvests)

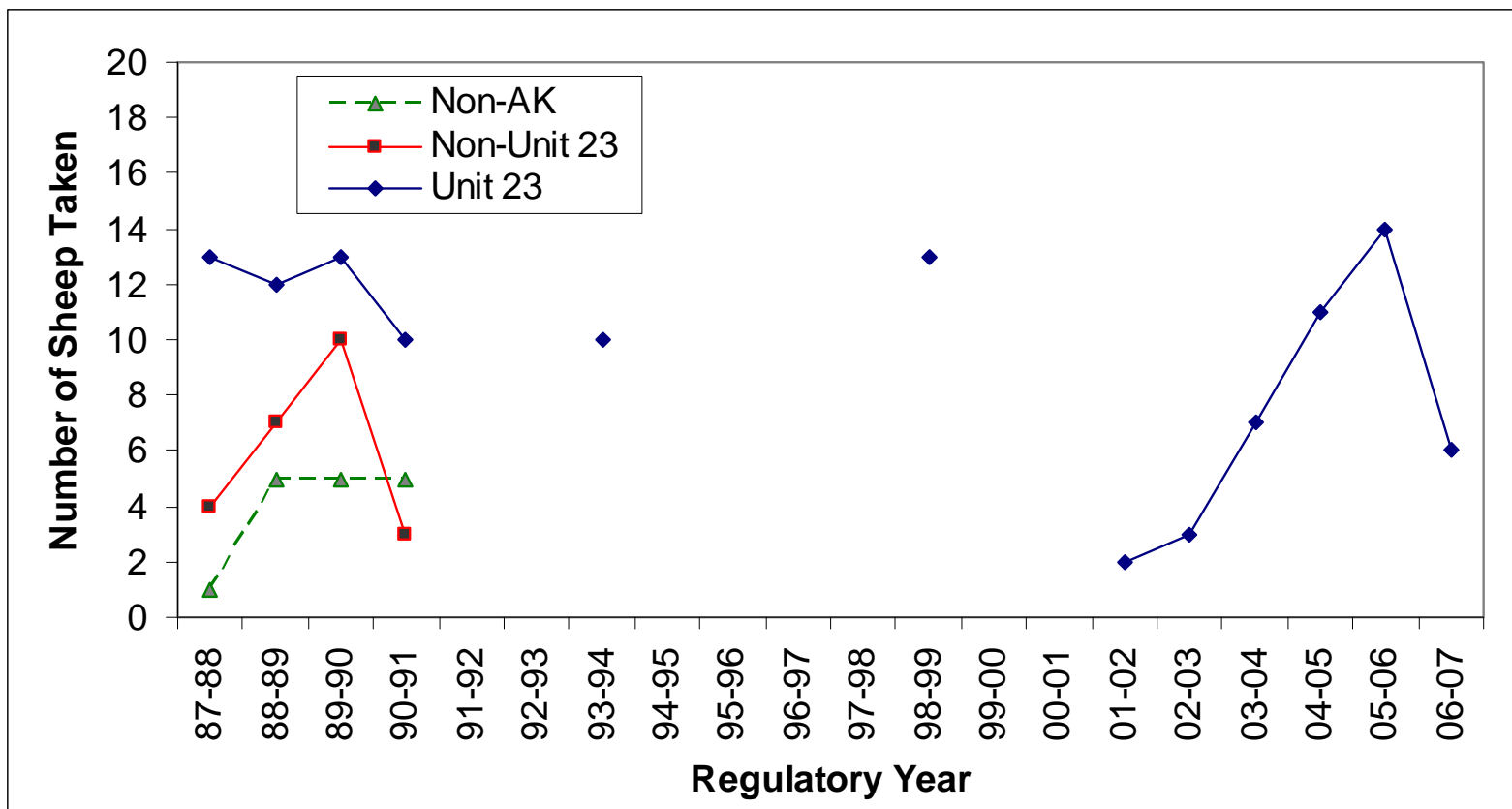


Figure 2 Baird Mountain sheep harvest in relation to hunter residence (data includes best information available for federal harvests)

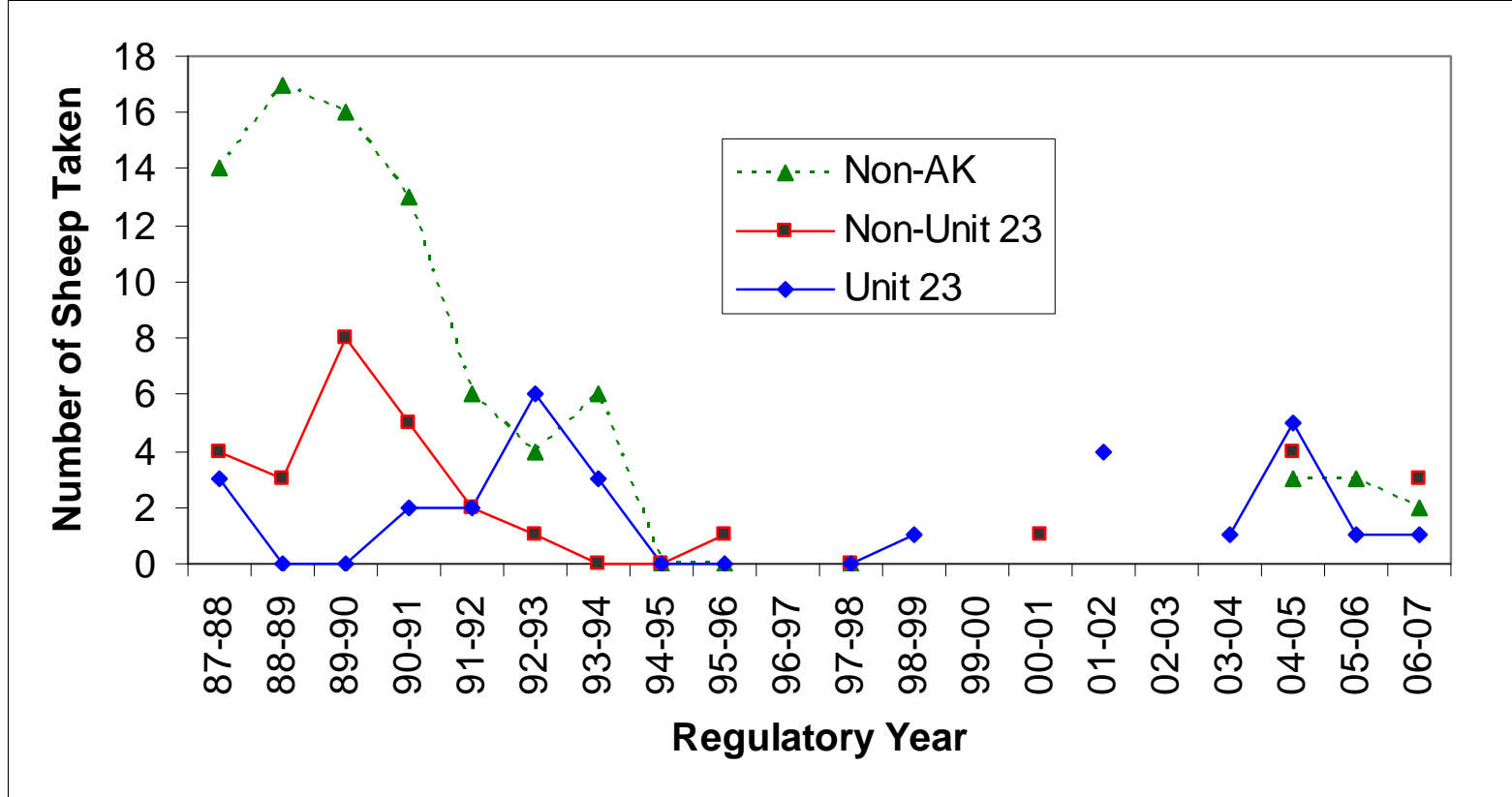


FIGURE 3 De Long Mountain sheep harvest in relation to hunter residence (data includes best information available for federal harvests)

**WILDLIFE**  
**MANAGEMENT REPORT**

**Alaska Department of Fish and Game**  
**Division of Wildlife Conservation**  
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**DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

**LOCATION**

**GAME MANAGEMENT UNITS:** 23 East, 24B, and portions of 24A and 26A (15,717 mi<sup>2</sup>)

**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 comprises portions of Units 23, 24A, 24B, and 26A. It includes the drainages of the upper Noatak, Killik, Chandler, and Koyukuk Rivers, encompassing the Schwatka and Endicott Mountains (Fig. 1). Dall sheep are irregularly distributed within the Central Brooks Range, but probably constitute a single 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 western Unit 24 (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 western Unit 24, sheep in Gates of the Arctic National Park and Preserve (GAAR) are managed under federal law. Federal subsistence hunting regulations have applied in GAAR since 1991.

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 had 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), except for annual fluctuations that were probably related to weather.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

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 (Lenart 2002). The average annual total harvest (reported and estimated unreported) was 50 rams. The take by Nunamiut hunters (inland Inupiat Eskimos) was unknown but was estimated to be  $\leq 50$  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 (4–17 rams). This was probably partially due to the low density of sheep on state land and because a majority of the best sheep habitat is in GAAR, where hunting is restricted to local residents. Reported harvest in GAAR has declined since regulatory year (RY) 2000 (RY = 1 Jul through 30 Jun; e.g., RY00 = 1 Jul 2000 through 30 Jun 2001) and there was no reported harvest in GAAR during RY04–RY06.

## **MANAGEMENT DIRECTION**

### **MANAGEMENT GOAL**

- Provide for harvest and viewing opportunity of Dall sheep.

### **MANAGEMENT OBJECTIVE**

- Maintain a general harvest of full-curl rams in the Central Brooks Range outside of GAAR.

### *Activity*

- Monitor harvest in the Central Brooks Range through the harvest ticket system and analyze harvest data.

## **METHODS**

### **POPULATION STATUS**

No comprehensive surveys of Dall sheep populations have been conducted in the Central Brooks Range since 1996, when GAAR and the Alaska Department of Fish and Game (ADF&G) cooperated to survey a 2220-mi<sup>2</sup> portion of GAAR (Whitten 1997; Brubaker and Whitten 1998). A subsample of the area was surveyed annually 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 Wildlife Troopers 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. 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. Currently, GAAR relies on the North Slope Borough to provide subsistence harvest data from this area (J. Lawler, GAAR, personal communication, 2008). These data are not available for this report period. ADF&G staff is not involved in collecting these data 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 monitors harvest on state land through the state general harvest data collected 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*

In 1982–1984, Singer (1984) estimated a population of 10,939 sheep in 10,132 mi<sup>2</sup> of sample units within GAAR (density = 1.1 sheep/mi<sup>2</sup>). In 1996, a population of 2758 ±8% (90% CI) sheep was estimated over an area of 2242 mi<sup>2</sup>, with densities ranging from 0.3 to 1.6 sheep/mi<sup>2</sup> 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<sup>2</sup>), 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, these surveys suggested that sheep numbers increased between 1982 and 1984, were stable during 1984–1987, and declined during 1988–1996 (Table 1; Whitten 1997). 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, U.S. Fish and Wildlife Service, unpublished data). The decline in sheep populations across all these areas appeared to be correlated with deep snowfall during winters between 1988 and 1993 (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, subsequent 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<sup>2</sup>) also found no evidence of a population trend between 2002 and 2007 (A. L. Hollis, ADF&G, memorandum dated 10 July 2007 on eastern Brooks Range sheep survey, Fairbanks).

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<sup>2</sup> of sheep habitat). These count areas were similar to count area 13 surveyed by Singer (1984) in 1983 (485 mi<sup>2</sup>), although the 2004 count area was slightly larger (521 mi<sup>2</sup>). In 2004, we counted 386 sheep (density = 0.74 sheep/mi<sup>2</sup>) in 9 hours. In 1983, Singer (1984) counted 507 sheep (density = 1 sheep/mi<sup>2</sup>). Different aircraft type and methodologies may have been used between the 2 surveys.

Currently GAAR staff is conducting a 4-year study to determine the population of sheep in GAAR (J. Lawler, personal communication, 2008). Results of this study should be available for the next reporting period.

### *Population Composition*

Estimates of percent lambs and the lamb:100 ewe ratios support the suggestion that the sheep population was stable between 1984 and 1987 (Table 1; Singer 1984; Adams 1988). These estimates both declined during 1993, then increased during 1996, which indicated that reproductive success had increased and the population might have been growing (Table 1; Whitten 1997; Brubaker and Whitten 1998).

To compare the data from 1998–2002 to the 1996 surveys, Lawler (2004) used data collected by fixed-wing aircraft in 1996, which used the same method as surveys conducted during 1998–2002. The ratio for 1996 was 38 lambs:100 ewe-like, with 24% 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, data collected in the trend count areas indicate that 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 ( $n = 14\text{--}18$ ; J. Lawler, personal communication); therefore, high mortality of ewes may have slowed or prevented a population increase.

## **MORTALITY**

### *Harvest*

Season and Bag Limit (RY98–RY06). Only state regulations are listed below, although federal subsistence regulations apply on federal lands within the area.

<u>Units and Bag Limits</u>	<u>Resident Open Season (General Hunts)</u>	<u>Nonresident Open Season</u>
Units 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
Unit 24B, that portion within the John River drainage upstream from Till Creek, and that portion within the Glacier River drainage.		
RESIDENT HUNTERS: 3 sheep.	1 Aug–30 Apr	No open season
Remainder of Unit 24B		
RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep
Units 23 (Schwotka Mountains) and Unit 26A, east of the Cutler, Redstone, Aniuk, and Etivluk Rivers.		
RESIDENT HUNTERS: 3 sheep by registration permit only (RS389).	1 Aug–30 Apr	
RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep

Harvest by Hunters. No harvest data are available for lands included in GAAR during RY04–RY06 (Table 3). Most of the harvest in GAAR probably was by residents of Anaktuvuk Pass. Three sheep were reported harvested in Unit 23 on GAAR lands in 2005 on state general harvest tickets. These were probably mistakes in reporting by the hunters.

The general harvest for the Central Brooks Range (excluding GAAR) averaged 10 sheep during the past 5 years (range: 4–17; RY02–RY06; Table 4) compared to an average of 8 during the previous 5 years (RY97–RY01; Table 4). The harvest has remained relatively constant at this low level since RY96, although in RY06 the harvest increased to 17 sheep. Prior to RY96 the 5-year average harvest was 21 sheep per year. 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 low harvest was also probably related to fewer hunters in the field as numbers of hunters also began to decrease in RY96 (Table 4). Individuals who reported on general harvest reports primarily reported hunting 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).

Hunter Residency and Success. In the state general harvest, the 5-year average success rate for the area was 46% (range: 26–61%; RY02–RY06). Success rates were higher for nonresident

hunters (range: 38–88%) compared with resident hunters (range: 18–50%). Nonresident hunters primarily used guides. The percent of nonresident hunters ranged from 33 to 46% during RY02–RY06 (Table 4). In general, most hunting occurred in Unit 24B and 26A and little or no hunting occurred in Unit 23.

Harvest Chronology. Since 1993 the highest harvest of sheep in the Central Brooks Range in the general hunt usually occurs during the first 10 days of the season (Table 6). This varied in RY95, RY98, and RY02 when more harvest occurred during the second 10 days. On years when the weather is bad during the first 10 days, the highest harvest normally occurs during the second 10 days. Due to the low harvest in the Central Brooks Range general hunt, the harvest chronology can vary with increased harvest of just a few rams during the second 10 days.

Transportation Methods. In the RY93–RY06 general hunts, aircraft were the major means of transportation because access by other means was limited (Table 7). Boats, primarily out of Bettles, were the second most commonly used means of transportation.

#### *Other Mortality*

GAAR personnel monitored 27 radiocollared sheep (22 ewes, 5 rams) in GAAR during 1997–2002 (Lawler 2004). They found the survival rate for these sheep was 0.78 ( $\pm 0.027$ ), comparable to populations in Kluane National Park, Yukon Canada, the Mackenzie Mountains in northwestern Alaska, and Denali National Park, Alaska (80%, 85%, and 85% respectively). However, mortality was higher in sheep older than 8 years old.

## **CONCLUSIONS AND RECOMMENDATIONS**

No survey data are available for the sheep population in the Central Brooks Range for RY04–RY06. However, some indicators suggest that the population is stable, although at lower density than observed in the 1980s. Sheep surveys conducted by ADF&G from 2002 through 2007 in an adjacent area directly east of the Central Brooks Range indicate stable population numbers in that area (A. L. Hollis, memorandum, 2007). The reported annual harvest in the general hunt was <18 rams taken by <30 hunters (Table 4). Because the harvest was low and was predominantly older rams it likely had little effect on the sheep population. However, because there are no data on the subsistence harvest on GAAR land we have to rely on historical data to estimate the subsistence harvest. If the subsistence harvest has remained less than 30 sheep with the majority of the sheep being rams, as it was from 1990 through 2003 (Tables 3 and 8), then there was probably little effect on the population. If the subsistence harvest increased and more ewes were harvested, this may have affected the population.

The goal of providing harvest and viewing opportunities for Dall sheep in the Central Brooks Range was met. GAAR was used by Dall sheep viewers and photographers, albeit sparingly. This activity has increased as a result of increased tour bus transit on the Dalton Highway in recent years. 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 outside of GAAR was also met. Seasons and bag limits did not change, allowing ample opportunity to harvest sheep. The number

of hunters has remained low since RY95 (range: 13–30) and success rates were good during RY02–RY06 ( $\bar{x}$  = 46%; Table 4).

We will continue to work with staff from GAAR to summarize harvest data, especially of sheep harvested in GAAR. We suggest a cooperative effort between the 2 agencies to continue existing sheep surveys conducted by GAAR staff and expand the surveys to the east.

For the next report period, management goals, objectives, and activities will be as follows:

#### **MANAGEMENT GOAL**

- Provide for harvest and viewing opportunity of Dall sheep.

#### **MANAGEMENT OBJECTIVE**

- Using a full-curl harvest strategy, maintain an average harvest of rams greater than or equal to full curl.

#### *Activity*

- Monitor harvest in the Central Brooks Range through the harvest ticket system and analyze harvest data.

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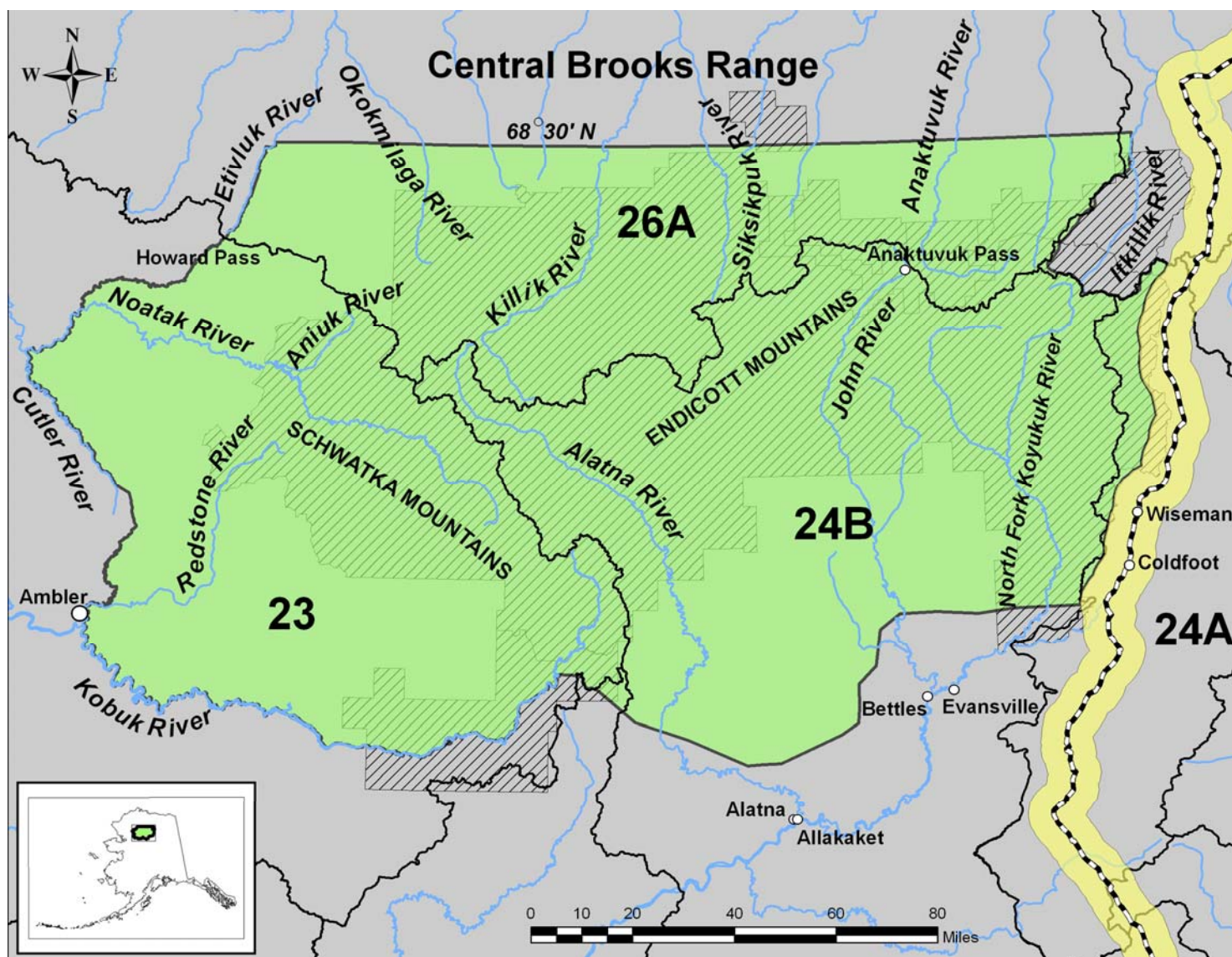


FIGURE 1 Central Brooks Range

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

Year	Lambs (%) <sup>a</sup>	Ewe-likes <sup>b</sup> (%) <sup>a</sup>	Lamb: 100 Ewes	Yearlings (%) <sup>a</sup>	Rams (%) <sup>a</sup>	Rams:100 Ewes	% Rams ≥ full curl <sup>a</sup>	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 <sup>c</sup>									358
(Singer 1984 count areas 1, 2, 3, and 6) <sup>d</sup>									
1993	102 (17)	356 <sup>e</sup> (58)	29		159 (26)	45	41	0	617
1996 <sup>f</sup>	85 (24)	191 (54)	45		80 (22)	42	33	0	356

<sup>a</sup> When calculating percent ratios, unknown classified animals were subtracted from total.

<sup>b</sup> Ewe-likes included ewes, yearlings, and rams smaller than ¼ curl.

<sup>c</sup> The 1996 survey for total sheep was an estimate, not a count.

<sup>d</sup> Not the exact same portions of the count areas were flown both years.

<sup>e</sup> In Osborne 1996, Table 1, the number reported is 393, but this was a typographical error.

<sup>f</sup> Data from ADF&G unpublished files (memorandum from Ken Whitten to Glenn Stout, ADF&G, Fairbanks, 1999).



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

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

*Data source:* Lawler 2004.

<sup>a</sup> Ewe-like includes adult ewes, yearlings, and rams smaller than ½ curl.

<sup>b</sup> Poor survey conditions; high winds and poor visibility.

<sup>c</sup> Wind, new snow, and fog were somewhat problematic.

<sup>d</sup> Late spring; snow and fog were problematic.

TABLE 3 Central Brooks Range sheep harvest, regulatory years 1993–1994 through 2006–2007

Regulatory year	Unit <sup>a</sup>						Total harvest		
	23		24 West		26A				
	GAAR <sup>b</sup>	Other <sup>c</sup>	GAAR	Other	GAAR	Other	GAAR	Other	Combined (% GAAR)
1990–1991							22	28	50 (44)
1991–1992							23	32	55 (42)
1992–1993							22	15	37 (59)
1993–1994	4	0	6	9	5	6	15	15	30 (50)
1994–1995	0	0	13	6	13	11	26	17	43 (60)
1995–1996	0	0	7	6	2	4	9	10	19 (47)
1996–1997	0	0	17	3	5	2	22	5	27 (81)
1997–1998	2	0	12	3	5	6	19	9	28 (68)
1998–1999	2	0	8	5	8	3	18	8	26 (69)
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	3	3	7	12	19 (42)
2003–2004	0	0	5	2	4	3	9	5	14 (64)
2004–2005	0 <sup>d</sup>	0	0 <sup>d</sup>	7	0 <sup>d</sup>	4	0 <sup>d</sup>	11	<sup>d</sup>
2005–2006	3 <sup>d,e</sup>	0	0 <sup>d</sup>	3	0 <sup>d</sup>	1	3 <sup>d,e</sup>	4	<sup>d, e</sup>
2006–2007	0 <sup>d</sup>	0	0 <sup>d</sup>	11	0 <sup>d</sup>	6	0 <sup>d</sup>	17	<sup>d</sup>

<sup>a</sup> 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.

<sup>b</sup> GAAR includes harvest by federally qualified hunters in Gates of the Arctic National Park (since 1981).

<sup>c</sup> Other sheep harvest includes all other harvest besides the GAAR harvest.

<sup>d</sup> No reported harvested was available from GAAR.

<sup>e</sup> These three sheep were incorrectly reported by subsistence hunters on a state harvest ticket.

TABLE 4 Central Brooks Range (excluding Gates of the Arctic National Park) hunter residency and success, regulatory years 1993–1994 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters (% nonresident)	
	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local <sup>a</sup> resident	Nonlocal resident	Nonresident	Unk	Total (%)		
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)
2004–2005	1	3	7	0	11 (46)	1	11	1	0	13 (54)	24	(33)
2005–2006	0	2	2	0	4 (31)	0	6	3	0	9 (69)	13	(38)
2006–2007	1	5	11	0	17 (61)	1	8	2	0	11 (39)	28	(46)

<sup>a</sup> 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, which is not reported in this table.

TABLE 5 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park and Preserve), regulatory years 1993–1994 through 2006–2007

Regulatory year	$\bar{x}$ Horn length	% Over 40"	$\bar{x}$ Age	Total rams
1993–1994	33.8	7	10.6	15
1994–1995	34.8	0	10.0	17
1995–1996	34.3	0	9.8	10
1996–1997	35.3	0	9.4	5
1997–1998	35.4	11	9.3	9
1998–1999	34.5	0	9.1	8
1999–2000	34.8	0	9.5	8
2000–2001	37.2	14	10.0	7
2001–2002	36.9	20	11.0	10
2002–2003	35.4	9	9.0	11
2003–2004	36.7	0	9.8	5
2004–2005	35.7	10	9.6	10
2005–2006	33.9	25	9.3	4
2006–2007	35.8	6	9.4	17

TABLE 6 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park and Preserve) chronology percent by month/day, regulatory years 1993–1994 through 2006–2007

Regulatory year	Harvest chronology percent by month/day				N
	8/10–8/20 (n)	8/21–8/31 (n)	9/1–9/10 (n)	9/11–9/20 (n)	
1993–1994	60 (9)	27 (4)	7 (1)	7 (1)	15
1994–1995	82 (14)	6 (1)	6 (1)	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
2004–2005	60 (6)	20 (2)	0 (0)	20 (2)	10
2005–2006	25 (1)	25 (1)	25 (1)	25 (1)	4
2006–2007	44 (7)	31 (5)	19 (3)	6 (1)	16

TABLE 7 Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park and Preserve) percent by transport method, regulatory years 1993–1994 through 2006–2007

Regulatory year	Harvest percent by transport method					<i>N</i>
	Airplane ( <i>n</i> )	Boat ( <i>n</i> )	Snowmachine ( <i>n</i> )	Horses ( <i>n</i> )	Unknown ( <i>n</i> )	
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
2004–2005	64 (7)	9 (1)	0 (0)	9 (1)	18 (2)	11
2005–2006	100 (4)	0 (0)	0 (0)	0 (0)	0 (0)	4
2006–2007	71 (12)	12 (2)	0 (0)	12 (2)	6 (1)	17

TABLE 8 Gates of the Arctic National Park and Preserve subsistence sheep harvest, regulatory years 1989–1990 through 2003–2004<sup>a</sup>

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

<sup>a</sup> Subsistence harvest data has not been collected by ADF&G or Gates of the Arctic National Park and Preserve since regulatory year 2003–2004.

## **DALL SHEEP MANAGEMENT REPORT**

From: 1 July 2004  
To: 30 June 2007<sup>1</sup>

### **LOCATION**

**GAME MANAGEMENT UNITS:** Eastern Unit 24A, Unit 25A, and Units 26B and 26C (49,600 mi<sup>2</sup>)

**GEOGRAPHIC DESCRIPTION:** Eastern Brooks Range

### **BACKGROUND**

Dall sheep are found throughout the mountains of the eastern Brooks Range. Heimer (1985) estimated there were 13,000 sheep in the eastern Brooks Range in 1985. In Unit 26C the population subsequently declined by approximately 40% in the Hulahula drainage and similar declines appear to have occurred throughout their range in Alaska. The most likely cause of the decline was severe weather, which reduced recruitment and may have increased predation. Although surveys have been sporadic in most areas, available survey and harvest data and observations by hunters indicate that populations have stabilized at lower levels since the late 1990s.

Consumptive 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. However, the opportunity to hunt sheep remains important to resident and nonresident hunters and the eastern Brooks Range has remained a popular area for sheep hunting. During regulatory years 2004–2006 (RY04–RY06; RY begins 1 Jul and ends 30 Jun, e.g., RY04 = 1 Jul 2004 through 30 Jun 2005), reported annual harvest ranged from 156 to 175 rams taken by 330–414 hunters.

### **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.

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<sup>1</sup> At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

- 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 Alaska Department of Fish and Game (ADF&G)-Subsistence Division and FWS to manage subsistence sheep harvests.

### **METHODS**

The eastern Brooks Range includes that portion of Unit 24A within and east of the Dalton Highway Corridor Management Area (DHCMA), Unit 25A, Unit 26B, and Unit 26C. Based on harvest reports, we evaluated harvest, hunter use patterns, and characteristics of harvested sheep by regulatory year (RY) which begins 1 July and ends 30 June (e.g. RY04 = 1 Jul 2004 through 30 Jun 2005). Federal subsistence permit hunts and state registration hunts were analyzed separately from general season hunts.

In eastern Unit 24A and Unit 25A, annual composition surveys have been conducted by ADF&G in the upper North Fork Chandalar River drainage since 2002 (A. L. Hollis, ADF&G, memorandum dated 10 Jul 2007 on eastern Brooks Range sheep survey, Fairbanks). The 799-mi<sup>2</sup> survey area includes the drainages south of the North Fork Chandalar River, west of Chandalar Lake, and east of Gates of the Arctic National Park and Preserve (GAAR). Drainages within the survey area include Mathews, Big Spruce, Sheep, Robert, Phoebe, Willow, Geroe, Baby, and Quartz creeks along with portions of the DHCMA. In late June or early July, elevation contours were flown with fixed-wing aircraft in all available sheep habitat within the survey area and observed sheep were classified as lamb, ewe-like, or ram. Rams were further classified by horn size as legal for harvest (full-curl or larger, including rams with both horns broomed) or sublegal. Ewe-like sheep included adult females plus yearlings and 2-year-olds of both sexes that could not be distinguished from ewes.

In 2003, ADF&G conducted an aerial survey in Unit 26B in the Atigun drainage. The 543-mi<sup>2</sup> survey area included the Atigun drainage from Atigun Pass to Galbraith Lake, Atigun Gorge, the drainages flowing into the west fork of the Sagavanirktok River, Imnavait Mountain, and a site commonly referred to as Slope Mountain (lat N68.7422, long W-149.0661) (E. A. Lenart, ADF&G, memorandum dated 30 Oct 2003 on Dall sheep survey, 28–30 June 2003, upper Chandalar and Atigun drainages, Fairbanks). In late June, elevation contours were flown with fixed-wing aircraft in all available sheep habitat within the survey area and observed sheep were classified as lamb, ewe-like, or ram. Rams were further classified by horn size as legal or

sublegal. Ewe-like sheep included adult females plus yearlings and 2-year-olds of both sexes that could not be distinguished from ewes.

In Unit 26B, annual ground-based composition surveys were conducted east of the Dalton Highway from Atigun Pass to Atigun Gorge from 1986 to 2007 by staff from the Arctic National Wildlife Refuge (ANWR). Sheep were located from highway vehicles and classified as lamb, ewe, yearling, 2-year-old, and ram. Rams were further classified by horn size as  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $\frac{5}{8}$ ,  $\frac{3}{4}$ ,  $\frac{7}{8}$ , or full curl. Double-broomed rams were not classified as full curl unless they were broomed at full curl or longer. For comparison to other surveys conducted by fixed-wing aircraft, we recategorized these classification data as lamb, ewe-like, legal ram, and sublegal ram, recognizing that most double-broomed rams would not be included in the legal ram class.

In Unit 25A, aerial surveys have been conducted by ANWR staff in the upper East Fork Chandalar River drainage periodically since 1991 (unpublished FWS reports entitled *Dall sheep survey in the Arctic Village sheep management area and vicinity*, authored by F. J. Mauer [1996], D. C. Payer [2006], and A. W. Brackney [2007], Fairbanks). Generally, the survey area encompasses the Arctic Village Sheep Management Area (AVSMA), which lies between Crow Nest and Cane creeks, west of the East Fork Chandalar River to the Continental Divide and from Red Sheep Creek to Gilbeau Pass north of the AVSMA. However, in most years, only portions of the survey area were surveyed. Surveys were flown with fixed-wing aircraft, along elevation contours for all available sheep habitat, and observed sheep were classified as lamb, ewe-like, or ram. Rams were further classified by horn size as mature (potentially full curl) and other ram. Ewe-like classification included adult females plus yearlings and 2-year-olds of both sexes that could not be distinguished from ewes.

In Unit 26C, aerial and ground-based composition surveys have been conducted by ANWR staff in the Hulahula drainage in most years since 1992. Aerial surveys were conducted by helicopter during 1993–1995 and included most of the Hulahula drainage. The ground-based route only included the upper Hulahula drainage and generally included sheep habitat adjacent to the Hulahula River downstream from the upper landing strip to East Patuk Creek. In both survey methods, observed sheep were classified as lamb, ewe, yearling, 2-year-old, and ram. Rams were further classified by horn size as  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $\frac{5}{8}$ ,  $\frac{3}{4}$ ,  $\frac{7}{8}$ , or full curl. Double-broomed rams were not classified as full curl unless they were broomed at full curl or longer. For comparison to other surveys conducted by fixed-wing aircraft, we recategorized these classification data as lamb, ewe-like, legal ram, and sublegal ram, recognizing that most double-broomed rams would not be included in the legal ram class. Ewe-like classification included adult females plus yearlings and 2-year-olds of both sexes that could not be distinguished from ewes.

## **RESULTS AND DISCUSSION**

### **POPULATION STATUS AND TREND**

#### *Population Size*

Population size for the eastern Brooks Range is unknown. However, we compared count data of total sheep observed during composition surveys to estimate trend in the upper Chandalar (eastern Unit 24A and Unit 25A) and upper Atigun River (Unit 26B) drainages. Both survey



areas consisted of the same geographic area and survey techniques have remained consistent within survey areas and between years. Aerial counts of total sheep in the upper Chandalar drainage of eastern Unit 24A and Unit 25A, though annually variable, remained relatively stable from 2002 to 2007 (range: 989–1589; Table 1). The cause of annual variability in counts is largely unknown, but variation in sheep survival and recruitment, movement, and measurement error likely affect indices of abundance in this survey area. In Unit 26B, ground-based counts conducted in the upper Atigun River also indicated a relatively stable population from 1986 to 2006 (Table 2). However, this survey area is likely biased to low elevation habitats that are easily sampled from the road. Although neither survey was designed to estimate sheep population size for their respective areas, dramatic changes would probably be detected.

### *Population Composition*

ADF&G conducted composition surveys in the upper North Fork Chandalar River drainage during 2002–2007. Lamb:100 ewe-like ratios and the proportion of lambs in the population have risen slightly but remained moderate since 2002 (range of lamb:100 ewe-likes: 18–43; Table 1). Although the numbers of legal rams have remained stable since 2002, the proportion of legal sheep among all rams observed increased in 2005–2007 ( $\bar{x}$  = 16.8%) compared to 2002–2004 ( $\bar{x}$  = 12.3%), indicating a shift in population age structure to older rams.

Unit 26B surveys conducted by ANWR during 2004–2006 in the upper Atigun River drainage indicated moderate and stable lamb:ewe-like ratios ( $\bar{x}$  = 31:100), similar to rates observed during 1986–2003 ( $\bar{x}$  = 29:100, Table 2). Although the proportion of legal sheep and the ratio of lambs:100 ewe-likes have been stable since 1986, the number of rams counted in this survey are likely biased low as a result of survey design and sexual segregation of sheep among different habitat types. In this survey, counts and classifications were conducted from the Dalton Highway and were biased to lower elevation habitats visible from the road. In addition, double-broomed rams were not included in the full-curl class unless they were broomed at full curl or longer.

In 2003, ADF&G surveyed the upper Atigun River drainage using fixed-wing aircraft. Although this was the only aerial survey completed for this area (Table 3), the lamb:ewe-like ratio (25 lambs:100 ewe-likes) and proportion of lambs (16%) was moderate and similar to ground based composition surveys conducted by ANWR from the Dalton Highway in the same year (Table 2). The proportion of legal rams among all rams (21%) was significantly higher than the ratio observed from the ground based survey (2%) and likely reflects differences in survey techniques and area and higher sightability of this age and sex class.

Fixed-wing aerial surveys have been conducted by ANWR staff in the upper East Fork Chandalar River drainage periodically since 1992 (Table 4). In most years, only portions of the survey area were surveyed. In 2006, Cane Creek to Gilbeau Pass west of the East Fork Chandalar River was surveyed in addition to a small portion between Ottertail Creek and Crow Nest Creek. In 2007, Cane Creek and Red Sheep Creek drainages were surveyed. Since 1992, Mauer (unpublished report, 1996), Payer (unpublished report, 2006), and Brackney (unpublished report, 2007) documented annual and subunit differences in sheep abundance and composition in this area. They attributed temporal and spatial variation in sheep abundance to food availability, habitat quality, and movements associated with mineral licks. Although trends in abundance have been difficult to detect from these surveys, sheep are more abundant in the upper drainages

of the East Fork Chandalar River compared to downstream drainages. Similar to survey results from the North Fork Chandalar River, the proportion of mature rams observed within this sex class have increased since 1992, suggesting a shift in age structure to older rams in the population (Table 4). However, the proportion of legal sheep is unknown because rams were classified as either mature or other and the mature sheep classification likely included sublegal rams.

Surveys in the upper Hulahula drainage in Unit 26C were conducted by ANWR staff in most years since 1992 (Table 5). Ground-based composition counts during 2004–2007 indicated moderate lamb:ewe-like ratios ( $\bar{x} = 27:100$ ) and were similar to other survey areas in the eastern Brooks Range (Table 5). Detecting a long-term trend within this survey area is difficult because in the 1990s, surveys were mostly conducted by helicopter and current techniques are ground based and cover a smaller geographic area. Similar to ground surveys conducted in Unit 26B, these surveys are biased to low elevation habitats. In addition, rams with double-broomed horns were not classified as full curl unless they were broomed at full curl or longer.

Direct comparisons of legal rams among surveys were not possible because the criteria for classifying rams differed between surveys. Although general inference about age structure among rams and between survey areas were made, consistency in classification is needed before more direct comparisons on this sex and age class can be made.

#### *Distribution and Movements*

No studies of sheep distribution and movement were done during RY04–RY06. Studies of radiomarked sheep during 1988–1992 indicated 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 similar to those 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*

Season and Bag Limit (RY04–RY05). Only state regulations are listed below, although federal subsistence regulations apply on federal lands within the area. Rams with both horns broken (broomed) and less-than-full-curl rams that were at least 8 years old were legal as full-curl rams under state regulations.

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. NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep 1 Oct–30 Apr	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. RESIDENT AND NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep

Season and Bag Limit (RY06). Only state regulations are listed below, although federal subsistence regulations apply on federal lands within the area. Rams with both horns broken (broomed) and less-than-full-curl rams that were at least 8 years old were legal as full-curl rams under state regulations.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 24A. 1 ram with full-curl horn or larger.	10 Aug–20 Sep	10 Aug–20 Sep
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. NONRESIDENT HUNTERS: 1 ram with full-curl horn or larger.	10 Aug–20 Sep 1 Oct–30 Apr	10 Aug–20 Sep

Unit 26B, private lands within

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Gates of the Arctic National Park. RESIDENT HUNTERS: 3 sheep. NONRESIDENT HUNTERS:	1 Aug–30Apr	No Open Season
Unit 26B, remainder. 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. In January 2004 the Alaska Board of Game adopted a statewide sealing provision that went into effect in RY04. This regulation required sealing by ADF&G personnel of sheep horns in most areas, including areas with full-curl regulations in eastern Unit 24A, and Units 25A, 26B, and 26C. In RY06, Unit 24 was subdivided into Units 24A, 24B, 24C, and 24D. The last major regulatory change for the eastern Brooks Range occurred in 1993, when the board established a full-curl regulation for general season hunts.

In 1991, the Federal Subsistence Board (FSB) established the AVSMA in Unit 25A in response to concern expressed by local hunters (residents of Arctic Village, Venetie, Fort Yukon, Kaktovik, and Chalkyitsik) that nonlocal hunters interfered with sheep hunting by federally-qualified subsistence users. The AVSMA includes the area between Crow Nest and Cane creeks, west of the East Fork Chandalar River to the Continental Divide and is entirely within ANWR. The AVSMA was closed to sheep hunting except by federally-qualified subsistence hunters. In 1995 the AVSMA was extended by the FSB northeast to include the entire drainages of Cane and Red Sheep creeks. Because local subsistence hunters did not report hunting sheep in Cane and Red Sheep Creek drainages, the FSB temporarily opened this portion of the AVSMA to the state's fall season in 2006. In 2007 the FSB made this change permanent.

Harvest by Hunters. The total reported annual harvest during RY04–RY06 increased by about 20% ( $\bar{x}$  = 162) compared to the previous 8-year period ( $\bar{x}$  = 133, Table 6). Most of the additional harvest occurred in Unit 25A and was likely due to more hunter effort. In addition, survey data indicates an older age structure among rams and proportionally more legal rams in the population compared to previous years. Since 1996 the number of hunters and harvest has remained relatively stable in eastern Unit 24A and Unit 26C. The number of hunters in Unit 26B increased ( $\bar{x}$  = 149) during RY04–RY06 compared to the previous 8-year period ( $\bar{x}$  = 121), but harvest remained stable. Although total harvest increased across the eastern range, horn length ( $\bar{x}$  = 35.5 inches) and the proportion exceeding 40 inches (6%) was stable (Table 7).

Permit Hunts. Participation in the state registration hunt RS595 has been open to all Alaska residents since RY90. During RY04–RY06, no reported harvest occurred for this permit hunt and few permits were issued annually (Table 8). In addition to RS595, 4 federal subsistence permit hunts (FS424, FS596, FS799 and FS699) occur in Unit 24A East, Unit 25A, Unit 25A and Unit 26C, and Unit 26B, respectively. These permits were available to federally-qualified subsistence hunters who hunt on federal land. During RY04–RY06, a combined total of 15 sheep

were harvested across all years and permits and accounted for a small proportion of the total annual harvest (Tables 6 and 8).

Hunter Residency and Success. In RY04–RY06, Alaska resident hunters comprised 63–70% of the total hunters, annually, in the eastern Brooks Range, consistent with previous years (Table 9). Overall success rates averaged 43% across RY04–RY06 and were similar to prior years. Nonresident hunters continued to have a higher success rate ( $\bar{x} = 72\%$ ) compared to residents ( $\bar{x} = 30\%$ ), reflecting the advantage of having a guide (Golden 1990). Success rates varied across the Brooks Range and were generally higher in areas that are more difficult to access or are accessible by aircraft only, compared to areas near the Dalton Highway. In addition, low success rates associated with archery-only hunts limit harvest within the DHCMA.

Harvest Chronology. Most sheep harvest in the eastern Brooks Range occurs during August when the weather is most conducive to hunting (Table 10). In RY04–RY06, 86–93% of the reported harvest occurred before 1 September, consistent with previous years.

Transport Methods. Aircraft were the primary means of transportation for most hunters and were used in 68–83% of successful hunts (Table 11). Transport methods associated with most of the remaining harvest (in descending order) included highway vehicle, horse, and boat.

## CONCLUSIONS AND RECOMMENDATIONS

Sheep populations across the eastern Brooks Range appear to be stable, and remain below levels observed in the mid 1980s. Although population size and recruitment appear to be stable, survival rates, distribution, and habitat quality are poorly understood in most parts of the range. Survey data indicate a recent shift in age structure to older rams within this sex class. The observed trend may be the result of an increase in lamb production beginning 7–10 years ago. Increased harvest of full-curl rams over the same period substantiates this hypothesis.

The number of hunters and the harvest of full-curl rams increased by about 20% during RY04–RY06 compared to the previous 8-year mean. Most additional hunting pressure occurred in Units 25A and 26B while most additional harvest occurred in Unit 25A only. There are growing public concerns that unregulated guiding of nonresident hunters on state land has resulted in excessive hunting pressure. The only area where this issue currently affects sheep management in the eastern Brooks Range is in the Middle Fork and North Fork Chandalar River (Units 25A and eastern Unit 24A). Recent population surveys in this area have improved our understanding of this situation and indicate that full-curl rams are not being overharvested. However, high hunter densities and competition in this area may reduce hunt quality.

ANWR contributed survey data in portions of the eastern Brooks Range that has helped assess sheep population status. However, survey techniques and classification schemes related to those surveys make comparisons difficult between years and survey areas. More specifically, consistency in classification is needed before inferences can be made about age structure among rams and the effects harvest may have on this segment of the population.

Management direction for the next report period (RY07–RY09) is as follows:

#### **MANAGEMENT GOALS**

- Protect, maintain, and enhance the sheep population and its habitat in concert with other components of the ecosystem.
- Provide for continued general season harvest and subsistence use of sheep.
- Provide an opportunity to hunt sheep under aesthetically pleasing conditions.
- Provide an opportunity to view and photograph sheep.

#### **MANAGEMENT OBJECTIVE**

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

#### **RELATED MANAGEMENT ACTIVITIES**

- Continue to monitor sheep population status through composition and trend count areas.
- Work with FWS to modify survey techniques so they are more conducive to the assessment of management objectives.
- Monitor the effects of the full-curl general season harvest and subsistence harvest.
- Work with ADF&G-Subsistence Division and FWS to manage subsistence sheep harvests.

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TABLE 1 Aerial sheep composition surveys in the upper Chandalar River drainage (Units 24A east and 25A, 779 mi<sup>2</sup>), 2002–2007. Surveys occurred in late June or early July of the year indicated.

Year	Legal (%) <sup>a</sup>	Sublegal	“Ewe-like” <sup>b</sup>	Lambs	% Lambs	Lamb:100 “ewes”	Unk rams <sup>a</sup>	Total
2002	50 (12)	380	884	221	14	25	4	1539
2003	34 (14)	207	621	114	11	18	13	989
2004	43 (12)	320	908	180	12	20	9	1460
2005	42 (17)	203	636	214	19	34	4	1099
2006	46 (13)	313	857	224	15	26	77	1517
2007	47 (24)	152	779	332	25	43	0	1310

<sup>a</sup> Unknown rams were censored in calculations of percent legal rams. Percent legal rams is calculated as a proportion of total rams.

<sup>b</sup> Includes adult females plus yearlings and 2-year-olds of both sexes.



TABLE 2 Ground-based sheep composition surveys in Atigun River drainage (Unit 26B), 1986–2006. Surveys occurred in June of the year indicated.

Year <sup>a</sup>	Legal (%) <sup>b,c</sup>	Sublegal <sup>c</sup>	“Ewe-like” <sup>d</sup>	Lambs	% Lambs <sup>b</sup>	Lamb:100 “ewes”	Unk sheep <sup>b</sup>	Total
1986	1 (2)	46	165	42	17	25	0	254
1987	0 (0)	59	130	47	20	36	0	236
1988	3 (5)	56	221	80	22	36	16	376
1989	0 (0)	87	237	40	11	17	0	364
1990	0 (0)	62	152	69	24	45	0	283
1991	2 (3)	73	296	122	25	41	22	515
1992	0 (0)	56	287	39	10	14	0	382
1993	1 (1)	69	183	24	9	13	0	277
1994	5 (7)	65	207	89	24	43	0	366
1995	0 (0)	55	224	28	9	13	0	307
1996 <sup>e</sup>	0 (0)	19	114	49	27	43	2	184
1997	0 (0)	40	91	16	11	18	0	147
1998	0 (0)	25	141	70	30	50	2	238
1999	0 (0)	32	140	40	19	29	8	220
2001	0 (0)	31	133	44	21	33	0	208
2003	1 (2)	54	256	68	18	27	10	389
2004	3 (5)	53	193	34	12	18	3	286
2005	2 (2)	81	189	80	23	42	3	355
2006	4 (9)	42	172	55	20	32	17	290

*Data source:* U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge.

<sup>a</sup> 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.

<sup>b</sup> Unknown sheep were censored in calculations of percent lambs. Percent legal rams is calculated as a proportion of total rams.

<sup>c</sup> Legal sheep do not include double broomed horns unless broomed at full-curl or longer; sublegal sheep includes double broomed sheep less than full-curl.

<sup>d</sup> Includes adult females plus yearlings and 2-year-olds of both sexes.

<sup>e</sup> Incomplete count in Atigun Gorge (snow).

TABLE 3 Aerial sheep composition surveys in the upper Atigun River Drainage (543 mi<sup>2</sup>), 2003. Surveys occurred in June of the year indicated.

Year	Legal (%) <sup>a</sup>	Sublegal	“Ewe-like” <sup>b</sup>	Lambs	% Lambs	Lamb:100 “ewes”	Total
2003	42 (21)	163	589	147	16	25	941

<sup>a</sup> Percent legal rams is calculated as a proportion of total rams.

<sup>b</sup> Includes adult females plus yearlings and 2-year-olds of both sexes.

TABLE 4 Aerial sheep composition surveys in the East Fork Chandalar River, Arctic Village Sheep Management Area, 1992–2007. Surveys occurred in June of the year indicated.

Year	Mature (%) <sup>a</sup>	Sublegal	“Ewe-like” <sup>b</sup>	Lambs	% Lambs	Lamb:100 “ewes”	Total
1992	4 (15)	23	155	34	16	22	216
1993	20 (22)	72	219	45	13	21	356
1994	16 (21)	60	121	0	0	0	197
1995	15 (29)	37	89	17	11	19	158
2006	32 (33)	64	262	58	14	22	416
2007	6 (43)	8	62	16	17	26	92

*Data source:* U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge.

<sup>a</sup> Mature rams may include sublegal sheep and are not directly comparable to other surveys that include a legal ram classification. Percent mature rams is calculated as a proportion of total rams.

<sup>b</sup> Includes adult females plus yearling and 2-year-olds of both sexes.

TABLE 5 Aerial and ground-based sheep composition surveys in the Hulahula drainage, 1992–2007. Surveys occurred in June of the year indicated.

Year	Legal (%) <sup>a,b</sup>	Sublegal <sup>b</sup>	“Ewe-like” <sup>c</sup>	Lambs	% Lambs <sup>a</sup>	Lamb:100 “ewes”	Unk sheep <sup>a</sup>	Total
1992 <sup>d</sup>	1 (2)	58	318	10	3	3	0	387
1993 <sup>e</sup>	12 (3)	369	709	171	14	24	0	1261
1994 <sup>e</sup>	6 (4)	164	595	99	11	17	0	864
1995 <sup>e</sup>	25 (8)	295	631	179	16	28	0	1130
1998 <sup>d</sup>	10 (8)	117	190	61	16	32	0	378
2000 <sup>d</sup>	7 (6)	106	219	20	6	9	0	352
2003 <sup>d</sup>	9 (12)	67	191	50	16	26	0	317
2004 <sup>d</sup>	9 (22)	32	201	71	23	35	0	313
2005 <sup>d</sup>	6 (6)	88	298	106	21	36	15	513
2006 <sup>d</sup>	4 (7)	50	320	80	18	25	13	467
2007 <sup>d</sup>	1 (1)	118	273	42	10	15	75	509

*Data source:* U.S. Fish and Wildlife Service, Arctic National Wildlife Refuge.

<sup>a</sup> Unknown sheep were censored in calculations of percent legal rams and percent lambs.

<sup>b</sup> Legal sheep do not include double broomed horns unless broomed at full-curl or longer; sublegal sheep includes double broomed sheep less than full-curl. Percent legal rams is calculated as a proportion of total rams.

<sup>c</sup> Includes adult females plus yearlings and 2-year-olds of both sexes.

<sup>d</sup> Ground survey: upper Hulahula only.

<sup>e</sup> Helicopter surveys over most of the drainage.

TABLE 6 Reported numbers of hunters<sup>a</sup> and harvest<sup>a</sup> in Units 24A East, 25A, 26B, and 26C, regulatory years 1996–1997 through 2006–2007

Regulatory year	Unit								Total harvest
	24A East		25A		26B		26C		
	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	
1996–1997	43	17	57	28	104	34	85	46	125
1997–1998	28	14	57	31	116	41	72	46	132
1998–1999	39	14	51	27	137	51	76	43	135
1999–2000	43	19	70	41	119	34	74	40	134
2000–2001	39	16	73	32	121	28	103	59	135
2001–2002	39	9	95	53	154	54	66	37	153
2002–2003	30	11	91	40	102	29	82	28	108
2003–2004	43	17	102	53	115	33	81	39	142
2004–2005	42	17	83	45	130	41	71	49	152
2005–2006	43	18	108	66	165	47	73	40	171
2006–2007	60	17	111	74	151	30	85	41	162

<sup>a</sup> Excludes state registration and federal subsistence permit hunts.

TABLE 7 Dall sheep mean horn length of harvested rams in Units 24 East, 25A, 26B, and 26C, regulatory years 1996–1997 through 2006–2007

Regulatory year	$n^a$	$\bar{x}$ Horn length (inches)	% $\geq 40$ inches
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
2005–2006	168	35.0	4
2006–2007	147	35.4	6

<sup>a</sup> Excludes state registration and federal subsistence permit hunts.

TABLE 8 Units 24A East, 25A, 26B, and 26C reported sheep harvest by permit hunt (FS424<sup>a</sup>, RS595<sup>b</sup>, FS596<sup>c</sup>, FS799<sup>d</sup>, and FS699<sup>e</sup>), regulatory years 1996–1997 through 2006–2007

Regulatory year	FS424 (Unit 24A)	RS595 (Unit 25A and Unit 26C)	FS596 (Unit 25A)	FS799 (Unit 25A and Unit 26C)	FS699 (Unit 26B)	Total reported harvest
1996–1997	2	0	0	4	2	8
1997–1998	2	1	0	0	0	3
1998–1999	2	2	0	2	0	6
1999–2000	3	1	0	2	1	7
2000–2001	3	8	0	6	0	17
2001–2002	2	2	0	0	0	4
2002–2003	2	0	0	3	0	5
2003–2004	2	0	0	0	0	2
2004–2005	3	0	0	1	0	4
2005–2006	2	0	0	2	0	4
2006–2007	5	0	1	0	1	7

<sup>a</sup> Federal subsistence hunt FS424 includes Unit 24A, except that portion within Gates of the Arctic National Park.

<sup>b</sup> State registration hunt RS595 includes Unit 25A, east of the Middle Fork Chandalar River and Unit 26C.

<sup>c</sup> Federal subsistence hunt FS596 includes Unit 25A within the Arctic Village Sheep Management Area.

<sup>d</sup> Federal subsistence hunt FS799 includes most of Unit 25A and all of Unit 26C.

<sup>e</sup> Federal subsistence hunt FS699 includes Unit 26B within the Dalton Highway Corridor Management Area.

TABLE 9 Units 24 East, 25A, 26B, and 26C sheep hunter<sup>a</sup> residency and success, regulatory years 1996–1997 through 2006–2007

Regulatory year	Successful hunters					Unsuccessful hunters					Total hunters
	Local <sup>b</sup> resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local <sup>b</sup> resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1996–1997	2	72	37	8	119 (43)	2	130	19	5	156 (57)	275
1997–1998	2	61	57	9	129 (50)	1	111	17	2	131 (50)	260
1998–1999	2	73	58	1	134 (45)	6	140	20	0	166 (55)	300
1999–2000	9	51	66	0	126 (42)	6	141	27	0	174 (58)	300
2000–2001	3	56	59	2	120 (38)	1	165	33	0	199 (62)	319
2001–2002	1	70	71	2	144 (46)	0	132	30	7	169 (54)	313
2002–2003	0	36	54	4	94 (35)	2	116	52	3	173 (65)	267
2003–2004	1	52	72	0	125 (42)	1	124	43	2	170 (58)	295
2004–2005	0	55	76	2	133 (48)	1	117	23	3	144 (52)	277
2005–2006	5	77	86	1	169 (44)	4	187	27	1	219 (56)	388
2006–2007	5	78	69	4	156 (39)	2	197	41	6	246 (61)	402

<sup>a</sup> Excludes state registration and federal subsistence permit hunts.<sup>b</sup> Local resident is a resident of Units 25A, 26B, 26C, Coldfoot, or Wiseman.

TABLE 10 Units 24 East, 25A, 26B, and 26C sheep harvest<sup>a</sup> chronology percent by harvest month/day, regulatory years 1996–1997 through 2006–2007

Regulatory year	Harvest chronology percent by month/day									<i>n</i>
	8/1–8/4 <sup>b</sup>	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 <sup>b</sup>	
1996–1997	0	21	52	10	9	6	0	0	0	117
1997–1998	0	28	40	15	6	6	3	2	0	127
1998–1999	0	12	40	23	11	6	6	1	0	129
1999–2000	0	20	29	26	14	2	6	3	0	126
2000–2001	1	24	30	15	15	10	3	2	0	117
2001–2002	0	17	31	26	18	4	1	2	0	141
2002–2003	0	5	31	30	19	7	3	4	0	93
2003–2004	0	17	39	24	14	3	2	1	2	122
2004–2005	1	21	39	20	12	5	2	0	0	134
2005–2006	0	20	37	23	12	5	1	1	1	169
2006–2007	0	25	33	14	14	6	4	3	1	156

<sup>a</sup> Excludes state registration and federal subsistence permit hunts.

<sup>b</sup> Sheep reported taken before 10 Aug or after 26 Sep were presumably incorrectly reported.



TABLE 11 Units 24 East, 25A, 26B, and 26C sheep harvest<sup>a</sup> percent by transport method, regulatory years 1996–1997 through 2006–2007

Regulatory year	Harvest percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4- wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1996–1997	82	2	3	0	0	0	13	0	119
1997–1998	83	8	0	0	0	0	9	0	129
1998–1999	84	2	2	0	0	0	12	1	134
1999–2000	76	6	3	0	0	0	14	2	126
2000–2001	79	10	1	0	0	0	8	2	120
2001–2002	88	5	0	0	0	0	7	0	144
2002–2003	84	4	3	0	0	0	9	0	94
2003–2004	80	8	3	0	0	0	7	2	125
2004–2005	83	8	0	0	0	0	8	1	136
2005–2006	75	8	1	0	0	0	15	1	169
2006–2007	68	10	9	1	0	0	12	1	156

<sup>a</sup> Excludes state registration and federal subsistence permit hunts.



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.



Photo by Stephen Arthur