

**Dall Sheep
Management Report**
of survey-inventory activities
1 July 2007–30 June 2010

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



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**Funded through
Federal Aid in Wildlife Restoration
Grants W-33-6, W-33-7, and W-33-8, Project 6.0
2011 Set**

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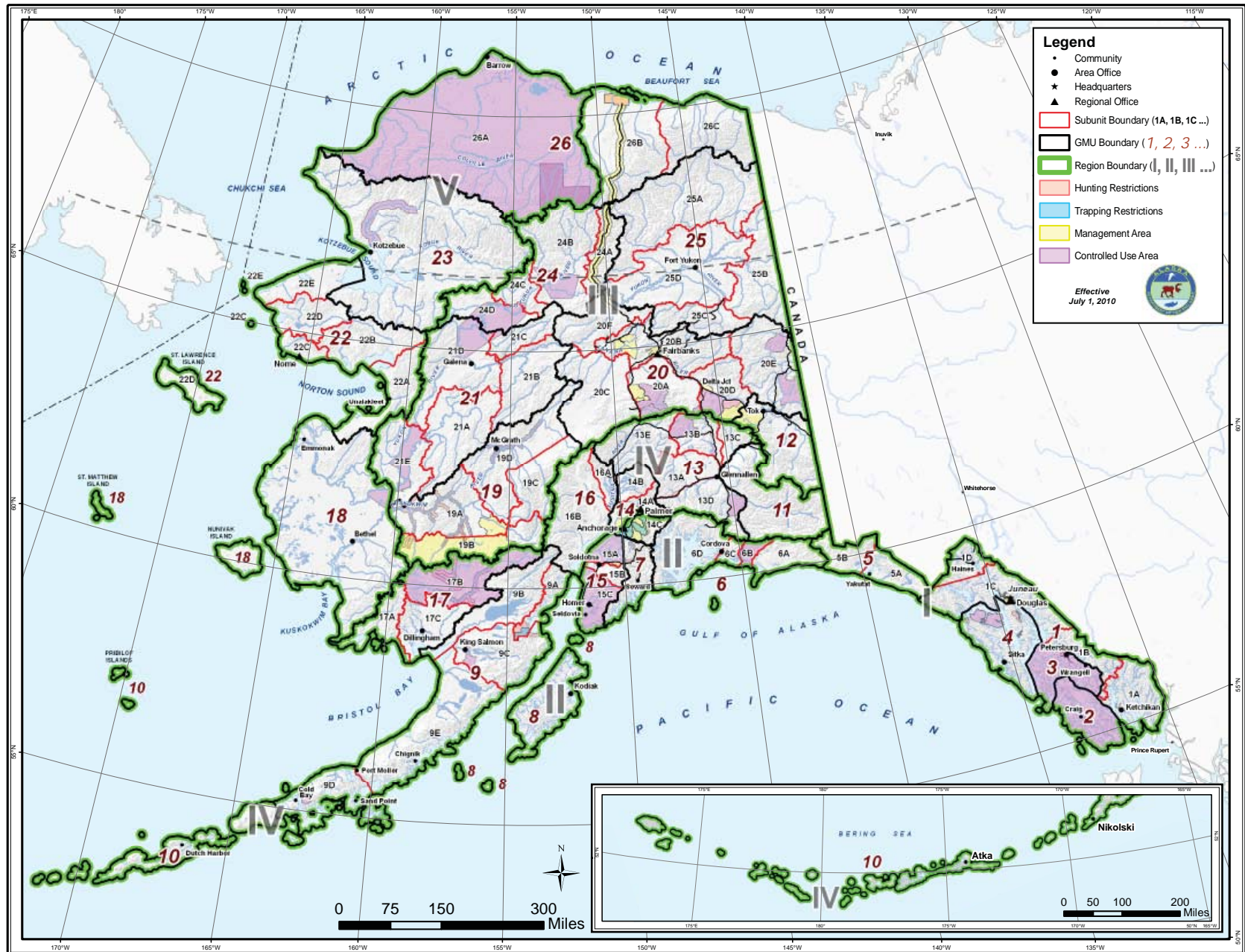
Cover Photo: A sheep in the Wrangell-St. Elias Mountains. ©1998 Stephen Arthur. Photo used courtesy of the photographer.

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

TABLE OF CONTENTS

Game Management Units Map	i
Units 7 and 15 – Kenai Peninsula.....	1
Units 9, 16, 17, and 19 Alaska Range west and south of Denali National Park and Preserve	6
Unit 11 – South Wrangell Mountains	13
Southern Unit 11 and subunits 13D, 14A, and 14C – Chugach Mountains	30
Unit 12 – Mentasta, Nutzotin, and northern Wrangell Mountains	40
Units 12, 13, and 20 – Tok Management Area	56
Subunits 13A, 13E, 14A and 14B Talkeetna Mountains and Chulitna-Watana Hills	72
Subunits 13B, 20A, and 20D Delta Controlled-use Area	80
Unit 14C, Chugach Mountains	93
Subunit 20A – North side of the Alaska Range east of the Nenana River, west of the Delta River, and south of the Tanana River	102
Subunits 20B, 20F, and 25C – White Mountains	111
Subunits 20B, 20D, and 20E – Tanana Hills	123
Unit 23 and Subunit 26A – Western Brooks Range	134
Unit 23 East, 24B, and portions of 24A and 26A – Central Brooks Range.....	148
Units 24, 25, and 26 – Eastern Brooks Range	162



DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

LOCATION

GAME MANAGEMENT UNIT: 7 and 15 (8,397 mi²)

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, their numbers are summarized together.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Population Composition

About 1,600 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 2,000 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 currently at the lowest levels since monitoring started in the late 1960s (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, north to the Skilak Glacier and Russian Mountain in Unit 15B, and in the eastern edge of Unit 15A including the Mystery Hills and Round Mountain. 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.

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 12 rams over the last 5 seasons (Table 3). The number of general season hunters has averaged 118 over the past 5 seasons, and a majority of successful hunters were local residents of the Kenai Peninsula (Table 3).

Harvest Chronology. Chronology of harvest followed similar patterns over the past 5 years; most of the harvest occurred during the first 2 weeks of the season (Table 4).

Transport Methods. Transportation methods vary from year to year, and aside from hiking in from the highway, include mostly airplane and boat access (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

Due to the decline in the sheep population across the Kenai Mountains, the department no longer issues drawing permits for ewes in the Crescent Lake or Round Mountain hunt areas. While the number of sheep hunters has been relatively stable over the past 5 seasons, the long-term decline in sheep numbers has greatly reduce both the harvest of legal rams and the number of hunters compared to the early 1990s. In 2010, the Alaska Department of Fish and Game regional sheep biologist initiated a pilot study on Kenai sheep. Based on the results of this preliminary work, and dependent on regional priorities, research identifying the limiting factors on Kenai sheep may start in the fall of 2011 or spring 2012.

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Table 1. Aerial sheep composition counts, Units 7 and 15, 2005–2009.

Regulatory year	Rams		Ewes and	Unclassified sheep	Lambs	Total sheep observed ^a	Estimated population size
	Full-curl	< Full-curl or unclassified rams	yearling rams				
2005–06	2	21	50		18	91	1000–1700
2006–07	6	92	240	40	66	444	1000–1700
2007–08	2	37	68	30	25	162	800–1200
2008–09	10	108	280	0	55	453	800–1200

^aThe amount of area surveyed varies each year.

Table 2. Results of drawing permit hunt, Units 7 and 15, 2005–2009.

Hunt	Regulatory year	# of permits issued	# of hunters	Harvest	Percent success
Rount Mt. Ram (DS 150)	2005–06	3	3	0	0
	2006–07	3	2	1	50
	2007–08	3	2	0	0
	2008–09	3	2	0	0
	2009–10	3	3	0	0
Rount Mt. Ewe (DS 152)	2005–06	0			
	2006–07	0			
	2007–08	0			
	2008–09	0			
	2009–10	0			
Crescent Lake Ewe (DS 154)	2005–06	10	3	3	100
	2006–07	10	6	0	0
	2007–08	10	5	0	0
	2008–09	10	7	3	43
	2009–10	0			
Crescent Lake Ram (DS 156)	2005–06	6	3	1	33
	2006–07	6	5	0	0
	2007–08	6	4	2	50
	2008–09	6	6	2	33
	2009–10	6	5	0	0

Table 3. Sheep hunter residency and success in the general season, Units 7 and 15, 2005–2009.

Regulatory year	Successful					Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Non-resident	Total	Percent success	Local ^a resident	Nonlocal resident	Non-resident	Total ^b	
2005–06	10	2	2	14	12	46	50	1	99	113
2006–07	10	3	0	13	10	51	53	7	111	124
2007–08	11	5	4	20	17	42	56	2	100	120
2008–09	4	0	1	5	4	49	59	7	117	122
2009–10	3	3	2	8	7	42	50	2	102	110

^a Residents of Units 7 and 15.

^b Includes unspecified residency.

Table 4. Sheep harvest chronology in the general season, Units 7 and 15, 2005–2009.

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		
2005–06	9	1	3	1	0	0	14	
2006–07	5	1	5	2	0	0	13	
2007–08	8	5	2	3	2	0	20	
2008–09	2	1	1	1	0	0	5	
2009–10	5	1	1	0	1	0	8	

Table 5. Transport methods used during the general season for sheep, Units 7 and 15, 2005–2009.

Regulatory year	3/4 wheel-		Highway				Unknow		Harvest
	ATV	Airplane	Boat	vehicle	Horse	ORV	n		
2005–06	0	0	10	2	1	0	1	14	
2006–07	0	2	2	5	4	0	0	13	
2007–08	1	8	4	3	3	0	1	20	
2008–09	0	2	2	1	0	0	0	5	
2009–10	0	0	2	5	1	0	0	8	

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNIT: Portions of 9B, 16B, 17B, 19B and 19C (4600 mi²)

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, a large number of guide operations offer hunts for sheep, and sealing of sheep has been required since fall 2005.

Aerial surveys were conducted in the ARW during the 1960s, 1970s, and 1980s. More recently, aerial sheep trend and composition surveys have been conducted in Unit 19, where about 90% of the sheep harvest within the ARW occurs.

MANAGEMENT DIRECTION

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 ≥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.

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

METHODS

Aerial trend and composition surveys were conducted in suitable sheep habitat in late June during 2008–2010, using 2 PA-18 aircraft. Surveys were flown during late evening when the air currents were more stable. Surveys were flown along contours at altitudes of 300–700 feet above ground level at airspeeds of 60–80 mph. During 2008 we surveyed the hills near Sheep Creek (70 mi²), Jones River (30 mi²), Tonzona River (70 mi²), Post River (100 mi²), Tired Pup Creek (40 mi²), Underhill Creek (35 mi²), and the Windy Fork (45 mi²). In 2009, we surveyed the Sheep Creek, Jones River, Tonzona River, Post River, and the Windy Fork areas, and in 2010 we surveyed the Sheep Creek (renamed Sheep Creek East on our data forms), Jones River, Tonzona River, Post River, and the Windy Fork areas and added new areas including Sheep Creek West (100 mi²), Little Tonzona River (50 mi²), Tatina River (65 mi²), and Knox Peak (45 mi²). The Sheep Creek, Jones River, Tonzona River, Post River, and the Windy Fork areas were surveyed in June 2008, 2009, and 2010, which provides a basis for comparison between years.

Sheep were counted and classified as legal rams (full curl or larger), sublegal rams, ewes, and lambs. The ewe category included adult ewes, all yearlings, and young rams ($\leq 1/2$ -curl horns) not distinguishable from ewes. Data from these areas were pooled each year.

Harvest by hunters, hunter effort, hunt location, transportation used, and age and horn characteristics of harvested rams were monitored using harvest reports submitted by hunters and sealing data. These data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY09 = 1 Jul 2009 through 30 Jun 2010).

RESULTS AND DISCUSSION

POPULATION SIZE AND COMPOSITION

Population size and trend

We did not estimate total sheep population size in the ARW, but data from aerial surveys of limited areas provide information about potential changes in sheep density. Density of sheep observed during these surveys was greater in 2010 compared to 2008 (3.21 vs. 1.47 sheep/mi²; Table 1). Although some count areas were different between these years, observed sheep densities increased from 1.98 to 2.83 sheep/mi² (Table 2) within areas surveyed in both 2008 and 2010. Cloud cover during 2008 prevented surveys of some small areas at higher elevations. Thus, sheep in these higher areas may have remained undetected, and the population may have been underestimated in 2008 relative to 2010.

Composition

The percentage of legal rams identified during 2008 (7.8%) was higher than 2009 (3.6%) and 2010 (3.9%). However, we believe this is an artifact of classification errors in 2008 rather than a real decrease.

The percentage of lambs observed increased from 12.2% in 2008 to 19.1% in 2010 (Table 1). Within areas surveyed each year, the percentage of lambs observed also increased from 12.0% in 2008 to 18.4% in 2010 (Table 2), suggesting improved production and/or survival of lambs, rather than an artifact of different survey conditions and other factors.

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 RY07–RY09, and no emergency orders were issued.

Season and Bag Limit. Resident and nonresident sheep hunters in the ARW were allowed to hunt during the open season of 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 $\frac{7}{8}$ -curl and prior to RY79 it was $\frac{3}{4}$ -curl or larger.

Harvest by Hunters. Reported harvest of sheep in ARW was 73, 84, and 76 rams during RY07, RY08, and RY09, respectively (Table 3). These were similar to harvests during RY04–RY06 (Peirce 2008), but substantially lower than the average annual harvest of 139 during RY90–RY97 (Szepanski 2005).

The total number of sheep hunters using the ARW was 174, 191, and 188 during RY07, RY08, and RY09, respectively (Table 4). This was lower than the average of 251 hunters per year during RY90–RY97 (Szepanski 2005).

During RY05–RY09, the average horn length of rams harvested was 35.7 inches and the average age of rams harvested was 8.8 years (Table 3). 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 ≥ 34 inches (Heimer and Smith 1975).

The percentage of rams harvested during RY07–RY09 with horns ≥ 40 inches varied from a low of 1.2% in RY08 to a high of 8.6% during RY07 (Table 3).

Permit Hunts. A federal subsistence hunt has occurred in Unit 9B since RY95. During RY07–RY09, the only reported harvest during this hunt was 1 ram taken in RY08.

Hunter Residency and Success. Resident hunters outnumbered nonresidents, but nonresidents were more successful than residents (Table 4). Average success by residents and nonresident hunters during RY05–RY09 was 28% and 61%, respectively. Success rates for nonresidents likely were higher than those for resident hunters because nonresidents typically were accompanied by licensed guides.

Harvest Chronology. As in previous reporting periods, most of the sheep harvest in ARW occurred during the first week of the 6-week season (Table 5). During RY05–RY09, an average of 39% of the harvest occurred during 10–16 August.

Transport Methods. Most successful sheep hunters used aircraft during RY05–RY09 (Table 6). Few villages or roads are within or adjacent to ARW sheep habitat, and few rivers are suitable for boat travel.

Other Mortality

Winter weather, wolves, coyotes, golden eagles and bears are all potential sources of mortality, but the effects of these are unknown in this area.

MANAGEMENT PROBLEMS–NEEDS

The number of guide–outfitters operating in the ARW was unlimited during RY07–RY09 and 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, which would limit the amount of guided hunting in these areas. If this occurs, the level of hunting activity in the ARW is likely to be reduced, because all nonresident sheep hunters are required to use a guide.

CONCLUSIONS AND RECOMMENDATIONS

Apparent increases in density and lamb recruitment are encouraging, but should be tempered with the understanding that survey conditions and other factors may influence these data. Methods to estimate statistical precision, e.g., by utilizing double-count methods (Whitten 1997) were not used because they are cost prohibitive. The unknown precision of these data limits our ability to interpret them.

Harvest report data show an average of 180 hunters during RY05–RY09. Hunters interviewed by Alaska Wildlife Troopers (AWT) and ADF&G during sealing have complained of hunter crowding. While the current level of hunting pressure is well below the average of 251 hunters per year during RY90–RY97 (Szepanski 2005), hunters were not required to bring sheep horns to be sealed during the 1990s, so may not have had complained because they did not encounter agency personnel. Harvest during RY05–RY09 continued to be lower than in the 1990s, but was comparable to reported harvest during RY04–RY06 (Peirce 2008).

We met our management goal of providing a sustained opportunity to harvest Dall sheep rams with an average harvest during RY07–RY09 of 78 full curl rams. With an average age of 8.9 years, we also met the management objective of maintaining a harvest of rams that averaged ≥ 8 years old (Table 3).

We met our management goal and objective with the current seasons and bag limits, which have been in effect since RY89. We recommend no regulatory changes. For the next report period, the management goal will be restated in order to clarify that small harvests, while sustainable, are inconsistent with our management goal:

- Provide an opportunity for sustainable harvest of Dall sheep rams similar to average historic levels.

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Table 1. Unit 19 aerial sheep composition counts, regulatory years 2007–2008 through 2009–2010. No surveys were conducted during regulatory years 2005–2006 or 2006–2007.

Date	Area (mi ²)	Survey time (min)	Rams			Ewe-likes ^a (%)	Lambs (%)	Unk (%)	Total sheep	Density (sheep/mi ²)
			Full curl (%)	<Full curl (%)	Total (%)					
June 20–22, 2008	435	17.1	50 (7.8)	130 (20.3)	180 (28.1)	382 (59.7)	78 (12.2)	0 (0)	640	1.47
June 26, 2009	315	14.3	23 (3.6)	162 (25.1)	185 (28.6)	361 (55.9)	100 (15.5)	0 (0)	646	2.05
June 21–22, 2010	575	24.4	72 (3.9)	380 (20.6)	452 (24.5)	1040 (56.4)	353 (19.1)	0 (0)	1845	3.21

^a Ewe-likes includes adult ewes, all yearlings, and young rams not distinguishable from ewes.

Table 2. Unit 19 aerial sheep composition counts, regulatory years 2007–2008 through 2009–2010 in Sheep Creek, Jones River, Tonzona, Post, and Windy Fork count areas.

Date	Area (mi ²)	Survey time (min)	Rams			Ewe-likes ^a (%)	Lambs (%)	Unk (%)	Total sheep	Density (sheep/mi ²)
			Full curl (%)	<Full curl (%)	Total (%)					
June 20–22, 2008	315	12.6	50 (8.0)	128 (20.5)	178 (28.5)	371 (59.5)	75 (12.0)	0 (0)	624	1.98
June 26, 2009	315	14.3	23 (3.6)	162 (25.1)	185 (28.6)	361 (55.9)	100 (15.5)	0 (0)	646	2.05
June 21–22, 2010	315	13.5	43 (4.8)	194 (21.7)	237 (26.6)	491 (55.0)	164 (18.4)	0 (0)	892	2.83

^a Ewe-likes includes adult ewes, all yearlings, and young rams not distinguishable from ewes.

Table 3. Alaska Range West sheep harvest, horn length, and age, regulatory years 2005–2006 through 2009–2010.

Regulatory year	Rams harvested	\bar{x} Horn length (inches)	% ≥40 inches		\bar{x} Age
2005–2006	75	35.4	5.3		8.7
2006–2007	74	35.8	5.6		8.9
2007–2008	73	36.1	8.6		9.1
2008–2009	84	35.3	1.2		8.7
2009–2010	76	35.9	2.7		8.8

Table 4. Alaska Range West sheep hunter residency and success, regulatory years 2005–2006 through 2009–2010.

Regulatory year	Successful				Unsuccessful				Total hunters
	Resident	Nonresident	Unk	Total (%)	Resident	Nonresident	Unk	Total (%)	
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
2007–2008	26	47	0	73 (42)	66	34	1	101 (58)	174
2008–2009	22	46	16	84 (44)	70	31	6	107 (56)	191
2009–2010	30	39	7	76 (40)	88	20	4	112 (60)	188

Table 5. Alaska Range West sheep harvest chronology percent by month/day, regulatory years 2005–2006 through 2009–2010.

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			
2005–2006	51	17	9	9	4	8	1	75	
2006–2007	36	16	26	8	5	7	1	74	
2007–2008	33	21	27	10	3	4	1	73	
2008–2009	42	25	11	11	6	6	1	84	
2009–2010	34	17	17	8	11	13	0	76	
Average	39	19	18	9	6	8	1	76	

Table 6. Alaska Range West sheep harvest percent by transport method, regulatory years 2005–2006 through 2009–2010.

Regulatory year	Harvest percent by transport method						Unk	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle		
2005–2006	89	3	1	1	3	0	3	75
2006–2007	92	0	0	3	0	1	4	74
2007–2008	86	7	1	5	0	0	0	73
2008–2009	89	4	1	2	2	0	1	84
2009–2010	82	9	4	1	3	1	0	76

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

LOCATION

GAME MANAGEMENT UNIT: 11 (12,784 mi²)

GEOGRAPHIC DESCRIPTION: Wrangell Mountains, East of the Copper River

BACKGROUND

Dall sheep inhabit most alpine and subalpine areas of the Wrangell Mountains in Unit 11 and have a long hunt history by both local and nonlocal hunters. Dall sheep in the Wrangell Mountains, which cross the Alaska–Canada border, exhibit a wide variety of morphology and population characteristics. The northern portion of the range is known for relatively high densities of sheep, while the southern portion of the range typically has lower densities of sheep, although more trophy potential. 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 remains 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 general season is reported under the state harvest ticket system.

Sheep numbers in the Wrangell Mountains prior to the 1950s are unavailable. 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 post hunt 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. Beginning in regulatory year (RY) 2010 (RY10 = 1 July 2010 through 30 June 2011), rams harvested during the federal general hunt will also be sealed and measured.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Status

Given the size of Unit 11, 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). Following surveys in the early 1990s, the NPS, through extrapolation, estimated 5,071 (\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). Throughout the late 1980s and 1990s sheep numbers declined across much of the southern portion of the unit. Extrapolations from department fixed-wing surveys of specific trend count areas during this reporting period indicated a minimum of 3,200 sheep inhabiting this area, slightly improved from the previous reporting period.

The National Park Service Central Alaska Network (CAN) used distance sampling techniques (Schmidt et al. 2011) in 2010 and 2011 to survey the entire Wrangell Mountain range. An estimate should be available in 2012.

Population Trends

Population trends for sheep across Unit 11 are documented periodically using trend count areas (CA; Table 1). The limited surveys conducted during this reporting period indicate population stability, although sheep numbers in some portions of the unit continue to be well below those observed during the 1980s and early 1990s. The most consistent survey areas are CA 11 and CA 12 between the Dadina and Kuskulana rivers in the southwest portion of Unit 11. The land status in CA 11 is National Preserve, while CA 12 is National Park.

Sheep in CA 11 declined steadily from the early 1980s, when 557 sheep were observed, through 2002. The population has remained relatively stable since then. The total number of sheep observed ranged from 149 to 203 during this reporting period.

Up through the late 1990s, CA 12 had fairly stable high numbers of sheep, with count observations ranging 490–601. Since then, sheep numbers have declined substantially. Similar to CA 11, sheep numbers in this area have remained relatively stable since 2002. The total number of sheep observed ranged from 165 to 208 during this reporting period.

Additional survey areas in the southwest Wrangells include CA 10 (Mt. Drum) and CA 14 (Crystalline Hills). Though CA 10 has not been flown consistently, surveys indicated the population increased from the early 1980s, when approximately 200 sheep inhabited the area, to the peak in 1992, when nearly 500 sheep were observed. The most recent count of 87 in 2002 was the lowest recorded. There are no indications this population has increased since then.

Approximately 70 sheep live on the Crystalline Hills, an isolated mountain block adjacent to the McCarthy Road (CA 14). Numbers have remained low and stable since the mid 1990s. Very few rams are ever observed in this area.

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 numbers in CA 21 have been relatively stable at about 200 since the mid 1990s, slightly below the average of 280 observed during the early 1980s. A total of 210 sheep were observed in 2005, and 162 in 2010. In CA 22, total sheep numbers since the early 1980s have ranged from 197 to 305 (average = 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. Recent anecdotal information suggests this population is increasing.

While total CA 23 sheep numbers have remained relatively stable over time, the survey data has been separated into CA 23 West (Preserve) and CA 23 East (Park) 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 to this area). Sheep numbers in the Preserve area declined from an average of 269 during the early 1980s to an average of 128 since 2001. Anecdotal information suggests sheep numbers in this area are stable to increasing. Surveys have not been flown as often in the Park area. The earliest count was conducted in 1982; 79 sheep were observed. Since 2001, the area has averaged 216. Anecdotal information suggests sheep numbers from this area, east to the Canadian border have been declining in recent years.

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 extensively 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 total of 565 sheep were observed during the most recent survey in 2007. During the last couple years, anecdotal reports have indicated this population has started to decline.

Population Composition

Composition data for sheep trend count areas are presented in Table 1. While sheep numbers have been low and stable in CA 11 for nearly a decade, the population composition has varied annually. The ram-to-ewe ratio averaged 32 rams:100 ewes from 2000–2004, but declined to an average of 18 rams:100 ewes in 2007–2009. Of the total rams observed from 2000–2008, an average of 36% were full-curl or greater. The percentage of rams full-curl or greater dropped to 13% in 2009. Summer lamb counts in this area have been consistently moderate, averaging 29 lambs:100 ewes from 2000–2008. In 2009, a record low 18 lambs:100 ewes were observed.

In adjacent CA 12, the ram:ewe ratio has always been somewhat higher due to lower hunting pressure. In contrast to CA 11, ram:ewe ratios have remained relatively consistent in this area, averaging 56 rams:100 ewes since 2000. In 2009 a record 79 rams:100 ewes were observed. Of the total rams observed between 2000 and 2008, an average of 44% were full-curl or greater. The percentage of rams full-curl or greater dropped somewhat to 39% in 2009. The most noticeable factor in this area is the highly variable lamb:ewe ratio. Since 2000, the observed range has been 11 to 39 lambs:100 ewes (average = 25 lambs:100 ewes). The high of 39 lambs:100 ewes was observed in 2008, followed by 25 lambs:100 ewes observed in 2009.

The Crystalline Hills (CA 14) have had low sheep numbers since the mid 1990s. Lamb: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 2010, 49 rams:100 ewes and 54 lambs:100 ewes. The most noticeable differences between the 2010 survey and the previous 2005 survey were a drop in ewe numbers from 136 down to 80, and a shift from 31% of rams being full-curl or greater down to 10%.

From Canyon Creek to the Barnard Glacier (CA 22) sheep numbers remained relatively stable between 2000 and 2005. During the most recent count in 2005, 40 rams:100 ewes and 32 lambs:100 ewes were observed. Of the rams observed, 29% were classified as full-curl or greater, similar to the previous 5 years. Recent anecdotal information suggests this population has been increasing.

Due to the differences in land status, CA 23 was separated into two units: CA 23 West (Preserve) and CA 23 East (Park). In the western count area, the ram: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, which 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. Lamb:ewe ratios have been variable in CA 23 West, ranging from 10 to 33 lambs:100 ewes, averaging 19 lambs:100 ewes since 2001. The variability is lower in CA23 East, though the average of 21 lambs:100 ewes is similar.

In CA 3 West in the north Wrangells, total sheep numbers increased only slightly between 2001 and 2007, 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-curled increased slightly from 46% to 50%. In 2007, 32 lambs:100 ewes were observed.

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, Alaska Science Center, has been studying sheep genetic diversity in the Wrangell Mountains 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 RY79, the Unit 11 bag limit was 1 ram with $\frac{3}{4}$ -curl or larger horns for all hunters. Beginning in RY79 the minimum horn size was increased to $\frac{7}{8}$ -curl or larger.

In RY89, 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 RY89, 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 RY90. 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 RY91 and RY00, the state bag limit for resident hunters was 1 sheep. Due to declining sheep numbers, the regulation was changed to 1 ram in RY01, and then to $\frac{3}{4}$ -curl or larger in RY03. The nonresident bag limit has remained full-curl or larger since RY89; guides are required.

In RY98, 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. No Board of Game (BOG) actions were taken for Unit 11 during this reporting period.

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 declined steadily in Unit 11 following the peak harvest of 170 sheep in RY91 (146 rams and 24 ewes). Harvest data are presented in Table 2. During this reporting period, harvest numbers stabilized. In RY07, a low of 51 sheep were harvested. Harvest has since increased with 64 sheep taken in RY09. The average horn size for all harvested rams with horn circumferences greater than 28 inches steadily increased through the 1980s and mid 1990s, peaking at 36.4 inches in RY97. The average horn length then declined until RY01, when it bottomed out at 34.5 inches. The average slowly increased

An average of 3 ewes were harvested annually during this reporting period. Since RY01 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. Success rates have been high and stable in this unit compared to other mountain ranges around the state. Up through RY05, success rates ranged from 31% to 53%. For the past 5 years, success rates have ranged 25% to 40%.

The number of sheep hunters in Unit 11 peaked in the early 1990s, and has steadily declined since. During this reporting period, the average number of hunters per season was 204.

During the 1990s local residents were taking 22–43 sheep per year. Nonlocal residents took 54–100 sheep per year, and nonresidents took 20–42 per year during the same time period. During this reporting period, the average harvests were 14, 34, and 9 respectively. Local hunter success rates averaged 28%, while nonlocal hunter success rates averaged 26%. Nonresident success was the lowest ever recorded during this reporting period, averaging 43%. Nonresidents remain the most successful group of hunters in Unit 11.

Hunter effort data are presented in Table 4. The average number of days hunted annually by successful hunters ranged from 4.5 to 5.8 days and averaged 5.0 days during this reporting period. This is up from the 4.5 day average during the last reporting period. The average number of days hunted annually reported by unsuccessful sheep hunters for this same period ranged from 5.6 to 6.1 days, averaging 5.8 days.

Harvest Chronology. Harvest chronology data for sheep taken in Unit 11 are presented in Table 5. Between RY95 and RY05, the majority of the harvest (average = 44%) occurred during the first week of the season. In RY06, a very wet hunting season, substantial harvest occurred through the third week of the season. The typical pattern was observed in RY07, though harvests in RY08 and RY09 were more spread out chronologically.

Transportation Methods. While 4-wheelers replaced aircraft as the primary mode of transportation for Unit 11 sheep hunters during the last reporting period, aircraft use increased over the past few years. During this reporting period, an annual average of 48 hunters (25%) used 4-wheelers while 77 (40%) used aircraft. Aircraft has remained the primary mode of transportation of successful hunters (Table 6). An annual average of 16 successful hunters (27%) used 4-wheelers, 24 (42%) used aircraft, and 9 (16%) used boats during RY07–RY09.

Sheep hunting in Unit 11 can be characterized by two distinct groups of hunters: local federal subsistence hunters in the Park, and all others in the Preserve. Very few all-terrain-vehicle trails exist in Unit 11, the majority of which access or cross Park land. Therefore, these trails and this

mode of transportation are generally limited to local federal subsistence sheep hunters. Recent trail closures for hunters in the northern portion of Unit 11 across Park lands due to ongoing legal issues and an Environmental Impact Statement (EIS) process have recently limited the use of 4-wheelers for hunting. The final EIS has been released, with trail improvement being a large component of the final recommendations (NPS 2011). Federal funding over the next decade will be essential to keeping these trails maintained and open to all hunters.

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. Severely deep snow winter conditions in the southern portion of the Wrangell Mountains have the potential to substantially increase adult mortality and impact lamb production and survival. The rain-shadow effect keeps snow levels lower in the north Wrangell Mountains. 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 the winter of 2000–2001, particularly in the southern portion of the unit. The Sanford and Dadina sites in the southwestern Wrangells had severely deep snow during the 2008–2009 winter, with 1 April snow depths of 34 inches and 31 inches respectively. Lacking adequate escape terrain, sheep in this area are highly susceptible to increased predation during deep snow years. May Creek near McCarthy in the south Wrangells also had above average snow depths throughout the reporting period, averaging 27 inches on 1 April. Snow depths were average or below average for the remainder of 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, weather, 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. Documenting lamb production and the timing of lamb losses would enhance our knowledge of recruitment trends across the unit.

Sheep population trends were variable across Unit 11 during this reporting period. The northern Wrangell Mountains within Unit 11 appear to have a moderately high density of sheep, although reports indicate numbers are starting to decline. While hunting occurs in this area mostly by local residents who qualify for federal subsistence, sheep hunting pressure is considered moderate due to the 4-wheeler accessible terrain. Although the federal subsistence regulations allow the take of any sheep, the majority of these hunters pursue mature rams. Each year, a few young rams are harvested from this area, which may help explain the high percentage of rams observed full-curl or greater in the area.

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.

Sheep numbers in the southwestern portion of the range have been low for some time now. While numbers increased somewhat between 2006 and 2008, the deep snow during the winter of 2008–2009 likely set the population back.

Anecdotal information for the south Wrangell Mountains indicates a slow increase in sheep 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, hunting pressure is expected to decline until recruitment improves. 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, followed by local residents, then nonresidents. Due to the lower numbers of sheep in the southern and southwestern 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, overall sheep hunter numbers are expected to remain relatively low and stable in Unit 11. The total harvest remains near the minimum management objective, although the take steadily increased during this reporting period from 51 in RY07 to 58 in RY08 and to 64 in RY09.

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). If the pattern continues, the percentage of large rams taken in Unit 11 should increase over the next 4–6 years. 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. Wrangell Mountains, Unit 11 sheep composition counts, calendar years 2005 through 2009.

CA 3W – UPPER COPPER RIVER

Calendar year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	<i>no survey data</i>				
2006	<i>no survey data</i>				
2007	56 (50)	55	344	110 (19)	565
2008	<i>no survey data</i>				
2009	<i>no survey data</i>				

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

CA 11 – DADINA RIVER TO LONG GLACIER

Regulatory year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005–06	10 (34)	19	127	36 (19)	192
2006–07	10 (45)	12	110	32 (20)	164
2007–08	11 (52)	10	118	37 (21)	176
2008–09	8 (33)	16	132	47 (23)	203
2009–10	2 (13)	13	114	20 (13)	149

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

CA 12 – LONG GLACIER TO KUSKULANA RIVER

Calendar Year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	19 (50)	19	105	28 (16)	171
2006	25 (63)	15	58	15 (13)	113
2007	27 (49)	28	112	41 (20)	208
2008	29 (53)	26	90	35 (19)	180
2009	25 (39)	39	81	20 (12)	165

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

^b Percent lambs is calculated as a proportion of total sheep observed.

24

CA 14 – CRYSTALLINE HILLS

Calendar Year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	0 (0)	2	49	21 (29)	72
2006	<i>no survey data</i>				
2007	<i>no survey data</i>				
2008	<i>no survey data</i>				
2009	<i>no survey data</i>				

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

CA 21 – MACCOLL RIDGE

Calendar year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	9 (31)	20	136	45 (21)	210
2006	<i>no survey data</i>				
2007	<i>no survey data</i>				
2008	<i>no survey data</i>				
2009	<i>no survey data</i>				
2010	4 (10)	35	80	43 (27)	162

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

25

CA 22 – CANYON CREEK TO BARNARD GLACIER

Calendar year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	16 (29)	39	139	44 (18)	238
2006	<i>no survey data</i>				
2007	<i>no survey data</i>				
2008	<i>no survey data</i>				
2009	<i>no survey data</i>				

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

CA 23W – BARNARD GLACIER EAST TO PARK/PRESERVE BOUNDARY

Calendar year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	<i>no survey data</i>				
2006	<i>no survey data</i>				
2007	4 (18)	18	86	28 (21)	136
2008	<i>no survey data</i>				
2009	<i>no survey data</i>				

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

26

CA 23E – PARK/PRESERVE BOUNDARY EAST TO ANDERSON GLACIER

Calendar year	Full-curl (%) ^a	< Full-curl	Ewes and yearling rams	Lambs (%) ^b	Total sheep observed
2005	<i>no survey data</i>				
2006	<i>no survey data</i>				
2007	23 (37)	39	103	22 (12)	187
2008	<i>no survey data</i>				
2009	<i>no survey data</i>				

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

Table 2. Wrangell Mountains, Unit 11 sheep harvest, regulatory years 2005 through 2009.

Regulatory year	Rams	Average horn length (in) of rams ^a	% of horn length \geq 40 in	Ewes	Total ^b sheep
2005	76	35.7	11	5	82
2006	62	36.1	16	1	63
2007	46	35.4	4	5	51
2008	54	35.8	9	4	58
2009	62	34.6	6	2	64

^a Excluding subsistence rams \leq 28 inches.

^b Includes sheep of unknown sex.

27

Table 3. Wrangell Mountains, Unit 11 sheep hunter residency and success, regulatory years 2005 through 2009.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total ^b (%)	Local ^a resident	Nonlocal resident	Nonresident	Total ^b (%)	
2005	14	51	17	82 (40)	30	84	9	123 (60)	205
2006	24	26	12	63 (31)	30	95	16	143 (69)	206
2007	13	29	9	51 (25)	38	102	14	154 (75)	205
2008	15	38	5	58 (28)	34	104	8	150 (72)	208
2009	15	35	14	64 (32)	39	84	13	136 (68)	200

^a Local means residents of Unit 11 and 13.

^b Total may exceed sum because some hunters fail to report residency.

Table 4. Wrangell Mountains, Unit 11 reported sheep hunting effort, regulatory years 2005 through 2009 ^a.

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
2005	80	337	4.2	119	703	5.9	199	1,040	5.2
2006	63	302	4.8	142	804	5.7	205	1,106	5.4
2007	51	231	4.5	153	926	6.1	204	1,157	5.7
2008	56	253	4.5	147	828	5.6	203	1,081	5.3
2009	64	372	5.8	135	788	5.8	199	1,160	5.8

^a Represents only reports with hunter effort data.

Table 5. Wrangell Mountains, Unit 11 sheep harvest chronology percent by harvest periods, regulatory years 2005 through 2009 ^a.

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	
2005	41	16	10	14	4	15	82
2006	24	21	19	10	11	15	62
2007	53	27	10	8	2	0	49
2008	42	12	10	18	7	11	58
2009	27	20	16	9	16	12	64

^a Represents only reports with date of kill.

Table 6. Wrangell Mountains, Unit 11 sheep harvest percent by transport method, regulatory years 2005 through 2009^a.

Regulatory year	Percent of harvest								<i>N</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Airboat	
2005	44	0	14	25	0	1	15	1	82
2006	27	3	22	38	0	2	8	0	63
2007	41	2	20	25	0	2	10	0	51
2008	43	0	17	29	0	2	9	0	58
2009	42	2	13	26	0	3	14	0	64

^a Represents only reports with transportation data.

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

LOCATION

GAME MANAGEMENT UNITS: Southern 11 (5,332 mi²) and southern 13D (5,745 mi²)

GEOGRAPHIC DESCRIPTION: Chugach Mountains

BACKGROUND

The 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), though high quality sheep population.

The central 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 subunit 13D averaged 152 hunters per year. In 1975 a 644 mi² portion of subunit 13D (east of the Richardson highway and north of the lower Tielke 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 subunit 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 subunit 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. Hunting pressure remains low in the eastern Chugach Mountains in Unit 11 due to restrictive federal subsistence regulations.

Despite concerns about the displacement of sheep hunters, sheep harvests stayed relatively consistent in subunit 13D until 1986, when the number of hunters increased significantly. This increase was likely due to a combination of factors. Aircraft access restrictions were 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. Perhaps, though, 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 Owsichuk Supreme Court decision. For the next twenty years, an unlimited number of guides had the ability to book sheep hunting clients in subunit 13D.

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.

Although the total number of sheep hunters and harvest in subunit 13D remained relatively stable through the 1990s, hunting patterns, such as the chronology of harvest and hunter residency, changed significantly. After 2002, sheep numbers began to decline in some portions of the subunit. Due to concerns of heavy hunting pressure and low sheep numbers, the general season in the central Chugach Mountains west of the Richardson highway was changed to drawing permit in 2008.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

- To provide a quality hunting experience as well as the opportunity to take a trophy class ram in the central Chugach Mountains in subunit 13D.
- To provide sustainable subsistence hunting opportunity in the eastern Chugach Mountains in Unit 11.

METHODS

Activities accomplished during this reporting period 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. Due to time and fiscal restraints, surveys are rotated between the surrounding mountain ranges.

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 1,028 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, numbers declined to 278 in 2002, then to 91 in 2007. The population may be slowly rebounding, with 138 observed in 2008 and 146 observed in 2009. The surrounding areas also declined, though not as severely. For all 5 count areas, 539 sheep were observed in 2008, a slight increase from 2007. The highest numbers

observed 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. The western 13D population appeared stable between 2008 and 2009.

Count areas 3, 4, 5, 7, and 9 cover east-central subunit 13D (Tazlina Glacier to the Richardson Highway). Based on periodic surveys in this area, the highest sheep numbers here likely occurred in 1997, when 479 sheep were observed in CA 3, 4, and 5 (between Tazlina and Klutina lakes). Counts slowly declined to 319 in 2009. Periodic surveys from CA 7 and 9 (between Klutina and Tonsina lakes) suggest these areas had up to 400 additional sheep during the 1990s. In 2009 a total of 154 sheep were observed in CA 7 and 9 combined.

Count areas 11, 12, and 13 cover eastern subunit 13D (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 indicated a population decline through 2006, when only 156 sheep were observed. In 2008, 171 sheep were observed, indicating the population may have stabilized.

Minimal survey data exist 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.

Population Composition

During this reporting period, the percentage of full-curl and larger rams observed in subunit 13D ranged 10–25% of all rams and 2–5% of all sheep. The percentage of lambs observed ranged 19–23% of all sheep (Table 1). While the percentage of full-curl rams for subunit 13D is lower than in adjacent areas, the lamb numbers are consistently high, indicating good production and initial survival.

Given the different management strategies across subunit 13D, composition data are most relevant when addressed by geographic area within the subunit.

The sheep composition for all 5 count areas in western subunit 13D ranged 33–42 rams:100 ewes and 29–42 lambs:100 ewes during this reporting period. During 2009 surveys in this area, only 5% of rams observed were judged to be full-curl.

In east-central subunit 13D, the sheep composition for all five count areas ranged 27–36 rams:100 ewes and 27–40 lambs:100 ewes for this reporting period. During surveys in 2009, 26% of rams observed in this area were judged to be full-curl. Total ram numbers for east-central were down from 2007, but the percentage of full-curl rams increased.

In eastern subunit 13D (TCUA), 20 rams:100 ewes and 38 lambs:100 ewes were observed in 2008. No surveys were flown in 2009. Of the rams observed in 2008, 27% were judged to be full-curl.

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

Distribution and Movements

Sheep distribution and movements in subunit 13D during the summer months have been documented by aerial surveys, although little is known about important rutting, wintering, and lambing areas. Predation risk and weather patterns likely 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. A research project initiated in 2009 has begun to address Dall sheep movements between the Matanuska and Tazlina glaciers, among other issues.

MORTALITY

Harvest

Seasons and Bag Limits. During this reporting period, the sheep season in subunit 13D was 10 August–20 September. Through regulatory year (RY) 2007 (RY07 = 1 July 2007 through 30 June 2008), the bag limit was 1 ram with full-curl horns or larger under the general season. Eastern subunit 13D (TCUA) remains open under the general season, with a bag limit of 1 ram with full-curl horns or larger. Since RY08, hunting in east-central subunit 13D (Tazlina Glacier to the Richardson Highway) has been by drawing permit only, with a bag limit of 1 ram with full-curl horns or larger. Since RY08, hunting in western subunit 13D (Coal Creek drainage to the Tazlina Glacier) has been by drawing permit only, with a bag limit of 1 ram.

In the Chugach portion of Unit 11, only local federally-qualified hunters hunt sheep. Method of access is limited to boats. The federal subsistence season was 10 August–20 September with a bag limit of 1 sheep. There is a small amount of private land in this area that is open to state general season hunting, although no state hunt reports have been received for this area.

Board of Game Actions and Emergency Orders. In March 2007, the board established drawing permit hunts in subunit 13D west of the Richardson Highway. Two hunt areas were established, east and west of the Tazlina Glacier. For each hunt area 2 hunts were established, 1 for residents and 1 for nonresidents. After reviewing the history of hunter residency for subunit 13D, the board allocated 80% of the permits for each hunt area to residents and the remaining 20% to nonresidents. The board 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 RY08 hunt season.

Hunter Harvest. The sheep harvest from the eastern Chugach Mountains in Unit 11 continues to be very low. For this reporting period, the average number of federal subsistence sheep hunters in this area was 3.7 per year, and the average harvest was 2.7 sheep per year (100% rams).

Sheep harvests for subunit 13D are reported in Table 2. The annual ram harvest for this reporting period ranged 7–36 (average=20 per year). A combination of low sheep numbers and the change from general season to drawing in RY08 caused a decline in the number of sheep harvested west of the Richardson Highway. Harvest dropped substantially for the TCUA in RY08 as well, although it remains open under the general season. Only 1 ram was taken in RY08 in the TCUA, though 4 were taken in RY09.

The harvest of trophy class rams peaked in the mid 1990s in subunit 13D, with 35 of the rams taken in RY94 having horn lengths greater than or equal to 38 inches and with 14 of the rams

taken in RY95 having horn lengths greater than or equal to 40 inches (18% of the total harvest). The harvest of large rams declined over time. By RY02 only 10 of the rams taken had horn lengths greater than or equal to 38 inches and only 2 rams had horns greater than or equal to 40 inches (4% of the total harvest). The number of large rams increased somewhat between RY03 and RY05, but total harvest and the number of large rams taken began declining again in RY06. In RY08, the first year of the drawing hunts, only 2 rams were taken that had horn lengths greater than or equal to 38 inches, and no 40-inch rams were taken. In RY09, 7 of the rams taken had horns that were greater than or equal to 38 inches, and 1 ram had horns that were greater than or equal to 40 inches (6% of the total harvest).

Permit Hunts. Since RY08 drawing permits have been issued for 2 hunt areas in subunit 13D. Permit numbers were initially set conservatively to allow sheep numbers to increase. West of the Tazlina Glacier, 8 permits were allocated for residents (DS160) and 2 permits were allocated for nonresidents (DS260), with a bag limit of any ram. Between the Tazlina Glacier and the Richardson Highway, 33 permits were allocated for residents (DS165) and 8 permits were allocated for nonresidents (DS265), with a bag limit of 1 ram with full-curl horns or larger.

Hunter Residency and Success. Hunter residency data for subunit 13D are reported in Table 3. The percentage of nonresident hunters and the percentage of rams harvested by those nonresidents increased dramatically during the 1990s and the early 2000s. In RY05, 34% of hunters were nonresidents, and they took 61% of the total sheep harvested. In RY07 there was a pulse of resident hunters in subunit 13D, likely in response to the planned implementation of drawing hunts the following year. When the drawing hunts were established, the board allocated 20% of available permits to nonresidents. For RY08 and RY09, the average nonresident percentage of subunit 13D sheep hunters dropped to 16%, although the harvest continued to be dominated by nonresidents (58% of the total harvest).

The nonresident percentage of TCUA hunters has generally been lower than the remainder of subunit 13D. Between RY05 and RY07, nonresidents averaged 19% of all TCUA hunters. For RY08 and RY09, the nonresident average actually dropped to 8%.

Harvest Chronology. Chronology data for sheep harvested in subunit 13D are reported in Table 4. Harvest patterns have changed dramatically over time in subunit 13D. Through the early 1990s it was common to see rams harvested throughout the entire 6-week season. During the late 1990s and early 2000s the percentage of the harvest occurring in the first week of the season increased significantly. This pattern continues even though much of subunit 13D is open only under drawing permit. For RY08 and RY09, an average of 50% of the harvest occurred during the first week of the season. The harvest chronology remains highly variable in the TCUA due to low harvest.

Transport Methods. Aircraft has consistently been the most popular and successful method of transportation for subunit 13D hunters outside the walk-in area. During this reporting period an average of 42% of all subunit 13D hunters used an aircraft, followed by 35% who hunted from a highway vehicle. Of the successful hunters (Table 5), an average of 72% used an aircraft and 20% hunted from their highway vehicle.

Other Mortality

Prior to 2009, no studies were conducted in subunit 13D addressing Dall sheep mortality factors. New research is beginning to address predation on lambs and ewes, as well as other mortality causes between the Matanuska and Tazlina Glaciers. Some of the mortality factors identified thus far include pneumonia, avalanches, and predation by eagles, wolverines, bears, and wolves.

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 the area declined considerably during the mid 2000s. Lamb numbers across the area varied tremendously, indicating lamb production and/or early survival in some areas may have played a role in the decline. Sheep numbers have started to rebound in the center of subunit 13D between the Nelchina and Klutina drainages, although numbers remain substantially lower in other portions of the subunit.

Composition data over the past decade indicated a low percentage of full-curl rams in subunit 13D outside the TCUA. Considering composition surveys are conducted prior to the hunting season, there were clear indications that few large mature rams were surviving to breed each year.

With the establishment of drawing hunts west of the Richardson Highway in RY08, hunting pressure has been reduced. The percentage of large mature rams is expected to increase in future years. Allowing more large mature rams to breed should help maintain the trophy potential and genetic diversity of the population.

Current Dall sheep management in the central Chugach Mountains reflects the historical trophy value of the area. The TCUA was originally established to provide a quality experience as well as the continued opportunity to take a trophy class ram. Due to the difficulty involved in hunting the TCUA, the objectives should continue to be attained under the general season. It is reasonable to assume that existing drawing hunts west of the Richardson Highway will also allow the same objectives to be met. As sheep numbers rebound, permit numbers will be adjusted accordingly.

Given favorable weather and lamb survival, the total number of rams available for harvest in subunit 13D should increase over the next several years. For the purpose of evaluating recent

management actions, we recommend long-term annual harvest objectives of 20 rams in western subunit 13D, 30 rams in east-central subunit 13D, and 8 rams in the TCUA.

Ongoing research in this area documenting baseline health parameters, as well as monitoring 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 disease, extreme weather, and perhaps even changing climate patterns.

LITERATURE CITED

McDonald, L.L., D. Strickland, D. Taylor, J. Kern, and Kurt Jenkins. 1991. Estimation of Dall sheep numbers in Wrangell–St. Elias National Park and Preserve – July 1991. Technical Research Work Order prepared for the National Park Service, Alaska Region, Anchorage, Alaska. 40p.

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Table 1. Chugach Mountains, subunit 13D sheep composition counts and estimated population size, calendar years 2005 through 2009.

Calendar year	Rams		Ewes and yearling rams	Lambs (%) ^b	Total sheep observed ^c	Minimum estimated population size ^d
	Full-curl (%) ^a	< Full-curl				
2005	<i>no survey data</i>					
2006	42 (23)	141	597	228 (23)	1008	N/A
2007	21 (10)	190	584	184 (19)	979	1160
2008	36 (25)	110	401	163 (23)	710	1280
2009	23 (17)	113	506	183 (22)	825	996

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Percent lambs is calculated as a proportion of total sheep observed.

^c The amount of area surveyed varies each year.

^d 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, subunit 13D sheep harvest, regulatory years 2005 through 2009.

Regulatory year	Rams	Average horn length (in) of rams	% of horn length \geq 40 in	Ewes	Total sheep
2005	52	37.5	13	0	52
2006	34	37.1	15	0	34
2007	36	36.3	11	0	36
2008	7	35.5	0	0	7
2009	17	37.2	6	0	17

Table 3. Chugach Mountains, subunit 13D sheep hunter residency and success, regulatory years 2005 through 2009.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total ^b	Local ^a resident	Nonlocal resident	Nonresident	Total ^b	
2005	2	18	31	52	7	72	19	99	151
2006	0	13	20	34	12	78	20	110	144
2007	0	13	22	36	14	127	10	151	187
2008	0	3	4	7	2	53	4	60	67
2009	0	7	10	17	1	36	2	39	56

^a Local means residents of Unit 13.

^b Total may exceed sum because some hunters fail to report residency.

Table 4. Chugach Mountains, subunit 13D sheep harvest chronology percent by harvest period, regulatory years 2005–06 through 2009–10^a.

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	
2005–06	52	16	18	6	0	8	50
2006–07	64	15	15	3	3	0	34
2007–08	40	23	11	11	6	9	35
2008–09	58	14	14	0	14	0	7
2009–10	47	17	6	12	6	12	17

^a Represents only reports with date of kill.

39

Table 5. Chugach Mountains, subunit 13D sheep harvest percent by transport method, regulatory years 2005–06 through 2009–10^a.

Regulatory year	Percent of harvest							<i>N</i>	
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle		Other
2005–06	79	2	6	6	0	0	7	0	52
2006–07	67	0	6	0	0	0	27	0	33
2007–08	69	0	3	11	0	0	17	0	36
2008–09	71	0	0	0	0	0	29	0	7
2009–10	76	0	0	0	0	0	24	0	17

^a Represents only reports with transportation data.

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2010^a

LOCATION

GAME MANAGEMENT UNIT: Portions of 12 (10,000 mi²)

GEOGRAPHIC DESCRIPTION: Mentasta, Nutzotin, and northern Wrangell Mountains

BACKGROUND

Dall sheep in the northern Wrangell, Mentasta, and Nutzotin (WMN) Mountains live at relatively high densities, mostly 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). Because most of the legal rams available in Unit 12 are harvested each year, recording horn size helps monitor possible effects of regularly removing all fast growing, large horned rams from the population. Consequently, the management objective for Unit 12 reflects our strategy to provide the greatest opportunity to participate in hunting sheep while maintaining a healthy population.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

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

MANAGEMENT OBJECTIVE

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

Related Management Activity

- Monitor harvest through hunter contacts and harvest reports.

^a At the discretion of the reporting biologist, this unit report may contain data collected outside the report period.

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., RY07 = 1 July 2007 through 30 June 2008).

We estimated Dall sheep population composition using aerial survey data collected primarily within the Wrangell–St Elias Preserve. During RY07–RY09 surveys in the Mentasta Mountains between Suslota Pass and the Nabesna River (Count Area 1); in the Nutzotin Mountains between the Nabesna River, Cooper Pass and Stuver Creek (Count Area 5W); and between Snag and Klein creeks and the Canada border (Count Area 7E). Results from surveys in the Wrangell, Nutzotin, and Mentasta mountains prior to this report period are included in Tables 1 and 2 to better present population and composition trends in Unit 12. Piper Super Cubs (PA-18) were used to conduct all surveys. Surveys were flown along contours in suitable sheep habitat during late June and early July, and flight paths were maintained at 300–700 feet above ground level at airspeeds of 60–80 mph. 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, and then stabilized about 1988. Based on composition data, we believe the population declined during the early 1990s due to adverse weather and possibly predation. 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 ram 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 RY07–RY09 is unknown, but based on studies conducted elsewhere, it may have been significant. Coyotes are important predators on lambs (Scotton 1998; Arthur and Prugh 2010) 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; Arthur and Prugh 2010). Sumanik (1987) determined that wolves were present at 5–7 wolves/1000 km² in the nearby Kluane region of Canada, but were not a significant predator on Dall sheep.

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). Sheep numbers then stabilized or declined, perhaps due to adverse weather in the winters of 1999–2000 and 2000–2001, and remained relatively low despite mild winters during RY04–RY06 (Table 2). Severe conditions in winter 2008–2009, including prolonged severe cold and ice on top of deep snow (Alaska Snow Survey report, April 1, 2009), likely caused further declines in some areas.

Population Composition

Composition data are not directly comparable between years because different areas were sampled each year. Nevertheless, survey data from 1971–2009 are included in Tables 1–3 because these population indicators frequently exhibited consistent trends between areas. Lamb abundance was low (9–19 lambs:100 ewes) during 1990–1993, 2001 and 2002 in many count areas, and moderate to high (27–32 lambs:100 ewes) in all areas surveyed during 1997 and 1998 (Tables 1 and 3). During 2005 and 2006, lamb abundance appeared to be high and ranged 24–43 lambs:100 ewes among areas surveyed (Table 2). In July 2007 we recorded 25 lambs:100 ewes in the Nutzotin Mountains between Snag Creek and the Canada border (Count Area 7E), and 32 lambs:100 ewes between the Nabesna River and Stuver Creek (Count Area 5W; Table 2). In July 2009 we recorded 30 lambs:100 ewes in the Mentasta Mountains between Suslota Pass and the Nabesna River (Count Area 1; Table 2). Slightly lower ratios of 23 lambs:100 ewes were observed during surveys conducted by National Park Service (NPS) staff in 2009 between the upper Copper River and the Jacksina River largely outside of Unit 12 (portions of Count Area 3).

The abundance of legal rams remained low during RY07–RY09. Possible low lamb recruitment during 1999 and 2000 may have caused the current low number of legal rams but no surveys were conducted those years. Survey data collected in the eastern Wrangell Mountains (Count Area 7W) indicate that the number of ewes was lower in 2001 than 1981 (Table 2), but we do not know when the decline occurred. Ewe numbers increased in that survey area in 2002, but then declined by 2005. In the Nutzotin Mountains (Count Area 9) total sheep counted, percent lambs, and lambs:100 ewes were lower in 2002 and 2005 (the most recent surveys available) than in 1981.

Ratios of rams:100 ewes ranged 37–59 in all areas surveyed since 2005 while the number of legal rams was as low as 2 rams:100 ewes in Count Area 1 surveyed in 2009, suggesting that recruitment of 8-year-old rams was low during RY07–RY09 and most legal rams were harvested each year (Table 2). The low abundance of legal rams were also recorded during aerial surveys by NPS staff in portions of the heavily hunted Count Area 3 where only 3 full curl rams were observed per 100 ewes.

Weather, predation, and harvest management directly influence annual population composition (Heimer 1988). During 2009, we observed 30 lambs:100 ewes and 18% lambs in Count Area 1, similar to our observations in 2007 in the Nutzotin Mountains of 15% lambs in Count Area 7E and 17% in Count Area 5W (Table 2). Weather conditions seem to be the primary factors limiting lamb production, ram numbers, and population growth in this area. During the early 1980s, winters were mild and lamb production was high (≥ 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 during the 2007–2009 surveys.

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; Arthur and Prugh 2010). Snowshoe hare populations in Unit 12 peaked again during 2008 and 2009 (Tetlin Wildlife refuge unpublished data 2011, Tok) and coyote predation may have been a significant factor limiting the sheep population during RY07–RY09 as hare numbers peaked and crashed.

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 4,000–7,000 ft elevation. Although small mineral licks occur throughout the area, three large mineral licks located in Lost Creek, Sonya Creek, and East Fork Snag Creek drainages 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 whether distribution and movements have changed since that time.

MORTALITY

Harvest

Season and Bag Limit. The sheep hunting season for resident and nonresident hunters 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. Since RY07 this included sheep harvested under subsistence regulations, although many sheep harvested under subsistence regulations in Unit 12 remain undocumented. No new Board of Game regulations or emergency orders were issued during RY07–RY09.

Harvest by Hunters. During RY07–RY09, 290–332 hunters ($\bar{x} = 309$) reported taking 94–128 rams ($\bar{x} = 113$; Tables 4 and 5), a 19% decrease from harvest numbers during RY04–RY06. Since RY92–RY94, harvest has declined 34% and hunter participation declined by 24%. During 1991–1993, lamb recruitment was poor, and during the severe winter of 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 aerial survey data (Table 2), the number of legal rams increased during RY01–RY03 but may have decreased again during RY04–RY09, especially following the severe conditions of winter 2008–2009. 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 among harvested rams was 34.6 inches during RY07–RY09. This has changed little since RY96; the 5-year average horn length was 34.7 inches and the 10-year average was 34.6 inches (Table 5). These horn lengths are slightly larger than the averages of 33.6 inches and 34.1 inches recorded in RY81–RY85 and RY86–RY90 respectively. The increase is likely due to the change in regulations that allowed only full curl or larger rams to be harvested after RY84.

During RY07–RY09, 4 rams had horns ≥ 40 inches (1.2%). The mean reported age of harvested rams was 8.5 years during RY07–RY09. The previous 3-year average was 8.4 years. In comparison, in the Tok Management Area northwest of the WMN Mountains, the percentage of the harvested rams with horns ≥ 40 inches frequently exceeds 10%, and the average annual age of harvested rams ranges between 8.6 and 9.6 years.

Similar to previous reporting periods, areas within the WMN Mountains that produced the largest rams (≥ 38 inches) were along the Nabesna Glacier, Cheslina River, Snag Creek, and the upper Tetlin River. The Tetlin River is within 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 37% during RY07–RY09 was lower than the average of 46% in both RY04–RY06 and RY01–RY03, and the 40% success reported in RY98–RY00 (Table 4). Nonresident success rates (71–74%) were much higher than resident success rates (22–31%) during RY07–RY09. The primary reasons nonresidents were more successful 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 RY07–RY09, nonresidents made up 21% of the sheep hunters and were responsible for taking 42% of the total harvest.

Harvest Chronology. Most sheep were taken early in the hunting season (Table 6). During RY07–RY09, 36–39% ($\bar{x} = 38\%$) of the harvest was taken during the first week of the season. Harvest decreased dramatically to an average of 15% of rams taken during the next 3 weeks, and 7% of rams were harvested during the final week of the season.

Transport Methods. During RY07–RY09, airplanes and horses were used by 61–71% of successful hunters (Table 7). Harvest by hunters who used aircraft and horses were 45% and 21% of the total harvest respectively. Success rates for nonresidents were much higher than residents who used these methods (airplanes 68% vs. 33%; horses 82% vs. 42%) because most nonresidents were guided and hunted the better quality areas. Annually during RY07–RY09, 21–24% of successful hunters used 4-wheelers, other ORVs, or highway vehicles to access sheep habitat. Hunters who used 4-wheelers and other ORVs averaged 18% success, and hunters who

used highway vehicles averaged 23% success. Resident hunters were the primary users of these transportation methods ($\bar{x} = 92\%$).

Other Mortality

We did not conduct studies to determine changes in the rate or type of natural mortality during RY07–RY09 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 a 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

We met the management goal to maintain the Dall sheep population in Unit 12 and its habitat in concert with other components of the ecosystem. Unit 12 continued to be the most hunted Game Management Unit in the state for sheep, although the number of hunters and total harvest decreased slightly during RY07–RY09 compared to RY04–RY06. In many areas of Unit 12, hunters harvested most of the legal rams available. Higher 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 sheep numbers and lamb production. Low numbers of legal rams were observed in the Mentasta and eastern Nutzotin mountains surveyed during RY07–RY09. Consistent surveys in regular survey areas are needed to better understand local population fluctuations.

Hunter numbers and success rates both declined slightly during RY07–RY09 compared to the previous 10 years. The management objective to maintain an average horn size on harvested rams of ≥ 34 inches during RY07–RY09 was met. Horn length averaged 34.6 inches and has been stable since full curl harvest regulations were implemented in 1984.

As in RY04–RY06, 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 offered trips to wildlife viewers.

For the next report period the management goal will be modified to:

- Maintain a harvestable population of Dall sheep fluctuating within historical limits of abundance and the carrying capacity of their habitat.

The management objective and related activity will remain the same:

MANAGEMENT OBJECTIVE

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

Related Management Activity

- Monitor harvest through hunter contacts and harvest reports.

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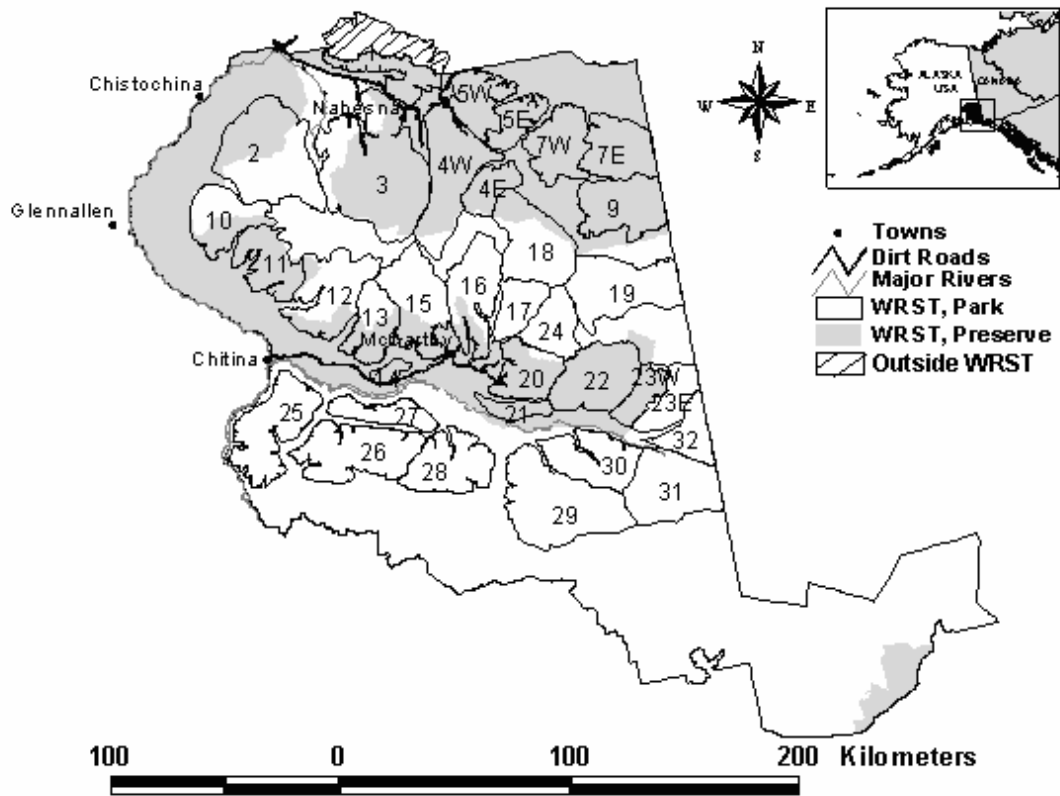


Figure 1. Locations of Unit 12 Dall sheep aerial survey units 4E, 4W, 5E, 5W, 7E, 7W, and 9, within Wrangell–St Elias (WRST) National Park and Preserve (Terwilliger 2005).

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

Sex/age class	1971 ^a	1973 ^a	1980 ^a	1997 ^b	1997 ^{c,d}
Legal rams	78	141	112	70	47
Sublegal rams ^e	10	106	185	97	246
Unclassified rams	22	19	10	0	0
Total rams	110	266	307	167	293
Ewes ^f	555	537	754	692	811
Lambs	137	41	356	196	222
Unidentified	0	150	132	0	0
Total other sheep	692	728	1242	888	1033
Total sheep	802	994	1549	1055	1326
Legal rams:100 ewes	14	26	15	10	5.8
Sublegal rams:100 ewes		20	25	14	30
Total rams:100 ewes	20	50	41	24	36
Lambs:100 ewes	25	8	47	28	27
Lambs % of total	17	4	23	19	17

^a Legal size ram is $\geq 3/4$ curl.

^b Subset of total area surveyed in 1997 to be consistent with counts conducted during 1971–1980.

^c Counts reflect sheep observed in entire 1997 survey area.

^d Legal ram is \geq full curl.

^e Greater than $1/4$ curl but less than legal size.

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

Table 2. Unit 12 Dall sheep aerial composition counts within the Wrangell–St Elias National Park and Preserve, 1981, 2001, 2002, 2005, 2006, 2007, and 2009.

	Year	Legal rams ^a	Sublegal rams ^b	Unclassified rams	Total rams	Ewes ^c	Lambs	Unidentified	Total other sheep	Total sheep	Legal rams:100 ewes	Sublegal rams:100 ewes	Total rams:100 ewes	Lambs:100 ewes	Lambs % of total
Count Area 1 ^d	2009	4	76	0	80	218	66	0	284	364	2	35	37	30	18
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 ^e	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 ^e	1981	15	210	21	246	511	140	51	702	948	3	41	48	27	15
	2001 ^f	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 ^e	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 ^g	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

^a Full curl or larger.

^b Greater than ¼ curl but less than full curl.

^c Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

^d Mentasta Mountains.

^e Wrangell Mountains.

^f Count Area 7 only included from Snag Creek East.

^g Nutzotin Mountains.

Table 3. Unit 12 Dall sheep aerial composition counts^a within Wrangell–St Elias National Preserve, 1991–1998.

Sex/age class	1991	1992	1993	1998 (East)	1998 (West)
Legal rams ^b		31	111	22	34
Sublegal rams ^c		140	544	110	117
Unclassified rams		30	0	0	0
Total rams	174	201	655	132	151
Ewes ^d	416	440	1323	373	470
Lambs	75	83	120	113	152
Unidentified	57	0	0	0	0
Total other sheep	548	523	1443	486	622
Total sheep	722	724	2098	618	773
Legal rams:100 ewes		7.1	8.4	5.9	7.2
Sublegal rams:100 ewes		31.8	41.1	29.5	24.9
Total rams:100 ewes	41.8	45.7	49.5	35.4	32.1
Lambs:100 ewes	18.0	18.9	9.0	30.3	32.3
Lambs % of total	10.4	11.5	5.7	18.3	19.7

^a Data from National Park Service.

^b Full curl or larger.

^c Greater than ¼ curl but less than full curl.

^d Ewe classification also includes yearlings of both sexes and rams of ¼ curl or less.

Table 4. Unit 12 sheep hunter residency and success, regulatory years 1990–1991 through 2009–2010.

Regulatory year	Successful				Unsuccessful				Total hunters ^b
	Local ^a resident	Nonlocal resident	Nonresident	Total ^b (%)	Local ^a resident	Nonlocal resident	Nonresident	Total ^b (%)	
1990–1991	12	129	83	237 (53)	28	159	16	211 (47)	448
1991–1992	17	159	92	272 (55)	23	173	19	219 (45)	491
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	167 (44)	14	177	18	209 (56)	376
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	126 (44)	12	121	22	158 (56)	284
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
2007–2008	2	65	61	128 (39)	13	166	25	204 (61)	332
2008–2009	0	79	39	118 (39)	12	162	14	188 (61)	306
2009–2010	3	49	42	94 (32)	7	174	15	196 (68)	290

^a Resident of Unit 12.

^b Total hunters includes hunters who did not report residency.

Table 5. Unit 12 sheep harvest, regulatory years 1990–1991 through 2009–2010.

Regulatory year	Rams	\bar{x} Horn length	\bar{x} Age	Total sheep ^a	Hunters
1990–1991	237	34.4		237	448
1991–1992	272	34.3	8.7	272	491
1992–1993	177	34.5	8.6	177	407
1993–1994	169	34.5	8.5	173	447
1994–1995	159	34.2	8.5	167	376
1995–1996	174	34.2	8.7	179	362
1996–1997	164	34.7	8.8	164	330
1997–1998	129	35.0	9.2	129	252
1998–1999	156	34.7	9.2	160	358
1999–2000	135	34.5	9.0	137	336
2000–2001	96	34.8	8.6	99	288
2001–2002	124	34.7	8.5	126	284
2002–2003	130	34.8	8.5	131	264
2003–2004	145	34.3	8.6	146	322
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
2007–2008	126	34.7	8.9	128	332
2008–2009	118	34.8	8.6	118	306
2009–2010	94	34.2	8.0	94	290

^a 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 2009–2010.

Regulatory year	Harvest chronology percent by time period						<i>n</i> ^a
	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
2007–2008	36	19	21	10	10	4	128
2008–2009	39	7	14	22	12	6	118
2009–2010	39	18	14	11	8	10	92

^a*n* (sample size) may be less than total harvest due to incomplete reporting of kill date.

Table 7. Unit 12 sheep harvest percent by transport method, regulatory years 1990–1991 through 2009–2010.

Regulatory year	Harvest percent by transport method								<i>n</i> ^a
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1990–1991	54	23	2	9	0	2	9	1	237
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	131
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
2007–2008	40	25	8	13	0	0	12	2	128
2008–2009	51	20	8	9	0	1	10	1	118
2009–2010	45	16	15	5	0	2	14	3	94

^a*n* (sample size) may be less than total harvest due to incomplete reporting of transportation type used.

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNITS: Portions of Units 12, 13C, and 20D (1500 mi²)

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. However, in recent years the number of rams harvested each year with horns 40 inches or greater in length, and the average horn size of harvested rams have been lower. This, combined with concerns of area residents, guides, and transporters about the size of the sheep population and the numbers of full curl or larger rams in the TMA, led to reductions in the number of permits issued and investigations into long-term population trends and trends in horn sizes and ages of harvested rams.

Providing the opportunity to hunt sheep under aesthetically pleasing conditions is also a goal of this drawing permit system. Low hunter density has prevented hunter crowding and competition and has generally resulted in an abundance of legal rams, including rams with horns ≥ 40 inches. This management strategy has also allowed ADF&G to maintain unrestricted methods of access to the area and other components of a high-quality hunting experience. Additional early history of management in the TMA is available in Kelleyhouse (1989).

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

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

- 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.
- 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., RY07 = 1 July 2007 through 30 June 2008).

Population composition and productivity have been periodically estimated in the TMA using aerial or ground survey techniques (Gardner 2002). We conducted aerial composition surveys in a 990 mi² portion of the TMA from mid July through early August in 2006 through 2010 to determine population and composition trends. This area makes up about two-thirds of the available sheep habitat in the TMA and was considerably more than the 580 mi² surveyed in 2002, 2003, and 2004. Because of differences in the areas surveyed in those different periods, apparent population trends must be viewed with caution. A trend area that includes the area consistently surveyed from 2002 through 2010 has also been included for analysis.

We examined average horn sizes and ram ages of sheep harvested in the TMA since 1974. These analyses were prompted by recent low numbers of rams harvested with horns over 40 inches in length combined with lower than average horn sizes during RY07–RY09 and concern expressed by local area guides and long-term residents about decreasing numbers of trophy quality rams. We compiled ram harvest data from 1974 through 2009 for which sheep age, horn length, and base diameter were recorded and examined long-term trends in age and horn length. Because sheep age, horn length, and base are highly correlated we used multiple regression models to examine changes in horn measurements while controlling for sheep age. This allowed us to determine whether the horn length of sheep harvested in the TMA has changed within individual age groups. These analyses were conducted using SAS version 8.0 (SAS Institute 1990) and $\alpha = 0.05$.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We did not obtain a sheep population estimate for the TMA during RY07–RY09. The last estimate was 2,000 sheep in 1989 (Kelleyhouse 1989). Anecdotal information from long-time area guides, transporters, and sheep hunters indicates that the population in the TMA has declined since 1974. Sheep survey data from 1974–2001 are inadequate to analyze population trend in the TMA. However, sheep numbers declined during this period in other Alaska and Yukon populations (Hik and Carey 2000; Schwanke 2008), and it is likely the TMA population also declined. Sheep population declines are primarily caused by deep snow or ice cover. Winter severity (snowfall) in the TMA was mild to average from the late 1980s until 1992. The sheep population suffered high mortality in 1992 and low productivity in 1992 and 1993. Age structure data collected during 1992–2003 composition surveys indicated the adult mortality rate was low and lamb survival was generally high (Tables 1 and 2).

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 limited population growth in the eastern TMA. Severe winter conditions in 2008–2009, including prolonged severe cold and ice on top of deep snow (Alaska Snow Survey report, USDA Natural Resources Conservation Service, April 1, 2009), may have caused further declines in some areas. Effects of weather are difficult to predict, but based on composition data (Tables 1 and 2), the overall population appears to have been stable in areas surveyed since the current survey method was begun in 2002. Although overall numbers in the 580 mi² trend area surveyed since 2002 were lower in 2006 through 2009 (range 750–924, \bar{x} = 840), than 2002 through 2004 (range 997–1,158, \bar{x} = 1,052), more sheep were observed in 2010 (1,158 sheep observed) than in any year since 2003 (Figure 1). A more rigorous monitoring regime is needed to better understand long-term changes and limiting factors in this population.

Population Composition

Annual population composition surveys were conducted between July 8 and August 2 during 2007–2010 (Tables 1 and 2). In 2007–2009 lamb survival was high (33–36 lambs:100 ewes; counts of ewes may include some young rams) and lambs averaged 20% of the total population over these years. Lamb production has consistently been at or above 30 lambs:100 ewes since 2002, which is a substantial increase from 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. This affected sheep populations throughout interior Alaska. The proportion of the total ram population that were full-curl rams declined from a 25% average during 2002–2006, to an average of 21% during 2007–2009. A low of 16% was observed in 2010. In contrast, composition data collected during the 1980s indicated that full-curl rams were $\geq 36\%$ of the ram population. Despite a reduction in numbers of permits issued to hunters beginning in 2002, the abundance of full-curl rams has remained low relative to

the 1980s. This is likely due to poor overwinter survival of lambs in RY99 and RY00 and does not appear to have increased despite increased survival of ram cohorts born in RY01 and RY02.

Distribution and Movements

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. During RY07–RY09 we collected no additional data on distribution and movements.

MORTALITY

Harvest

Season and Bag Limit. One hundred permits were issued annually in the TMA during RY07–RY09. One additional permit each year, the Alaska Governor’s TMA Dall Sheep permit, was auctioned to raise funds for wildlife research and management in Alaska (Table 3). 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 ≥ 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 limiting nonresidents to a maximum of 10% of permits issued for sheep hunting in the TMA. This insures that resident hunters continue to have a higher probability of receiving these valued permits, and addressed concerns of high harvest of full-curl rams due to the disproportionately high success rates of guided nonresident hunters.

In 2008 the board reviewed a proposal to divide the permits among 2 periods using ADF&G’s discretionary permit authority. The Board supported the plan, and starting in RY09, 50 permits were issued for August 10–25 (DS102), and another 50 permits for 26 August–20 September (DS103).

In 2010 the board received a proposal to reduce the number of permits from 100 to 80 following 3 years (RY07–RY09) in which the percent of harvested rams with horns ≥ 40 inches in length was at or below the management objective of 7%. Although the board supported the idea, it took no action on this proposal because ADF&G has discretionary permit authority to issue fewer permits. In 2010 we issued 80 permits: 40 each for the early (DS102) and late seasons (DS103).

No emergency orders were issued during RY07–RY09.

Harvest by Hunters. During RY07–RY09, annual harvest ranged 40–44 rams ($\bar{x} = 42$). The previous 5-year mean harvest was 43 rams (Table 3). No ewes have been reported harvested in the TMA since before 1990. Hunter participation averaged 85% during RY07–RY09, similar to 85% 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 during the hunting season in RY03 and good lamb recruitment during 1994–1999.

Mean horn length during RY07–RY09 was 35.9 inches compared to the previous 5-year mean of 36.2 inches (Table 3). The percentage of harvested rams with horn length ≥ 40 inches was 6% ($n = 2-3$) of the annual harvest, compared to the previous 5-year mean of 12%. The percent of harvested rams with horn length ≥ 40 inches was high during RY04–RY06 with a record high of 22% in RY06. However, no rams with horns ≥ 43 inches were taken during RY04–RY06 or RY07–RY09. Relatively high harvests during RY95–RY99 and RY03–RY09 combined with possible poor horn growth due to unfavorable environmental conditions in 2000 and 2001 may have been factors in the lower-than-average horn size of rams harvested in RY07–RY09. The average reported age of rams harvested during RY07–RY09 was 9.2 years, slightly older than the mean of 8.8 years during RY04–RY06.

Among records of 1,416 sheep harvested between 1974 and 2009, sheep age, horn length and base size data were available for 1,162 sheep (data for 1981, 1982, 1983, and 1985 are incomplete or unavailable). Although the average size of sheep horns has not changed significantly since the creation of the TMA ($F = 1.66$, $P = 0.1983$), the age of sheep harvested has increased from 8.2 to 9.1 years ($F = 36.04$, $P < 0.0001$). Multiple regression models, controlling for age of the sheep, indicate significant declines from 1974 to 2009 for both horn size ($F = 135.33$, $P < 0.0001$) and horn base ($F = 21.91$, $P < 0.0001$). Although the length of horns on harvested rams has not decreased, horn growth rate in the population appears to have decreased.

These results must be interpreted with caution because the models make a number of assumptions. Records of which sheep horns were broken (broomed) are poor prior to RY00. Therefore broomed rams were not eliminated from the analysis, and harvest data include unknown numbers of broomed horns. We therefore assume that the proportion of broomed rams has not changed since RY74. We eliminated all 13, 14, and 15-year-old sheep from the analysis due to very small sample size and the high probability of broomed horns. Prior to RY04 all data are from hunter harvest reports. Some hunters may tend to overestimate the sheep age and horn length. Starting in RY04 ADF&G staff collected horn length and age data. However, we did not detect pronounced changes in age or horn length between RY03 and RY04. Horn size still decreased significantly with year when controlled for age during 1974–2003 ($F = 103.56$, $P < 0.0001$). The assumptions of multiple regression for normal distribution of residuals of horn length, age, and year were met for all models.

Our ability to detect small changes in horn size with sheep age is high due to the large number of sheep examined in each age class ($n_{6\text{-year-olds}} = 59$, $n_{7\text{-year-olds}} = 147$, $n_{8\text{-year-olds}} = 281$, $n_{9\text{-year-olds}} = 303$, $n_{10\text{-year-olds}} = 223$, $n_{11\text{-year-olds}} = 105$, $n_{12\text{-year-olds}} = 32$). Horn length of 8-year-old sheep decreased at a rate of 0.043 inches per year during RY74–RY09 ($F = 7.78$, $P = 0.006$). This resulted in a change in horn size among 8-year-old rams from 36.6 inches in RY74 to 35.1 inches in RY09. However, the biological significance of these relationships must be viewed carefully.

Many factors may have affected horn growth among rams in the TMA. These include 1) forage quality, 2) weather events and subsequent sheep nutrition, 3) genetic changes from movements of sheep in or out of the population, and 4) a long-term response to the selective hunting pressure

on rams with the best horn growing potential. Although the change we estimated based on harvest records is not large, this is an issue of concern and should be monitored. We will continue to collect sheep horn and age data to reexamine trends in the future.

Hunter Residency and Success. During RY07, RY08, and RY09, 3,489, 3,197, and 4,514 applicants applied for 100 permits, resulting in a 2.9% and 3.1% chance of being drawn in RY07 and RY08 respectively. For the split season in RY09 there were 2,605 and 1,909 applicants for the 50 permits in the early and late seasons respectively (1.9% and 2.6% chance of being drawn). Eighty-eight percent of participating hunters were Alaska residents, and they took 76% of the harvested rams during RY07–RY09 (Table 4). Eleven nonresidents (12%–13% of permittees) were drawn annually during this period compared to 7 to 16 nonresidents (8%–18% of permittees) drawn during RY04–RY06. Overall, 100% of the nonresidents who drew a permit participated, compared to 84% of residents.

During RY07–RY09 the mean annual success rate was 49% (range 46%–51%), which was similar to the previous 5-year mean annual success rate of 50% and close to the mean success rate of 52% during RY94–RY98 (Table 4). During RY07–RY09, hunters had the greatest success in RY08 (51%) and spent an average of 4.5 days in the field. Successful hunters were in the field 4.7 and 4.3 days during RY07 and RY09. Despite hunter concerns about increased difficulty in finding legal rams in the TMA, the average number of days that successful hunters spent in the field did not increase. In 1985–1994 and 1995–2005 the averages were 5.1 and 5.0 days respectively. Favorable weather is frequently the primary reason hunters spend more time hunting during certain years, which increases their chance of successfully harvesting a sheep.

Harvest Chronology. Since the creation of the TMA in 1974, most sheep harvest occurred during the first 10 days of the hunting season (10–20 Aug). During RY07–RY08, 48% of the harvest was during the first 10 days and 27% was during the second 10 days. Hunters generally choose to hunt during the first week of the season because they are concerned about adverse weather later in the season and believe they have to be hunting on opening day to take the largest rams.

In RY09 100 permits were split evenly between the 10–25 August season (DS102) and the 26 August–20 September season (DS103). Twenty (40% success) sheep were harvested in the early season and 22 (42% success) in the late season. Eighty percent and 59% of the harvest occurred in the first week of both seasons respectively. Participation was 82% in the first season and 84% in the later season.

Transport Methods. Airplanes were the primary method of transport during RY07–RY09 (Table 5). During this report period, 71% of successful hunters used aircraft to access the area. Of the other common transport methods, ATV use (7%) was lower than highway vehicle use (15%). During RY07–RY09, the average success rate for hunters who used aircraft was 50%, while success rates were 44% 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 2002–2009 composition surveys, it appears that adult survival and lamb productivity were good during 2001–2009. Although survival was likely lower across all age classes during the severe winter conditions of 2008–2009, it appeared to have little effect on lamb production in 2009.

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 a peak in the snowshoe hare population (Gross 2004). Based on anecdotal data and hare pellet count transects (Krebs et al. 2001) conducted in Eastern Unit 12, the snowshoe hare population again peaked in 2008–2009 (Tetlin National Wildlife Refuge, unpublished data 2011, Tok).

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, Arthur and Prugh 2010). Although coyote predation may not have been a significant factor limiting the sheep population during RY07–RY09, it may be important as the hare population declines.

Golden eagle numbers in the TMA are unknown. However incidental sightings of golden eagles are recorded during July sheep surveys. Within the 990 mi² survey area, ADF&G staff observed 9, 7, and 6 golden eagles in 2008, 2009, and 2010, respectively. Although these data are inadequate to estimate population size or trend, we will continue to monitor numbers during future sheep surveys.

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 1 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 RY07–RY09. We have no data estimating mortality due to accidents.

HABITAT

Assessment

The TMA consists of rugged, glaciated terrain with *Dryas*-dominated habitats. Mixed bunchgrass and forb communities are also available and important to 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 continue to 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 maintain an average harvest of rams with horns ≥ 36 inches, including a minimum percentage of rams with horns ≥ 40 inches (7%), 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). He found differences 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 121 to 101 sheep, to ensure that management objectives continue to be met. This number of permits was further lowered to 81 permits in 2010 following concerns of guides and local residents over the low number of rams with horns over 40 inches harvested in 2007, 2008, and 2009.

CONCLUSIONS AND RECOMMENDATIONS

This is the first report period (RY07–RY09) since creation of the TMA that the average horn size fell below the management objective of 36 inches and the number of rams taken with horns ≥ 40 inches was below 7%. Both may be the effects of severe winter conditions in 2000–2001 and associated poor survival of rams now reaching full curl, combined with record high harvest of rams with horns ≥ 40 inches in 2006, but they raise concerns about the condition of sheep in the TMA. The age of harvested rams continued to meet the minimum harvest management objective of 8 years or older.

The absence of exceptionally large rams harvested in RY07–RY09 may indicate that few rams survive to their maximum horn potential. However the average age of rams harvested has increased since RY74 without any change in average horn size. When sheep age is controlled for however, the horn size of sheep harvested in the TMA appears to have decreased. A variety of factors may be responsible for this decline, including the possible genetic consequences of long-term trophy management (Harris et al 2002). More than 35 years of selective harvest of the largest horned rams in the TMA may have affected the horn growth in the population. Declining numbers of large horned rams have also been reported in the Wrangell Mountains of Unit 11 (Schwanke 2008). In the Yukon, harvest percentages of large horned rams were found to follow an approximately 10-year cycle based on large-scale weather patterns (Hik and Carey 2000). No clear cycle is currently apparent in the horn length or base data from the TMA.

We will continue monitoring both horn length and public opinion of what constitutes a trophy ram and will take action if necessary. Although the TMA sheep population generally appears to be stable, long-term consistency in areas surveyed are needed for precise estimates of population status and trends. There has been no increase in the average number of days hunters spend in the field to harvest a legal ram. Lamb ratios have been above 30 lambs:100 ewes since 2002, which indicates the population was not limited by production, but by mortality related to specific winter weather events during RY07–RY09.

We met our objective to prevent unacceptable increases in hunter concentration and maintain aesthetically pleasing qualities associated with sheep hunting in the TMA. The split of the sheep hunt into early and late seasons beginning in RY09 seems to have been effective at further reducing hunter crowding. Hunter participation and success rates were very similar between both seasons.

The total number of permits was reduced in RY02, and again in RY10 due to concern over the difficulty of finding legal rams and the low number of rams in the harvest with horns ≥ 40 inches. As rams born in 2002–2004 reach full curl we will assess whether recent reductions in permits are sufficient to reduce harvest of younger rams and increase the proportion of large-horned rams in the population. Public opinion regarding trophy quality and the aesthetic importance of an uncrowded hunt has not been quantified since 2000. However, complaints from hunters concerning the reduced number of permits or hunter crowding were low. We recommend surveys of public opinion to reassess the desires of sheep hunters following recent changes in sheep management, and have revised our objective related to hunt conditions to reflect a quantitative evaluation of hunter satisfaction

For the next report period the management objectives will be:

- Maintain abundance of mature rams sufficient to produce a harvest of 30–45 rams with mean horn size of >36 inches and mean age of >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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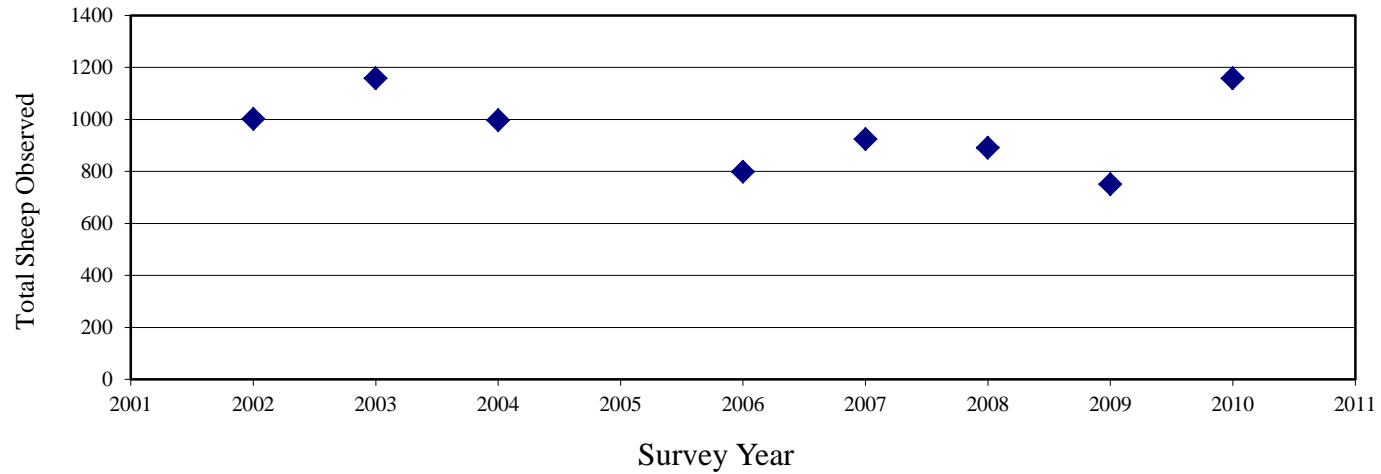
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Figure 1. Numbers of Dall sheep observed in 580-mi² trend count area* within the Tok Management Area from 2002 through 2010.



*Area includes all drainages along the Tok River from the Tok glacier to the Glenn highway, the Clearwater creek drainages, Mt. Newburger, and the mountains between Yerrick Creek and the Robertson River, the mountains between Rumble creek and the upper Tok River and all drainages flowing into the west bank of the west fork of the Robertson River.

Table 1. Tok Management Area sheep composition counts from aerial surveys, 2002 through 2010.

Year	Rams			Other Sheep			Total other sheep	Total sheep	Area surveyed ^d	
	Legal rams ^a	Sublegal rams ^b	Un-classified rams	Total rams	Ewes ^c	Lambs				Un-identified sheep
2002	85	264	0	349	466	187	1	654	1003	580 mi ²
2003	53	182	0	235	692	224	7	923	1158	580 mi ²
2004	65	153	0	218	593	186	0	779	997	580 mi ²
2006	56	179	1	236	580	207	27	814	1050	990 mi ²
2007	54	196	0	250	683	245	0	928	1178	990 mi ²
2008	66	202	18	286	716	245	0	961	1247	990 mi ²
2009	52	235	0	287	562	187	0	749	1036	990 mi ²
2010	64	319	12	395	833	250	0	1083	1478	990 mi ²

^a Full curl or larger.

^b Greater than 1/4 curl but less than full curl.

^c Ewe classification also includes yearlings of both sexes and rams of 1/4 curl or less.

^d The area surveyed 2002–2004 is included in the larger area surveyed 2006–2010.

Table 2. Tok Management Area sheep composition ratios from aerial surveys, 2002 through 2010.

Year	Legal rams: 100 ewes	Sublegal rams: 100 ewes	Total rams: 100 ewes	Lambs: 100 ewes	Lambs % of total
2002	18.2	56.6	74.9	40.1	18.7
2003	7.7	26.3	34	32.4	19.3
2004	11	25.8	36.8	31.4	18.7
2006	9.7	30.9	40.5	35.7	19.7
2007	7.9	28.7	36.6	35.9	20.8
2008	9.2	28.2	39.9	34.2	19.7
2009	9.3	41.8	51.2	33.3	18.1
2010	7.7	39.7	47.4	30	16.9

2002–2004 is included in the larger area surveyed 2006–2010.

Table 3. Tok Management Area harvest of Dall sheep rams, regulatory years 1990–1991 through 2009–2010.

Hunt no.	Regulatory year	Permits issued	% Did not hunt	% Unsuccessful hunter	% Successful hunter	\bar{x} Horn length	$n \geq 40''$ (%)	\bar{x} Age	Total harvest
DS102	1990–1991	120	28	56	44	37.0	6 (17)	9.2	36
and	1991–1992	120	23	44	56	36.9	9 (17)	8.9	52
DS103*	1992–1993	120	26	58	42	37.1	6 (16)	8.6	37
	1993–1994	120	13	58	42	37.3	6 (14)	9.0	44
	1994–1995	120	28	54	46	36.9	3 (8)	9.2	39
	1995–1996	120	18	39	61	37.2	8 (13)	9.4	60
	1996–1997	120	17	44	56	36.2	5 (9)	8.9	56
	1997–1998	120	20	57	43	36.5	3 (7)	8.9	41
	1998–1999	120	13	46	54	36.2	4 (7)	9.0	56
	1999–2000	120	13	60	40	36.3	4 (10)	9.5	42
	2000–2001	121	19	66	34	36.1	3 (9)	9.3	33
	2001–2002	121	17	66	34	35.4	3 (9)	8.7	34
	2002–2003	101	13	61	39	36.2	3 (9)	8.9	34
	2003–2004	101	10	48	52	35.6	4 (9)	8.7	46
	2004–2005	101	21	41	59	36.5	5 (11)	8.4	47
	2005–2006	101	16	47	53	36.1	4 (9)	8.6	45
	2006–2007	101	17	51	49	36.8	9 (22)	9.4	41
	2007–2008	101	13	54	46	35.6	3 (7)	8.7	41
	2008–2009	101	14	49	51	36.4	2 (5)	9.6	44
	2009–2010	101	16	50	50	35.7	2 (5)	9.2	42

*DS102 and DS103 in 2009–2010 only

Table 4. Tok Management Area sheep hunter residency and success, regulatory years 1990–1991 through 2009–2010.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident ^a	Nonlocal resident	Nonresident	Total (%)	Local resident ^a	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
2007–2008	0	31	9	40 (46)	0	45	2	47 (54)	87
2008–2009	2	32	10	44 (51)	0	41	1	42 (49)	86
2009–2010	0	31	11	42 (50)	1	41	0	42 (50)	84

^a 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 2009–2010.

Regulatory year	Percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	<i>n</i>
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
2007–2008	83	0	0	5	0	0	12	0	40
2008–2009	70	0	2	5	0	5	17	2	44
2009–2010	62	0	0	12	0	10	16	0	42

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

LOCATION

GAME MANAGEMENT UNIT: 13A, 13E, 14A (north), and 14B (14,849 mi²)

GEOGRAPHIC DESCRIPTION: Talkeetna Mountains and Chulitna–Watana Hills

BACKGROUND

The first large-scale sheep survey in the Talkeetna Mountains and the Chulitna–Watana Hills (TCW) was conducted in 1974. Although a final estimate of the total number of sheep was not specifically stated (McIlroy 1976), the population contained approximately 2,500–3,000 sheep in 1974, assuming 80% of the sheep were counted. Sheep densities have historically been highest in the count areas surrounding the Chickaloon River drainage. During the late 1980s the population estimate for TCW was approximately 2,500 sheep (Grauvogel 1990). Included in the estimate were approximately 200 sheep in the Sheep Mountain Closed Area, an area that has been closed to hunting since the 1940s. A harsh winter in 1999–2000 decreased the population to approximately 1,750 sheep (McDonough 2002). By 2003 the population had increased to approximately 2,000 sheep, but never returned to the population sizes observed prior to the 1999–2000 winter. Since 2003 the population has remained in the range of 1,500–2,000 sheep.

Sheep harvests in the TCW have been limited to adult rams, and harvest data have been collected from hunter harvest reports since 1967. Sheep harvests were initially managed under a ¾-curl or greater horn size regulation, and annual harvests averaged 90 rams from 1967–1978. In 1979 sheep hunting regulations were changed, and a legal ram was required to have a ⅞-curl or greater horn. Under the new regulation, sheep harvests averaged 87 rams annually from 1979–1988. In 1989 the horn size of a legal animal was changed again with the implementation of a full-curl or greater horn size regulation. Initially, annual harvests remained relatively unchanged, averaging 85 rams from 1990–1999, but decreased to an average of 56 rams in 2000–2009 (McDonough 2002) after the sheep population declined during the winter of 1999–2000. The reported harvests from the TCW reached a peak of 118 rams in 1969 and 1986. Since then, the highest reported harvest was 109 rams taken in 1995.

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 harvests were monitored through harvest reports. Hunters were required to report the duration of their hunt, the location of the hunt, methods they used, and information about harvested sheep. Mandatory sheep sealing began in regulatory year (RY) 2004 (RY04 = 1 July 2004 through 30 June 2005). Horns were measured, aged, and a permanent plug was affixed to one of the horns.

Summer sex and age composition surveys were also conducted in some count areas in the TCW.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The estimated population for sheep in TCW increased from 2,000–2,500 in 1994 (Masteller 1996) to 2,500–3,000 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 conducted between 2000 and 2003 suggested that the overall sheep population was beginning to recover from the decline, but surveys conducted during this reporting period indicate that the population size remains low (Table 1). Assuming 80% of the sheep are observed during surveys, the current population is approximately 1,562 sheep.

MORTALITY

Harvest

Season and Bag Limit. The hunting season in Units 13A, 13E, 14A and 14B for RY07–RY09 was 10 August–20 September. The bag limit was 1 ram with a full-curl or greater horn size.

Hunter Harvest. Hunter harvests were below management objectives during this reporting period with an average annual harvest of 50 rams during RY07–RY09 (Table 2). Harvests were similar to the last reporting period, which averaged 55 rams per year during RY04–RY06, but represent a decrease from the average of 82 rams during RY90–RY00.

The average horn size during RY07–RY09 (35.2 inches) was similar to the average during the previous reporting period (35.5 inches). The percentage of horns greater than 40 inches was 3.4% over the last 10 years (Table 2)

Hunter Residency and Success The total number of hunters has decreased slightly during the past 10 years (Table 3). The success rate during RY07–RY09 (14.3%) was similar to the previous reporting period (15.3%). Nonresidents continued to be more successful than residents. During RY07–RY09 nonresidents accounted for 11% of hunters but took 42.8% of the sheep (Table 3). This high success rate is attributed to fact that nonresidents are required to hunt with guides and because they use aircraft to access remote areas.

Harvest Chronology. During RY07–RY09 51% of the reported harvest was taken during the first week of the season and 69% during the first two weeks of the season (Table 4).

Transport Methods. The majority of successful hunters used aircraft or four-wheelers to access their hunting areas (Table 5).

CONCLUSIONS AND RECOMMENDATIONS

The sheep population size and harvests have been significantly lower than the previous decade, and harvests remain below the 75-rams-per-year objective. Population size and trend appear to be independent of the number of rams harvested in the TCW. Additionally, because the number of ewes and lambs, which are not part of the harvest, remains low, there is no indication that hunting is limiting the population. The same trend has been noted in the Chugach Range as well.

Periodic surveys of the TCW sheep population should be conducted in the count areas in Units 13 and 14 on a more consistent basis to adequately assess population trends. Surveys conducted on a 3-year basis in all count areas would provide a more meaningful measure of the population trend, which could be used to identify significant changes in population size and herd composition.

During the March 2007 Board of Game meeting sheep hunting opportunity in the Chugach Range was restricted by the adoption of a draw permit hunt structure. Sheep managers initially thought that this change would shift hunting pressure to the TCW and result in increased complaints of crowding in the TCW. To date these concerns have not been realized. In fact the total number of hunters in the TCW appears to have decreased slightly over the past decade.

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Table 1. Talkeetna Mountains and Chulitna-Watana Hills summer aerial sheep composition counts, calendar year 1999 through 2009

Calendar Year	Full Curl ^a	(%)	<Full Curl Rams	Ewes ^b	Lambs ^c	(%)	Sheep/ Hour	Total Sheep Observed
Boulder Creek								
1999	16	29%	39	286	90	21%	209.4	431
2000	5	10%	47	161	10	4%	121.6	223
2003	2	5%	40	148	53	22%	120.6	243
2007	6	21%	22	189	56	21%	109.2	273
2009	16	32%	34	182	67	22%	124.5	299
Chickaloon River – east								
1999	8	17%	38	157	63	24%	131.2	266
2003	13	32%	28	103	28	16%	84.7	172
2007	9	26%	25	106	38	21%	93.7	178
Hicks Creek								
1999	2	12%	15	112	46	26%	211.3	175
2003	0	0%	17	89	27	20%	130.0	133
2007	10	32%	21	61	24	21%	96.7	116
2008	8	32%	17	82	28	21%	122.7	135
2009	10	24%	32	80	28	19%	150	150
Caribou Creek								
1999	36	19%	152	409	142	19%	224.3	739
2000	29	27%	77	243	36	9%	147.8	385
2002	38	21%	146	242	97	19%	78.9	523
2003	40	31%	91	187	66	17%	55.3	384
2006	16	30%	38	134	72	28%	74.3	260
2007	16	29%	39	146	44	18%	72.1	245
2008	17	25%	51	141	56	21%	69.7	265
2009	16	31%	36	160	68	24%	75.7	280

Table 1. continued

Calendar Year	Full Curl ^a	(%)	<Full Curl Rams	Ewes ^b	Lambs ^c	(%)	Sheep/ Hour	Total Sheep Observed
Sheep Mountain								
1999	18	35%	33	36	14	14%	91.0	101
2003	11	19%	48	76	14	9%	40.0	149
2007	11	73%	4	32	13	22%	75.0	60
2008	12	71%	5	58	26	26%	101	101
2009	8	35%	15	46	11	14%	na	80
Watana Hills								
1999	2	8%	22	56	17	18%	44.1	97
2003	0	0%	10	33	7	14%	21.5	50
2008	1	6%	16	29	17		25.2	63
Little Susitna to King's River								
1999	7	19%	29	77	24	18%	32.6	137
2006	3	16%	16	23	9	18%	34	51
2009	0	0%	20	59	11	12%	22	90
King's River to west side Chickaloon River								
1999	5	8%	58	190	66	21%	76.0	319
2006	7	26%	20	96	31	20%	33.2	154
2009	3	14%	19	72	19	17%	18.8	113
Sheep River – Iron Creek								
1999	3	19%	13	25	8	16%	14.4	49

^a Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed. Percent full-curl is calculated as a proportion of total rams.

^b Ewes include yearlings of both sexes and rams of ¼ curl or less.

^c Percent lambs is calculated as a proportion of the total sheep observed.

Table 2. Talkeetna Mountains and Chulitna-Watana Hills sheep harvest, regulatory years 2000 through 2009.

Regulatory Year	Rams ^a	Average Horn Length (inches)	% \geq 40 in.	Ewes	Total sheep
2000	51	34.4	1.3	0	51
2001	41	34.2	0.0	0	41
2002	79	35.3	3.8	0	79
2003	74	35.3	2.6	0	74
2004	64	34.9	1.3	0	64
2005	59	35.4	5.2	0	59
2006	42	36.0	5.1	0	42
2007	61	35.8	4.8	1	62
2008	44	35.3	7.5	0	44
2009	46	34.4	2.2	0	46

^a Includes only rams for which horn length was reported.

Table 3. Talkeetna Mountains and Chulitna-Watana Hills sheep hunter residency and success, regulatory years 2000 through 2009.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Total (%)	
2000	11	12	28	51 (13)	170	135	25	330 (87)	381
2001	11	9	21	41 (13)	139	104	23	266 (87)	307
2002	26	24	29	79 (22)	151	106	27	284 (78)	363
2003	33	16	25	74 (21)	138	124	22	284 (79)	358
2004	24	12	28	64 (17)	153	130	20	303 (83)	367
2005	14	14	31	59 (16)	126	112	28	266 (84)	325
2006	16	8	18	42 (13)	151	102	24	277 (87)	319
2007	24	11	27	62 (18)	130	134	14	278 (82)	340
2008	13	9	15	37 (11)	131	139	18	288 (89)	325
2009	18	8	20	46 (14)	148	115	19	282 (86)	328

^a Local means residents of game management subunits 13A, 13E, 14A and 14B.

Table 4. Talkeetna Mountains and Chulitna-Watana Hills sheep harvest chronology percent by harvest period, regulatory years 2000 through 2009.

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	
2000	44	18	8	10	10	10	51
2001	46	10	17	15	7	5	41
2002	49	11	9	13	8	9	79
2003	54	18	15	7	5	0	74
2004	59	16	13	8	6	2	63
2005	41	22	17	10	3	7	59
2006	29	10	17	14	7	24	42
2007	52	17	12	17	2	2	60
2008	57	17	12	7	2	5	42
2009	43	22	9	11	9	7	46

Table 5. Talkeetna Mountains and Chulitna-Watana Hills sheep harvest percent by transport method, regulatory years 2000 through 2009.

Regulatory year	Percent of harvest							<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unknown	
2000	54	2	2	30	0	12	0	51
2001	51	10	0	34	0	2	2	41
2002	38	4	1	44	8	3	3	79
2003	47	4	0	45	0	4	0	74
2004	46	3	0	48	0	3	0	63
2005	66	2	0	22	0	10	0	59
2006	43	0	0	40	2	14	0	42
2007	51	2	0	36	2	10	2	62
2008	52	0	2	40	0	5	0	42
2009	58	0	0	38	0	4	2	46

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNIT: Portions of 13B, 20A, and 20D (1,680 mi²)

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 of populations, 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.

¹ 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, regulations initially prohibited use of motorized vehicles and pack animals for transporting hunters, hunting gear, or game 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. The 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 to 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 1,800 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 periodic 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., RY07 = 1 Jul 2007 through 30 Jun 2008).

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

The most recent sheep survey of the entire DCUA was in July 1995, when 1,285 sheep were observed and the population was estimated to be 1,673 (1,436–1,910) when a 1.3 sightability correction factor was applied (DuBois 1999).

R_Y07. Aerial surveys were flown 4–12 July 2007 for 10.9 hours of survey time in the DCUA west of the Jarvis Creek drainage. A total of 473 sheep were observed, including 98 lambs, 98 rams $\geq\frac{1}{2}$ curl (including 8 full-curl rams), and 277 other sheep (ewes and rams $<\frac{1}{2}$ curl) (Table 1).

Combining results from the R_Y06 (DuBois 2008) and R_Y07 surveys resulted in an estimate of 2,187 sheep in the entire DCUA for R_Y07–R_Y08, including 338 lambs, 525 rams $\geq\frac{1}{2}$ curl (including 91 full-curl rams), and 1,324 other sheep. Composition ratios were 26% lambs and 40% rams, and 17% of rams were full curl.

R_Y08. Aerial surveys were flown 3–13 July 2008 for 17.1 hours of survey time in the DCUA east of the Jarvis Creek drainage. A total of 1,258 sheep were observed including 223 lambs, 339 rams $\geq\frac{1}{2}$ curl (including 43 full-curl rams), 677 other sheep (ewes and rams $<\frac{1}{2}$ curl), and 9 unidentified sheep.

Combining results from the R_Y07 and R_Y08 surveys resulted in an observed estimate of 1,731 sheep for the complete DCUA. Applying a 1.3 sightability correction factor calculated from 1995 in a population estimate of 2,250 for R_Y07–R_Y08, which meets the population objective. Composition ratios from the combined observed data were 19% lambs and 25% rams $\geq\frac{1}{2}$ curl $<$ full curl, and 12% of rams were full curl.

R_Y09. Aerial surveys were flown 30 June–2 August 2009 for 11.8 hours of survey time in the DCUA west of Jarvis Creek. A total of 368 sheep were observed including 78 lambs, 81 rams $\geq\frac{1}{2}$ curl with 6 of those rams being full curl, and 209 other sheep (ewes and rams $<\frac{1}{2}$ curl).

Combined results from the R_Y08 and R_Y09 surveys for the complete DCUA resulted in an observed estimate of 1,626 sheep. Applying a 1.3 sightability correction factor calculated from 1995 resulted in a R_Y08–R_Y09 combined population estimate of 2,114, which meets the population objective. Composition ratios from the combined observed data were 19% lambs and 26% rams $\geq\frac{1}{2}$ curl, and 12% of rams were full curl.

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. There were no Board of Game actions or emergency orders pertaining to DCUA sheep during R_Y07–R_Y09. However, in 2004 the board adopted a statewide provision that required sealing of sheep horns in most areas, including the DCUA, by ADF&G personnel or by Alaska State Troopers.

Harvest by Hunters. DCUA combined harvest for hunts DS203 and DS204 met the harvest objective in RY07–RY09 (Table 2) and averaged 52 sheep/year.

Mean horn length for all sheep taken during RY07–RY09 was below the objective each year, ranging from 35.3 inches (RY07) to 35.0 inches (RY09; Table 2). Average horn length has been slowly declining in the last decade as combined DS203 and DS204 harvest has exceeded 50 sheep per year since RY01. If this trend continues it may be necessary to reduce harvest by reducing the number of permits issued, or the average horn length goal may need to be adjusted. The public should be consulted on these options if a change is necessary.

Mean age of all sheep taken in the DCUA met the management objective each year during RY07–RY09 ranging from 8.1 in RY07 to 8.6 years in RY08 (Table 2).

Permit Hunts. The number of drawing permit applicants for DS203 and DS204 continued to slowly increase to a high of 3,596 in RY07 for both hunts combined and declined slightly during RY08 and RY09 (Table 3). DS204 receives more applicants than DS203. DS203 averaged 1,521 applicants during RY07–RY09 compared to an average of 1,891 for DS204 (Table 3).

Hunter Residency and Success. Most DCUA hunters continued to be Alaska residents with an average of 13.3 (11%) nonresident hunters each year during RY07–RY09 (Table 4). Nonresidents continued to have a higher success rate of 63% for all hunts compared to 42% for resident hunters.

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 RY07–RY09. 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, 3- or 4-wheelers, and highway vehicles 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 2,443-foot Isabel Pass through the Alaska Range. Winter storms frequently bring high winds and warm temperatures so 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 RY07–RY09, but the horn length objective was not met. 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 possibly increase. However, this would decrease hunting opportunity. Because hunters have not complained about slightly smaller horn size, this objective will be monitored but no reduction in the number of permits will be considered at this time. The combined DCUA population estimates were met based on sightability corrected estimates.

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

MANAGEMENT GOAL

- Provide aesthetically pleasing hunting conditions.
- Maintain a harvestable population of Dall sheep fluctuating within historical limits of abundance and the carrying capacity of DCUA habitat.
- Maintain sheep abundance sufficient to allow for nonconsumptive uses.

MANAGEMENT OBJECTIVE

- Manage for a population of approximately 1,800 sheep.
- Manage for a mean annual harvest of 35 full-curl rams with a mean horn length of more than 36 inches.
- Manage for mean age of harvested rams 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 periodic questionnaire to hunters and quantify their satisfaction with aesthetics of Dall sheep hunting in the DCUA.

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Table 1. Aerial survey data for sheep seen in the Delta Controlled Use Area during 2007 through 2009.

Drainage	Lambs	Rams ≥1/2 curl <full curl	Full curl	Total rams	Others	Unk	Total	Survey minutes	Survey hours
<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
<i>2008</i>									
Johnson River	14	35	2	37	74	0	125	108	1.8
Spur Creek	35	68	5	73	110	5	223	166	2.7
Boulder Creek	22	18	2	85	42	1	85	85	1.4
Gerstle River	47	32	3	35	128	0	210	118	2.0
Granite Mountains–Bradford Creek	8	18	3	21	1	0	30	121	2.0
Southern McCumber, Morningstar	7	55	16	71	42	0	120	88	1.5
July Creek	25	33	5	38	113	0	176	159	2.7
Riley Creek	11	24	3	27	40	0	78	35	0.6
Pegmatite, Little Gerstle, Sheep Creek	30	0	0	0	58	0	88	54	0.9
Jarvis Creek	24	13	4	17	69	13	123	87	1.5
Subtotal	223	296	43	339	677	19	1,258	1021	17.1
<i>2009</i>									
Ruby–Trims Creek	36	14	0	14	95	0	145	253	4.2
Pillsbury–McGinnis Creek	18	40	4	44	26	0	88	98	1.6
Castner Glacier	0	3	0	3	0	0	3	75	1.2
Eel Glacier	0	0	0	0	0	0	0	44	0.7
Canwell Glacier	0	3	2	5	0	0	5	42	0.7
Augustana–S Black Rapids	0	0	0	0	0	0	0	43	0.7
N Black Rapids	18	13	0	13	59	0	90	141	2.4
Little Gold Creek	6	2	0	2	29	0	37	10	0.2
Subtotal	78	75	6	81	209	0	368	706	11.8

Table 2. Delta Controlled Use Area sheep harvest data by permit hunt, regulatory years 2000–2001 through 2009–2010.

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	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
	2008–2009	75	12	52	36	27	35.2	8.8	0
	2009–2010	75	23	47	31	23	35.7	8.1	4
DS204	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
	2008–2009	75	16	47	37	28	35.2	8.3	4
	2009–2010	75	31	31	39	28	34.5	8.3	7
Total for all permit hunts	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
	2008–2009	150	14	49	37	55	35.2	8.6	2
	2009–2010	150	27	39	35	51	35.0	8.2	6

Table 3. Number of applications received for Delta Controlled Use Area Hunts DS203 (restricted access) and DS204 (unrestricted access), regulatory years 1989–1990 through 2009–2010.

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
2008–2009	1514	1865	3379
2009–2010	1433	1828	3261

Table 4. Delta Controlled Use Area sheep hunter residency and success, regulatory years 2000–2011 through 2009–2010.

	Regulatory	Successful					Unsuccessful					Total
		Local ^a	Nonlocal				Local ^a	Nonlocal				
DS203	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
	2008–2009	1	24	2	0	27 (41)	3	31	5	0	39 (59)	66
	2009–2010	2	16	5	0	23 (40)	0	32	3	0	35 (60)	58
DS204	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
	2008–2009	3	19	6	0	28 (44)	6	28	1	0	35 (56)	63
	2009–2010	2	23	4	0	29 (57)	1	21	0	0	22 (43)	51
Total for all permit hunts	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
	2008–2009	4	43	8	0	55 (43)	9	59	6	0	74 (57)	129
	2009–2010	4	39	9	0	52 (48)	1	53	3	0	57 (52)	109

^a Local is a hunter who resides in Unit 20D.

Table 5. Delta Controlled Use Area sheep harvest chronology percent by month/day, regulatory years 2000–2001 through 2009–2010.

Hunt	Regulatory year	Harvest chronology percent by month/day							Unknown	n
		8/10–8/16	8/17–8/23	8/24–8/30	8/31–9/6	9/7–9/13	9/14–9/20			
DS203 ^a	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	
	2008–2009	70	30					0	27	
	2009–2010	61	35					4	23	
DS204 ^b	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	
	2008–2009			54	43	0	4	0	28	
	2009–2010			34	38	17	7	3	29	
Total for all Permit Hunts	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	
	2008–2009	35	13	29	22	0	2	0	55	
	2009–2010	27	15	19	21	10	4	2	52	

^a Season open from 10 August to 25 August.

^b Season open from 26 August to 20 September.

Table 6. Delta Controlled Use Area sheep harvest percent by transport method, regulatory years 2000–2001 through 2009–2010.

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	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 ^a	12	0	25
	2006–2007	14	0	10	0	0	0	67 ^a	10	0	21
	2007–2008	24	0	0	0	0	0	67 ^a	10	0	21
	2008–2009	19	0	11	0	0	4	52	15	0	27
	2009–2010	22	0	9	4	0	0	61	4	0	23
DS204	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	0	54	0	7	14	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
	2008–2009	19	0	11	0	0	4	52	15	0	27
	2009–2010	19	0	7	4	0	0	52	4	0	23
Total for all permit Hunts	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 ^a	7	4	54
	2005–2006	40	0	2	13	0	11	29 ^a	5	0	55
	2006–2007	18	0	4	37	0	6	33 ^a	4	0	49
	2007–2008	29	0	0	25	0	6	29 ^a	6	4	48
	2008–2009	35	0	5	16	0	9	27	7	0	55
	2009–2010	35	0	7	19	0	2	33	2	0	52

^a Transportation mode of “foot” is combined with “highway vehicle” on the assumption that hunters used a highway vehicle to get to the departure point.

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

LOCATION

GEOGRAPHIC DESCRIPTION: Chugach Mountains

GAME MANAGEMENT UNITS: 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 mi² 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). Current sheep populations in Unit 14C are twice as large as estimated in 1951.

Sport hunting was not considered to have had much influence on sheep populations in the early 20th century. However, the annual harvest reported to the U.S. Fish and Wildlife Service was 3–4 times higher in the mid 1940s compared to a decade earlier, increasing from about 200 per year to 600 per year (Scott et al. 1950). Beginning in 1942, the bag limit was reduced from 2 or 3 rams in various areas to 1 ram. Hunting pressure was heaviest near human settlements, and accessible ranges near Anchorage were closed to sheep hunting to protect sheep that otherwise might have been hunted to depletion (Scott et al. 1950). Hunting season was reopened in 1961, except for the Rainbow Closed Area, which extended along Turnagain Arm from Potter to Girdwood.

In 1968 the sheep habitat bounded by the Knik River, Turnagain Arm, Lake George, and the Twentymile River was established as the West Chugach Controlled Use Area. No motorized vehicles other than boats and airplanes were allowed for hunting or transporting game in this area during the sheep hunting season. In 1971 much of this area was incorporated into Chugach State Park, which continued to allow sheep hunting in most of the park, but prohibited all motorized access, except along the north side of Eklutna Lake. The bag limit for ¾-curl rams was further restricted to ⅞-curl rams in 1979. This regulation remained in effect for 10 years. Because of

increasing demand for sheep hunting in Unit 14C, a drawing permit was instituted in 1982 to maintain the number of large rams and 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 for some drawing hunts 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. However, current non-archery sheep permits are issued for full curl rams only and no ewe-only permits have been issued since regulatory year 2008 (RY08; a regulatory year runs from 1 July through 30 June; e.g., RY08 = 1 July 2008 through 30 June 2009).

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

Maintain a minimum harvest of 30 full-curl or larger rams throughout Unit 14C while maintaining aesthetically pleasing hunt conditions and avoid overcrowding of hunters in the field.

METHODS

Activities accomplished for regulatory years (RY) 2007–2009 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 2008 and 2010.

All rams harvested in Unit 14C are required to be sealed by an ADF&G technician or biologist. Horns were measured, age was noted, and a permanent plug was placed in one of the horns. Any ewes taken are aged and measured by ADF&G.

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 2,400 sheep in 1998 to a low of 904 sheep counted in 2009 (Table 1). The overall population decline during the reporting period has been primarily attributed to severe snow and ice conditions during several consecutive winters. The winters of 2003–04 and 2006–07 were characterized by deep snow and severe ice, respectively, which may have significantly impacted sheep survival. Since 2009, sheep numbers have been steadily increasing, with 1,099 sheep counted in the summer of 2010.

Population Composition

The percentage of full-curl and larger rams observed in Unit 14C has remained low during this reporting period (5–7%; Table 1). 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 was 13% in RY07 and 12% in RY09. 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 7,500 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 and Peters Creek drainages.

Little is known about winter distribution patterns, except that most sheep frequent relatively snow-free areas and windblown ridges above 3,000 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 until 2009, when the bag limit was changed to full curl ram 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 2008, the Board of Game allocated 13% of all rifle permits and 5% of all archery-only permits to nonresident sheep hunters. New permit hunts were created to accommodate both nonresident and resident hunters.

Hunter Harvest. Total harvests of sheep in Unit 14C for this reporting period were: 64 (2007–08), 25 (2008–09), and 24 (2009–10; Table 2). The number of hunters has ranged from 118–243 in Unit 14C during the reporting period (Table 3). 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 190 and 345 drawing permits, including 105–135 archery-only drawing permits, were issued annually in Unit 14C (Table 2). The number of permits issued was reduced to 190 in 2009–10. 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 2007 to 2009 ranged from 19% to 27%. Total annual harvest has declined since the beginning of the reporting period; however, this decline is, in part, a result of permit reduction (Table 3).

Hunter Residency and Success. During the reporting period, nonresident hunters took 46 sheep (40%) out of 115 harvested in Unit 14C (Table 3). Thirty-seven percent (42 of 115) 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 4).

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 2,200–2,600 during the mid 1990s and early 2000s, reaching a population high in 1998. Since 2002, sheep numbers in 14C declined until 2008, when the population reached 904 sheep. This decline has been attributed primarily to several severe winters; however, other variables undoubtedly impact the population as well. The most recent survey revealed a slight increase in sheep numbers. As a result of this recent decline and current population status, we have eliminated ewe hunt permits for RY09. 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.

Management activities in Unit 14C have been limited to aerial population surveys; no research has been conducted on sheep in this area of the Chugach. While we have speculated that declines in sheep numbers are related to inclement winter weather, actual health, and productivity of the population is unknown. To better manage the harvest objective of Unit 14C sheep, we recommend research to determine productivity and lamb survival rates.

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Table 1. Chugach Mountains, Unit 14C aerial sheep composition counts, 2005–2010.

Regulatory Year	Rams		Ewes ^a	Lambs (%)	Total sheep observed ^b
	≥ full curl (%)	<full curl			
2005–06 ^c					
2006–07 ^c					
2007–08	60 (7)	237	492	115 (13)	904
2008–09 ^c					
2009–10	56 (5)	309	600	134 (12)	1099

^a Includes yearlings of both sexes and rams of ¼ curl or less.

^b Total includes unclassified sheep.

^c No survey conducted.

Table 2. Chugach Mountains, Unit 14C sheep harvest data by permit hunt, 2005–2010.

Hunt Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters ^a	Percent successful hunters	Rams	Horn length (inches)	% Rams ≥ 40 in.	Ewes (%)	Unk	Total harvest
DS121-122, 124-129, 224-229 Northeast, East Eklutna	2005–06 ^a	22	32	87	13	2	38.7	50	0	0	2
	2006–07	22	45	67	33	4	37.9	0	0	0	4
	2007–08	22	14	63	37	6	37.5	17	1 (14)	0	7
	2008–09	18	6	92	8	0	--	--	1 (100)	0	1
	2009–10	12	42	71	29	2	36.6	0	0	0	2
DS111-112, 130-135, 230-235 Northwest, Upper Eagle River	2005–06	66	24	62	38	6	35.4	0	13 (68)	0	19
	2006–07	66	24	86	14	3	33.6	0	4 (57)	0	7
	2007–08	66	26	76	24	6	36.1	0	6 (50)	0	12
	2008–09	33	0	81	19	4	36.1	0	1 (20)	0	5
DS117-118, 136-138, 236-238 Southwest	2009–10 ^b	27	37	56	44	7	35.7	0	0	0	7
	2005–06	50	28	56	44	11	38.0	13	5 (31)	0	16
	2006–07	50	24	61	39	8	35.6	0	7 (47)	0	15
	2007–08	50	28	64	36	10	37.1	0	3 (23)	0	13
	2008–09	34	9	81	19	6	36.3	0	5 (39)	0	11
DS119-120, 139, 239 West (late season --rifle)	2009–10	24	21	74	26	5	34.8	0	0	0	5
	2005–06	70	26	75	25	11	36.5	11	2 (15)	0	13
	2006–07	70	19	75	23	11	36.6	10	2 (15)	0	13
	2007–08	70	23	67	43	15	35.9	0	8 (35)	0	23
2008–09	45	9	89	11	3	37.2	0	0	0	3	
2009–10 ^c	20	10	83	17	5	38.2	0	0	0	5	

Hunt Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters ^a	Percent successful hunters	Rams	Horn length (inches)	% Rams \geq 40 in.	Ewes (%)	Unk	Total harvest
DS140 240, West (late season --archery)	2005-06	100	34	89	9	5	33.6	0	1 (17)	0	6
	2006-07	100	55	93	7	2	35	0	1 (33)	0	3
	2007-08	100	43	93	7	4	21.7	0	0	0	4
	2008-09	81	40	96	4	2	30.8	0	0	0	2
	2009-10	80	43	91	9	4	30.2	0	0	0	4
DS141, 241 West Eklutna (archery)	2005-06	35	46	95	0	0	---	---	0	0	0
	2006-07	35	34	87	9	2	37.1	0	0	0	2
	2007-08	35	40	86	14	3	34.2	0	0	0	3
	2008-09	25	24	95	5	1	14.25	0	0	0	1
	2009-10	25	40	100	0	0	---	---	0	0	0
Governor's Permit	2005-06	1	0	100	0	0	---	---	0	0	0
	2006-07	1	0	0	100	1	41.8	100	0	0	1
	2007-08	1	0	0	100	1	41.5	100	0	0	1
	2008-09	1	0	0	100	1	39.9	0	0	0	1
	2009-10	1	0	0	100	1	37.3	0	0	0	1
DS123	2006-07	1	0	0	100	1	38.3	0	0	0	1
	2007-08	1	0	0	100	1	36.5	0	0	0	1
	2008-09	1	0	0	100	1	35.5	0	0	0	1
	2009-10	1	0	100	0	0	---	---	0	0	0
Total all hunt areas	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
	2007-08	345	30	72	28	46	35.2	4	18 (28)	0	64
	2008-09	248	30	84	24	18	34.6	0	7 (28)	0	25
	2009-10	190	35	82	18	24	35.0	0	0	0	24

^a Sum of percent successful and unsuccessful hunters may not equal 100% because some hunters fail to report.

^b No permits issued for DS111-112.

^c No permits issued for DS119-120.

Table 3. Chugach Mountains, Unit 14C sheep hunter residency and success, 2005–2010.

Regulatory Year	Successful				Unsuccessful				Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Total (%) ^b	Local ^a resident	Nonlocal resident	Nonresident	Total (%) ^b	
2005–06	43	8	5	56 (24)	150	26	6	182 (76)	238
2006–07	21	9	16	46 (20)	143	27	12	182 (80)	228
2007–08	22	17	27	66 (27)	99	66	12	177 (73)	243
2008–09	12	7	8	27 (23)	40	39	12	91 (77)	118
2009–10	8	3	11	22 (19)	52	45	12	109 (81)	131

^a Local means residents of Unit 14C.

^b Total may exceed sum because some hunters fail to report residency.

Table 4. Chugach Mountains, Unit 14C sheep harvest percent by transport method, 2005–2010.

Regulatory Year	Percent of harvest									<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Other	Unknown	
2005–06	9	5	0	4	0	0	48	34	0	56
2006–07	4	9	2	4	0	0	60	21	0	46
2007–08	9	10	7	4	0	1	70	3	0	66
2008–09	0	19	0	4	0	0	67	4	6	27
2009–10	0	9	5	5	0	0	54	18	9	22

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007

To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNIT: 20A (6,796 mi²)

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 to be 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 3,576 sheep in Unit 20A. McNay (1990) estimated 5,000 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 2,000 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 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.

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

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

- Manage for a Dall sheep population of approximately 5,000 sheep.
- Using a full-curl harvest strategy, maintain an average harvest of rams ≥ 8 years old.

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., RY09 = 1 July 2009 through 30 June 2010).

We conducted 2 aerial surveys during RY07–RY09 to monitor population status. We conducted the surveys on June 27 and 30, 2009 and June 18 and 19, 2010. 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). Data collected in Sections I–III is comparable to earlier surveys flown in the same area. All surveys were conducted from R-44 helicopters (Whitten and Eagan 1995). We flew contours of all sheep habitat within the survey sections during RY07–RY09. We classified sheep as lambs, yearlings, ewes, or rams and also classified rams according to horn size.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Composition

During RY07–RY09, we believe that Unit 20A sheep population was stable or increasing. Total sheep counted in our survey area rose from 496 sheep in RY02 to 882 sheep in RY10, a likely increase. No surveys were conducted during RY08, but 752 sheep were counted in RY07 and 743 in RY09 (Table 1).

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 ($\bar{x} = 41:100$; range 28:100–46:100) and yearling:ewe ratios ($\bar{x} = 27:100$; range = 22:100–31:100) also suggest a stable or increasing population during 2005–2010.

MORTALITY

Harvest

Seasons and Bag Limit. The sheep hunting season was open 10 August through 20 September throughout RY07–RY09. The bag limit was 1 ram with a full-curl or larger horn, with both horns broken (broomed), 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 RY07–RY09, and we issued no emergency orders. However, in 2004 the board adopted a statewide provision that required sealing of sheep horns in most units, including Unit 20A, by Alaska Department of Fish and Game (ADF&G) personnel.

Harvest by Hunters. Reported harvests increased from a 3-year average of 72 (range 51–85) rams during RY04–RY06 to 92 (range 86–97) rams during RY07–RY09 (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 harvested rams with ≥ 40 -inch horns over the past 9 years. The proportion of rams harvested with horns ≥ 40 inches long was 1.6% during RY98–RY00 compared to 4.8% (8 of 167) during RY01–RY03, 1.9% (4 of 216) during RY04–RY06 and 0.7% (2 of 278) during RY07–RY09. The average age of rams harvested during RY07–RY09 was 8.8 years.

Hunter Residency and Success. Success rates remained higher for nonresidents than for resident hunters (Table 3). During RY07–RY09, nonresident success was 72–75%, while Alaska resident success was 18–22%. Overall success rates were 36–41% during RY07–RY09.

Harvest Chronology. During RY07–RY09, 42–51% 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 during 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. Three- or 4- wheelers were the third most common method used by successful sheep hunters. (Table 5).

Natural Mortality

No unusual natural mortality was known to occur during RY07–RY09. We did not observe cases of *Pasteurella trehalosi* or *Arcanobacterium pyogenes* pathogens that caused mortality of Unit 20A sheep during 2004 (Young 2008).

HABITAT

Assessment

No significant human caused disturbance or destruction of sheep habitat occurred in Unit 20A during RY07–RY09. In 2009, a 409 km² forest fire occurred in the Totatlanika River canyon and on the north side of Rex Dome. This fire burned through some known sheep habitat and may have a short-term (1-2 years) negative effect on the sheep in that area. The benefits in the next 5 or more years (e.g., new forage growth and delaying shrub encroachment) are expected to outweigh the short-term habitat degradation.

CONCLUSIONS AND RECOMMENDATIONS

We met our goal of maintaining a Dall sheep population and its habitat with biological diversity in concert with other components of the ecosystem during RY07–RY09. However, we probably did not meet our population objective of 5,000 sheep. This population objective may be 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 expect harvests to remain below levels sustained in the mid to late 1980s (\bar{x} = 134 rams, 1984–1989). Conversely, we also expect harvests to remain above levels 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. No changes in seasons and bag limits are recommended unless a severe weather event precipitates a population decline. We met our objective of maintaining a average harvest of rams ≥ 8 years old using a full-curl harvest strategy. Restricting harvest to full-curl rams should continue to allow us to meet this objective and provides the greatest sustainable annual hunting opportunity and greatest sustainable annual harvest.

For the next report period the management goal and objectives will be:

Management Goal:

- Maintain a harvestable population of Dall sheep fluctuating within historical limits of abundance.

Management Objectives:

- Manage for a Dall sheep population of approximately 5,000 sheep.
- Provide the opportunity for hunters to harvest mature rams during a general hunting season.

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Table 1. Unit 20A sheep composition counts, calendar years 2001 through 2010.

Calendar year	Rams:100 ewes ^a	% Full-curl rams	Lambs:100 ewes ^a	Yearlings:100 ewes ^a	Total Sheep
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
2008 ^b					
2009	52	7	28	31	743
2010	51	14	46	22	882

^a Counts of ewes likely include some young rams.

^b No survey conducted

Table 2. Unit 20A sheep harvest, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Reported harvest	Total hunters	Percent success	\bar{x} Horn length (in) ^a
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
2007–2008	95	234	41	34.8
2008–2009	86	214	40	34.3
2009–2010	97	267	36	34.3

^a Includes broomed horns.

Table 3. Unit 20A sheep hunter residency and success, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Successful					Unsuccessful					Total hunters
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total	
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
2007–2008	21	12	62	0	95	69	46	24	0	139	234
2008–2009	16	13	57	0	86	62	46	19	1	128	214
2009–2010	13	17	65	2	97	79	62	25	4	170	267

^a Includes all of Unit 20.

Table 4. Unit 20A sheep harvest chronology percent by day-month, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Harvest chronology percent by period				Unknown	<i>n</i>
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep		
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
2007–2008	42	27	17	12	2	95
2008–2009	48	24	17	9	0	86
2009–2010	51	27	13	9	0	97

Table 5. Unit 20A sheep harvest percent by transport method, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Percent by transport method						Unknown	<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle		
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
2007–2008	39	26	1	25	3	3	2	95
2008–2009	53	17	2	17	3	6	0	86
2009–2010	48	28	1	16	0	4	2	97

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNIT: Portions of 20B, 20F, and 25C (534 mi²)
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 steadily increased beginning in 1980, and peaked in the late 1990s and early 2000s (Seaton 2008).

Survey data indicate this sheep population increased from the 1980s to 2000s (Seaton 2008). From the 1950s through the 1980s, surveys were infrequent, but have increased in frequency during the 1990s and 2000s (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.

During surveys, the number of rams classified as legal to harvest during hunting season generally decreased from 1970 to 1995, 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.

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. 1990). Sheep in the White Mountains were found in small, widely scattered groups throughout approximately 534 mi² of alpine habitat in the vicinity of Victoria Mountain, Mount Schwatka,

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

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 during summer in 2007 and 2008 to estimate population size and composition. Observers classified sheep as lambs, ewes, sublegal rams and legal rams. 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. The 2007 survey included Big Bend to Windy Gap, Windy Gap to Willow Creek, Cache Mountain, Lime Peak, Mount Prindle, Mount Schwatka and Victoria Mountain. In 2008 surveys were attempted in the same area, but poor weather prevented surveys in the Windy Gap to Willow Creek and Lime Peak areas. In 2009 surveys were not conducted because of poor weather. 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., RY09 = 1 July 2009 through 30 June 2010).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The estimated population during RY07–RY09 was 435 sheep. We based this estimate on the 2007 survey, since the 2008 survey was not complete and no survey was conducted in 2009. This

population estimate is similar to estimates since the 1990s, except in 1999 when we observed more than 700 sheep. During the 2007 survey observers counted 379 sheep (Table 1). We counted 366 sheep in 2008, but the survey did not include the Windy Gap to Willow Creek area and Lime Peak. In past surveys 100 to 200 sheep were observed in these areas; therefore we assume the population in 2008 was similar to the 2007 estimate.

Population Composition

The mean ratio of lambs:ewes was 26:100 during 1970–2006. This ratio was higher during 2007 (44:100) and 2008 (34:100) (Table 1). The percentage of legal rams in the population has ranged 3–7% since the 1970s. In 2007, 4.2% of the total sheep counted were legal rams. In 2008, 5.7% were legal. 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 that could not be distinguished from ewes.

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 RY07–RY09. 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 RY07–RY09. In 2004 the board adopted a statewide provision that required hunters to allow ADF&G personnel or Alaska Wildlife Troopers to seal horns of sheep taken in areas with full-curl regulations, including the White Mountains.

Harvest by Hunters. The reported annual harvest during RY07–RY09 ranged 4–16 ($\bar{x} = 10$) (Table 3). The long-term (RY00–RY09) average annual harvest was also 10 sheep. The harvest of only 4 rams in RY09 was the lowest harvest in the last 10 years, possibly the result of smoke from forest fires in the area, which may have impeded hunters. Since RY99, each year of high harvest (10–6 rams) has been followed by a year of low harvest (4–9 rams), except that RY03 and RY04 (19 and 10 rams, respectively) were both years of high harvest. It is possible that this observation is a result of a small sample size. The consistent percentage of legal rams observed during surveys since the 1970s indicates that the current harvest level will likely not result in overharvest.

The average length of horns from sheep harvested during RY07–RY09 was 32.5 inches (Table 4). This is slightly smaller than the average of 33.3 inches during RY00–RY06. The average length of sheep horns in the White Mountains is generally smaller than other areas of the state because a high percentage of them are broomed or broken. It is also common for rams in the White Mountains to severely broom their horns past the 5th or 6th annuli. Total horn length for these rams is commonly 12 to 16 inches. Average age of rams harvested during RY07–RY09 was 9.3 years, slightly older than the RY00–RY06 average of 9.1 years.

Hunter Residency and Success. Most sheep hunters in the White Mountains were Alaska residents (Table 3). The average success rate of all hunters during RY07–RY09 was 16% compared to 22% during RY00–RY06. In RY07–RY09, successful hunters spent an average of 4 days afield and unsuccessful hunters spent 5 days (Table 5). Total number of hunters increased during RY07 and RY08 to 61 and 75, respectively. In RY09, 51 hunters reported sheep hunting in the White Mountains. This is an increase compared to the annual average of 48 hunters during RY00–RY06. The increased hunting pressure did not increase harvest, but did result in a lower success rate.

Harvest Chronology. During RY07 and RY08, 44% of the sheep harvest occurred during the first 10 days of the season; similar to most other areas in Alaska. During RY09, 100% of the harvest occurred during the first 10 days, but harvest was low (Table 6).

Transport Methods. Aircraft access was at a few small airstrips in the mountains, gravel bars along creeks, and on small lakes. 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

< 1,500 lb were allowed in most of the area between the Steese Highway and Mount Prindle, which provided some motorized access to sheep habitat.

During RY07–RY09, 69% of successful hunters who reported their method of transport 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. Because of ORV restrictions by BLM on most of the trails that access the White Mountains, it is difficult for hunters to access the majority of the sheep with ORVs. Some of this difference in success per mode of transport may also 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 or moose 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. Black and grizzly bears are commonly seen during surveys in the area. 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.

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. For recreational purposes, BLM maintains several trailheads and the 18-mile Nome Creek Road, which links the Steese Highway with 2 campgrounds.

CONCLUSIONS AND RECOMMENDATIONS

Our goal to provide opportunity to hunt sheep in the White Mountains under aesthetically pleasing conditions was met. 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 430–530 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 in sheep habitat (Durtsche et al. 1990). We will continue to work closely with BLM and other stakeholders on these issues.

For the next report period, our management goal will be:

- Maintain a harvestable population of Dall sheep.

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Table 1. White Mountains aerial sheep composition counts, 1970–2008.

Date	Rams			Rams: 100 ewes	Ewes ^c	Lambs	Lambs:100 ewes	Total sheep ^b	Count time (hr)
	Legal ^a	Sublegal	Total ^b						
28 Aug 1970	19	25	44	26	171	70	41	285	5.9
5–8 Aug 1977	13	25	38	58	66	20	30	124	6.5
29 Jun–3 Jul 1982	15	30	45	58	77	10	13	132	9.6
17–29 Jun 1986	17	42	59	45	132	49	37	240	14.6
4–10 Aug 1989	6	50	56	42	132	31	23	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 ^d	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	– ^e
5 Aug 1997 ^f	10	88	98	37	266	53	20	417	12.1
1–3 Aug 1999 ^g	26	125	151	37	406	160	39	717	13.1
5–7 Aug 2000 ^g	24	121	145	38	381	41	11	567	13.1
19 Jul 2002 ^g	25	125	150	57	262	73	28	485	– ^e
Jul–Aug 2003 ^g	21	70	91	29	318	99	31	508	10.9
3–5 Aug 2004 ^g	19	107	126	48	262	55	21	443	14.3
1–4 Aug 2005 ^g	25	107	132	42	317	64	20	513	14.9
2–5 Aug 2006 ^g	21	102	123	38	321	39	12	483	13.2
26–28 July 2007 ^g	16	55	71	31	229	79	34	379	– ^e
23–25 July 2008 ^h	21	22	43	19	224	99	44	366	– ^e

^a 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.

^b Total numbers may include sheep that were not classified.

^c Ewes includes unclassified young rams and yearlings of both sexes.

^d Numbers include sheep observed during the 12–13 July 1994 ground survey of Mount Prindle, which was not surveyed in August due to severe turbulence.

^e Total count time could not be calculated from data sheets.

^f Victoria Mountain was not surveyed in 1997 (47 sheep were counted in this area in 1996).

^g Big Bend to Windy Gap, Windy Gap to Willow Creek, Cake Mountain, Lime Peak, Mount Prindle, Mount Schwatka, and Victoria Mountain.

^h Windy Gap to Willow Creek and Lime Peak not included in survey.

Table 2. White Mountains sheep seasons and bag limits, regulatory years 1983–1984 through 2009–2010.

Regulatory year	Season	Bag limit	Legal horn size ^a	
			Portion in Unit 20	Portion in Unit 25
1983–1984	10 Aug–20 Sep	1 ram	$\frac{7}{8}$ -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 2009–2010	10 Aug–20 Sep	1 ram	Full-curl horn or larger	Full-curl horn or larger

^a 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 2000–2001 through 2009–2010.

Regulatory year	Successful hunters				Unsuccessful hunters				Total	
	Resident	Nonresident	Unspecified	Total	Resident	Nonresident	Unspecified	Total	Hunters	% Success
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
2007–2008	8	1	0	9	51	1	0	52	61	15
2008–2009	16	0	0	16	59	0	0	59	75	21
2009–2010	4	0	0	4	46	1	0	47	51	8

Table 4. White Mountains sheep harvest characteristics, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Average horn			
	Age (yr)	Broomed (%)	Length (in)	Base (in)
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
2007–2008	8.7	44	31.3	13.2
2008–2009	10.4	44	31.8	13.4
2009–2010	9.0	0	34.5	13.6

Table 5. White Mountains sheep hunter effort^a, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Successful		Unsuccessful		Total hunters
	Hunters	\bar{x} days	Hunters	\bar{x} days	
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
2007–2008	9	4	52	5	61
2008–2009	16	4	59	5	75
2009–2010	4	4	47	6	51

^a 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 2000–2001 through 2009–2010.

Regulatory year	Harvest chronology by day-month			
	10–20 Aug	21–31 Aug	1–10 Sep	11–20 Sep
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
2007–2008	4	3	1	1
2008–2009	7	5	1	3
2009–2010	4	0	0	0

Table 7. White Mountains sheep hunter success by transport method, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Number of Hunters by Transport method				
	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other\Unknown
<u>Successful hunters</u>					
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
2007–2008	5	1	1	1	1
2008–2009	11	4	1	1	1
2009–2010	4	0	0	0	0
<u>Unsuccessful hunters</u>					
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
2007–2008	5	26	2	10	9
2008–2009	13	32	2	7	5
2009–2010	12	24	3	5	3

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2009¹

LOCATION

GAME MANAGEMENT UNIT: Portions of Units 20B, 20D, and 20E (1,641 mi²)

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.

MANAGEMENT OBJECTIVES

- Maintain a full-curl harvest strategy of rams averaging ≥ 8 year old.
- Limit hunters in the Tanana Hills to fewer than 50.

¹ 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 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 Unit 20D and Unit 20E portion of the Mount Harper complex and limiting access into the Glacier Mountain area under a controlled-use regulation. 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., RY08 = 1 July 2008 through 30 June 2009).

I surveyed the Mt. Harper–Upper Goodpaster River area in a Piper PA-18 Super Cub. This area consisted of two main survey areas in the hills along the boundary of Units 20B, 20D, and 20E. Along the Unit 20D and 20E boundary, the survey area included Mt. Harper and sheep habitat in the upper drainages of the Healy River, Boulder Creek, and the Eisenmenger Fork of the Goodpaster River. Along the Unit 20B and 20D boundary the survey area in Unit 20D included sheep habitat in the upper drainages of the Goodpaster River, Slate Creek, and Glacier Creek. In Unit 20B the survey area included sheep habitat in the upper Charley River, Stone Boy Creek, Porcupine Creek, and Upper and Lower Boulder Creek.

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 with full-curl rams identified when possible, and others which included ewes and rams $< \frac{1}{2}$ curl.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Composition

Mount Harper–upper Goodpaster River. In July 2007 we flew a population estimation and composition survey in the Mount Harper–upper Goodpaster River. Portions of the 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: 20 rams (including 9 with full curl horns), 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).

In 2008, the Mt. Harper–upper Goodpaster River area was surveyed on 2 July 2008. Survey time totaled 7.0 hrs. One hundred sheep were seen: 46 rams (including 9 with full curl horns), 14 lambs, and 40 ewe-like sheep. Resulting composition ratios were 115 rams:100 ewe-like sheep and 35 lambs:100 ewe-like sheep (Table 1).

In 2009, the Mt. Harper–upper Goodpaster River area was surveyed on 24 June 2009. Survey time totaled 8.7 hrs. One hundred eight sheep were seen: (37 rams (including 6 with full curl horns), 17 lambs, and 50 ewe-like sheep. Resulting composition ratios were 74 rams:100 ewe-like sheep and 34 lambs:100 ewe-like sheep (Table 1).

Glacier Mountain. No surveys were flown during RY07–RY09.

Distribution and Movements

No sheep movement data were collected during RY07–RY09.

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 DS206 hunt area defined as that portion of Units 20D and 20E north of the Alaska Highway and north and west of the north bank of the Middle Fork of the Fortymile River upstream from and including the Joseph Creek drainage. A harvest ticket was required for the remainder of Unit 20E and 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. No action was taken by the Alaska Board of Game and no emergency orders were issued during RY07–RY09. In 2004 the Board of Game adopted a statewide provision that required sealing by ADF&G personnel of sheep horns taken in areas with full-curl regulations, including the Tanana Hills.

Harvest by Hunters. Hunter harvest was analyzed for the Mount Harper DS206 drawing permit hunt separately. All other harvest classified as Tanana Hills is from Unit 20E.

Mount Harper — During RY07–RY09, harvest was low, with only 1 sheep killed in RY09 (Table 2). Horn size and age for the sheep killed in RY09 was 42.0 inches and 13 years old (Table 2), which met the harvest objective.

Tanana Hills — During RY07–RY09, Tanana Hills sheep harvest averaged 5 sheep/year (range 0–7; Table 3). Average horn length was 37.7 inches. Average age of sheep harvested was 10.1 years (Table 3), which met the harvest objective.

Hunter Residency and Success. *Mount Harper* — Most hunters in the Mount Harper DS206 drawing permit hunt continue to be nonlocal residents. No nonresidents reported hunting in this area during RY07–RY09 (Table 4).

Tanana Hills — Most hunters in the Tanana Hills continued to be Alaska residents. Two nonresidents reported hunting in this area during RY07–RY09 (Table 5).

Harvest Chronology. *Mount Harper* — The only sheep killed in the Mount Harper DS206 drawing permit hunt during RY07–RY09 was killed during the first 5 days of the hunting season (Table 6).

Tanana Hills — Harvest during RY07–RY09 was concentrated in the first 5 days of the hunting season (Table 6).

Transport Methods. Except for the Glacier Mountain CUA where motorized access is prohibited and the lower Charley River where other access methods are possible, terrain features and landownership restrictions limit sheep hunters to using aircraft to access sheep habitat.

Mount Harper — The single ram taken in DS206 during RY07–RY09 was taken by a hunter using aircraft for access (Table 7).

Tanana Hills — Most sheep taken in the Tanana Hills outside of the DS206 hunt area were taken by hunters using aircraft for transportation, although a variety of transportation methods were used (Table 7).

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 direction is recommended at this time. However, to better represent the intent of the management program, management goals and objectives will be as follows for the next reporting period:

MANAGEMENT GOALS

- Maintain a harvestable population of Dall sheep fluctuating within historical levels of abundance and the carrying capacity of their habitat.

MANAGEMENT OBJECTIVE

- Provide opportunity for up to 50 hunters to harvest mature rams.

Related Management Activity

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

The Tanana Hills sheep population tends to be widely dispersed, often below tree line. The area has few trails or suitable aircraft 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.

Most of the Mt. Harper–upper Goodpaster River area within Units 20B, 20D and 20E is within drawing permit hunt DS206. However, it is also possible to hunt this small population of sheep in the Unit 20B portion of the Mt. Harper–upper Goodpaster River area without having a drawing permit. To better manage this population, a regulation proposal should be submitted to make hunting in Unit 20B within the Mt. Harper–upper Goodpaster River part of the DS206 drawing permit hunt. Thus all sheep in this population would be hunted by drawing permit.

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Table 1. Mount Harper–upper Goodpaster River Dall sheep composition counts from aerial surveys, 2003–2009.

Sex/age class	2003	2004	2005	2007	2008	2009
Legal rams ^a	10	8	5	9	9	6
Sublegal rams ^b	29	16	8	11	37	31
Unclassified rams	0	0	0	0	0	0
Total rams	39	24	13	20	46	37
Ewes ^c	35	32	27	67	40	50
Lambs	4	12	9	21	14	17
Yearlings	0	0	0	0	0	0
Unidentified	0	0	0	0	0	4
Total other sheep	39	44	36	88	54	71
Total sheep	78	68	49	108	100	108
Legal rams:100 ewes	29	25	19	13	23	12
Sublegal rams:100 ewes	83	50	30	16	93	62
Total rams:100 ewes	111	75	48	30	115	74
Lambs:100 ewes	11	38	33	31	35	34
% Lamb	5	18	18	19	14	16

^a Full curl or larger.

^b Greater than 1/2 curl but less than full curl.

^c Ewe classification also includes yearlings of both sexes and rams of ½ curl or less.

Table 2. Mount Harper DS206 drawing permit sheep harvest, regulatory years 1990–1991 through 2009–2010.

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
2008–2009	4	3	1	0			0
2009–2010	4	2	1	1	42.0	13	1

Table 3. Tanana Hills sheep harvest, regulatory years 1990–1991 through 2009–2010.

Regulatory year	Rams	\bar{x} Horn length	\bar{x} Age	Ewes	Total sheep
1990–1991 ^a	1	36.0	11.0	0	1
1991–1992 ^a	3	33.7	8.3	0	3
1992–1993 ^a	1	33.0	10.0	0	1
1993–1994 ^b	5	34.0	8.8	0	5
1994–1995 ^b	3	33.7	8.0	0	3
1995–1996 ^b	8	36.3	9.1	0	8
1996–1997 ^b	5	35.0	9.4	0	5
1997–1998 ^b	9	35.3	10.5	0	9
1998–1999 ^b	5	35.6	10.0	0	5
1999–2000 ^b	10	36.9	10.8	0	10
2000–2001 ^b	5	37.4	9.8	0	5
2001–2002 ^b	7	37.3	10.2	0	7
2002–2003 ^b	8	30.7	8.9	0	8
2003–2004 ^b	10	34.8	9.6	0	10
2004–2005 ^b	3	35.5	9.0	0	3
2005–2006 ^b	8	35.7	9.8	0	8
2006–2007 ^b	2	37.3	9.5	0	2
2007–2008 ^b	7	37.1	10.0	0	7
2008–2009 ^b	3	39.0	10.3	0	3
2009–2010 ^b	0			0	0

^a Includes the Glacier Mountain Controlled Use Area only.

^b 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 4. Tanana Hills, drawing permit hunt DS206 (Mount Harper) sheep hunter residency and success, regulatory years 1993–1994 through 2009–2010.

Regulatory year	Successful				Unsuccessful				Total hunters
	Local resident ^a	Nonlocal resident	Nonresident	Total (%)	Local resident ^b	Nonlocal resident	Nonresident	Total (%)	
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
2008–2009	0	0	0	0 (0)	0	1	0	1 (100)	1
2009–2010	0	1	0	1 (50)	0	1	0	1 (50)	2

^a Residents of Unit 20D.

Table 5. Tanana Hills, Unit 20E outside of DS206, sheep hunter residency and success^a, regulatory years 1993–1994 through 2009–2010.

Regulatory year	Successful				Unsuccessful			Total hunters	
	Local resident ^b	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Non-resident		
2005–2006	0	8	0	8 (73)	0	3	0	3 (27)	11
2006–2007	0	3	0	3 (21)	0	13	0	11 (78)	14
2007–2008	0	7	0	7 (47)	0	8	0	8 (53)	15
2008–2009	0	3	0	3 (23)	0	10	0	10 (77)	13
2009–2010	0	0	0	0 (0)	0	11	2	13 (100)	13

^a Excludes hunters in permit hunts.

^b Residents of Unit 20E.

Table 6. Tanana Hills area sheep harvest chronology percent by month/day, regulatory years 2005–2006 through 2009–2010.

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	
DS206	2005–2006	100	0	0	0	0	0	0	2
	2006–2007	100	0	0	0	0	0	0	2
	2007–2008	0	0	0	0	0	0	0	0
	2008–2009	0	0	0	0	0	0	0	0
	2009–2010	100	0	0	0	0	0	0	1
Tanana Hills	2005–2006	25	0	0	25	50	0	0	8
	2006–2007	33	67	0	0	0	0	0	3
	2007–2008	29	0	14	43	14	0	0	7
	2008–2009	67	0	33	0	0	0	0	3
	2009–2010	0	0	0	0	0	0	0	0

Table 7. Tanana Hills area sheep percent harvest by transport method, regulatory years 2005–2006 through 2009–2010.

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
DS206	2005–2006	100	0	0	0	0	0	0	0	0	2
	2006–2007	100	0	0	0	0	0	0	0	0	2
	2007–2008	0	0	0	0	0	0	0	0	0	0
	2008–2009	0	0	0	0	0	0	0	0	0	0
	2009–2010	100	0	0	0	0	0	0	0	0	1
Tanana Hills	2005–2006	88	0	0	0	0	0	0	0	13	8
	2006–2007	67	0	0	0	0	0	33	0	0	3
	2007–2008	14	29	14	0	0	0	29	0	14	7
	2008–2009	100	0	0	0	0	0	0	0	0	3
	2009–2010	0	0	0	0	0	0	0	0	0	0

SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010

LOCATION

GAME MANAGEMENT UNITS: 23 (44,000 mi²) and 26A (53,000 mi²)

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 1991). For many years, Alaska resident and nonresident hunters living outside Unit 23 also hunted sheep 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 more abundant habitat and 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 >350,000 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. Additionally, the presence or absence of overwintering caribou in proximity to sheep habitat may influence predation. (Murie 1944; Jim Dau, ADF&G, Kotzebue, personal communication)

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 general 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 ewe-likes in areas receiving significant hunt pressure.

Units 23 and 26A

- Monitor sheep in cooperation with the National Park Service (NPS) within each area at least once within each 3-year reporting period for changes in population status.
- 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 2008 (although weather prevented survey completion) and 2009. 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-likes includes female sheep and males with ewe-like horns (1- to 2-year-old rams); “small ram” includes rams < $\frac{7}{8}$ curl; and “large ram” includes 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 mi²) 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 2004–2007 represent varying levels of incomplete survey coverage (sometimes approximately 50%),

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, most likely due to 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

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 ($\geq 7/8$ curl rams) and 11% (range 6–13%) of all rams annually from the Baird Mountains. During this time, the ram:ewe-likes ratio declined from 35 to 23 rams:100 ewe-likes and the ratio of large rams declined from 11 to 7 rams:100 “ewe-likes”. In 1991, the year seasons were closed, ram: ewe-like ratios roughly doubled to 45 rams:100 ewe-likes and 15 large rams:100 ewe-likes. The season remained closed until 1995, when limited hunting was allowed as administered by the NPS. From 1995–1999, the average rams:100 ewe-likes was 42 and average large rams:100 ewe-likes was 21. From 2000 through 2002, the last year until 2009 with complete survey data, the average ram:100 ewe-likes was 37 and average large rams:100 ewe-likes was 14. In 2009, 36 rams:100 ewe-likes were observed and 7 large rams:100 ewe-likes were observed (Fig. 1).

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.

MORTALITY

Harvest

State Seasons and Bag Limits

Seasons and bag limits in Units 23 and 26A were the same for each regulatory year in the reporting period (July 2007 through June 2010). A regulatory year (RY) begins 1 July and ends 30 June (e.g., RY 2007 = 1 July 2007–30 June 2008).

<u>RY 2007, RY 2008,</u> <u>RY 2009</u> Bag Limit	Hunt Type*	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
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; (RS388; quota is 5 sheep)	R	10 Aug–30 Apr (Subsistence hunt only)	
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 26(A), west of the Etivluk River (DS384)	D	10 Aug–20 Sep	10 Aug–20 Sep
Unit 23, that portion south of Rabbit Creek, Kyak Creek and the Noatak River and west of the Cutler and Redstone Rivers (“Baird Mountains”)			
Resident hunters:		No open season (Federal subsistence permit has season 10 Aug–30 Apr)	
All hunters: 1 ram with full-curl horn or larger by drawing permit only provided that the harvestable surplus is >47 sheep	D	10 Aug–20 Sep	10 Aug–20 Sep

<u>RY 2007, RY 2008,</u> <u>RY 2009</u> Bag Limit	Hunt Type*	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Seasons
Remainder of Unit 23 ("Schwatka Mountains")			
Resident hunters: 3 sheep by registration permit only (RS389)	R	1 Aug–30 Apr	
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 ("De Long Mountains")			
Resident hunters: 1 sheep by registration permit only (RS388; quota is 5 sheep)	R	10 Aug–30 Apr (Subsistence hunt only)	
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 excluding Gates of the Arctic National Park			
Resident hunters: 3 sheep by registration permit only (RS389)	R	1 Aug–30 Apr	

<u>RY 2007, RY 2008,</u> <u>RY 2009</u> 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

* 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 ongoing 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 ≥ 20 sheep:

1. The NPS will issue federal registration permits where federal harvest can be divided between fall and spring hunts. Federal permits will 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 will be valid within the Noatak National Preserve, and the bag limit will be 1 full-curl ram. The department will also issue registration permits under hunt RS388. Registration permits will be valid within the Noatak National Preserve and the bag limit will 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 report data, sheep harvest report data likely are incomplete for hunters who reside within Units 23 and 26A. This is most problematic for the Baird Mountains, where most unit residents hunt sheep. Because many communities do not have access to sheep, there are less community survey data to consider. Additionally, not all

community surveys ask about sheep harvest. In one of the two communities for which data exist, the survey harvest estimate is more than twice as high as the harvest data reports. However, sheep harvests by village residents seem to have declined. In the early 1990s, the estimated harvest of sheep by residents of Noatak was 10–30 sheep (Georgette and Loon 1991). A more recent household survey found that 5 sheep were taken (Magdanz et. al, 2010). Seasonal sheep hunting camps that were previously used by residents of Noatak have been abandoned for decades (Jim Dau, ADF&G Kotzebue, personal communication). The sheep closures in the early 1990s may have caused village hunters to be less familiar with sheep hunting traditions and less comfortable navigating a more complicated regulatory framework instituted when sheep hunting resumed. Additionally, a decrease in trapping activity (resulting in less opportunistic sheep harvest) and the presence and abundance of caribou may have led to less harvest pressure on sheep (Georgette and Loon 1991.)

Henceforth, the source of harvest data will be the Winfonet online database for hunt reports. Although most hunts in Unit 23 have “any sheep” bag limits, only 12 ewes have been reported as harvested since 1990 (less than 5% of the total harvest). However, the number of ewes may be underestimated due to the low reporting rate for residents of Unit 23. 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 a gradual decrease in annual mean horn length from 35.78 inches in 2006 to 32.54 inches in 2009. However, sample sizes are small (4–10 sheep) and observed standard deviation ranges from 17.9 inches (in RY 2006) to 37.7 inches (in RY 2008.) Age data show a parallel trend in mean annual sheep age with a mean age of 11.3 years in 2006 (N=4) and a mean age of 8.0 years in 2009 (N=6) and standard deviation between 0.4 and 1.6. With such small sample sizes the similar patterns and trends may be simply coincidental rather than reflective of trends in the population.

Permit Hunts. As previously mentioned, all harvest in the Baird Mountains takes place by federally qualified subsistence users with a federal permit, FS023. In the De Long Mountains, most harvest is from the drawing hunt DS384 (11 permits issued annually.) In most years, nonlocal Alaskans comprise the majority of successful applicants. The registration hunt open to Alaskans that acquire the permit (RS388) has been used to take less than 3 sheep in each year (Fig. 1).

Hunter Residency and Success. 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. 2), predominantly by residents of Unit 23 and nonlocal Alaska residents (Fig. 3). Now, the harvest in the Baird Mountains is 100% Unit 23 residents and the hunt is administered to only federally qualified subsistence users. In contrast, the harvest in the De Long Mountains is by a mixture of nonresidents, nonlocal Alaska residents, and Unit 23 residents (Fig. 4). Annual nonresident success rates since 2004 have been 75–100%. Annual nonlocal Alaskans and Unit 23 resident success rates are much more variable (31–100%.)

Chronology. In most years, the majority of the harvest occurs in the Fall (August and September.) However, in some years the harvest of sheep by Unit 23 residents in the Spring (March and April) can be substantial (30–75% of the harvest by Unit 23 residents). Overall, the most popular month of harvest is August.

Transportation. The majority of sheep harvested in both the De Long and Baird Mountains is by hunters using aircraft (82% and 55% respectively). The second most prevalent transportation means for taking a sheep in both areas is a snowmachine (13% in the De Longs and 30% in the Bairds.) Sheep are occasionally taken by boat but very rarely by other means.

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, 2006, 2008, and 2009, as it will 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, 1989–2009.

Sex/Age class	Year																		
	89	90	91	92	93	94	95	96	97	98	99	00	01	02	04 ^{ab}	05 ^b	06 ^b	07 ^b	09 ^a
Rams 1/2+	162	105	108	130	123	93	90	75	114	116	86	107	145	157	123	149	60	64	175
Rams 7/8+	51	32	35	42	37	41	23	56	72	70	28	25	50	79	51	29	13	14	36
Ewe-likes ^c	574	466	239	267	256	204	166	169	314	289	243	317	389	381	343	307	223	306	481
Lambs	170	133	17	59	47	20	95	58	83	72	77	101	73	118	91	55	55	110	157
Unknown	75	14	36	0	0	0	0	0	0	0	0	0	9	26	41	0	0	0	10
Total Sheep ^d	981	718	400	456	426	317	351	302	511	477	406	525	616	682	598	511	338	480	823
Total Adults ^e	736	571	347	397	379	297	256	244	428	405	329	424	534	538	466	456	283	370	666
Lambs:100 ewe-likes ^c	30	29	7	22	18	10	57	34	26	25	32	32	19	31	27	18	25	36	33
Rams 1/2+:100 ewe-likes ^c	28	23	45	49	48	46	54	44	36	40	35	34	37	41	36	49	27	21	36
Rams 7/8+:100 ewe-likes ^c	9	7	15	16	14	20	14	33	23	24	12	8	13	21	15	9	6	5	7
Adults/mi ²	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	0.94

^a No survey completed in 2003 or 2008.

^b Partial surveys completed. Detailed information is available from NPS or ADF&G.

^c Ewe-likes defined as adult females, yearling of either sex, and 1/4 curl rams.

^d Total does not duplicate animals contained in “ewe-likes” classification.

^e Total adults defined as all sheep excluding lambs and unknowns.

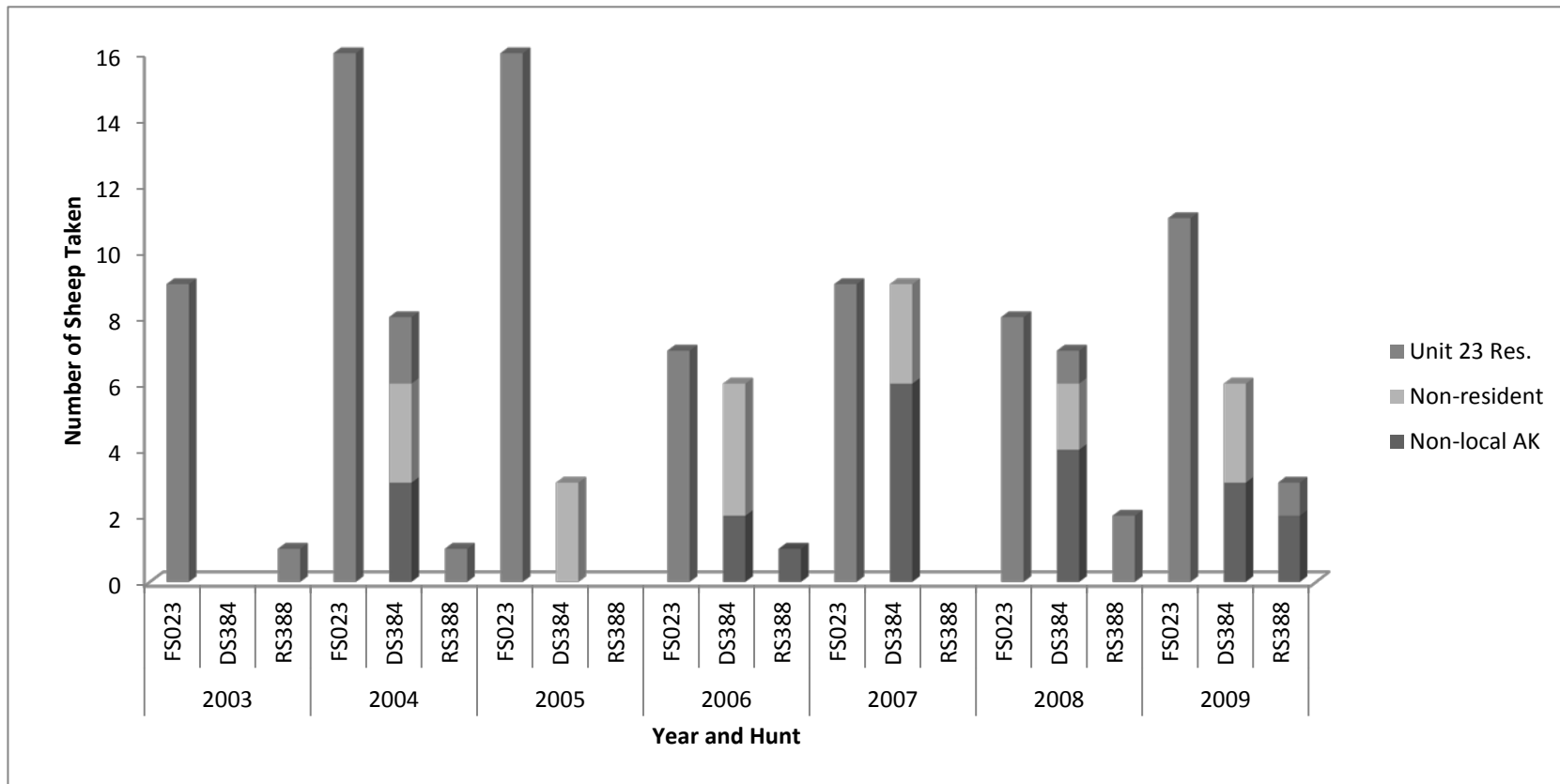


Figure 1. Number of sheep harvested in Unit 23 by regulatory year, hunt, and residency.

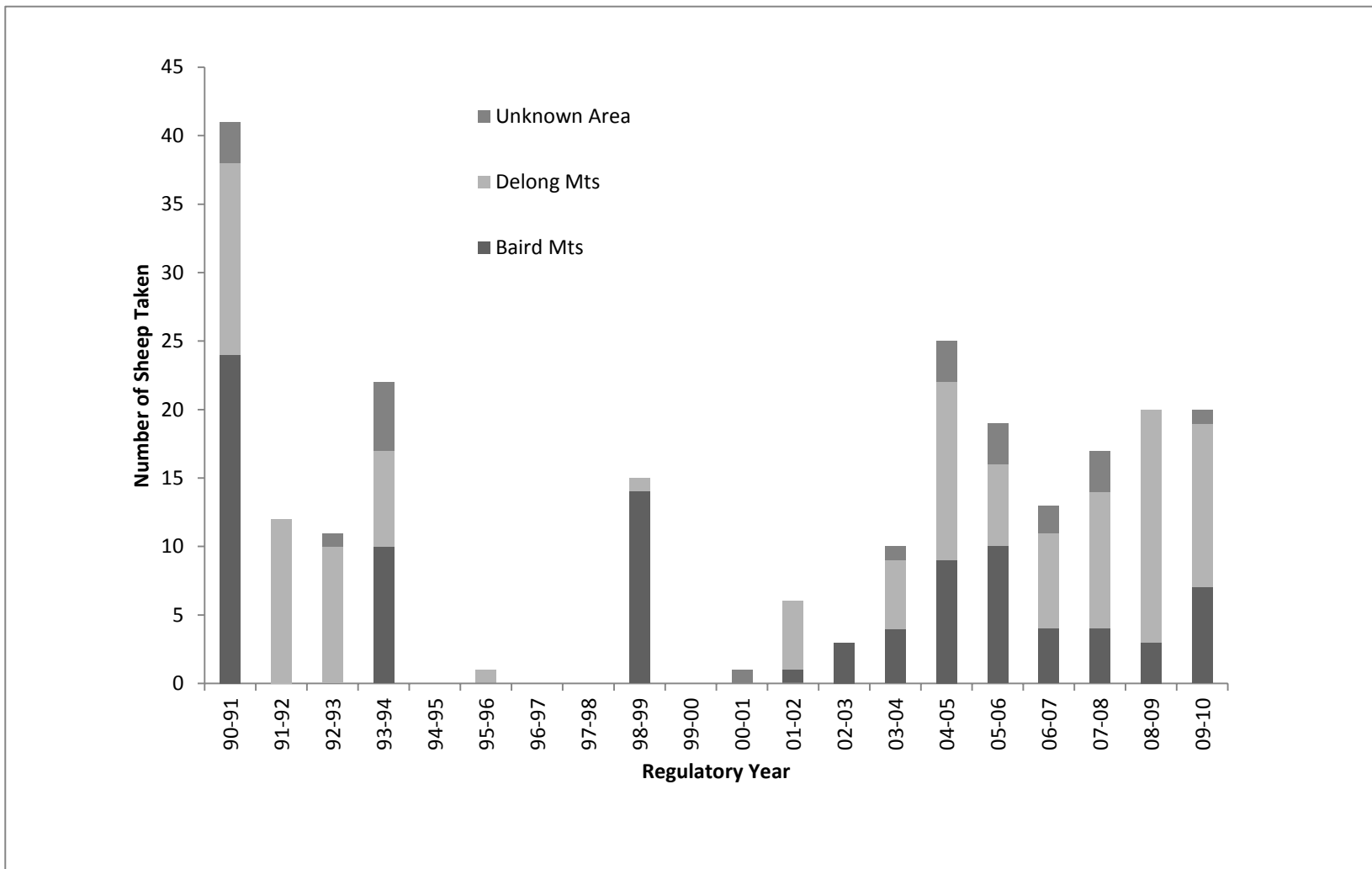


Figure 2. Number of sheep harvested in Unit 23 by area (data includes best information available for federal harvests).

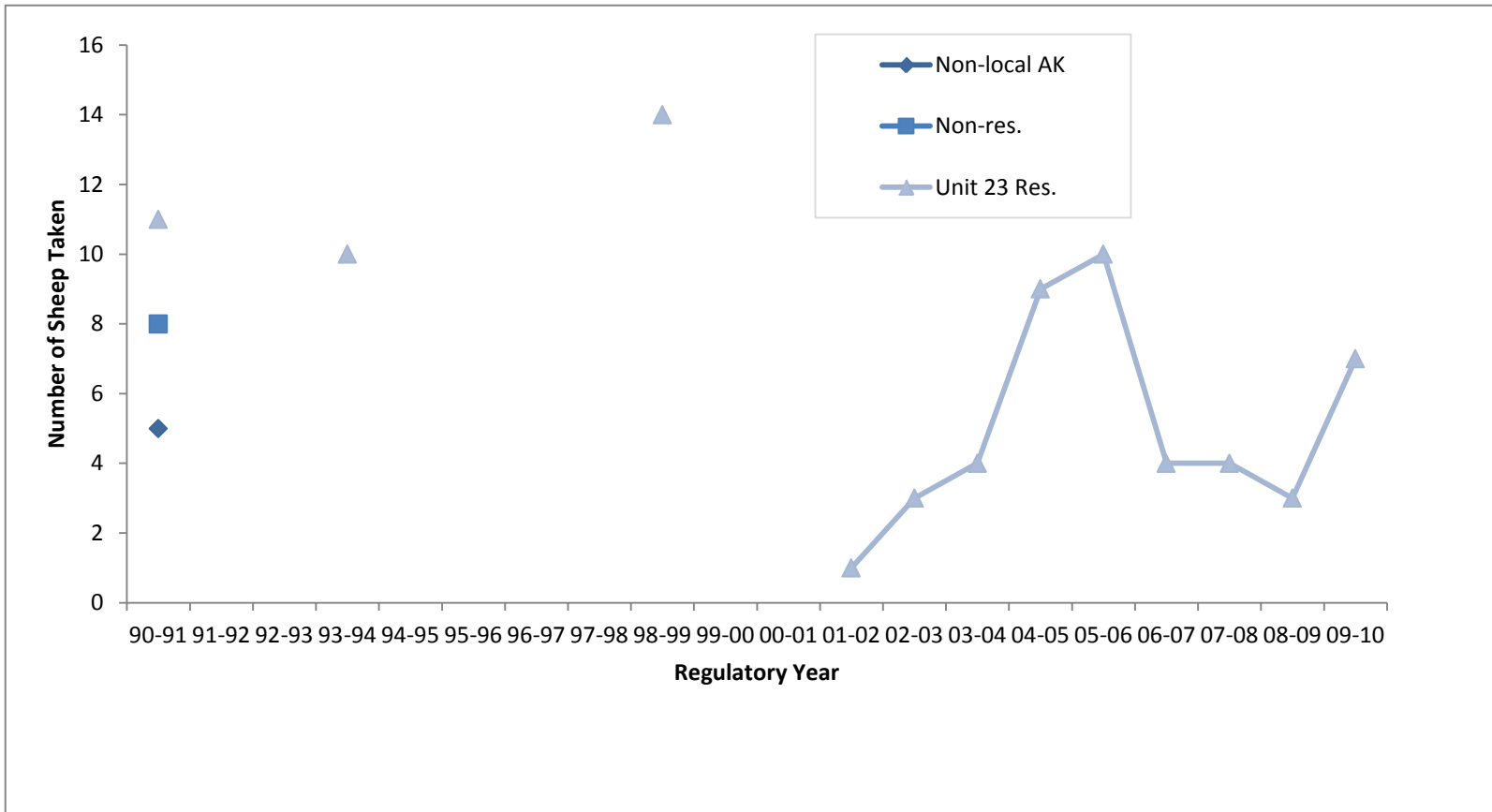


Figure 3. Baird Mountain sheep harvest in relation to hunter residence (data includes best information available for federal harvests).

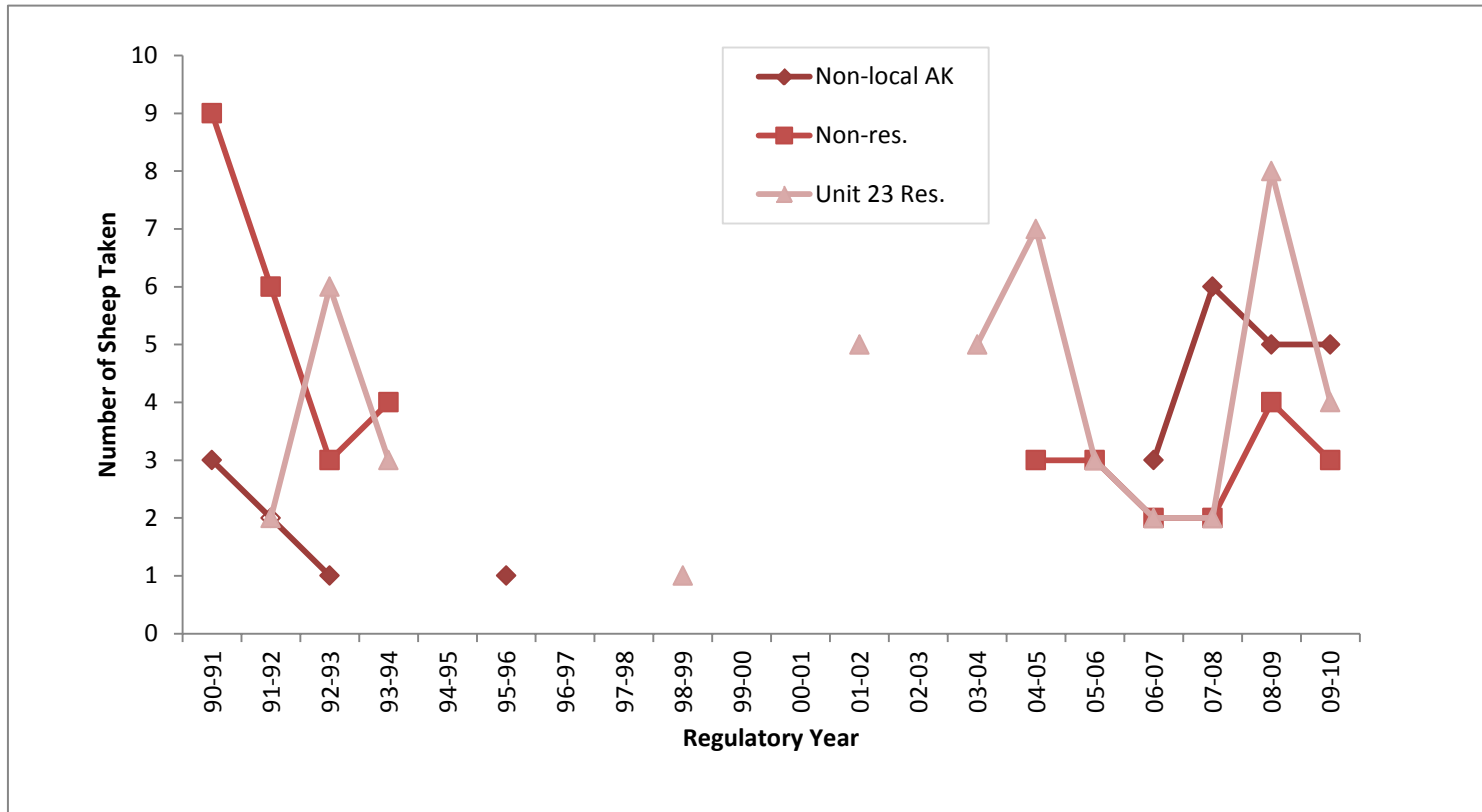


Figure 4. De Long Mountain sheep harvest in relation to hunter residence (data includes best information available for federal harvests).

DALL SHEEP MANAGEMENT REPORT

From: 1 July 2007
To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNITS: Eastern 23, 24B, and portions of 24A and 26A (15,717 mi²)

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.

Most sheep surveys conducted within the Central Brooks Range have occurred 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 following several winters 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 2009 the population was stable (albeit at lower densities than observed in the 1980s), except for annual fluctuations that were probably related to weather.

¹ 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 ≤ 50 per year (Osborne 1996). During the 1980s, hunting regulations for this area changed substantially and general sheep hunting was closed in GAAR. Harvest in the state general hunt has been low (4–18 rams) since 1992 (Hollis 2008). 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 July through 30 June; e.g., RY09 = 1 July 2009 through 30 June 2010).

MANAGEMENT DIRECTION

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.

METHODS

POPULATION STATUS

No surveys were conducted on state land in the Central Brooks Range between July 1, 2005 and June 30, 2010. During 2005, 2008, 2009 and 2010, several different sheep surveys were conducted in the Central Brooks Range by GAAR staff on federal lands with some support from the Alaska Department of Fish and Game (ADF&G). Survey methods and study areas varied each year. Surveys conducted in 1983 by Singer (1984), 1996 by Brubaker and Whitten, and in 2005 and 2008 by Rattenbury and Lawler all encompass an area referred to by GAAR staff as the Itkillik Study area (Rattenbury and Lawler 2010). The Itkillik Study area is a 954 mi² area located in the northeastern portion of GAAR and includes some portions of the preserve that are open to hunting by the general public. Sheep surveys conducted in 2009 and 2010 encompassed all sheep habitat on GAAR lands (Schmidt and Rattenbury, National Park Service unpublished data, Fairbanks).

Different survey methods have been used in conducting the surveys. The 1983 survey by Singer and 2008 survey by Rattenbury and Lawler were minimum count and composition surveys. The 1996 survey by Whitten and Brubaker used double sampling to estimate a sightability correction factor (Whitten 1997). The 2005 survey by Rattenbury and Lawler was a stratified random sample (Rattenbury and Lawler 2010). The 2009 and 2010 surveys by Rattenbury and Schmidt

were both line transect surveys (Schmidt and Rattenbury, National Park Service unpublished data, Fairbanks).

HARVEST

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.

ADF&G does not collect harvest data for federally qualified hunters in GAAR National Park because federal regulations do not require those hunters to use state harvest tickets. GAAR regulations allow only residents of Unit 24 who live north of the Arctic Circle and residents of Allakaket, Alatna, Hughes, and Huslia to hunt within GAAR park lands. Hunting by the general public is allowed on GAAR preserve lands. 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 were not available for RY07–RY09.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and composition

In 2009 and 2010, Schmidt and Rattenbury (unpublished data, National Park Service, Fairbanks) estimated 8,736 sheep (density = 0.84 sheep/mi²) and 9,456 sheep (density = 0.91 sheep/mi²) respectively in 10,394 mi². The 1983, 2009, and 2010 surveys encompassed all GAAR lands. The minimum count and composition surveys in 1983 and line transect surveys in 2009 and 2010 suggest that sheep densities are stable, but at a lower level than during the 1980s. An analysis of the survey methodologies to determine if the data can be compared statistically has not been conducted.

Within the Itkillik Preserve study area (854 mi², Table 1), results from surveys conducted by GAAR staff also showed no noticeable change between 2005 and 2008. In 1983, 1,965 sheep were counted in the Itkillik Preserve. Results from surveys 1996, 2005, and 2008 were 1,365, 1,638, and 1,239 sheep, respectively (Table 1). In 1983, Itkillik Preserve surveys indicated 29 lambs:100 ewes and 40 lambs:100 ewes in 2005 and 2008. Between 4.1% and 4.3% of the sheep observed in 1983, 2005, and 2008 were full curl or larger rams (Rattenbury and Lawler 2010). Composition data were not available for 1996. During 2008, only 77% of the Itkillik Preserve study area was surveyed, which likely explains a slightly lower total number of sheep compared to 2005. Although it is difficult to compare Itkillik Preserve survey results because different survey techniques and search intensities were used (Rattenbury and Lawler 2010), it appears that

sheep numbers were stable or increased slightly since 1996. Aerial surveys during 1996–2002 in Gates of Arctic National Park and Preserve are summarized in Table 2.

MORTALITY

Harvest

Season and Bag Limit (RY98–RY09). 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 (Schwatka Mountains) and Unit 26A, east of the Cutler, Redstone, Aniuk, and Etivluk Rivers. Resident Hunters: 3 sheep by registration permit only (RS389). Resident and Nonresident Hunters: 1 ram with full-curl horn or larger.	1 Aug–30 Apr 10 Aug–20 Sep	10 Aug–20 Sep

Alaska Board of Game Actions and Emergency Orders. The Alaska Board of Game did not change any seasons or bag limits for sheep in the Central Brooks Range during RY07–RY09, and we issued no emergency orders. In 2004 the board adopted a statewide provision that required sealing of sheep horns in most units, including the Central Brooks Range, by Alaska Department of Fish and Game (ADF&G) personnel.

Harvest by Hunters. Very little harvest data are available during RY07–RY09 for lands included in GAAR, where 2 sheep were reported harvested (Table 3). Most of the harvest in GAAR likely was by residents of Anaktuvuk Pass and probably was not reported.

The general season harvest in the Central Brooks Range (excluding GAAR) averaged 11 sheep during the past 5 years (range: 4–17; RY05–RY09; Table 4) compared to an average of 9 during RY00–RY04 (Table 4). During RY90–RY94 the 5-year average harvest was 21 sheep per year. Harvest has remained at 5–11 sheep since RY96, although in RY06 the harvest increased to 17 sheep. 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. 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 season harvest, the 5-year average success rate for the area was 48% (range: 31–61%; RY05–RY09). Success rates were higher for nonresident hunters (range: 40–100%) compared with resident hunters (range: 17–40%). Nonresident hunters primarily used guides. Nonresidents made up 38–46% of all hunters during RY05–RY09 (Table 4). In general, most hunting occurred in Unit 24B and 26A and little or no hunting occurred in Unit 23.

Harvest Chronology. The highest harvest of sheep in the Central Brooks Range in the general hunt usually occurred during the first 10 days of the season (Table 6). This is consistent with most general season sheep hunts throughout Alaska. On years when the weather is bad during the first 10 days, the highest harvest may occur 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. During RY07–RY09, aircraft were the major means of transportation (Table 7) because access by other means was limited.

CONCLUSIONS AND RECOMMENDATIONS

Survey data for the sheep population in the Central Brooks Range suggest that the population was stable during RY07–RY09, although at lower density than observed in the 1980s. Sheep surveys conducted by ADF&G during 2002–2007 in the adjacent area directly east of the Central Brooks Range indicate stable population numbers in that area (A. L. Hollis, ADF&G, memorandum dated 10 July 2007 regarding eastern Brooks Range sheep survey, Fairbanks).

Because the general season harvest was low and made up of predominantly older rams, this harvest likely had little effect on the sheep population. Even though there are no data available for subsistence harvest on federal lands, it was probably minimal and did not likely affect the sheep 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 since 2000 as a result of increased tour bus transit on the Dalton Highway. The goal of providing an opportunity for a general harvest outside of GAAR was met, as there was a season and bag limit for this sheep population.

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 RY00 (range: 13–31) and success rates were good during RY05–RY09 (\bar{x} = 46%, Table 4). For the next report the management objective will change to the following:

- Provide the opportunity for hunters to harvest mature rams during a general hunting season.

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 GAAR and ADF&G to continue sheep surveys currently conducted by GAAR staff.

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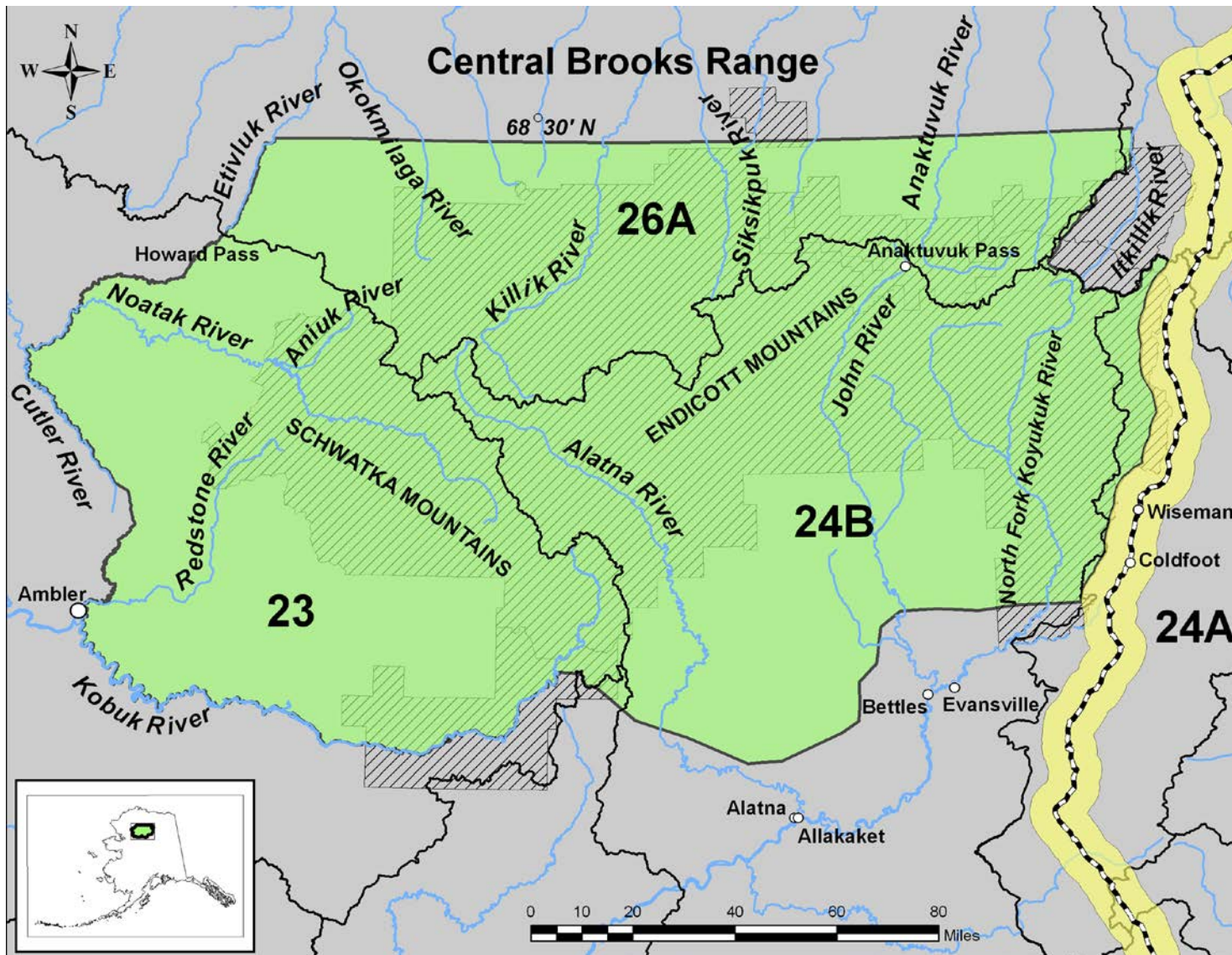


Figure 1. Central Brooks Range (shaded area).

Table 1. Results from aerial Dall sheep surveys in the 854 mi² Itkillik Preserve study area, 1983, 1996, 2005 and 2008 (Rattenbury and Lawler 2010).

Year	Lambs (%) ^a		Ewe-likes ^b (%) ^a		Lamb: 100 Ewes		Rams:100	% Rams ≥	Unk	Total
						Rams (%) ^a	Ewes	full curl ^a	adults	sheep
1983 ^d	341	(17)	1167	(59)	29	457 (23)	39	4.1	26	1965
1996 ^e										1365 ^c
2005 ^f	371	(23)	926	(57)	40	311 (19)	34	4.3	0	1638
2008 ^{f,g}	276	(22)	683	(55)	40	278 (22)	41	4.3	1	1239

^a When calculating percent ratios, unknown classified animals were subtracted from total.

^b Ewe-likes included ewes, yearlings, and rams smaller than ¼ curl.

^c The 1996 survey for total sheep was an estimate, not a count.

^d Singer 1984

^e Whitten 1997

^f Rattenbury and Lawler 2010

^g The 2008 survey was only conducted on 77% of the Itkillik Preserve study area.

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

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

Data source: Lawler 2004.

^a Ewe-like includes adult ewes, yearlings, and rams smaller than ½ curl.

^b Poor survey conditions; high winds and poor visibility.

^c Wind, new snow, and fog were somewhat problematic.

^d Late spring; snow and fog were problematic.

Table 3. Central Brooks Range sheep harvest, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Unit ^a						Total harvest		
	23		24 West		26A		GAAR	Other	Combined
	GAAR ^b	Other ^c	GAAR	Other	GAAR	Other			
2000–2001	0	0	6	6	6	1	12	7	19
2001–2002	0	0	3	7	2	3	5	10	15
2002–2003	0	0	4	9	3	3	7	12	19
2003–2004	0	0	5	2	4	3	9	5	14
2004–2005	0 ^d	0	0 ^d	7	0 ^d	4	0 ^d	11	11
2005–2006	3 ^{d,e}	0	0 ^d	3	0 ^d	1	3 ^{d,e}	4	7
2006–2007	0 ^d	0	0 ^d	11	0 ^d	6	0 ^d	17	17
2007–2008	0 ^d	0	1	8	0 ^d	4	1	12	13
2008–2009	0 ^d	0	0 ^d	6	1	2	1	8	9
2009–2010	0 ^d	0	0 ^d	9	0 ^d	4	0 ^d	13	13

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

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

^c Other sheep harvest includes all other harvest besides the GAAR harvest.

^d No reported harvested was available from GAAR.

^e 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 2000–2001 through 2009–2010.

Regulatory year	Successful					Unsuccessful					Total hunters (% nonresident)
	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^a resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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 (45)
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)
2007–2008	0	3	9	0	12 (57)	2	7	0	0	9 (43)	21 (43)
2008–2009	0	1	7	0	8 (40)	0	11	1	0	12 (60)	20 (40)
2009–2010	0	3	9	1	13 (42)	0	15	3	0	18 (58)	31 (40)

^a Local residents includes residents of Ambler, Shungnak, and Kobuk in Unit 23; Wiseman, Bettles, and Coldfoot in Unit 24; and Anaktuvuk Pass in Unit 26A. Most 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 2000–2001 through 2009–2010.

Regulatory year	\bar{x} Horn length	% Over 40"	\bar{x} Age	Total rams
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
2007–2008	36.0	17	9.6	12
2008–2009	35.8	0	10.3	8
2009–2010	35.9	0	10.2	13

Table 6. Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park and Preserve) chronology percent by month/day, regulatory years 2000–2001 through 2009–2010.

Regulatory year	Harvest chronology percent by month/day				<i>N</i>
	8/10–8/20 (<i>n</i>)	8/21–8/31 (<i>n</i>)	9/1–9/10 (<i>n</i>)	9/11–9/20 (<i>n</i>)	
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
2007–2008	58 (7)	33 (4)	8 (1)	0 (0)	12
2008–2009	63 (5)	13 (1)	25 (2)	0 (0)	8
2009–2010	54 (7)	31 (4)	15 (2)	0 (0)	13

Table 7. Central Brooks Range sheep harvest (excluding Gates of the Arctic National Park and Preserve) percent by transport method, regulatory years 2000–2001 through 2009–2010.

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>)		
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	
2007–2008	75 (9)	0 (0)	0 (0)	0 (0)	25 (3)	12	
2008–2009	100 (8)	0 (0)	0 (0)	0 (0)	0 (0)	8	
2009–2010	85 (11)	15 (2)	0 (0)	0 (0)	0 (0)	13	

Table 8. Gates of the Arctic National Park and Preserve subsistence sheep harvest, regulatory years 1989–1990 through 2003–2004^a.

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

^a 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 2007
To: 30 June 2010¹

LOCATION

GAME MANAGEMENT UNITS: Eastern Unit 24A, Unit 25A, and Units 26B and 26C (49,600 mi²)

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 in many other areas of Alaska. The most likely cause of the decline was severe weather, which reduced recruitment and may have increased predation. Although few surveys have been conducted 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.

MANAGEMENT DIRECTION

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.

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

RELATED MANAGEMENT ACTIVITIES

- Continue to monitor sheep population status through composition and trend count areas.
- Work with the U. S. Fish and Wildlife Service (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.

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). Federal subsistence permit hunts and state registration hunts were analyzed separately from general season hunts.

ADF&G has conducted annual composition surveys in the upper North Fork Chandalar River drainage in eastern Unit 24A and Western Unit 25A since 2002 (S. Arthur, ADF&G, memorandum dated 21 July 2009 regarding Brooks Range sheep survey, Fairbanks). The 799 mi² 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-mi² 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 Slope Mountain (lat N68.7422, long W149.0661) (E. A. Lenart, ADF&G, memorandum dated 30 Oct 2003 regarding 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 during 1986–2007, Arctic National Wildlife Refuge (ANWR) staff conducted annual ground-based composition surveys east of the Dalton Highway from Atigun Pass to Atigun Gorge. 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 1/4, 3/8, 1/2, 5/8, 3/4, 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 reclassified these

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, ANWR staff have conducted aerial surveys periodically since 1991 in the upper East Fork Chandalar River drainage (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, ANWR staff have conducted aerial and ground-based composition surveys 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 reclassified these 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.

In 2008, ADF&G initiated a 5-year research project to evaluate demographics and spatial ecology of Dall sheep in western Unit 25A and eastern Unit 24A (Arthur 2010). This study area is the same geographic region where ADF&G has conducted the composition surveys mentioned above since 2002. Objectives of the research are to estimate birth rates and the lambing period of ewes, lamb and ewe survival, and sheep movement.

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 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 remained relatively stable in 2009 (1,535) compared to 2002–2008 (range: 989–1,589, 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 indicated a relatively stable population from 1986 to 2006 (Table 2). In 2007, the lowest count of total sheep was observed for this survey since 1986. In 2008, the number of sheep observed increased but was below the long-term mean. This survey area is likely biased to low elevation habitats that are easily sampled from the road and sheep distribution at the time of the survey may affect survey results. Although neither survey was designed to estimate sheep population size for their respective areas, dramatic changes can probably be detected.

Population Composition

ADF&G conducted composition surveys in the upper North Fork Chandalar River drainage during 2002–2009. Lamb:100 ewe-like ratios and the proportion of lambs in the population rose slightly in 2007 and 2009 (range of lamb:100 ewe-likes: 32–43, percent lambs: 19–25) compared to 2002–2006 (range of lamb:100 ewe-likes: 18–34, percent lambs: 12–19) but remained moderate across all years (Table 1). Although the numbers of legal rams have remained stable since 2002, the proportion of legal sheep among all rams observed in 2009 (10%) was the lowest since 2002 and lower than the 2002–2007 mean (\bar{x} = 15%, Table 1).

Unit 26B surveys conducted by ANWR during 2007–2008 in the upper Atigun River drainage indicated moderate and stable lamb:ewe-like ratios (\bar{x} = 33:100), similar to rates observed during 1986–2006 (\bar{x} = 30:100, 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 classified as full-curl unless they were broomed at full curl or longer.

In 2003, ADF&G surveyed the upper Atigun River drainage in Unit 26B 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. A survey of this area was not completed in RY07–RY09.

Fixed-wing aerial surveys were conducted by ANWR staff in the upper East Fork Chandalar River drainage in Unit 25A during 1992–2007 (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 (1996 unpublished report, ANWR, Fairbanks), Payer (2006 unpublished report, ANWR, Fairbanks), and Brackney (2007 unpublished report, ANWR, Fairbanks) 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 are difficult to detect from these surveys, it is apparent that 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 increased during 1992–1996, 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 2007–2009 indicated moderate lamb:ewe-like ratios (\bar{x} = 18:100) similar to rates observed during 1992–2007 (\bar{x} = 24:100, Table 5). Detecting a long-term trend within this survey area is difficult because survey methods differed. 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, upper Hulahula ground-based 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 we made general inferences about age structure among rams and between survey areas, we need consistency in classification before we can make more direct comparisons in this sex and age class.

Distribution and Movements

An ongoing study of GPS radiocollared sheep in eastern Unit 24A and western Unit 25A will investigate daily, seasonal, and yearly distribution and movement of adult ewes and lambs. Results will be available in the next report period.

Studies of radiocollared 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).

Survival Rates

A 5-year ADF&G research project will investigate survival rates of ewes and lambs during 2008–2013 in eastern Unit 24A and western Unit 25A. Lamb survival to age one was 68% (n = 19) for the 2009 cohort. Survival rates of ewes and lamb cohorts for 2010–2012 will be available in the future.

MORTALITY

Harvest

Season and Bag Limit (RY07–RY09). Only state regulations are listed below, although federal subsistence regulations applied 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 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. No Board of Game action was taken during RY07–RY09. Regulatory actions in recent years include 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 sheep in 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 RY07–RY09 increased by 37% (\bar{x} = 222) compared to the previous 3 years (RY04–RY06; \bar{x} = 162) and has increased by 53%

compared to the previous 8 years (RY99–RY06; \bar{x} = 145, Table 6). Additional harvest and hunting pressure occurred in all units but was most substantial in Units 25A, 26B, and 26C. Although total harvest and the number of hunters increased across the eastern range during RY07–RY09, success rates increased slightly (\bar{x} = 46%, Table 7) and horn length remained stable (\bar{x} = 35.4 inches, Table 8). The proportion of harvested rams with horns \geq 40 inches in length declined slightly (\bar{x} = 3%) compared to the previous 3-year mean (\bar{x} = 5%, Table 8).

Permit Hunts. Participation in the state registration hunt RS595 has been open to all Alaska residents since RY90. However, with the exception of the first year the hunt was open, few permits have been issued each year (0–8) because the hunt is logistically difficult and they have limited interest in harvesting sheep during winter. During RY07–RY09, 4 sheep were harvested under RS595 (Table 9). In addition to RS595, 4 federal subsistence permit hunts (FS424, FS596/598, FS799, and FS699) occur in eastern Unit 24A, Unit 25A, Unit 25A and Unit 26C, and Unit 26B, respectively. Permits for these hunts were available to federally qualified subsistence hunters who hunted on federal land.

Hunter Residency and Success. In RY07–RY09, Alaska resident hunters comprised 69–74% of the total hunters, annually, in the eastern Brooks Range, consistent with previous years (Table 7). Overall success rates averaged 46% across RY07–RY09 and were slightly higher compared to prior years. Nonresident hunters continued to have a higher success rate (\bar{x} = 70%) compared to residents (\bar{x} = 36%), 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 RY07–RY09, 85–90% 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 73–78% 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. An ongoing study of GPS radiocollared sheep in eastern Unit 24A and western Unit 25A will begin to address some of these knowledge gaps.

The number of hunters and the harvest of full-curl rams increased by about 35% and 37%, respectively, during RY07–RY09 compared to the previous 3-year mean. Since RY99, the number of hunters and harvest has increased by 50% and 53%, respectively. Most additional harvest was due to an increase in the number of hunters. However, the rate of increase in hunters was less than that of harvest, and success rates slightly increased. We don't know why such a large increase in hunters and harvest occurred during RY07–RY09 but contributing factors may

include 1) a shift in hunting pressure from other areas in the state where general season closures have occurred, 2) favorable weather conditions for hunting sheep in the eastern Brooks Range during August 2007–2009, 3) increased access by commercial transporters and increased nonresident guiding opportunity, and 4) an increase in the number of sheep. Less substantial increases in hunters and harvest occurred from 2000 to 2006 and limited survey data indicated that full-curl rams could sustain those levels of harvest (Caikoski 2008). Harvest in RY07–RY09 was lower than in the late 1980s and early 1990s when the sheep population was thought to be high and harvest ranged 250–350 rams annually. We don't know whether current harvest levels in the eastern Brooks Range are sustainable. Future surveys, research, and harvest data may indicate sustainable thresholds.

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 (RY10–RY12) 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

- Provide maximum opportunity to hunt sheep.

RELATED MANAGEMENT ACTIVITIES

- 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 (eastern Unit 24A and Unit 25A, 779 mi²), 2002–2009. Surveys occurred in late June or early July of the year indicated.

Year	Legal rams (%) ^a	Sublegal rams	“Ewe-like” ^b	Lambs	% Lambs	Lamb:100 “ewes”	Unk rams ^a	Total
2002	50 (12)	380	884	221	14	25	4	1539
2003	34 (14)	207	621	114	12	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
2009	31 (10)	298	911	295	19	32	0	1535

^a Percent legal rams is calculated as a proportion of total rams. Unknown rams were censored in calculations of percent legal rams.

^b 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), 1986–2008. Surveys occurred in June of the year indicated.

Year ^a	Legal rams (%) ^{b,c}	Sublegal rams ^c	“Ewe-like” ^d	Lambs	% Lambs ^b	Lamb:100 “ewes”	Unk sheep ^b	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 ^e	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
2007	1 (5)	21	69	20	18	29	9	120
2008	1 (3)	39	127	46	22	36	13	226

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

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

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

^c 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.

^d Includes adult females plus yearlings and 2-year-olds of both sexes.

^e Incomplete count in Atigun Gorge (snow).

Table 3. Aerial sheep composition surveys in the upper Atigun River Drainage (543 mi²), 2003. Surveys occurred in June of the year indicated.

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

^a Percent legal rams is calculated as a proportion of total rams.

^b 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 rams (%) ^a	Young rams	“Ewe-like” ^b	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.

^a 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.

^b 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, 1992–2009. Surveys occurred in June of the year indicated.

Year	Legal rams (%) ^{a,b}	Sublegal rams ^b	“Ewe-like” ^c	Lambs	% Lambs ^a	Lamb:100 “ewes”	Unk sheep ^a	Total
1992 ^d	1 (2)	58	318	10	3	3	0	387
1993 ^e	12 (3)	369	709	171	14	24	0	1261
1994 ^e	6 (4)	164	595	99	11	17	0	864
1995 ^e	25 (8)	295	631	179	16	28	0	1130
1998 ^d	10 (8)	117	190	61	16	32	0	378
2000 ^d	7 (6)	106	219	20	6	9	0	352
2003 ^d	9 (12)	67	191	50	16	26	0	317
2004 ^d	9 (22)	32	201	71	23	35	0	313
2005 ^d	6 (6)	88	298	106	21	36	15	513
2006 ^d	4 (7)	50	320	80	18	25	13	467
2007 ^d	1 (1)	118	273	42	10	15	75	509
2008 ^d	2 (3)	77	318	89	18	28	26	512
2009 ^d	10 (9)	112	472	48	7	10	50	692

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

^a Unknown sheep were censored in calculations of percent legal rams and percent lambs.

^b 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.

^c Includes adult females plus yearlings and 2-year-olds of both sexes.

^d Ground survey: upper Hulahula only.

^e Helicopter surveys over most of the drainage.

Table 6. Reported numbers of hunters^a and harvest^a in eastern Unit 24A and Units 25A, 26B, and 26C, regulatory years 1999–2000 through 2009–2010.

Regulatory year	Unit								Total harvest
	24A East		25A		26B		26C		
	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	
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
2007–2008	48	14	121	77	168	55	120	70	216
2008–2009	60	27	145	74	205	57	112	67	225
2009–2010	53	17	142	84	147	47	117	76	224

^a Excludes state registration and federal subsistence permit hunts.

Table 7. Eastern Unit 24A and Units 25A, 26B, and 26C sheep hunter^a residency and success, regulatory years 1999–2000 through 2009–2010.

Regulatory year	Successful hunters					Unsuccessful hunters					Total hunters
	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local ^b resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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
2007–2008	2	116	97	1	216 (47)	2	206	32	1	241 (53)	457
2008–2009	0	123	87	15	225 (43)	3	241	44	7	295 (57)	520
2009–2010	0	122	94	8	224 (49)	3	185	44	3	235 (51)	459

^a Excludes state registration and federal subsistence permit hunts.

^b Local resident is a resident of Units 25A, 26B, 26C, Coldfoot, or Wiseman.

Table 8. Dall sheep mean horn length of harvested rams in eastern Unit 24A and Units 25A, 26B, and 26C, regulatory years 1999–2000 through 2009–2010.

Regulatory year	n^a	\bar{x} Horn length (inches)	% ≥ 40 inches
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
2007–2008	218	35.5	2
2008–2009	225	35.3	2
2009–2010	224	35.5	6

^a Excludes state registration and federal subsistence permit hunts.

Table 9. Eastern Unit 24A and Units 25A, 26B, and 26C reported sheep harvest by permit hunt (FS424^a, RS595^b, FS596^c, FS799^d, and FS699^e), regulatory years 1999–2000 through 2009–2010.

Regulatory year	FS424 (Unit 24A)	RS595 (Unit 25A and Unit 26C)	FS596/598 (Unit 25A)	FS799 (Unit 25A and Unit 26C)	FS699 (Unit 26B)	Total reported harvest
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
2007–2008	1	0	3	0	0	4
2008–2009	0	1	0	0	1	2
2009–2010	0	3	0	0	0	3

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

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

^c Federal subsistence hunt FS596/598 includes Unit 25A within the Arctic Village Sheep Management Area.

^d Federal subsistence hunt FS799 includes most of Unit 25A and all of Unit 26C.

^e Federal subsistence hunt FS699 includes Unit 26B within the Dalton Highway Corridor Management Area.

Table 10. Eastern Unit 24A and Units 25A, 26B, and 26C sheep harvest^a chronology percent by harvest month/day, regulatory years 1999–2000 through 2009–2010.

Regulatory year	Harvest chronology percent by month/day									<i>n</i>
	8/1–8/4 ^b	8/5–8/11	8/12–8/18	8/19–8/25	8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29 ^b	
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
2007–2008	0	22	29	26	12	6	3	3	0	213
2008–2009	<1	17	30	25	13	8	5	1	0	223
2009–2010	<1	16	38	24	12	5	3	2	<1	215

^a Excludes state registration and federal subsistence permit hunts.

^b Sheep reported taken before 10 Aug or after 26 Sep were presumably incorrectly reported.

Table 11. Eastern Unit 24A and Units 25A, 26B, and 26C sheep harvest^a percent by transport method, regulatory years 1999–2000 through 2009–2010.

Regulatory year	Harvest percent by transport method								<i>n</i>
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	
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
2007–2008	78	10	2	0	0	0	9	1	216
2008–2009	73	9	3	0	0	0	14	1	225
2009–2010	74	10	2	<1	0	1	11	1	224

^a 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.



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