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DALL SHEEP

Mary V Hicks, Editor

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Grants W-24-1, W-24-2, W-24-3
Study 6.0
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STATE OF ALASKA
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DEPARTMENT OF FISH AND GAME
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LOCATION

GAME MANAGEMENT UNIT: 7 AND 15 (8,397 MI^2)

GEOGRAPHICAL DESCRIPTION: Kenai Mountains

BACKGROUND

U.S. Fish and Wildlife Service (USFWS) reports indicate aerial sheep surveys were initiated on the Refuge portion of the Kenai Mountains in 1949. Records after statehood (ADF&G and FWS files) show the Kenai Mountains sheep population steadily increased from 1949 to 1968, before sharply declining until 1977 and 1978, when the lowest counts were recorded.

Since the late 1970s the sheep population has been rebuilding from its previous low levels; the controlling factors were effects of weather and habitat. Although not significant factors, predation, regulated hunting, natural and disease-related mortalities have also controlled the size of the sheep population in the Kenai Mountains.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

To maintain a population of sheep that will sustain an annual harvest of 25 rams.

METHODS

Biologists used a Piper PA-18, flown at 200-400 ft elevation (AGL), to count, sex and age sheep during the summer in selected count areas of the Kenai Mountains sheep habitat. Surveys were generally conducted during early morning or late evening hours to avoid midday increases in sun glare and turbulence. Sheep were classified into categories of lambs, sublegal rams (7/8-curl or less), legal rams (full-curl or larger) and unidentified sheep. The unidentified sheep category was comprised primarily of ewes and a low number of yearling and 2-year-old rams. In addition to counting selected count areas and Round Mountain, 3 count areas from Skilak Glacier to Fox River were designated in 1987 to be used as areas to assess trend of the sheep population.

In addition to standard surveys, a census of all known sheep range was conducted during the summer of 1992. This census was designed to evaluate 3 different survey methods to determine which method provided the highest level of precision, safest flying conditions and was most economic (Loranger and Spraker 1994). This project was a cooperative effort between the U.S. Fish and Wildlife Service and the department.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We counted 1508 sheep in the summer of 1992, representing the first complete Kenai Mountains survey since 1968. This population has not reached the size found in 1968 (2200 to 2500);

however, it has increased steadily, following the sharp population decline during the early 1970s due to overpopulation and severe winters.

Population Size

During 1991-1992, 9 of 12 count areas were surveyed and 926 sheep were classified (Table 1). From 1992-1993, all known sheep range in the Kenai mountains were surveyed, resulting in a total observed of 1508 sheep. Assuming an observation rate of 85 percent, we placed the 1992 summer population size between 1508 and 1774 animals. This estimate included 135 sheep in the Unit 7 Cooper Landing Closed Area. In 1993-1994, 4 of 12 count areas, including the trend count area and Round Mountain, were surveyed and 742 sheep classified. We counted 632 sheep in the trend areas in 1993-1994, compared with 689 the previous year, indicating a relatively stable population (Table 2). The Round Mountain trend count area (Table 3) was counted from 1990 to 1993. Results of these counts indicated a peak count in 1991 followed by declining numbers through 1993.

Population Composition

Aerial surveys from 1991-1992 to 1993-1994 resulted in 926, 1508 and 742 sheep classified, respectively (Table 1). The 1992-1993 data was the most complete with all known range surveyed. We classified 1508 sheep, comprised of 49 (3%) legal rams (full-curl or larger), 322 (21%) sublegal rams, 257 (17%) lambs and 880 (58%) ewes, yearlings and 2-year-old rams.

Distribution and Movements

Sheep were throughout the central portion of the Kenai Mountains, north of Sheep Creek in Unit 15 and north of Snow River in Unit 7. The highest density of sheep ($6/mi^2$) was on Round Mountain in Subunit 15A.

The count area containing the highest number of sheep (498) was between Killey Glacier and Tustumena Glacier. This area has traditionally supported the highest number of animals due to its size and available habitat. Sheep were not found along the coast of Unit 7 or the southern coast of Unit 15.

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

MORTALITY

Harvest

Season and Bag Limit. The sheep season for resident, subsistence, and nonresident hunters was 10 August through 20 September, and the bag limit was 1 ram with full-curl horn or larger. Beginning in 1993, a drawing permit hunt was authorized for that portion of Subunit 15A south of Dike Creek and east of Fuller Lake trail (Round Mt.). We issued 20 permits for ewe sheep from Aug. 10 to Sept. 20.

Game Board Actions and Emergency Orders. The Board of Game changed the size of a legal ram from 7/8-curl to full-curl for the 1989 season. They also authorized a drawing permit hunt for ewe sheep on Round Mountain. No emergency orders were issued during this reporting period.

Hunter Harvest. As a result of the change in legal horn size, the sheep harvest declined from 42 in 1988 to 8 in 1989 then increased to 33 in 1990 as the number of full-curl rams increased (Table 4). The 1991 harvest increased to 40 rams then declined and remained stable at 33 for the next 2 years, yielding a 3-year mean harvest of 35 rams.

Fifteen of the 20 permit holders for the Round Mountain ewe hunted, and eight were successful (Table 5).

Mean horn length of harvested rams increased slightly each year of this reporting period, ending with a mean horn length of 35.6 inches in 1993 (Table 4). Horn size ranged from 32.0 to 43.0 inches and mean age of harvested rams was 8.0 years old, from 1991 to 1993.

Hunting effort has steadily increased over the past five years, from 132 reported in 1989 to 268 in 1993 (Table 6). Comparing the number of hunters in 1989 to 1993 indicated the hunting effort has doubled in five years. Hunter success has gone from a high of 20 percent in 1990 to 12 percent in 1993.

Hunter Residency and Success. Ninety-four (91%) of the 103 hunters reporting residency from 1991 to 1993 were Alaska residents and nine (9%) were nonresidents (Table 6). Three successful hunters failed to report residency. Unsuccessful hunters were comprised of 578 (98%) residents, 15 (3%) nonresidents and 15 of unknown residency, from 1991 to 1993.

Harvest Chronology. Chronology of harvest followed similar patterns over the past 3 years (Table 7). Most of the harvest occurred during the first 2 weeks of the season with an increase in harvest during the last week.

Transport Methods. From 1991-1992 successful hunters used aircraft (50%), boats (20%), and highway vehicles (30%). In 1993-1994, hunters used aircraft and boats (36% each) and highway vehicles (18%) (Table 8).

HABITAT

Assessment

According to Culbertson et al. (1980), the only significant sheep habitat enhancement documented for the Kenai Mountains resulted from the 1974 wildfire on Round Mountain in Subunit 15A. This fire burned approximately 50 acres from 2500 ft to 3500 ft altitude on the south-facing slopes from the alder-brush zone through the alpine-tundra zone. Culbertson recorded 40% more sheep observations per acre in the burned versus the adjacent unburned area. Two grasses important to sheep, *Trisetum spicatum* and *Festuca rubra*, were more abundant and vigorous in burned areas when compared to nearby unburned areas. In midsummer sheep made equal or probably more use of the 1974 burn than the adjacent unburned alpine habitat.

CONCLUSIONS AND RECOMMENDATIONS

A primary objective of the sheep management program for the Kenai Mountains should be to maintain a population database which accurately reflects changes in sex and age composition,

relative abundance, and changes among areas during the same period. The Cooper Landing Closed Area should be counted annually to sample an unhunted area. Areas that border suitable sheep range, Mills Creek (Area 834) and Snow River (Area 844), should be included in surveys to serve as early indicators of weather or range-related population changes.

Data collected from 1991 to 1993 indicated the Kenai Mountain's sheep population has continued to increase, reaching an estimated size of 1508 to 1774 animals by 1992. The reported harvest in 4 of the past 5 years has met the management objective of maintaining a population capable of sustaining an annual harvest of 25 rams. Horn length of harvested rams increased slightly each year of this reporting period, ending with a mean horn length of 35.6 inches in 1993. Compared with the mean horn length during the last 5 years of the 7/8 curl regulation (1984 to 1988), the mean horn length has increased from 32.7 to 35.0 inches (1989 to 1993) under full-curl regulations. Horn length ranged from 32.0 to 43.0 inches and mean age of harvested rams was 8.0 years old from 1991 to 1993. The full-curl regulation has also added approximately 1 year to the mean age of a harvested ram, compared to the 7/8 regulations.

The small population of sheep inhabiting the Round Mountain area has slowly declined since 1992. The suspected reason for this decline is overuse of range by the high density of 6 sheep per square mile. In an effort to protect the remaining habitat, a season allowing the harvest of ewes was initiated in 1993. Hunting for ewes on Round Mountain should continue until the number of countable sheep reaches 80 to 90 animals.

The increase in hunter effort and decline in hunter success relates well to an increased local human population and a high demand for sheep hunting. To address this issue, we should begin a process of communicating with the public to determine acceptable options for future management. Limiting hunter participation, by issuing permits to maintain acceptable levels of hunter density, is more readily accepted by sheep hunters since sheep are not generally considered a meat animal. Sheep hunters are also much less tolerant of high hunter densities, generally acceptable to moose or caribou hunters.

Passage of full-curl regulations have reduced our need for intensive management programs for sheep populations on healthy range. With the reduced trend in intensive sheep management at least two problems will occur. In the short term, hunting opportunities will be missed. Over the long term, population management needs will be realized too late to be easily corrected, and populations will be controlled by habitat quality rather than management. Sheep in the Kenai Mountains have recently gone through one recorded decline driven by overutilization of range, and we are currently documenting another rebuilding of the population's size.

To avoid the high sheep densities recorded in the late 1960s, followed by a sharp decline, we need to increase our monitoring efforts and achieve the following objectives by 1998-1999; (1) delineate winter range, (2) complete a range evaluation to provide an estimate of allowable density, (3) in areas where we suspect habitat may be limited, reduce the population by harvesting ewes and (4) set an upper limit for sheep numbers well below the level reached in the late 1960s. By establishing an upper population limit of 1800 to 2000 animals, we would maintain current objectives for hunting opportunities and harvest, and allow time for continued habitat evaluations.

No change in season or bag limit is recommended.

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Table 1. Kenai Mountains, Units 7 and 15 summer aerial sheep composition counts and estimated population size, 1989-93.

Regulatory year	Rams				Ewes	Lambs(%)	Sheep/ hour	Total Sheep observed	Estimated Population size
	Full-curl(%)	3/4 to full-curl	1/2 to 3/4-curl	<1/2-curl					
1989/90[a]	--	No Data Available		--					
1990/91[b]	5(2)	44[c]	--	--	121	54 (24)	--	224	1,200-1,500
1991/92[b]	40(4)	201[c]	--	--	512	173 (19)	--	926	1,200-1,500
1992/93[b]	49(3)	322[c]	--	--	880	257 (17)	--	1,508	1,508-1,774
1993/94[b]	24(3)	150[c]	--	--	472	96(13)	--	742	1,500-1,775

a Legal ram 7/8 curl or larger.
b Legal ram 4/4 curl or larger.
c Sublegal rams 7/8 curl or smaller.

Table 2. Kenai Mountains, Units 7 and 15 trend count areas (855, 856, and 857), 1989-93.

Regulatory year	Rams			Ewes	Lambs	Total sheep	Change in count
	Full-curl	7/8 or smaller	Total rams				
1989/90	No Data Available	--					
1990/91	No Data Available	--					
1991/92	26	135	161	348	108	617	±0
1992/93	16	157	173	385	131	689[a]	+12%
1993/94	20	135	155	394	83	632	-9%

a Count was part of the Kenai Mountains census. Trend areas were counted three times to determine maximum observable number.

Table 3. Round Mountain, Subunit 15A summer aerial sheep composition counts and estimated population size, 1989-93.

Regulatory year	Rams				Ewes	Lambs	Sheep/ hour	Total Sheep observed	Estimated Population size
	Full-curl(%)	3/4 to full-curl	1/2 to 3/4 curl	<1/2 curl					
1989/90[a]	--	No Data Available	--						
1990/91	3(2)	37	--	--	79	16	--	224	1,200-1,500
1991/92[b]	3(2)	33[b]	--	--	89	26	--	926	1,200-1,500
1992/93[b]	5(4)	28[b]	--	--	86	12	--	1,508	1,508-1,774
1993/94[b]	5(4)	17[b]	--	--	81	18	--	742	1,500-1,775

a Count data included in larger count area.
b Sublegal rams less than full-curl.

Table 4. Kenai Mountains, Units 7 and 15 general sheep harvest, 1989-1994.

Regulatory year	Rams	$\bar{x}$ Horn Length (in)	% ≥ 40 in	Ewes	Total Sheep
1989/90[a]	8	34.6	0	0	8
1990/91	33	35.5	0	0	33
1991/92	40	34.2	0	0	40
1992/93	33	35.0	0	0	33
1993/94	33	35.6	0	0	33

a Reduced effort and harvest due to increased horn size of legal rams.

Table 5. Round Mountain, Subunit 15A drawing permit ewe sheep hunt, 1989-93.

Regulatory year	Number of Permits Issued	Number of Hunters	Number of Ewes	Percent Successful	Season Length
1989/90	--	--	--	--	--
1990/91	--	--	--	--	--
1991/92	--	--	--	--	--
1992/93	--	--	--	--	--
1993/94[a]	20	15	8	53	Aug. 10 - Sept. 20

a Permit ewe hunt started in 1993.

Table 6. Kenai Mountains, Units 7 and 15 general sheep hunter[a], residency and success, 1989-93.

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1989/90	6	2	0	8(6)	46	66	1	125(95)	132
1990/91	23	10	--	33(20)	72	53	4	134(80)	167
1991/92	15	20	3	40(19)	80	85	4	173(81)	213
1992/93	22	10	1	33(14)	76	107	7	200(86)	233
1993/94	21	6	5	33(12)	120	110	4	235(88)	268

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

Table 7. Kenai Mountains, Units 7 and 15 general sheep harvest chronology percent by time period, 1989-93,

Regulatory year	Harvest Periods						
	8/10-8/16	8/17-8/23	8/24-8/30	8/31-9/6	9/7-9/13	9/14-9/20	*n*
1989/90	75	0	13	13	0	--	8
1990/91	56	3	13	19	3	6	32
1991/92	63	5	`8	10	3	13	40
1992/93	48	19	10	13	3	7	31
1993/94	66	13	9	0	0	13	32

Table 8. Kenai Mountains, Units 7 and 15 general sheep harvest percent by transport method, 1989-93.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1989/90	13	0	75	0	0	0	13	0	8
1990/91	27	3	36	3	0	0	27	3	33
1991/92	50	0	20	0	0	0	30	0	40
1992/93	49	0	24	0	0	0	27	0	33
1993/94	36	3	36	0	0	0	18	6	33

LOCATION

GAME MANAGEMENT UNIT: 9, 16, 17, 19 (approximately 4600 mi^2)

GEOGRAPHICAL DESCRIPTION: All sheep habitat within the Alaska Range west and south of Denali National Park and Preserve

BACKGROUND

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

ADF&G revised management plans (G Bos, pers commun, 1988) to recognize that diversified human recreational uses of Dall sheep include both consumptive and nonconsumptive uses. Nonconsumptive uses include viewing and photography. The spectrum of consumptive use objectives for this species includes maximum opportunity to hunt, opportunity to hunt under aesthetically pleasing conditions, and opportunity to harvest unusually large rams as trophies. Providing opportunity to hunt sheep under aesthetically pleasing conditions is the present consumptive use objective in the Alaska Range West (ARW).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

- Manage to maintain the existing Dall sheep populations at recorded levels of abundance and productivity.

- Manage for sustained uncrowded hunting conditions by monitoring hunter participation and location and assessing hunter satisfaction with hunting experiences in the ARW.

- Manage for a sustained harvest of more than 100 legal rams per year with a mean horn length of more than 34 inches and a mean age exceeding 8 years.

METHODS

Aerial surveys were flown in 1994 and 1995 to determine sex and age composition in permanent trend count areas. Harvest and hunting pressure were monitored by requiring harvest ticket reports from all hunters.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In 1974 an estimated 3200 sheep inhabited the area. In 1978, following a more comprehensive survey, Shepherd (1979) estimated the sheep population at 4000-5000. In 1984 and 1985 (Pegau 1985, 1986, respectively) the sheep population was thought to be about 4000 animals. Increases noted between 1974 and 1978 were probably a result of more comprehensive surveys and not due to any significant changes in the sheep population. Reports from guides and other hunters in the area indicate that sheep populations are not greatly different from past years. Sheep surveys conducted in 1994 and 1995 did not include the entire ARW, so overall population size was not determined.

Sheep population status may be superficially inferred from harvest data. Sheep harvests in the ARW were relatively light before the mid-1960s (mean reported harvest from 1962 to 1967 was 60 rams). From 1968 through 1995, the mean number of rams reported harvested was 112. This mean, however, has varied considerably (low of 71, high of 157) depending upon weather and regulations regarding what constitutes a "legal" sheep. During the past 5 years, harvest has averaged 138 rams (range 126-151). Based on hunter success rates and numbers of rams harvested, sheep populations have been relatively stable the past decade.

If there are 4000-5000 sheep in the population, the harvest rate is about 3% and should be easily sustainable. If this is the case, present harvest levels may be maintained indefinitely without depleting the population.

Population Composition

Permanent trend count areas for sheep were established in the ARW in 1994 and 1995. Six areas totaling 479 mi^2 were surveyed in 1994 and 7 areas totaling 515 mi^2 were surveyed in 1995. Counts for all trend count areas in 1994 totaled 827 sheep (1.73 sheep/mi^2) with 20.4% lambs and 25.8% rams. Of the 213 rams surveyed in 1994, 72 were judged as full-curl or legal rams. Counts for all trend count areas in 1995 totaled 1147 sheep (2.23 sheep/mi^2) with 19.7% lambs and 20.4% rams. Of the 234 rams surveyed in 1995, 85 were judged as full-curl or legal rams.

If survival in the ARW is similar to that projected from Murie's (1944) data from Denali Park, a population of 4000 Dall sheep could be expected to produce about 850 lambs annually. These lambs should provide a 222-ram increment at age 7 years if survival is not greatly different than in Denali Park. The recent harvest average of 132 rams per year is approximately 60% of the anticipated increment under these conditions.

Distribution and Movements

No studies of sheep movements have been undertaken on ARW sheep during this reporting period. However, based on incidental observations and analyses of kill locations reported by hunters, probably no significant shifts have occurred in sheep harvest distribution within the ARW. The north side of the Alaska Range from Denali Park west to Big River produces most of the harvest. From Big River south, the Lake Clark National Park sheep habitat seems less than optimum.

MORTALITY

Harvest

Season and Bag Limit. The Alaska Range west of Denali Park in Units 9, 16, 17, and 19 has had an open season from 10 August through 20 September for over 20 years. Bag limit for the area during this reporting period was 1 ram having full-curl or larger horns. Historically, the bag limit was 1 ram with 3/4-curl or larger horns until 1979, when it was changed to a 7/8-curl minimum that was in effect until 1989.

Hunter Harvest. Reported harvest of sheep within the ARW probably approximates actual harvest. Few illegal or unreported harvests are thought to occur. During the last 5 years, harvest has been fairly stable with a reported average harvest of 138 sheep (Table 1).

During the previous 5 years, mean reported horn length in the harvested segment of ARW rams has not changed significantly and remains between 35 and 36 inches (Table 1). During the 1994 season, mean reported horn length was 35.3 inches. Ages of harvested rams during 1994 averaged 8.7 years, not significantly different from any of the age data for the previous 5 years.

Hunter Residency and Success. A significant proportion of hunters utilizing the ARW sheep population are nonresidents. During the 1993-1994 regulatory year, 47% were not Alaskan residents; in 1995 this nonresident proportion rose to 47.5% (Table 2). Because these hunters are generally guided by licensed guides, their success rates are significantly higher than resident hunters; during 1993, 44% of resident hunters were successful while nonresidents indicated a 64% success rate. During 1994, 41% of the resident hunters were successful while 63% of nonresidents were successful. Overall reported success rates have been at least 50% since 1977.

Harvest Chronology. Chronology of the sheep harvest in the ARW is somewhat dependent on weather conditions during the season. As a general rule, however, over half the harvest occurs during the first 2 weeks of the 6-week season, when weather is less likely to adversely restrict access (Table 3).

Transport Methods. Since the late 1970s, aircraft provided 80%-90% of access to the ARW for sheep hunters. There are no occupied villages within or adjacent to sheep habitat, no roads bisecting the area, and drainages generally are not conducive to boat travel. Other access means are minor in comparison with that provided by aircraft (Table 4) and changed little during the preceding 5-year reporting period.

Other Mortality

Natural mortality among the ARW sheep is thought to be typical for Dall sheep. Winters within the portion of the Alaska Range have not been especially extreme over the last 5 years. I suspect that wolf predation effects may become more pronounced in the next few years with the change in land-and-shoot harvest methods for wolves. That mortality factor should be investigated.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

The unregulated guide/outfitter industry in the ARW is suspected to be negatively affecting the sheep hunting experience in several drainages where access is readily available. We are not achieving our goal of hunting under uncrowded conditions. In one of the more popular drainages, for example, up to 17 different guide/outfitters were operating during the 1994 season. The Big Game Commercial Services Board should be encouraged to adopt reasonable guide/outfitter regulations as soon as possible.

CONCLUSIONS AND RECOMMENDATIONS

The management objective of providing an aesthetically pleasing hunting opportunity is apparently being attained in the ARW at present except for a few problem areas with easy access and unlimited outfitting activity. To better respond to changes in the demographic parameters of the sheep population, productivity, population status, and population trend data should continue to be collected annually.

Full-curl restrictions seem to be regulating the harvest of rams within the ARW. Unless weather, disease, or predation effects become prevalent, the current regulations seem to be capable of sustaining the Dall sheep population in the ARW. At this time, I have no recommendations for regulation changes.

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Table 1 ARW Mountains reported sheep harvest, 1989-1994

Regulatory year	Rams	$\bar{x}$ horn length (inches	% ≥ 40"	Ewes	Total sheep
1989-1990	141	35.8	5.0	0	141
1990-1991	151	36.1	7.8	0	151
1991-1992	139	36.0	5.8	0	139
1992-1993	126	35.4	7.9	0	126
1993-1994	142	35.8	8.5	0	142
1994-1995	132	35.3	1.5	0	132

Table 2 ARW Mountains reported sheep hunter residency and success, 1989-1994

Regulatory year	Successful				Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	
1989-1990	4	57	80	141 (59)	5	64	29	98 (41)	239
1990-1991	0	49	102	151 (55)	9	70	44	123 (45)	274
1991-1992	1	53	80	134 (54)	1	81	34	116 (46)	250
1992-1993	1	45	73	126 (57)	4	67	24	97 (43)	223
1993-1994	1	58	80	142 (54)	2	73	44	121 (46)	263
1994-1995	4	51	76	132 (52)	2	76	45	123 (48)	255

[a] Local hunters are those residing in Units 9, 17, or 19.

Table 3 ARW Mountains reported sheep harvest[a] chronology percent by time period, 1989-1994

Regulatory year	Harvest periods							
	8/10-8/16	8/17-8/23	8/24-8/30	8/31-9/6	9/7-9/13	9/14-9/20	Unk	*n*
1989-1990	37	22	17	7	7	9	1	141
1990-1991	46	12	10	14	9	8	2	151
1991-1992	42	9	16	14	6	12	1	139
1992-1993	34	13	26	9	13	3	2	126
1993-1994	46	12	12	11	10	4	4	142
1994-1995	42	17	8	16	7	4	7	132

[a] No permit hunts in ARW.

Table 4 ARW Mountains reported sheep harvest percent by transport method, 1989-1994

Regulatory year	Percent of harvest								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1989-1990	83	6	2	3	0	3	< 1	3	141
1990-1991	86	6	2	2	0	0	< 1	4	151
1991-1992	79	5	2	5	0	1	< 1	8	134
1992-1993	83	9	0	4	0	4	0	0	126
1993-1994	83	8	1	4	0	3	0	<1	142
1994-1995	75	11	4	6	0	1	0	< 1	132

LOCATION

GAME MANAGEMENT UNIT: 11 (13,300 MI^2)
South Wrangell Mountains

GEOGRAPHICAL DESCRIPTION: Chitina Valley and the eastern half of the Copper River Basin

BACKGROUND

Dall sheep inhabit most alpine and subalpine areas of the Wrangell Mountains and have a long history of being hunted for sport and subsistence purposes. The Wrangell Mountains are famous for trophy-sized rams. Little information is available on the number of sheep harvested before 1962 because harvest data were not collected. Since 1962 harvest reports have provided managers with numbers and locations of harvests.

In late 1978 the Wrangell Mountains, including all of Unit 11, was designated as a National Monument. During the 1979 hunting season only subsistence hunting by local rural residents was allowed under National Monument regulations.

Wrangell-St. Elias National Park and Preserve was established by the Alaska National Interest Lands and Conservation Act (ANILCA) in 1980. Harvest of sheep in the portion designated as Park was limited to subsistence hunting by rural residents of designated communities within Units 11, 13, and 12. Sport hunting for sheep in the Preserve areas was open to residents and nonresidents. Effective 1 July 1990, all Alaska residents were considered subsistence hunters under state law. However, subsistence hunting in the Park was still limited to local residents under federal regulations.

Estimates of historical sheep numbers in the Wrangell Mountains are unavailable. Sheep surveys flown during the late 1950s and 1960s are generally not comparable because survey intensity and specific areas counted are unknown. Specific count areas and techniques for aerial surveys were established in 1973 when sex and age composition surveys were flown over large portions of the Wrangell and Chugach Mountains. Additional surveys to census sheep and to determine sex and age composition have continued to date.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

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

METHODS

Aerial surveys were conducted during most years to determine sex and age composition and population trends of sheep in selected count areas within Unit 11. Harvests and hunting pressure were monitored by requiring harvest ticket reports from all hunters.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Survey data for selected sheep trend count areas surveyed during this reporting period in Unit 11 are presented in Table 1.

The most recent surveys covered Count Areas 11 and 12, located between the Dadina and Kuskalana Rivers; CA 14, the Crystalline Hills; and CA 22, Hawkins Glacier. In CA 11 the lowest sheep count occurred in 1993 with 268 animals observed. By 1995 the number of sheep counted in this area had increased by 21% to 347, but this latest account is still 14% below the average count ($\bar{x}$ = 404, range = 268-559) for all fixed-wing surveys since 1981. The 1993 sheep surveys in both count area 12, (adjacent to CA 11) and CA 22 resulted in the highest number of sheep observed to date during fixed-wing surveys. In the Crystalline Hills the number of sheep counted declined by 62% from 1980 and by 36% between 1993 and 1994.

Population Size

Historical information on the size of the Unit 11 sheep population is limited. Maximum ADF&G Super Cub counts from the established count areas indicated a minimum of 4000 sheep inhabited the Wrangell Mountains from Mount Drum, southeast to the Canada border. An extrapolated population estimate of 5,071 (+- 137) was obtained for this portion of the Wrangell Mtns. in Unit 11 by the NPS during 1992 (Strickland et al. 1993).

The National Park Service (NPS) conducted sheep surveys in Wrangell-St. Elias National Park and Preserve during 1990 and 1991 (McDonald et al. 1990; 1991). NPS estimated 25,972 sheep +- 6,233 (95% CI) in 1990, and 27,972 sheep +- 6,448 (95% CI) in 1991. Areas counted in the NPS surveys included the northern Wrangell Mountains (Unit 12), and the eastern Chugach Mountains. In 1992 Strickland et al. revised the NPS estimate to 17,455 +- 3,883 sheep in the Wrangell Mtns.

Population Composition

The percentage of lambs in the population during 1993 ranged from 21% in Count Area 22 to 7% in CA 12. All count areas except CA 22 showed a decline in lamb production or survival during 1993, with the decline continuing in CA 14 during 1994. Unfortunately sheep counts were not conducted between 1990 and 1992, a period with severe winter weather. Lamb production and/or survival increased in CA 11 during both 1994 and 1995. The number of rams counted during aerial surveys declined in CA's 11 and 12 in recent years (Table 1). The largest decline was in the number of legal rams observed. In CA 22 only full-curl rams declined while in CA 14 rams increased slightly.

Distribution and Movement

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

MORTALITY

Harvest:

Seasons and Bag Limit. The open season for resident and nonresident sheep hunters was 10 August through 20 September, and the bag limit was 1 sheep for resident (subsistence) hunters and 1 ram with full-curl horn or larger for nonresident hunters. Guides were required for nonresident sheep hunters.

Board of Game Actions and Emergency Orders. Before 1978 the bag limit was 1 ram with 3/4-curl or larger horns. Beginning in 1978, the minimum horn size was increased to 7/8-curl or larger. In 1989 the bag limit was changed to 1 sheep (any size or sex) for subsistence hunters and 1 ram with full-curl or larger horns for sport hunters. Subsistence hunters for the state were defined as any Alaska resident. No emergency orders restricting the take or season on sheep in this portion of Unit 11 have been issued during this reporting period.

Hunter Harvest. The reported sheep harvest varied from 114 to 170 animals during the period from 1990-1994 (Table 2). The number of ewes killed during this period is also presented in Table 2. Ewe harvests have decreased during the past 2 years after peaking in 1992 with a reported kill of 36. During 1994 there were 84 rams taken with reported horn sizes large enough to consider them mature. Between 1990 and 1994 the number of rams taken that could fall into the mature ram category averaged 107 a year (range = 84-128). The number of rams with especially small horns or estimated age < 6 years, indicating immature rams taken for subsistence, has averaged 17 a year (range = 11-22).

Harvest reporting requirements provided horn measurements of sheep harvested from Unit 11 (Table 3). Average horn size data from specific areas in the unit were compared year-to-year and within the unit. Table 3 details average horn size in the harvest by harvest location. The Eastern Region includes the area from the Nizina River to the Canada border. The Mid Region includes the area from the Dadina River to west of the Nizina River. The Western Region includes that area of the northern and western Wrangells from Jack Creek to the Dadina River.

Average horn size varied annually from within each of the regions. Historically, sheep horn size has decreased from east, to west and north. Contributing factors are suspected to include favorable habitat, weather conditions, and genetic influence. The world record sheep came from the Eastern Region of the Wrangells, an area which produces a number of large sheep every year.

Hunter Residency and Success. The number of reported sheep hunters in Unit 11 is presented in Table 4. Between 1990 and 1994 the number of sheep hunters averaged 365 per year. Hunting effort during this period increased by 53% over the prior 5-year period from 1986-89 when an average of 238 hunters (range 220-258) reported hunting in the Wrangell Mountains. During this period the overall hunter success rate declined yearly from a high of 49% in 1990 to 31% in 1994.

Local residents averaged 31 sheep a year (range = 22-42) during the reporting period while nonlocal residents averaged 79 (range = 59-98) and nonresidents 30 (range = 22-41). During this 5-year period, locals averaged 21% of the yearly harvest, nonlocals 54%, and nonresidents 20% with 5% residency unknown. In comparison, for the 5-year period between 1985-89, locals

reported taking an average of 20 sheep a year (range = 16-25), nonlocals 53 (range = 49-57), and nonresidents 33 (range = 20-42). Between 1985-89 the local harvest averaged 18% of the kill, nonlocal hunters averaged 46%, and nonresidents 29% with 7% unknown. The most successful group of sheep hunters were nonresidents, having an average success rate of 75% compared to 36% average success rate for locals and 35% for nonlocal hunters.

The average number of days hunted annually by successful hunters ranged from 4.5 to 5.2 days and averaged 4.8 days between 1990 and 1994 (Table 5). The average number of days hunted annually reported by unsuccessful sheep hunters for the same period ranged from 4.3 to 5.7 days and averaged 4.8 days. Hunting effort declined during this reporting period compared to the 5-year period from 1985-89 when successful hunters averaged 5.2 days and unsuccessful 5.3 days hunting.

The observed decline in average hunt length of time for successful hunters was probably due to the increased number of sublegal rams and ewes taken for subsistence. Young rams and ewes are more numerous and accessible than large mature rams. The reason for the decline in hunting effort by unsuccessful hunters is unknown.

Harvest Chronology. Table 6 presents harvest chronology data for sheep taken in Unit 11. During much of this reporting period, the first 2 weeks of the sheep season had the highest harvest.

Transportation Methods. Aircraft were the primary mode of transportation for successful sheep hunters in Unit 11 (Table 7). The percentage of successful hunters using aircraft decreased in the last few years, as hunters tried using alternate and less expensive transportation methods. Opening a subsistence season for small rams and ewes allowed hunters to use alternate transportation methods as roadside habitats often contain huntable numbers of legal subsistence sheep but not full-curl rams.

Other Mortality

Studies of natural mortality of sheep in the area have not been conducted in recent years. Sources of natural mortality common to sheep populations include accidents and starvation during periods of deep snow and icing. Wolf predation has also been observed in portions of Unit 11. Reports by trappers and local residents suggested wolf predation may be an important mortality factor; however, predation rates have not been determined. Field observations by ADF&G personnel also substantiate wolf predation on sheep throughout Unit 11.

HABITAT

Assessment

Studies of sheep habitat assessment or carrying capacity have not been conducted in the Wrangell Mountains. A subjective evaluation based on sheep numbers and horn growth indicated most of the area consists of quality sheep habitat. The lack of adequate escape habitat in areas with high wolf numbers may be more limiting than food.

CONCLUSION AND RECOMMENDATIONS

Historically, the Dall sheep in the Wrangell Mountains were considered abundant and the population seemed productive. Population estimates, however, were difficult to obtain because of the expense and logistical problems with conducting surveys throughout the Wrangell Mountains. Earliest population estimates often utilized surveys conducted over a period of years. The current population estimates of between 17,000 and 27,000 sheep obtained by the NPS represent the best total count figures available to date. I do not consider the differences in these estimates to reflect changes in sheep numbers between years. Both estimates were obtained as a result of research projects designed to develop different methods of counting sheep. The differences in the resulting population estimates probably reflect differences and refinement of counting technique.

Annual sheep surveys have been difficult to maintain in Unit 11 due to budget constraints. Surveys have been conducted in years when funding was available but unfortunately yearly continuity was lost, especially from 1990-1992. In the future, an emphasis should be maintaining annual counts on at least 3 count areas to provide yearly production and survival estimates for lambs in various regions of the Wrangells.

Population trends are difficult to determine from trend counts when they are completed only infrequently and when only 1 small area is counted with any degree of consistency. Even though there is limited data, sheep numbers did seem to decline in the Western portion of Unit 11 extending from Long Glacier to at least the slopes of Mt. Drum. The latest survey data from CA 11 indicate the decline may be over and sheep numbers stabilized or increased. Additional field observations by the public and ADF&G staff during flights along the western portions of Unit 11 also support the conclusion that sheep numbers declined in this area. Additional trend count data from CA's 22 and 12 do not suggest that sheep numbers declined unitwide. However, local fluctuations have occurred as evidenced by a large decline in the Crystalline Hills.

Available composition data indicate a period of reduced lamb production and survival along the slopes of Mt. Drum and extending eastward at least to the Kennicott Glacier. The 1993 survey data from the Hawkins Glacier suggest lamb production and/or survival was higher in the eastern portion of Unit 11. Snow survey records for the Copper River Basin show a period of severe winters with deep snow conditions from 1990-1995. Severe winter conditions and increased predation could decrease lamb production or survival. Unfortunately survey data are not available for 1990-92 when the winters were the worst.

Sex and age composition data indicate a decline in the number of full-curl rams in recent years. This would be expected as the definition of legal rams has been increased from 3/4 to 7/8, then full curl. It is a safe assumption the most sought after class of sheep in the Wrangell Mountains is the full-curl ram. This area has the potential to produce large rams and draw hunters seeking such animals. Our increasing hunting pressure on the full-curl segment of the population assures a full-curl ram decline.

In CA 11 the number of smaller rams also declined. This was not a result of hunting and human harvests. Over the past 5 years, harvest locations for small rams taken by subsistence hunters indicate none was taken from CA 11. The decline in small rams is attributed to increased natural

mortality or lack of lamb recruitment. In CA 14, the Crystalline Hills, rams actually increased even though this area had a subsistence harvest of small rams.

The number of large or mature rams harvested in Unit 11 peaked in 1991, then declined. Ewe harvests increased from the initial opening of the season in 1990 until 1992, then declined. The subsistence harvest of small rams exhibits a similar pattern but the harvest peaked in 1993, then declined in 1994. The decline in the ram harvest is probably a result of fewer numbers of full-curl rams present in the population and available for hunters. Despite a decline in the harvest, the opportunity still exists to take large, mature rams.

The decline in the harvest of ewes and small rams is unexplainable. Counts in every portion of the unit indicate ewes and small rams are abundant enough to sustain the small harvests obtained so far. Ewe and small ram harvests have to date been dispersed enough that no area has been singled out for overharvesting.

The number of sheep hunters increased in Unit 11 during the reporting period. Sheep hunting in the Wrangell Mountains increased in popularity appreciably compared to prior reporting periods. Most of the increase in hunters was attributed to residents of Alaska, with nonresident hunters remaining relatively constant. One factor limiting nonresident participation is that a guide is required to hunt sheep. Nonlocal Alaskan residents harvested over half the sheep taken, followed by local residents, then nonresidents.

The impact of wolf predation on sheep numbers is unknown. Reported incidental observations of wolf predation on sheep in Unit 11 indicate it is relatively common. Research is needed to determine the exact level and influence wolf predation has on sheep abundance.

At this time, no changes in season dates or bag limits are recommended. The department should, however, continue to monitor harvests of mature and immature rams and ewes. Also, we need to emphasize maintaining composition trend counts, especially since there is a ewe harvest. Heimer (1986) stated a ewe harvest greater than 2% could lead to a population decline. The current subsistence harvest of ewes, and small rams, is low and widely dispersed, although more hunting pressure occurs in areas accessible by transportation means other than aircraft. To date I can find no evidence a low level ewe and small ram harvest has had any effect on sheep numbers in Unit 11.

The entire unit is open to any sheep and some consideration should be given to creating a trophy management area where all but very large rams are protected. Such an area would allow for a high quality sheep hunt for very large rams. The area between the Nizina and Chitina Rivers is an area in Unit 11 that should be considered a possible location. Management options to obtain this objective include reducing the bag limit to a sheep every 2 to 4 years or a drawing for a limited number of permits for full-curl rams.

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Table 1. GMU 11 summer aerial sheep composition counts and estimated population size, 1981-95.

Regulatory Year	Rams[a]					Ewes[b]	Lambs	(%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full curl	(%)	3/4-full curl	1/2-3/4 curl	<1/2 curl						
COUNT AREA 11 - DADINA TO LONG GLACIER											
1981	24	4%	48	-	-	359	126	23%	168.8	557	557
1983	12	3%	59	-	-	283	60	14%	118.3	414	414
1986	52	9%	71	-	-	330	106	19%	192.8	559	559
1989	28	8%	24	-	-	231	78	22%	109.4	361	361
1993	25	9%	36	-	-	172	35	13%	76.6	268	268
1994	18	6%	21	-	-	197	85	26%	84.5	321	321
1995	9	3%	18	-	-	237	83	24%	102.0	347	347
COUNT AREA 12 - LONG GLACIER TO KUSKULANA											
1973	51	12%	--	-	-	---	47	11%	---	410	410
1981	26	5%	52	-	-	359	129	23%	---	566	566
1982	60	12%	49	-	-	341	64	12%	111.7	514	514
1983	65	13%	67	-	-	290	68	14%	122.5	490	514
1993	36	6%	67	-	-	426	39	7%	145.6	568	568
COUNT AREA 14 - CRYSTALLLINE HILLS											
1980	2	1%	5	-	-	142	60	29%	90.9	209	209
1993	13	10%	8	-	-	85	18	15%	103.3	124	124
1994	5	6%	12	-	-	56	6	8%	79.0	79	79
COUNT AREA 22 - HAWKINS GLACIER											
1970	35	14%	13	-	-	131	61	25%	--	246	246
1981	27	11%	28	-	-	143	51	20%	71.1	249	249
1984	33	14%	34	-	-	125	43	18%	94.0	235	235
1993	20	7%	31	-	-	190	63	21%	86.9	304	304

[a] Legal rams included under "Full-curl" column, Sublegal rams included under "3/4-full curl" column. Prior to 1989, 7/8ths curl horn or larger were legal. After 1989, full curl horn or larger were legal for sport hunting, and for subsistence hunting, any ram was legal.

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

Table 2. Unit 11 Wrangell Mountains sheep harvest, 1990-94.

Regulatory year	Rams[a]	Average horn length (in)[b]	% ≥ 40 in	Ewes	Total[c] sheep
1990/91	134	35.3	7	13	147
1991/92	146	35.1	8	24	170
1992/93	123	35.1	14	36	159
1993/94	122	36.1	9	21	143
1994/95	96	35.8	10	18	114

[a] Before 1989, rams with 7/8-curl horns or larger were legal for sport hunting. Beginning in 1989, rams with full-curl horns or larger were legal for sport hunting and any sheep was legal for subsistence hunting.
[b] Average of only "legal " rams.
[c] Includes sheep not classified as to sex.

Table 3. Unit 11, Wrangell Mountains, harvest numbers for adult rams and average horn lengths, 1990-94.

Region	1990/91		1991/92		1992/93		1993/94		1994/95	
	n	Average horn length	*n*	Average horn length	*n*	Average horn length	*n*	Average horn length	*n*	Average horn length
Eastern	42	37.9	36	36.8	37	37.4	40	37.5	36	36.8
Middle	41	34.3	49	34.8	34	33.9	35	35.1	29	35.2
Western	35	33.2	37	34.6	22	31.7	10	32.1	15	34.2
Unknown	5	35.2	6	36.1	7	37.5	1	39.0	0	--
Total	123	35.3	128	34.6	100	35.0	86	36.0	80	35.8

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

Table 4. Unit 11, Wrangell Mountains, sheep hunter residency and success, 1990-94.

Regulatory year	Successful					Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Non-resident	Total[b]	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total[b]	
1990/91	36	59	41	147	(49)	58	80	8	151	298
1991/92	42	93	33	170	(43)	64	144	14	227	397
1992/93	32	98	22	159	(41)	53	159	7	229	388
1993/94	22	83	27	143	(39)	50	158	10	228	371
1994/95	22	64	26	114	(31)	43	195	12	255	369

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

Table 5. Unit 11 Wrangell Mountains sheep hunting effort[a], 1990-94.

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
1990	144	749	5.2	148	831	5.6	292	1,580	5.4
1991	170	789	4.6	224	1,071	4.8	394	1,860	4.7
1992	157	736	4.6	229	1,075	4.7	388	1,811	4.7
1993	143	645	4.5	228	978	4.3	371	1,714	4.6
1994	111	580	5.2	252	1,213	4.8	363	1,793	4.9

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

Table 6. Unit 11 Wrangell Mountains sheep harvest chronology percent by time period, 1990-94.[a]

Regulatory year	Harvest periods							n[a]
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	
1990/91	14	28	8	15	10	14	10	138
1991/92	18	13	15	15	9	14	16	163
1992/93	22	28	16	13	13	4	3	155
1993/94	21	32	10	11	12	9	5	142
1994/95	25	25	10	10	16	7	7	104

[a]Includes only reports with date of kill.

Table 7. Unit 11 Wrangell Mountains sheep harvest percent by transport method, 1990-94.

Regulatory year	Percent of harvest								*n*
	Airplane	Horse	Boat	3-or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
1990/91	48	6	6	21	0	3	16	0	145
1991/92	41	5	3	23	0	1	22	5	170
1992/93	33	--	4	21	0	6	33	3	159
1993/94	38	2	8	15	0	4	32	1	143
1994/95	35	12	10	21	0	4	18	0	114

LOCATION

GAME MANAGEMENT UNITS: 11, 13D, 14A AND 14C (13,200 MI^2)
GEOGRAPHICAL DESCRIPTION: Chugach Mountains

BACKGROUND

Large numbers of miners, railroad workers, and market hunters probably decimated Dall sheep populations in accessible areas between Turnagain Arm and the Knik River beginning around 1900. A thorough aerial survey of 29,000 square miles of potential sheep range in 1949 found numbers 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, but in accessible areas illegal hunting was also a major factor.

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 Subunit 14C) and 185 between the Knik River and Matanuska Glacier (now Subunit 14A and a portion of 13D). Current sheep populations in Subunit 14C are over 4 times higher than in 1951.

Sport hunting was not considered to have had much influence on sheep populations in the Territory. However, the annual harvest reported to the U. S. Fish and Wildlife Service was 3-4 times higher in the mid-1940s compared with a decade earlier, increasing from about 200/yr to about 600/yr (Scott et al. 1950). 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 about this time to protect sheep which otherwise might have been hunted out (Scott et al. 1950). The sheep hunting season was reopened in 1961, except for the Rainbow Closed Area, which extended along Turnagain Arm from Potter to Girdwood.

In 1968 all of the sheep habitat bounded by the Knik River, Turnagain Arm, Lake George and the Twentymile River was established as the West Chugach Controlled Use Area. No motorized vehicles, other than boats and airplanes, were allowed for hunting or transporting game in this area during the sheep hunting season. In 1971 much of this area was incorporated in the Chugach State Park, which continued to allow sheep hunting in most of the park, but also prohibited all motorized access, except along the north side of Eklutna Lake. The bag limit for 3/4-curl rams was restricted to 7/8-curl rams in 1979. This regulation remained in effect for 10 years. Because of increasing demand for sheep hunting in Subunit 14C, a drawing permit was instituted beginning in 1982 to maintain the number of large rams and uncrowded hunting conditions.

As the number of sheep increased through the 1980s, managers became concerned about exceeding the carrying capacity of the range. Sheep populations are regulated primarily by deep snow and ice cover. However, if vegetation on winter ranges is depleted by overabundant sheep, severe snow and ice conditions could have an even greater effect. Consequently, the bag limit was

changed to "any sheep" in 1989 to better control the population through ewe harvests. This regulation remained in effect through 1995.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Maintain a minimum harvest of 120 full-curl or larger rams.

METHODS

From 1994-1995 we conducted summer aerial sex and age composition surveys, identified and documented critical sheep habitat, mineral licks, lambing areas, harvest location, and the number and horn size of harvested sheep. Aerial sex and age composition surveys were completed in Unit 14C in 1994 and 1996, but not in 1995. The most recent, albeit partial, surveys in Unit 14A and Unit 13D were flown in 1995 and 1994, respectively. In 1995 volunteers from the local chapter of the Foundation for North American Wildlife Sheep (FNAWS) hiked in to Chugach State Park in Unit 14C to determine sex and age composition of ewe bands at known mineral licks.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

An estimated 6000-7000 sheep inhabit the Chugach Mountains, including about 400 in Unit 11. An estimated 1100 and 2500 sheep inhabit Units 14A and 14C, respectively (Tables 1 and 2). It is difficult to estimate the Unit 13D population based on partial aerial surveys in 1992, 1993, and 1994; however, assuming a Dall sheep population can sustain an annual harvest of full-curl rams that is 3% of the total population, Unit 13D may have as many as 2000-3000 sheep.

Sheep numbers in the western Chugach Mountains (Unit 14C) have remained relatively stable (2200-2500 sheep) since 1987 (Table 1). In Unit 14A sheep numbers have maintained an increasing trend through 1995 (Table 2). Total sheep observed increased over 50% in Unit 14A count areas repeated between 1992 and 1995. The status of the sheep population in Unit 13D was uncertain because of the absence of recent extensive aerial surveys (Table 3). However, considering recent severe winters and limited surveys, we believe numbers of sheep probably declined 15%-20% since the late 1980s in most of the Unit 13D portion of the range.

Population Composition

Since 1991 the percentage of 7/8-curl and larger rams in Unit 14C increased slightly from 10% to 13%. The percentage of young rams declined approximately 20%. The percentage of lambs has fluctuated from 12%-18%, probably reflecting winter conditions. Numbers of ewes and yearling rams remain high, slightly over one-half of the total population.

The number of full-curl rams in Units 13D and 14A were 2%-6% of total sheep observed. Lamb production in both units was higher than usual in 1992 (20%-21%) but dropped to 8% in Unit 13D in 1994. A lack of recent data precludes meaningful assessment of herd composition for these populations.

Distribution and Movements

Sheep distribution and movements during the summer months have been documented by aerial surveys. Major latesummer concentration areas have also been determined from harvest records and discussions with hunters. Although sheep were found throughout the mountain range below 7500 feet elevation, concentrations vary greatly among drainages. In Unit 14C, the Eagle River and Eklutna-Goat Creek drainages supported the largest numbers of sheep. In Unit 14A moderate numbers of sheep frequented the upper reaches of Coal, Carbon, Carpenter, Wolverine, Metal, and Friday creeks. In Unit 13D sheep were most abundant between the Nelchina and the Klutina Glaciers.

Little is known about winter distribution patterns except that most sheep frequent relatively snow-free areas and windblown ridges above 3000 ft elevation. 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 Units 13D and 14A the seasons were from 10 August to 20 September. The bag limit was 1 ram with full-curl horn or larger.

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

In the remainder of Unit 14C the season was 10 August to 30 September and the bag limit was 1 sheep by drawing permit only. A late season (1-10 October) archery hunt had a bag limit of 1 sheep by drawing permit only.

Board of Game Actions and Emergency Orders. Inspring1989, the Board of Game passed a regulation requiring all sheep taken in the Chugach Mountains have horns full-curl or larger, except in Unit 14C where the bag limit was changed to "any sheep" under a drawing permit. The rationale for the full-curl regulation, supported by the department, was to increase the number of large rams and improve productivity.

The "any sheep" bag limit in Unit 14C was intended to stabilize growth of the large population. The sheep population remained large, however, because many sheep hunters were looking for large rams and were unwilling to shoot ewes. Hunters who were interested in harvesting a sheep only for its meat were unlikely to apply for a permit because of the low odds of being selected (2%-4%). Few ewes were harvested under the "any sheep" regulation (Table 6). Unable to find a large ram, some permittees settled for young rams. From 1990-1994, hunters in Unit 14C shot 67

rams with horns less than 7/8-curl; i.e., 20% of all rams harvested. Taking young rams reduced the future number of large rams, without helping to control the population.

Therefore, the board established 2 kinds of drawing permits for Unit 14C, beginning in 1996. Up to 250 permits will allow a hunter to take 1 full-curl ram or 1 ewe. A bag limit of 1 ewe only for up to an additional 150 permits was also established. This should increase the number of rams with full-curl or larger horns in the population and allow greater opportunity to control population growth.

In 1996 the Legislature amended Alaska Statute 16.05.343 that allows nonprofit organizations to raffle or auction state hunting permits to provide money for wildlife research and management. The Alaska Chapter of FNAWS petitioned the division for a Dall sheep drawing permit in Unit 14C to be auctioned at the FNAWS national meeting in 1997.

Hunter Harvest. The mean annual harvest for 1994 and 1995 was 184 sheep, compared with 162 sheep in 1991-93 (Tables 4-9). The increasing harvest was the result of more hunters and higher success rates in 1994 and 1995. The number of sheep hunters throughout the Chugach Mountains in 1994 and 1995 was 582 and 574, respectively. The illegal harvest was unknown.

Permit Hunts. From 1991-1993, 240 drawing permits and 105 archery-only drawing permits were issued in Unit 14C (Table 6). We issued fewer drawing permits in 1994 (190) and 1995 (211). Success rates from 1991 to 1994 were 30%-32%, increasing to 36% in 1995. From 1991 to 1993 inclement weather and a decline in the number of young rams reduced harvest (mean annual harvest was 162) compared with the 2 previous years (mean annual harvest in 1989 and 1990 was 198) Since 1991 the number harvested has been relatively stable, except in 1994 when fewer than usual ewes were shot (Table 6).

Hunter Residency and Success. In Units 14A and 14C, nonresident hunters have taken 52 of 507 sheep (10%) during the past 5 years (Tables 7 and 8). In Unit 13D, nonresidents composed 47% (163 of 345) of all successful sheep hunters over the past 5 years (Table 9). Most sheep hunters in Units 14A and 14C were residents of Unit 14; whereas, only 2%-3% of Unit 13D sheep hunters were residents of Unit 13.

Harvest Chronology. Harvest chronology for the nonpermit hunts was influenced by weather patterns and fluctuated slightly year to year (Table 10). Typically, 30%-50% of the harvest occurs during the first week of the season; the second and third weeks hunters take 11%-18% of the animals each week.

Transport Methods. Methods of transport used by sheep hunters differed widely in the units because of motorized access restrictions in Chugach State Park and proximity of roads. In Unit 13D over 60% of successful hunters used aircraft, 11%-18% used highway vehicles, and 5%-9% used horses (Table 11). In Unit 14A, the largest proportion of successful hunters used aircraft, more than those using highway vehicles, and about 20% used either boats or horses (Table 12). The number of hunters using 4-wheelers has increased in recent years. Transport methods in Unit 14C have not changed substantially during the past 5 years, although the proportion using 4-

wheelers has doubled. Approximately 65%-80% of all successful hunters used highway vehicles (Table 13).

Other Mortality

Dall sheep natural mortality is seldom documented in the Chugach Mountains. However, in areas where annual counts occur and the population remains stable from year to year, natural mortality, including predation, is approximately 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.

Beginning in 1989-1990, the sheep population has been affected by a series of harsh winters. An estimated 430 and 477 sheep died in Unit 14C during the severe winters of 1989-1990 and 1992-1993, respectively. These were the largest winter mortalities on record. Mortalities in 1990-1991 and 1991-1992 were 168 and 221, respectively. Natural mortality in 1993-1994 was only an estimated 23 sheep (the last management report erroneously reported 230 mortalities). Apparently the Unit 13D population declined 15%-20% as a result of severe winter weather in 1989-1990 and 1990-1991, and subsequent harsh winters have apparently delayed recovery.

HABITAT

Assessment

Techniques for evaluating sheep winter range in Alaska have not been developed. Snow depth and hardness, rather than range quality or quantity, may be the primary determinant of winter mortality. Funding for winter range evaluation during this report period was unavailable. The FNAWS is evaluating a proposal by Dr Don Spalinger at the University of Alaska–Anchorage to conduct an assessment of sheep winter range in Chugach State Park.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in Unit 14C was stable at 2200-2400 during the early 1990s. Winter mortality among lambs and old ewes on crowded winter range may prevent the population from increasing further. Numbers of full-curl or greater rams are expected to decrease in several years as smaller cohorts of young rams reached maturity. However, the new full-curl and ewe permits should allow numbers of large rams to stabilize short-term and then increase.

The Unit 14A population had maintained its increasing trend through 1995; however, the number of full-curl rams is not likely to increase substantially.

The status of the Unit 13D population is uncertain. Harvests over the past 5 years have increased.

The harvest objective of a minimum of 120 full-curl or larger rams for the Chugach Mountains was exceeded by 19 sheep in 1994 and 11 sheep in 1995. These figures do not include an additional 94 sheep, including 68 rams with 7/8-curl or less horns and 26 ewes, taken from Unit 14C in 1994 and 1995.

A thorough survey of all sheep habitat in the Chugach Mountains is needed to determine the overall population level. Depending on how many sheep are found in Units 13D and 14A, it may be appropriate to increase the harvest objective.

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Table 1. Chugach Mountains, Unit 14C aerial sheep composition counts and estimated population size, 1991-1995.

Regulatory year	Rams ≥ 7/8 curl (%)	Rams 1/2 to 3/4-curl	Ewes[a]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
1991/92	228 (10)	416	1,228	410 (18)	190	2,282	2,500
1992/93	235 (10)	419	1,324	344 (15)	--	2,322	2,600
1993/94	203 (10)	360	1,200	259 (13)	--	2,022	2,200
1994/95	298 (13)	337	1,291	329 (15)	--	2,255	2,500
1995/96[b]	--	--	--	--	--	--	2,500

[a] Includes yearlings of both sexes and rams of 1/4-curl or less.
[b] No survey due to inclement weather.

Table 2. Chugach Mountains, Unit 14A sheep composition counts and estimated population size, 1991-1995.

Regulatory year	Rams Full curl (%)[a]	Rams Sublegal	Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
1991/92[c]	--	--	--	--	--	--	--
1992/93	25 (3)	157	503	176 (20)	72	867[d]	1,100
1993/94[c]	--	--	--	--	--	--	--
1994/95[c]	--	--	--	--	--	--	--
1995/96[e]	15 (10)	27	77	24 (17)	31	143	1,200

[a] Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed.
[b] Includes yearlings of both sexes and rams of 1/4-curl or less.
[c] No survey.
[d] Includes 3 unclassified rams.
[e] Count areas A, B, and portion of C only; data collected during mountain goat survey (during 1992 the same area produced 5 legal rams, 22 sublegal rams, 38 ewes, and 16 lambs for a total of 81 sheep.)

Table 3. Chugach Mountains, Unit 13D sheep composition counts and estimated population size, 1991-1995.

Regulatory year	Rams		Ewes[b]	Lambs (%)	Sheep/ hour	Total sheep observed	Estimated population size
	Full curl (%)[a]	Sublegal					
1991/92[c]	--	--	--	--	--	--	--
1992/93[d]	13 (4)	15	--	65 (21)	53	312[e]	--
1993/94[d]	7 (6)	6	--	13 (11)	21	159[e]	--
1994/95[f]	20 (11)	51	95	14 (8)	180	180	--
1995/96[c]	--	--	--	--	--	--	2,000-3,000

[a] Does not include an unknown number of legal rams at least 8 years old or with both horn tips broomed.
[b] Includes yearlings of both sexes and rams of 1/4-curl or less.
[c] No survey.
[d] Tonsina Controlled Use Area (count areas 11, 12, and 13).
[e] Minimum count, due to inclement weather conditions and poor visibility; most sheep were not classified.
[f] Count area 5.

Table 4. Chugach Mountains, Unit 13D sheep harvest, 1991-1995.

Regulatory year	Rams	Average horn length (in)	% ≥ 40 in	Ewes	Total sheep
1991/92	70	37.0	7	0	70
1992/93	44	37.3	18	0	44
1993/94	62	37.1	11	1	62
1994/95	86	36.7	7	2	88
1995/96	80	37.4	18	1	81

Table 5. Chugach Mountains, Unit 14A sheep harvest, 1991-1995.

Regulatory year	Rams	Average horn length (in)	% ≥ 40 in	Ewes	Total sheep
1991/92	26	36.2	8	0	26
1992/93	20	35.4	5	0	20
1993/94	25	34.9	8	0	25
1994/95	29	36.1	14	0	29
1995/96	19	37.1	21	0	19

Table 6. Chugach Mountains, Unit 14C sheep harvest data by permit hunt, 1991-1995.

Hunt area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Rams	Horn length (inches)[a]	% rams ≥ 40 in.	Ewes (%)	Unk	Total harvest
DS124-129	1991/92[b]	105	16	53	47	28	33.2	4	8 (22)	5	41
Northeast,	1992/93[b]	96	29	44	56	34	35.3	6	4 (11)	0	38
East Eklutna	1993/94[b]	111	26	61	39	24	35.4	8	8 (25)	0	32
	1994/95	42	29	47	53	18	38.2	28	0 (0)	0	18
	1995/96	54	30	58	42	16	37.4	19	0 (0)	0	16
DS130-135	1991/92[c]	18	17	62	38	4	35,5	0	1 (20)	0	5
Northwest,	1992/93[c]	24	21	79	21	2	40.4	50	1 (33)	1	4
Upper	1993/94[c]	33	30	74	26	5	36.3	0	1 (17)	0	6
Eagle River	1994/95	72	19	57	43	17	29.1	6	6 (26)	2	25
	1995/96	90	21	58	42	25	30.6	0	5 (17)	0	30
DS136-138	1991/92	75	27	64	36	17	32.4	0	3 (15)	0	20
Southwest	1992/93	72	22	59	41	19	35.5	0	4 (17)	0	23
	1993/94	69	26	63	37	17	35.1	0	2 (11)	0	19
	1994/95	48	21	55	45	17	32.1	6	0 (0)	0	17
	1995/96	39	21	39	61	14	33.8	0	5 (26)	0	19
DS139	1991/92	30	17	64	36	8	28.7	0	1 (11)	0	9
West	1992/93	48	19	64	36	11	36.2	18	2 (15)	1	14
(late season	1993/94	27	30	74	26	4	37.2	0	1 (20)	0	5
--rifle)	1994/95	28	18	87	13	3	30.6	0	0 (0)	0	3
	1995/96	28	18	78	22	3	33.7	33	2 (40)	0	5

Table 6. Continued

Hunt area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Rams	Horn length (inches)[a]	% rams ≥ 40 in.	Ewes (%)	Unk	Total harvest
DS140	1991/92	80	24	95	5	0	--	0	3(100)	0	3
West	1992/93	80	31	98	2	0	--	0	1(100)	0	1
(late season	1993/94	80	42	87	13	1	31.0	0	5 (83)	0	6
--archery)	1994/95	80	29	93	7	3	31.3	0	1 (25)	0	4
	1995/96	80	36	82	18	6	29.3	0	3 (33)	0	9
DS141	1991/92	25	8	78	22	2	38.7	0	3 (60)	0	5
West Eklutna	1992/93	25	16	91	8	1	32.9	0	1 (50)	0	5
(archery)	1993/94	25	20	75	25	2	--	0	3 (60)	0	5
	1994/95	25	28	94	6	0	--	--	1(100)	0	1
	1995/96	25	36	81	19	2	10.0	0	1 (33)	0	3
Total all	1991/92	345	25	69	31	59	32.8	2	19 (24)	5	83
hunt areas	1992/93	345	25	68	32	67	35.6	8	13 (16)	2	82
	1993/94	345	30	70	30	53	35.4	4	20 (27)	0	73
	1994/95	295	24	70	30	58	33.0	12	8 (12)	2	68
	1995/96	316	27	64	36	66	32.3	6	16 (20)	0	82

[a] Mean length of longest horn on rams with 7/8-curl or larger horns.
[b] Includes Peters and Thunderbird creek drainages.
[c] Upper Eagle River only.

Table 7. Chugach Mountains, Unit 14A sheep hunter[a] residency and success, 1991-1995.

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Total hunters
1991/92	19	3	4	26 (27)	67	2	1	71 (73)	97
1992/93	12	2	6	20 (19)	75	2	6	87 (81)	107
1993/94	22	0	3	25 (22)	82	5	1	91 (78)	116
1994/95	23	0	6	29 (26)	78	3	1	82 (74)	111
1995/96	16	1	2	19 (15)	97	6	3	107 (85)	126

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

Table 8. Chugach Mountains, Unit 14C sheep hunter[a] residency and success, 1991-1995.

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Total hunters
1991/92	73	8	2	83 (31)	166	19	1	186 (69)	269
1992/93	71	3	8	82 (32)	154	17	2	176 (68)	258
1993/94	63	3	4	73 (30)	149	15	2	168 (70)	241
1994/95	50	7	10	68 (30)	141	13	1	156 (70)	224
1995/96	60	15	7	82 (36)	127	14	6	148 (64)	230

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

Table 9. Chugach Mountains, Unit 13D sheep hunter[a] residency and success, 1991-1995.

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Local[b] resident	Nonlocal resident	Nonresident	Total (%)[c]	Total hunters
1991/92	2	33	33	70 (32)	12	110	29	151 (68)	221
1992/93	3	21	20	44 (25)	9	105	19	134 (75)	178
1993/94	2	38	19	62 (34)	13	85	17	118 (66)	180
1994/95	3	39	40	88 (36)	14	120	20	159 (64)	247
1995/96	2	27	51	81 (37)	10	108	18	137 (63)	218

[a] Excludes hunters in permit hunts.
[b] Local means residents of Unit 13.
[c] Total may exceed sum because some hunters fail to report residency.

Table 10. Chugach Mountains, Units 13D and 14A sheep harvest chronology percent by time period, 1991-1995.

	Harvest periods						
Regulatory year	8/10 - 8/16	8/17 - 8/23	8/24 - 8/30	8/31 - 9/6	9/7 - 9/13	9/14 - 9/20	*n*
1991/92	30	17	17	11	10	15	96
1992/93	38	13	11	7	7	2	78
1993/94	39	10	14	8	11	11	93
1994/95	58	13	15	9	11	6	112
1995/96	32	17	17	13	10	10	99

Table 11. Chugach Mountains, Unit 13D sheep harvest percent by transport method, 1991-1995.

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1991/92	67	9	6	5	0	2	11	--	64
1992/93	64	5	9	0	0	2	18	2	44
1993/94	65	5	5	6	0	0	18	2	62
1994/95	64	9	9	0	0	3	13	2	88
1995/96	67	5	7	6	0	0	14	1	81

Table 12. Chugach Mountains, Unit 14A sheep harvest percent by transport method, 1991-1995.

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1991/92	48	4	4	0	0	9	35	--	23
1992/93	30	21	9	15	0	0	24	0	33
1993/94	28	10	10	17	0	3	28	3	29
1994/95	35	3	17	21	0	3	17	3	29
1995/96	53	16	5	5	0	0	21	0	19

Table 13. Chugach Mountains, Unit 14C sheep harvest percent by transport method, 1991-1995.

Regulatory year	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1991/92	9	4	1	4	0	3	80	--	79
1992/93	9	0	9	6	0	0	66	11	82
1993/94	11	0	3	12	0	3	69	3	73
1994/95	6	3	1	15	0	1	72	1	68
1995/96	5	0	6	11	0	0	72	6	82

LOCATION

GAME MANAGEMENT UNIT: Portions of 12 (10,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Mentasta, Nutzotin, and northern Wrangell Mountains

BACKGROUND

The Dall sheep population in the northern Wrangell, Mentasta, and Nutzotin mountains (WMN) traditionally exists at relatively high densities in rugged, glaciated habitats. The WMN mountains sheep population produces rams with horns of below average size, compared with other sheep populations in Alaska (Heimer and Smith 1975). The relative abundance of sheep and production of rams with slightly less than average sized horns indicate that conservative harvest for maximum trophy production would be an unsuitable management strategy for consumptive use in Unit 12 (Kelleyhouse and Heimer 1989). Consequently, the strategic consumptive use goal for Unit 12 is to provide the greatest opportunity to participate in hunting sheep. No restrictions beyond limiting harvest to full-curl rams during the fall hunting season and requiring hunting licenses and harvest tickets are applied in Unit 12 (excluding the Tok Management Area). The evolution of these restrictions has been presented by Kelleyhouse and Heimer (1989).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

- Provide for diversified human recreational use of sheep in the WMN mountains.

MANAGEMENT OBJECTIVES

- Provide the greatest level of sustainable annual opportunity to participate in hunting Dall sheep

- Provide the greatest level of sustainable annual harvest of Dall sheep.

- Monitor harvest through hunter contacts and harvest reports.

METHODS

Methods applied during this reporting period were harvest data collection and analysis. Due to poor weather conditions or financial constraints, we conducted no aerial surveys during 1993-1995. The National Park Service (NPS) completed annual aerial surveys between 1991 and 1993 within portions of Unit 12 in the Wrangell-St. Elias National Park and Preserve (northern Wrangells).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Kelleyhouse and Heimer (1990) reported the Unit 12 sheep population increased between the late 1970s and mid 1980s and then stabilized in 1988. The population declined during the early 1990s. Heimer (1988) found that Dall sheep populations tend toward stability under average prevailing climatic conditions. During the late 1970s until the mid 1980s, weather conditions were primarily mild, but between 1990 and 1992 adverse weather prevailed. Lamb production was low during this period, and the number of legal and sublegal rams declined. Investigators and local long-term residents/guides also believed the number of ewes declined. Climatic conditions improved during 1994 and 1995, and incidental sightings during caribou surveys indicate lamb production improved to above 25 lambs/100 ewes.

Population Composition

Composition survey results are presented in Table 1. These results are not directly comparable because different areas were sampled each year. One consistent factor between areas was low lamb production (range 9-19/100 ewes).

Annual population composition is directly influenced by weather, natural predation, and harvest management (Heimer 1988). Unfavorable weather conditions prevailed during summers 1990-1993 (drought), spring 1992 (deep snow conditions), and fall 1992 (very deep snow conditions). Harvest remained constant with no significant increase ($P > 0.3$) in the number of hunters nor in the percent success between 1981 and 1991, but between 1992 and 1994 hunter numbers were the sixth and third lowest on record since 1975 and the percent success during 1992 and 1994 were the second and third lowest on record since 1981. The fall 1994 wolf density in the WMN mountains below 4500 ft was estimated to be between 7 and 9 wolves/1000 km^2 and has been increasing since 1990. Coyote numbers were high between 1990 and 1992 but have declined. Golden eagle and grizzly bear populations are believed to be stable. Unfavorable weather conditions in concert with wolf and possibly coyote predation have caused the WMN sheep population to decline during the early 1990s. Hunting has had no limiting affect on the population's ability to grow.

Distribution and Movements

There are no data that indicate distribution and movements are different than reported by Kelleyhouse and Heimer (1989).

MORTALITY

Harvest

Season and Bag Limit. The open season for residents and nonresidents is 10 August to 20 September. The bag limit is 1 ram with full-curl horn or larger or with both horns broken.

Hunter Harvest. During 1994, 376 hunters reported taking 167 sheep (159 full-curl rams, 2 ewe, and 6 unknown). The number of hunters and number of sheep harvested was below the 5-year means of 434 and 205, respectively (Table 2). Overall, since 1992 harvest has declined. Winter 1992-1993 was severe and possibly many legal rams died. We know many older sheep died during this winter in the adjacent Tok Management Area.

Mean horn length was 34.2 inches, slightly lower than the 5-year mean of 34.4 inches. Only 5 rams were taken with horns greater than 40 inches (3%). The mean reported age of harvested rams was 8.5 years, typical for this area. In contrast, in the Tok Management Area, located just north of the WMN Mountains, the percentage of the harvested rams > 40 inches normally exceeds 10% and the average reported age ranges between 8.9 and 10 years.

Hunter Residency and Success. Of the 372 hunters reporting residency in 1994, 80 were nonresidents (22%), 22 were unit residents (6%), and 370 were other Alaska residents (Table 3). Success rates were 78%, 36%, and 25% for nonresidents, unit residents, and other Alaska residents, respectively. Overall, the hunter success rate in 1994 was 44%, slightly below the 5-year mean of 47%. The average success rate between 1992 and 1994 was 42% compared with 53% between 1987 and 1991.

Harvest Chronology. Traditionally, in the WMN Mountains most sheep are taken early in the hunting season (Table 4). In 1994, 40% of the harvest was taken during the first week of the season which is comparable with most years. During the past 3 years, more harvest has been occurring during the third week of the season. This may be due to more sheep hunters learning that a greater percentage of the larger rams are taken after 24 August.

Transport Methods. In Unit 12 airplanes and horses are the primary modes of transportation for sheep hunters (Table 5). In 1994 of the 167 successful hunters reporting their transportation methods, 59% used aircraft and 20% used horses. Success rates for hunters using aircraft and horses were 49.3% and 73.3%, respectively, while the overall success rate was 44.4%.

Other Mortality

No studies were conducted during this report period to determine any changes in the rate or type of natural mortality from that reported by Kelleyhouse and Heimer (1989). However, based on public reports, it seems predation by coyotes may have been a significant source of mortality between 1990 and 1992. During 1992 I received numerous reports from local residents and guides of coyotes chasing ewes and lambs, and in several incidences they witnessed a coyote killing sheep. Trapper questionnaires and incidental sightings by ADF&G personnel indicate coyote numbers in the WMN mountains were high during 1990 and 1992 but have declined during the past 3 years. Wolves have been increasing since 1990 and may be having a greater effect on the sheep population. Between 1991 and 1993 lamb survival was low, ranging between 9 and 19 lambs/100 ewes by July. Comparatively, calf survival in the sympatric Chisana Caribou Herd has ranged from 0 to 7 calves/100 cows since 1990. Environmental conditions were not favorable between 1990 and 1993, but weather alone probably does not account for the

magnitude of the lamb and calf mortality in this area. Predators may be having a much larger effect on the sheep and caribou populations in the area, compared with predation in the 1980s.

HABITAT

Assessment

The WMN mountains are glaciated and offer steep, rugged terrain with excellent escape cover near feeding areas dominated by *Dryas* spp. Human development has not substantially affected sheep habitat in the WNM mountains, and the present land ownership pattern is expected to protect most sheep habitat in the future.

CONCLUSIONS AND RECOMMENDATIONS

We are meeting management goals and objectives for Dall sheep in Unit 12. The number of hunters utilizing the area for sheep is high but has declined the past 3 years, probably as a result of declining success. Harvest may decline even further beginning in 1997 due to poor lamb production at least since 1991. If the WMN mountains sheep population is suffering from the same mortality factors as the sympatric Chisana Caribou Herd, lower lamb production may have begun as early as 1990.

Hunter satisfaction of current management objectives may be changing, based on the number of negative comments received concerning crowded hunting conditions and lower number of legal rams. Even though hunting is not the cause of the decline, some hunters have expressed interest in regulations restricting the numbers of hunters, thereby reducing competition, and enacting tougher wanton waste regulations. One possible method that may assist Fish and Wildlife Protection to enforce the wanton waste regulation for sheep is to require hunters to transport all meat, regardless if blood shot or spoiled, from the field.

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Table 1 Unit 12 Dall sheep composition counts from aerial surveys conducted by ADF&G and NPS, 1991-1995

Sex/age class	1991	1992	1993
Legal rams[a]	--	31	111
Sublegal rams[b]	--	140	544
Unclassified rams	--	30	0
Total rams	174	201	655
Ewes[c]	416	440	1323
Lambs	75	83	120
Unidentified	57	0	0
Total other sheep	548	523	1443
Total sheep	722	724	2098
Legal rams:100 ewes	--	7.1	8.4
Sublegal rams:100 ewes	--	31.8	41.1
Total rams:100 ewes	41.8	45.7	49.5
Lambs:100 ewes	18.0	18.9	8.9
Lambs % of total	10.4	11.5	5.7

[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.

Table 2 Unit 12 annual sheep harvest, 1990-1994

Year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Total sheep[a]	No. hunters
1990	237	34.4	--	237	448
1991	272	34.3	8.7	272	491
1992	177	34.5	8.6	177	407
1993	169	34.5	8.5	173	447
1994	159	34.2	8.5	167	376

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

Table 3 Unit 12 annual sheep hunter residency and success, 1990-1994

	Successful					Unsuccessful					
Year	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	Total hunter[b]
1990	12	129	83	224	(52)	28	159	16	203	(48)	427
1991	17	159	92	268	(55)	23	173	19	215	(45)	483
1992	10	83	81	177	(43)	17	194	14	230	(57)	407
1993	4	104	62	173	(39)	24	222	23	274	(61)	447
1994	8	93	62	163	(44)	14	177	18	209	(56)	372

Table 4 Unit 12 annual sheep harvest chronology percent (*n*) by time period, 1990-1994

Year	Harvest dates						*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	
1990	43 (99)	20 (47)	12 (27)	10 (24)	7 (17)	7 (16)	230
1991	40 (108)	21 (57)	8 (21)	13 (35)	12 (32)	5 (14)	267
1992	34 (59)	20 (34)	19 (33)	14 (24)	5 (8)	8 (14)	172
1993	41 (68)	15 (25)	16 (26)	15 (25)	11 (18)	3 (5)	167
1994	40 (65)	13 (21)	19 (31)	16 (26)	5 (9)	7 (12)	164

Table 5 Unit 12 annual sheep harvest percent (n) by transport method, 1990-1994

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	n
1990	53	21	2	9	0	2	16	1	266
1991	56	22	4	5	0	2	9	3	272
1992	62	27	1	2	0	2	6	1	177
1993	62	24	2	5	0	1	5	2	173
1994	59	20	6	9	0	0	5	1	167

LOCATION

GAME MANAGEMENT UNIT: Portions of 12, 13, and 20 (1500 mi^2)

GEOGRAPHICAL 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. This objective is the primary consumptive use aspect of a management goal to provide for diversified human recreational use in this area (Kelleyhouse 1989). The TMA is known for production of fast-growing, large-horned rams (Heimer and Smith 1975).

Sheep harvest in the TMA is managed by controlling hunter numbers through a limited entry drawing-permit system. This system keeps 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 has been successful, and the primary human-use objective of providing an opportunity to take large rams (ADF&G 1976) is being achieved.

A secondary management objective of providing the opportunity to hunt sheep under aesthetically pleasing conditions is also being attained through this limited-entry drawing-permit system. Maintaining low hunter density has created a situation of high legal ram abundance and presence of large trophy rams and has allowed for the maintenance of varied opportunities for access to the area and other high-quality hunting experience components. A more complete history of management in the TMA is available in Kelleyhouse (1989).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

- Maintain a population capable of allowing hunters to be selective in harvesting 30-45 rams each year.
- Maintain a mean horn length of 36-37 inches among harvested rams and a mean age of 8-9 years.
- Maintain an average of 7%-10% rams with 40-inch or greater horns in the harvest.

- Prevent unacceptable increases in hunter concentration and maintain the existing aesthetically pleasing qualities associated with sheep hunting in the TMA.

METHODS

We monitored harvest through drawing permit report cards. We analyzed data on harvest success, hunt area, hunter residence and effort, transportation type, age, and horn size.

Population composition and productivity of the TMA sheep population was estimated in July 1994 by an aerial survey and during June and July 1992 from a survey conducted at the Sheep Creek mineral lick. All sheep visiting the lick were classified and any marked individuals were identified. We classified rams as 1/4, 1/2, 3/4, 7/8, or full curl or larger. Other sheep were classified as ewes, yearlings, or lambs. During the aerial survey, sheep were classified as legal rams (> full curl), sublegal rams (1/2-full curl), unclassified rams, ewe-like (ewes, small rams and yearlings), and lambs.

A serologic survey of TMA sheep was continued during July 1992. We captured ewe sheep at the Sheep Creek lick and took blood samples. The objective of the study was to determine bacterial disease in TMA sheep.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Under normal environmental conditions, sheep populations in Interior Alaska are generally stable (Heimer 1988). Winter severity in the TMA was mild to average during the late 1980s and until 1992. Age structure data collected at the Sheep Creek lick indicate that during this period the adult mortality rate was at minimal levels. In 1989 the TMA sheep population was estimated to be 2000 sheep (Kelleyhouse 1989).

During May and June 1992 temperatures were well below normal and were accompanied by numerous snowstorms. On 10 September 1992, 2-3 inches of heavy, wet snow fell across the entire TMA. Summer 1992 offered the least number of snow-free days in the past 20 years. Data collected from the Sheep Creek lick and during aerial surveys indicate poor lamb recruitment during 1992-1993, accompanied by a large die-off of older sheep. Lamb recruitment during 1993 was also thought low based on incidental observations by area staff. The TMA sheep population may have declined by 10%-20% based on the number of sheep observed/hour in 1994, compared with previous years.

Population Composition

Volunteers under the supervision of biologist Wayne Heimer (ADF&G) classified 898 sheep between 20 June and 7 July 1992. Many of these were counted more than once. The 1992 lamb:ewe and yearling:ewe ratios were 17:100 and 24:100, respectively. The 1992 lamb:ewe ratio is substantially below the 1974-1986 mean of 49:100. The low lamb crop was probably due to a combination of inclement spring weather and a higher than normal proportion of old ewes in the

population. The 1992 yearling:ewe ratio was slightly lower than the 1974-1986 mean ratio of 28:100. The 1994 lamb and ram:100 ewe-like ratios determined by aerial survey across the TMA were 24 and 74:100, respectively (Table 1). The number of full-curl rams:100 ewe-like was 22. The actual number of legal rams and ewes are probably lower than the early 1990s due to an apparent die-off of adult sheep during winter 1992-1993.

Distribution and Movements

Heimer and Watson (1986) summarized movement and distribution data of ewes in the TMA. No further data on distribution and movements were collected during this report period.

MORTALITY

Harvest

Season and Bag Limit. Harvest is restricted to 1 full-curl ram every 4 regulatory years by drawing permit only. Rams must have at least one full-curl horn or both horns broken. Up to 120 permits may be issued.

Hunter Harvest. During 1994 hunters reported taking 39 full-curl rams in the TMA. The previous 5-year mean was 42 rams (Table 2). The lower overall harvest and the lowest percentage of 40" rams in the harvest for the past 8 years indicate fewer legal rams in the population compared with past years. This trend is not expected to continue since the TMA currently supports a healthy sublegal ram population. The 1994 participation rate was 72% compared with the previous 5-year mean of 76%.

Mean horn length during 1994 was 36.9 inches, similar to the previous 5-year mean of 37.0 inches (Table 3). Three rams (8%) had horns greater than 40 inches, the lowest percentage for the past 8 years. The previous 5-year mean was 15%. The average reported age of rams harvested was 9.2, similar to the 5-year mean of 9.0. Mean horn length and age of harvested rams and the percentage of harvested rams exceeding 40 inches continue to meet the harvest management objectives.

Hunter Residency and Success. There were 2345 applicants for the 120 available permits in 1994 (5.1% chance of being drawn). This represents a 7% annual increase in the number of applicants since 1991 and a decrease of the probability of being drawn from 1 in 16 to 1 in 20. Alaskan residents were responsible for 90% of the 1994 harvest (Table 4). Six nonresidents participated in the hunt. The 1994 overall success rate was 46%, higher than in 1992 and 1993 (42% each year) but substantially below the mean annual success rate between 1987 and 1991 (58%). The primary cause for the decline in success since 1992 is a reduction in the legal ram population.

Harvest Chronology. Traditionally, the greatest harvest is during the first 10 days of the sheep season (10-20 Aug). During 1994, 46% of the harvest occurred during this period. Recently there has been an increasing trend for sheep hunters to go to the field later (24 Aug-5 Sep) throughout Unit 12. This slight change in harvest chronology (41% of the harvest) is perhaps a result of more sheep hunters becoming aware that more large-horned sheep (> 40") are shot later in the season and competition between hunters is lower. Commonly during this middle portion of the season,

rams descend lower on the mountain due to snow at high levels. Only 3% of the harvest occurred during the last 10 days of the season (10-20 Sep).

Transport Methods. Airplanes and highway vehicles are the primary methods of transport into the TMA (Table 5). During 1994, 89% of all hunters used 1 of these 2 methods to access the area. ATVs are not commonly used to access the TMA because few areas in the TMA are accessible to ATVs. During the report period, average success rates for hunters using aircraft and highway vehicles have been 51% and 35%, respectively, while the overall success rate was 43%.

Other Mortality

Severe winter weather and predation are the most important natural mortality factors for Dall sheep (Murie 1944, Heimer and Watson 1986). Winter conditions in the TMA during the late 1980s to 1991 were mild to average and did not cause the overwinter mortality rate to increase. Based on sightings of marked animals during this period, it seemed that overwinter survival was high. During 1992 and possibly 1993, weather conditions were unfavorable, and, consequently, lamb recruitment was very low. Also, during 1992 adult mortality seemed to be high.

The overall limiting effects of wolf predation on the TMA sheep population are not known. Dall sheep are not normally a preferred prey item for wolves; however, the area's wolf population has been increasing since 1989 due to increased numbers of caribou during the winter. The effects of this larger population of wolves in the TMA could be changing the sheep population, especially when caribou migrate out of the area.

Presently, disease and accidents are not causing significant mortality and have little effect on the TMA's population trend.

HABITAT

Assessment

The TMA may be characterized as rugged, glaciated terrain with *Dryas*-dominated habitats prevalent at elevations below 5000 feet. Mixed bunch-grass and forb communities are also important to TMA sheep. In winter windblown ridges are important when the sheep are feeding primarily on browse species and lichen (Heimer 1983).

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 areas and could be developed. Currently, there is mining exploration in the upper Robertson River, an area that supports a high number of sheep. Coordination with Habitat Division to minimize effects of development will occur if any such plans emerge.

Enhancement

During spring 1993 we planted 5 different native grasses on nonvegetated gravel outcrops within a important wintering area in the TMA. The grasses grew and were extensively used by sheep. More study is necessary to determine the best grass to use for the best yield with the least amount of fertilizer. No other habitat enhancement for sheep is planned for the TMA.

CONCLUSIONS AND RECOMMENDATIONS

The sheep population in the TMA has declined up to 10%-20% since 1990. Harvest has had little effect on the population trend but currently may be affecting the overall number of full-curl rams. The TMA continues to provide unique opportunities for hunters to seek large-horned rams under aesthetically pleasing conditions. Low lamb recruitment during 1992 and 1993 will alter trophy ram recruitment in 5 years but may not cause a significant problem to the management objective because there is a healthy sublegal ram population and lamb survival in 1994 and 1995 was good. Management objectives are being met, making changes in the hunt format unnecessary.

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Table 1 Tok Management Area Dall sheep composition counts from aerial surveys conducted in 1980 and 1994

Sex/age class	1980	1994
Legal rams[a]	148	123
Sublegal rams[b]	263	294
Unclassified rams	9	0
Total rams	420	417
Ewes[c]	922	567
Lambs	350	137
Unidentified	6	3
Total other sheep	1278	707
Total sheep	1698	1124
Legal rams:100 ewes	16.1	21.7
Sublegal rams:100 ewes	28.5	51.9
Total rams:100 ewes	45.5	73.5
Lambs:100 ewes	38.0	24.2
Lambs % of total	20.6	12.2

[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.

Table 2 Harvest of Dall sheep rams in the Tok Management Area, 1990-1994

Hunt no./area	Year	Permits issued	Did not hunt %	Unsuccessful hunter %	Successful hunter %	$\bar{x}$ horn length	$n \geq 40$" (%)	Total harvest
1102	1990	120	28	56	44	37.0	6 (17)	36
	1991	120	23	44	56	36.9	9 (17)	52
	1992	120	26	58	42	37.1	6 (16)	37
	1993	120	13	58	42	37.3	6 (13)	44
	1994	120	28	54	46	36.9	3 (8)	39

Table 3 Tok Management Area annual sheep harvest, 1990-1994

Year	Rams	Mean horn length	No. ≥ 40" (%)	Mean age	Ewes	Total sheep
1990	36	37.0	6 (17)	9.2	0	36
1991	52	36.9	9 (17)	8.9	0	52
1992	37	37.1	6 (16)	8.6	0	37
1993	44	37.3	6 (13)	9.0	0	44
1994	39	36.9	3 (8)	9.2	0	39

Table 4 Tok Management Area annual sheep hunter residency and success, 1990-1994

	Successful				Unsuccessful				
Year	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	Total hunter
1990	2	31	3	36 (44)	3	43	0	46 (56)	82
1991	3	47	2	52 (56)	0	38	3	41 (44)	93
1992	4	30	3	37 (42)	4	46	2	52 (58)	89
1993	3	39	2	44 (42)	6	54	1	61 (58)	105
1994	4	31	4	39 (46)	4	44	2	46 (54)	85

Table 5 Tok Management Area annual sheep harvest percent (*n*) by transport method, 1990-1994

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1990	53 (19)	0	0	8 (3)	0	3 (1)	36 (13)	0	36
1991	63 (33)	2 (1)	0	0	0	6 (3)	27 (14)	2 (1)	52
1992	57 (21)	3 (1)	0	3 (1)	0	3 (1)	30 (11)	3 (1)	37
1993	75 (33)	0	0	5 (2)	0	0	18 (8)	2 (1)	44
1994	82 (32)	0	0	3 (1)	0	0	13 (5)	3 (1)	39

LOCATION

GAME MANAGEMENT UNIT: 13A, 13E, 14A (NORTH), AND 14B (14,849 MI^2)

GEOGRAPHICAL DESCRIPTION: TALKEETNA MOUNTAINS AND CHULITNA-WATANA HILLS

BACKGROUND

Sheep populations in the Talkeetna Mountains and Chulitna-Watana Hills (TCW) probably increased rapidly from low numbers before 1950, reaching peak densities during the late 1960s (McIlroy 1976). Trend counts in a portion of the area indicated populations fluctuated slightly before peaking again during the 1980s.

Most of the sheep habitat in the TCW mountains was aerial surveyed in 1974. Large scale composition surveys were not conducted before this time. Although an estimate of the total number of sheep was not specifically stated in 1974 (McIlroy 1976), the population probably contained 2,500-3,000 sheep, if we assume 80% of the sheep were seen. Portions of the TCW have been surveyed periodically since 1974. Sheep densities have traditionally been highest in the southeastern portion of the area, both east and west of the Chickaloon River. During the late 1980s the population estimate for TCW was approximately 2,500 sheep (Grauvogel 1990). Included in that estimate were approximately 200 sheep in the Sheep Mountain closed area, which has been closed to hunting since the 1940s.

Minimum sheep harvest data has been collected from hunter harvest reports since 1967. The reported harvest peaked at 118 during 1969 and again in 1986. A peak at 114 rams occurred during 1974, following a low of 61 rams taken in 1973. Harvests reached similar lows during 1977 and 1983.

Sheep harvest has been restricted to adult rams since statehood. Mean annual harvest under a 3/4-curl horn minimum regulation, 1967-1978, was 90 rams. Under a 7/8-curl horn minimum, 1979-1988, the annual harvest averaged 87 rams. In 1989 hunters were required to harvest only full-curl rams, and during 1989-1994 the average harvest was 83 rams.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The management goals for sheep populations in the TCW are to provide the greatest opportunity to participate in hunting sheep (Unit 14); to provide an opportunity to hunt sheep under aesthetically pleasing conditions (Unit 13); and to provide an opportunity to view, photograph and enjoy sheep (Sheep Mountain Closed Area).

MANAGEMENT OBJECTIVE

Maintain sheep populations that will sustain an annual harvest of 75 rams.

METHODS

Sheep harvest was monitored from harvest reports. Hunters were required to report within 15 days of the close of the season or within 15 days of killing a sheep. Days hunted, method of take, date of kill, location of kill, transportation used, length of horns and age of sheep were noted on the harvest report. The number of sheep killed but not reported was assumed to be small.

Sex and age composition surveys were conducted during May and July 1994, using Piper PA-18 aircraft. Ten count areas were surveyed, including three in Unit 14 and seven in Unit 13. Observers classified animals as lambs, ewes or rams, and further classified rams as either having horns between 1/4- and 7/8-curl, or larger than 7/8-curl (legal rams). Rams smaller than 1/4-curl and yearlings of both sexes were classified as ewes. No effort was made to identify critical habitats (mineral licks and lambing areas).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During 1994 observers classified 1747 sheep in 10 count areas, including 304 sheep in Units 14A and B, and 1443 sheep in Units 13A and E (Table 1). Assuming approximately 80% of the sheep were seen, the total population for the TCW mountains was estimated at 2,000-2,500 sheep during 1994.

The number of sheep found in the 3 count areas in Unit 14 (western TCW) was 50-70% lower than the number seen in those areas during 1988 (ADFG files), and 3-70% lower than the average number found during 4 surveys conducted during the 1980s. The largest declines occurred in the 2 count areas from the Chickaloon River west to the headwaters of the Little Susitna River.

In contrast to the decline in Unit 14 (western TCW), the 1443 sheep seen in Unit 13 (eastern TCW) count areas during 1994 represented an increase over the 1249 sheep in the eastern TCW when the area was last surveyed in 1982 (Grauvogel 1990). However, there were fewer sheep seen in 1994 than during 1974 or 1977, when we counted 1752 and 1602 sheep, respectively (McIlroy 1976, Grauvogel 1990).

Throughout the TCW, lamb production in 1994 was similar to past surveys (Grauvogel 1990), with 16% lambs in the population. The proportion of total rams in the population was also similar to past years. However, in Unit 14 the number of large rams increased from 3% in 1988 to 8% in 1994 (Table 1). Although not reflected in the wide "<7/8- and >1/4-curl" category, observers remarked they saw few rams smaller than 1/2-curl. A decline in the number of small rams is a strong indicator that sheep numbers in Unit 14 (western TCW) declined because lambs were not recruited to the population in recent years.

The apparent differences in population trend between sheep populations in the eastern and western TCW could be related to differing snow accumulation patterns in those areas. During 1989-1994 snow depths recorded during March and April were significantly greater in the western TCW than in the eastern TCW (Table 2). Also, colder temperatures in the eastern TCW

may produce snow more likely to be blown off ridges, keeping important forage resources exposed. Recent declines in lamb survival and recruitment in the Alaska Range have also been attributed to severe winter weather (Eagan 1993).

Greater snow depths in the western TCW may also predispose sheep to greater predation by wolves. Wolf densities in Unit 14 have probably increased in recent years (Masteller, in press), but are unlikely to be greater than wolf densities in Unit 13.

MORTALITY

Harvest

Season and Bag Limit. The hunting season in Subunits 13A, 13E, 14A and 14B for regulatory years 1992/93 through 1994/95 was 10 August-20 September. The bag limit was 1 ram with a full-curl horn or larger.

Hunter Harvest. Hunter harvest increased from 75-91 rams during 1992-1994 (Table 3). Harvest has fluctuated in this range since the full-curl regulation went into effect in 1989, averaging 83 rams per year during 1989-1994. Mean horn size from rams shot during 1990-1994 increased steadily to slightly over 35 inches (Table 3). When regulations allowed harvest of 7/8-curl sheep (1979-1988), the mean horn size was 33.2 inches (Griese 1993).

Hunter Residency and Success. During 1992-1994 the proportion of TCW sheep hunters who were Alaska residents averaged 88% (Table 4), compared with an average of 83% between 1987-1991 (Griese 1993). However, Alaska residents composed 95% of the unsuccessful hunters. The total number of hunters increased 40%, to 516 hunters, between 1992 and 1994 (Figure 1). This followed a period of relative stability during 1987-1991, when the average was 351 hunters each year (range = 323-375, Griese 1993).

The success rate for all hunters has steadily declined from 23% in 1990 to 18% in 1994 (Table 4). During 1983-1988, with the 7/8-curl minimum restriction, success averaged 30% (Grauvogel 1990). The success rate for resident hunters declined from 18% in 1990 to 11% in 1994. The success rate for nonresident hunters increased from 30% to 38% during the same period.

The increase in hunting pressure is probably because the TCW is one of the few places near Anchorage where sheep hunting is not restricted through a permit system and where sheep habitat can be accessed from off-road vehicles. During 1992-1994 the number of hunters in Units 13A and 13E (the areas where 4-wheeler access has improved the most) increased 51% and 57%, respectively. In contrast, the number of hunters declined 12% and 20% in Units 14A and 14B, respectively, where trail networks have grown more slowly.

In general, nonresident success rates are higher because they are required to have a guide, and they often use aircraft to access more remote areas. There is evidence, however, that more nonresidents are utilizing ground transportation (see Transport Methods). Because of the good road and ground access, the TCW area may be favored by nonresidents who are guided by Alaskan relatives, providing an alternative to an expensive, professionally guided hunt.

Harvest Chronology. During 1992-1994 an average of 41% of the rams harvested were taken the first week of the season, and 62% were taken in the first 2 weeks (Table 5). In comparison, during 1983-1988 approximately 40% of the sheep harvested were killed during the first 2 weeks (Grauvogel 1990). With the increase in the number of hunters comes a concomitant increase in pressure to take a sheep early in the season.

Transport Methods. Trends in the use of various transport methods differed between successful and unsuccessful hunters. Most successful hunters used aircraft or 4-wheelers to access their hunting areas, and recent trends in mode of transport for these hunters are stable (Table 6). During 1987-1990 the use of 4-wheelers more than doubled (Griese 1993), but since that time their use has stabilized. During 1991-1994 an average of 30% of successful hunters used 4-wheelers to access sheep habitat.

Among unsuccessful hunters the use of ground transportation, primarily 4-wheelers, increased between 1992 and 1994. The increase was largest in Unit 13A, where 64% of unsuccessful hunters used 4-wheelers in 1994, compared with 58% in 1992. Both resident and nonresident unsuccessful hunters increasingly relied on ground transportation. Among residents, use of 4-wheelers increased from 51% to 56%, while use of aircraft declined from 14% to 11%. Among nonresidents, the use of highway vehicles increased from 9% to 21%, and the use of aircraft declined from 91% to 63%.

CONCLUSIONS AND RECOMMENDATIONS

The mean annual harvest of rams under the full-curl minimum requirement during 1992-1994 was 83, ranging between 75-91 sheep. This harvest met the management objective for the population. The TCW sheep population was estimated to be slightly decreasing at 2,000-2,500 sheep. Surveys have occurred too infrequently to clarify trends, but a small increase in the number of sheep in the eastern TCW partially offset a larger decline in the western TCW.

There is evidence harvest in the TCW will fall below the objective level within 5-6 years. If trends in lamb recruitment in the western TCW continue for the next 2-3 years, we should detect a large increase in the proportion of large rams (>7/8-curl) in that area. Although a decline in the number of small rams is difficult to detect with the ">1/4- and <7/8-curl" category, the decrease in proportion of small rams should be apparent by 1997. In the longer term the number of large rams in Unit 14 will decline. This should reduce overall TCW harvest by 20%; during 1992-1994 harvest from the western TCW accounted for 16%-25% of the overall TCW harvest.

I recommend a complete TCW survey in 1997 to determine if differences between the eastern and western TCW continue. In the future every effort should be made to survey count areas in Units 13 and 14 during the same year. The infrequency of aerial surveys was identified by Grauvogel (1990) as an obstacle to effective sheep conservation in the TCW. While surveys have been conducted periodically in both units, the survey schedules have overlapped only in 1974 and 1994.

Surveys conducted every 3 years would provide meaningful trend count information useful in alerting biologists to significant population or composition changes. These data, combined with

information on hunter effort and success, help managers evaluate potential proposals affecting hunter access, harvest, and distribution of hunting pressure.

There is a clear need to align the Unit 13 and 14 management goals for the TCW mountains (Griese 1993). With the increase in number of hunters, it is impossible to provide both aesthetically pleasing hunting conditions (Unit 13) and maximum opportunity to hunt sheep (Unit 14). The number of complaints concerning hunter crowding and harassment of sheep by aircraft has increased in recent years. Additional conflicts arise because the hunting season for Nelchina caribou (Unit 13), for which 10,000-12,000 permits are issued annually, also starts August 10, and hunters for both species use the same access points. If hunting pressure continues to increase, the number of complaints will grow, along with the incentive to harvest undersized sheep.

Griese (1993) recommended a statewide planning process to align sheep management goals and population objectives with current management philosophies and capabilities. Rapid increases in hunter participation in TCW sheep hunting and constant improvements in 4-wheeler access exacerbate the need for such a process. Absent a comprehensive review of statewide sheep management goals, I concur with the Unit 13 management biologist (R. Tobey, pers commun) that sheep populations in the entire TCW (outside of Sheep Mountain) be managed to provide the maximum opportunity to hunt sheep.

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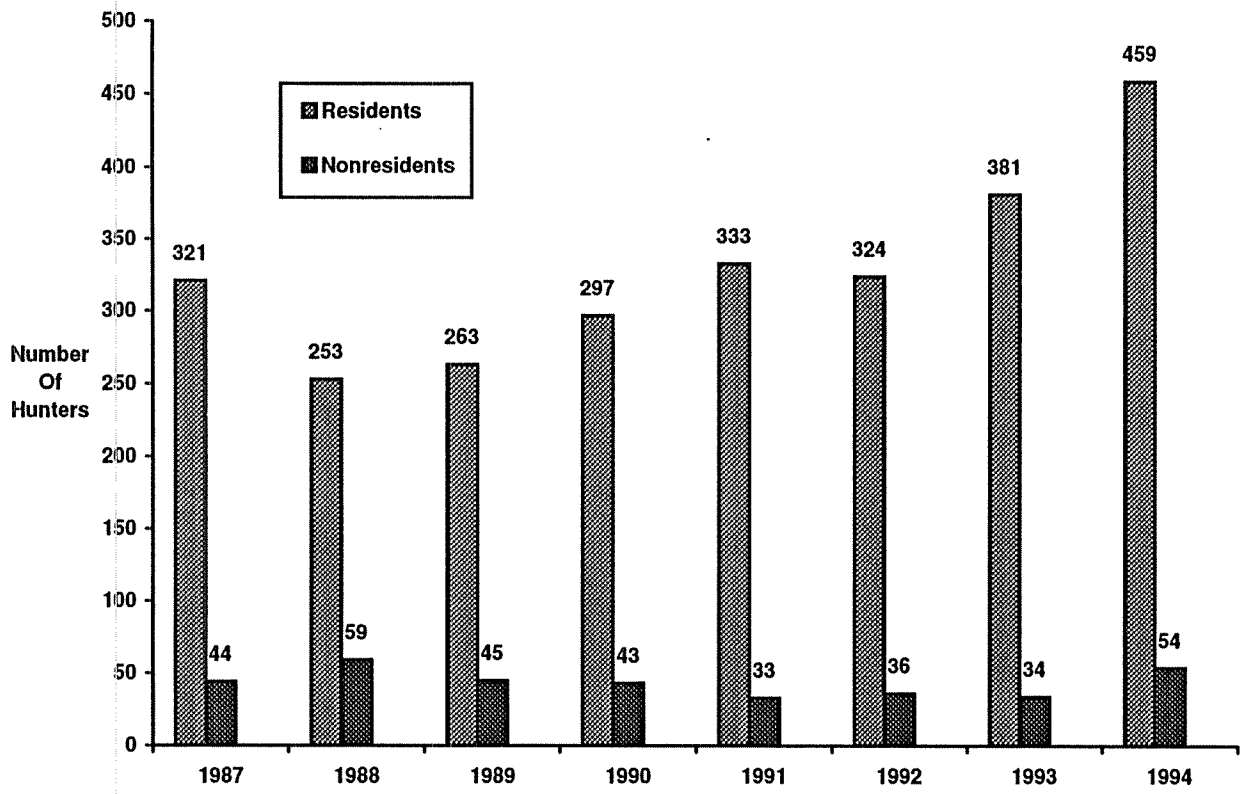

Figure 1. Number of hunters pursuing sheep in the Talkeetna-Chulitna-Watana Mountains of southcentral Alaska, 1987-1994.

Table 1. Talkeetna Mountains and Chulitna-Watana Hills summer aerial sheep composition counts and estimated population size, 1988-94.

Regulatory year	Rams ≥7/8 curl(%)	Rams <7/8 and >1/4-curl	Ewes[a]	Lambs (%)	Sheep/ hour	Total Sheep observed	Estimated population size
1988/89							
GMU 14[b]	24 (3)	178	500	163 (19)	44	866	2,150-2,600
1989/90 to 1993/94		No surveys flown					
1994/95							
GMU 14[b]	26 (8)	71	159	48 (16)	24	304	
GMU 13[c]	132 (9)	234	844	232 (16)	97	1443	
Total	158 (9)	305	1003	280 (16)	63	1747	2,000-2,500

[a]Includes yearlings of both sexes and rams of 1/4-curl or less.
[b]A summary of subunits 14A and 14B within the Talkeetna Mountains
[c]A summary of subunits 13A and 13E within the Talkeetna Mountains

Table 2. Average snow depths during March and April, 1989-1994, from 3 locations in both the eastern (E-TCW) and western (W-TCW) Talkeetna Mountains. For both March and April the average snow depths are significantly greater ($p<0.05$) in the western Talkeetna Mountains. Data from Alaska Climatological Reports, U.S. Dept. of Commerce, NOAA, National Environmental Satellite, Data and Information Service, National Climate Data Center, Asheville, North Carolina.

	Average Snow Depth in Inches			
	March[a]		April[a]	
Year	W-TCW[b]	E-TCW[c]	W-TCW	E-TCW
1989	46.7	24.3	45.5	19.3
1990	97.7	33.3	64.7	26.3
1991	59.0	26.3	43.3	30.0
1992	51.3	38.7	38.7	35.0
1993	52.7	28.7	47.7	25.7
1994	41.0	32.3	40.0	27.3

a Means are significantly different ($p<0.05$, paired T-test).

b Average snow depths calculated from stations at Chulitna Lodge, Talkeetna and Willow West

c Average snow depths calculated from stations at Tahneta Pass, Tonsina and Snowshoe Lake

Table 3. Talkeetna Mountains and Chulitna-Watana Hills sheep harvest, 1990-94.

Regulatory Year	Rams	Average Horn Length (inches)	% ≥ 40"	Ewes	Total sheep
1990/91	79	34.5	0.0	1	82
1991/92	86	34.7	2.2	0	91
1992/93	75	34.8	1.3	0	75
1993/94	82	35.0	3.6	0	82
1994/95	90	35.3	3.3	1	91

Table 4. Talkeetna Mountains and Chulitna-Watana Hills sheep hunter residency and success, 1990-94.

	Successful				Unsuccessful				
Regulatory year	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Total hunters
1990/91	9	45	25	82 (23)	53	190	18	270 (77)	352
1991/92	17	41	29	91 (24)	62	213	4	284 (76)	375
1992/93	13	35	25	75 (20)	58	218	11	294 (80)	369
1993/94	5	48	27	82 (19)	48	280	7	340 (81)	422
1994/95	10	46	35	91 (18)	56	347	19	425 (82)	516

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

Table 5. Talkeetna Mountains and Chulitna-Watana Hills sheep harvest chronology percent by time period, 1990-94.

Regulatory year	Harvest periods						*n*
	8/10-8/16	8/17-8/23	8/24-8/30	8/31-9/6	9/7-9/13	9/14-9/20	
1990/91	45	17	15	5	9	9	76
1991/92	47	19	8	9	8	9	89
1992/93	41	24	16	7	7	5	74
1993/94	38	16	19	11	7	8	82
1994/95	43	25	9	10	7	4	91

Table 6. Talkeetna Mountains and Chulitna-Watana Hills sheep harvest percent by transport method 1990-94.

Regulatory year	Percent of harvest							*n*
	Airplane	Horse	Boat	3 or 4-wheeler	ORV	Highway vehicle	Unknown	
1990/91	39	15	0	35	1	9	1	82
1991/92	52	7	0	26	5	2	8	91
1992/93	45	7	0	35	3	9	1	75
1993/94	44	1	0	27	8	17	2	82
1994/95	52	4	0	33	2	9	0	91

LOCATION

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

GEOGRAPHICAL DESCRIPTION: Delta Controlled Use Area (DCUA)

BACKGROUND

Alaska Department of Fish and Game (ADF&G) management plans for Dall sheep (ADF&G 1976; G Bos, pers commun, 1988) define the management goals for this species in Alaska. These goals include protection and maintenance, scientific and educational study, diversified recreational use, and commercial and subsistence uses. Federal and state subsistence laws mandate subsistence use as the highest priority of fish and wildlife when harvest is allowable. However, the Alaska Board of Game, acting in compliance with these subsistence laws, has found 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, pers commun, 1988) to recognize that diversified human recreational uses of Dall sheep include both consumptive and nonconsumptive uses. Nonconsumptive uses include viewing and photography. The spectrum of consumptive use objectives for this species includes maximum opportunity to hunt, opportunity to hunt under aesthetically pleasing conditions, and the opportunity to harvest unusually large rams as trophies. Providing opportunity to hunt sheep under aesthetically pleasing conditions is the present consumptive use objective 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. 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, which was formerly known as the Delta Management Area, was the first attempt to meet these demands. The Delta Management Area was established before the hunting season in 1971 to provide sheep hunters with quality walk-in hunting opportunities free from competition with other transportation types.

In the Delta Management Area, use of motorized vehicles and pack animals for transporting hunters, hunting gear, or game was initially prohibited for the first portion of the 10 August-20 September hunting season. After 25 August, transportation restrictions were lifted and mechanized and pack animal access permitted. Bag limit was 1 ram with 3/4-curl or larger horns.

Designation of the Delta Management Area as a walk-in only area successfully provided walk-in only hunting opportunity but failed to reduce harvest to the desired level or provide high-quality hunting experiences. The harvest and 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 being subjected to heavy hunting pressure, resulting in excessive harvest, reduced horn size, and hunter competition for available rams. In 1977 hunters killed 78 rams, even though the desired harvest objective was 40 rams (Larson 1979).

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

In 1979 minimum horn size for legal sheep in all of Unit 20 was increased from 3/4- to 7/8-curl. The 7/8-curl regulation did not affect the number of rams harvested in the Delta Management Area, but average horn size increased from 31.2 inches in 1978 to 34.6 inches in 1979 (Larson 1979).

The Delta Management Area was renamed the Delta Controlled Use Area in 1981 to more accurately reflect its classification as a controlled use area rather than a management area.

In 1982 the number of drawing permits issued was increased to 75 for each portion of the drawing permit hunt (hunt numbers D1103 and D1104).

Minimum horn size for legal sheep in Unit 20 was raised from 7/8-curl to full-curl in 1984. The season and bag limit in the DCUA have not changed since 1984, with the exception of 1985, when Tier II subsistence regulations were adopted for the DCUA.

The size of the DCUA was reduced in July 1992 to exclude a portion of nonsheep habitat between the Richardson Highway and the Delta River. This area of nonsheep habitat is a popular area for hunting small game and upland game, and DCUA access restrictions unnecessarily complicated hunting in the area and confused hunters.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

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

- Monitor Dall sheep harvest through hunter contacts and permit reports.

- Conduct aerial and/or ground composition surveys of Dall sheep.

- Mail a questionnaire to hunters and quantify their satisfaction with aesthetics of Dall sheep hunting in the DCUA.

METHODS

Hunters selected in the permit drawing were required to report on their activities. Data contained on the permit reports were analyzed to determine hunter success, hunter residence, hunter effort, ram horn size, hunt location, transportation type, and other information.

In 1993, 1994, and 1995, all hunters were mailed a sheep hunter questionnaire and asked a variety of questions about their hunt, aesthetics of their hunt, and their opinions on DCUA management. Not all questionnaire data were summarized for this report, but questions that related to DCUA management goals were analyzed. Hunters were asked to rate satisfaction with their hunt on a scale of 1 (very satisfied) to 10 (extremely disappointed). Hunters who rated their hunt satisfaction from 1 to 5 were considered satisfied with their hunt. A mean satisfaction rating was also calculated for all hunters. Data were pooled for both hunts D1103/DS203 and D1104/DS204. DCUA management goals were listed in the questionnaire and hunters were asked whether they agreed with the goals. A copy of the questionnaire is in Appendix A.

An aerial survey of the Granite Mountain Trend Count Area was flown on 14 July and 3 August 1993 from a PA-18 Piper Supercub. Ram horn curl was classified as 1/2, 3/4, 7/8, or 4/4. All sheep not classified as rams or lambs were classified as "ewes." Because of the difficulty distinguishing between ewes and young rams during aerial surveys, the ewe classification includes yearling and 2-year-old rams (often referred to as 1/4-curl rams) and all ewes regardless of age and reproductive status.

An aerial census of the DCUA was flown on 20-21 July 1995. All sheep habitat within the DCUA was divided into sample units (SUs) ranging in size from 20-30 mi^2. Each SU was flown with a low intensity search averaging 2.4 min/mi^2 of search effort with fixed-wing aircraft. During the low intensity search, observers counted all sheep seen and plotted their location on topographic maps. Sheep observed during the low intensity search were only classified as adults or lambs. A high intensity search was conducted of 9 randomly selected SUs with a search effort of approximately 3.4 min/mi^2 with a Robinson R-22 helicopter. During the high intensity search, all sheep were classified as either ewes, lambs, yearlings (includes both ewes and rams), or rams. Rams were classified by horn curl as <1/2, 1/2-7/8, or 4/4. The Moosepop program (Moose Population Estimation Survey version 2.0, DeLong and Reed) was used to calculate population parameters. A sightability correction factor (SCF) was calculated by comparing the number of sheep seen during low and high intensity searches in those SUs that had both surveys. Moosepop was also used to calculate population composition data and confidence intervals (CI).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The 1993 Granite Mountain trend count survey was not completed due to poor weather. Data from the incomplete survey are presented in Table 1.

Results of the July 1995 DCUA census are preliminary at this time because the Moosepop program may need to be modified for sheep survey data analysis. Preliminary analysis resulted in a mean population estimate of 1673 sheep +/- 14.16% at the 90% CI (lower CI = 1436 sheep; upper CI = 1910 sheep). This population estimate results in a mean density of 2.9 sheep/mi^2 of sheep habitat in the DCUA. A SCF of 1.30 was calculated for the census.

Population Composition

Composition data collected from high intensity searches during the census are listed in Table 2. Mean lamb survival was 36.9 lambs:100 ewes (90% CI = +/- 20.42%). Mean yearling survival was 18.9 yearlings:100 ewes (90% CI = +/- 27.9%). The mean ram:ewe ratio was 49.7 rams:100 ewes (90% CI = +/- 45.7%). Legal rams composed 30% of all rams observed during high intensity searches.

Distribution and Movements

Hunters observed sheep with visual collars this reporting period and reported them in the sheep questionnaire; collared sheep were seen during aerial surveys. None of these data have been analyzed at this time.

MORTALITY

Harvest

Season and Bag Limit. Hunt numbers were changed for DCUA hunts during this reporting period. In 1993 hunt D1103 was changed to hunt DS203 and hunt D1104 was changed to DS204.

The DCUA sheep hunting season was open from 10 August through 20 September and was split between 2 drawing permit hunts. For permit hunt D1103/DS203 the season was open from 10 August through 25 August. Hunters were not allowed to use motorized vehicles or pack animals to transport sheep hunters, sheep hunting gear, or sheep within the DCUA from 5 August through this period. Normal travel continued on the Richardson Highway and at recognized airports lying within the DCUA boundaries. For permit hunt D1104/DS204 the season was open from 26 August through 20 September with no access restrictions. Each portion of the season had a bag limit of 1 full-curl ram. We issued 75 permits each for hunt D1103/DS203 and D1104/DS204.

Board of Game Actions and Emergency Orders. The Alaska Board of Game changed access restrictions for hunt D1103/DS203 so aircraft were allowed to use the "Charlie Boyd" airstrip along the Johnson River. Although this airstrip is within the DCUA, it is located near several marginal airstrips outside the DCUA and legal to use. Hunters were confusing the legal airstrips

with the illegal Charlie Boyd airstrip, causing enforcement problems. Because hunters have traditionally accessed the eastern portion of the DCUA by several airstrips along the Johnson River and because the Charlie Boyd airstrip is much safer to use, this regulation was changed to eliminate confusion about legal versus illegal airstrips and provide hunters with a safer airstrip.

Hunter Harvest. Total DCUA harvest met the management objective for 2 of 4 years from 1992-1995, with a reported harvest of 41 rams during 1992, 40 rams during 1993, 28 rams during 1994, and 32 during 1995 (Table 3). Slightly more sheep (53%) were taken during hunt D1104/DS204 than during hunt D1103/DS203 (47%) from 1992-1995.

Mean horn length for all sheep taken during 1992-1994 was slightly below the management objective. Mean horn length was 35.9 inches during 1992 and 1993 and declined to 35.2 inches in 1994 (Table 3).

Mean age of all sheep taken met the management objective during 1992 and 1993 with 8.7 and 8.5 years old, respectively (Table 3). Mean age of sheep taken in 1994 was slightly below the management objective at 7.9 years old.

Most hunters were satisfied with their DCUA hunt and agreed with DCUA harvest and aesthetic management goals. From 80.6% to 92.9% of hunters responded they were satisfied with their hunt, and their mean satisfaction rating ranged from 2.7 to 3.3 (Table 7). When asked if they agreed with DCUA harvest goals, 85.5% to 95.9% answered yes, and when asked if they agreed with DCUA aesthetic goals, 90.2% to 96.8% of hunters answered yes.

Harvest Chronology. No changes in harvest chronology were observed during 1992-1994. Harvest continues to be highest during the first week of each permit hunt (Table 6). From 83%-97% of DCUA harvest occurred from 10 August to 6 September. Harvest declines significantly during the last 3 weeks of the hunting season.

Permit Hunts. Both drawing permit hunts showed increased interest by hunters as indicated by the number of permit applications received. A mean of 812 permits was received for hunt D1103/DS203 each year from 1992 to 1995, with the following number of applications received each year: 1992 = 740, 1993 = 677, 1994 = 929, and 1995 = 901. Hunt D1104/DS204 was more popular than D1103/DS203, with a mean of 972 applications received each year from 1992 to 1995. The following number of applications were received each year: 1992 = 953, 1993 = 971, 1994 = 970, and 1995 = 994.

Hunter Residency and Success. Most DCUA hunters continue to be Alaskan residents, and 95% of all hunters were residents from 1992 to 1994 (Table 4). Resident hunters are nearly evenly divided between local residents of Unit 20D and nonlocal residents, with a mean of 48% and 47%, respectively, from 1992 to 1994. For those permittees who actually hunted, hunters' mean success rate was 36% from 1992 to 1994 (range = 31%-39%) (Table 3).

Transport Methods. No changes in mode of transportation were detected during 1992-1994. Highway vehicles, airplanes, and 3- or 4-wheelers remain the most popular modes of transportation for accessing the DCUA (Table 5). Highway vehicles are used most commonly

during hunt D1103/DS203 because most hunters walk into the DCUA from either the Richardson or Alaska Highway due to access restrictions. Airplanes and 3- or 4-wheelers are used commonly during hunt D1104/DS204, along with highway vehicles.

Other Mortality

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

Climate is a chronic limiting, but infrequently depressing, factor for sheep in the DCUA. The DCUA is located at the north end of the 2443 ft Isabel Pass through the Alaska Range, so winter storms frequently bring high winds and warm temperatures. Therefore, much of the area is either snow-free or has little snow during much of the winter. Hence, it provides suitable stable winter range for Dall sheep.

HABITAT

Assessment

Sheep habitat seems sufficient to support the population at its current level, although no habitat assessment surveys have been conducted. 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 closely monitored.

CONCLUSIONS AND RECOMMENDATIONS

The DCUA population objective of 1800 sheep is within the 90% confidence interval of the 1995 census, based on preliminary analysis of the survey data.

The harvest objective for the DCUA calls for a harvest of 35 full-curl rams, with a mean horn length exceeding 36 inches and mean age greater than 8 years. Harvest during 1992-1995 met the quota for 2 years, was only slightly below the quota 1 year, and was well below the quota 1 year. Horn size objectives were not met for any year from 1992 to 1994; however, they were only slightly below. Mean age from 1992-1994 met the objective for 2 of the 3 years. Composition data collected during the 1995 census indicate lamb survival is adequate. Based on hunter responses to questionnaires, the management objective of providing aesthetically pleasing hunting conditions is being met in the DCUA.

Even though harvest and horn size goals were not met during all years of this reporting period, recent survey data indicate harvest rates are not excessive in the DCUA; no change to hunting seasons or bag limits are recommended at this time.

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Table 1 Granite Mountain trend count area July aerial sheep composition data, 1974-1994. Data from 1974-1975, 1975-1976, and 1980-1981 were recorded within the trend count area during Delta Controlled Use Area surveys.

Regulatory year	No. of rams (%)								Total sheep observed
	Legal ram[a]	Sublegal ram	Unclass ram	Total ram	Ewes[b] (%)	Lambs (%)	Unclass (%)	Sheep/hr	
1974-1975	72 (45)	72 (45)	15 (9)	159 (21)	315 (42)	142 (19)	130 (17)	unk	746
1975-1976	34 (43)	45 (57)	(0)	79 (14)	394 (70)	88 (16)	(0)	unk	561
1980-1981	63 (48)	68 (52)	(0)	131 (22)	319 (54)	144 (24)	(0)	unk	594
1992-1993	39 (21)	147 (79)	(0)	186 (28)	428 (65)	48 (7)	(0)	66	662
1993-1994[c]	7 (9)	68 (91)	(0)	75 (40)	93 (49)	20 (11)	(2)	--	190

[a] Ram composition data are not comparable because of changes in definition of a legal ram; 1992-1993 = 7/8 curl; 1974-1976 = 3/4 curl.
[b] Includes yearlings of both sexes and rams of 1/4 curl or less.
[c] Incomplete survey.

Table 2 Delta Controlled Use Area July aerial composition data collected during high intensity searches of sample units in a population estimation survey

Regulatory year	No. of rams (%)							Total sheep observed	Population estimate
	Legal ram	Sublegal ram	Unclass ram	Total ram	Ewes[a] (%)	Lambs (%)	Unclass (%)		
1995-1996	47 (30)	108 (70)	0	155 (24)	371 (58)	115 (18)	1 (0.2)	642	1673 +/- 14.16

[a] Includes yearlings of both sexes.

Table 3 Delta Controlled Use Area sheep harvest data by permit hunt, 1987-1995

Hunt no./area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Rams	$\bar{x}$ horn length (inches)	$\bar{x}$ age (yr)	% ≥ 40"	Ewes	Unk	Total harvest
D1103	1987-1988	75	25	40	29	22	35.4		--	0	0	22
	1988-1989	75	36	47	17	13	35.4		15	0	0	13
	1989-1990	75	29	35	36	27	37.0		7	0	0	27
	1990-1991	75	32	44	20	15	34.6		0	0	0	15
	1991-1992	75	21	48	31	23	35.9		13	0	0	23
	1992-1993	75	32	43	25	19	36.0	8.4	5	0	0	19
DS203	1993-1994	75	33	39	28	21	36.1	8.6	14	0	0	21
	1994-1995	75	41	41	15	11	34.7	7.7	9	0	0	11
	1995-1996	75	32	48	20	15	na	na	na	0	0	15
D1104	1987-1988	75	41	35	15	11	35.1		--	0	0	11
	1988-1989	75	23	39	39	29	36.3		3	0	0	29
	1989-1990	75	35	32	31	23	36.6		13	0	0	23
	1990-1991	75	27	49	17	13	34.8		8	0	0	13
	1991-1992	75	36	37	25	19	36.5		21	0	0	19
	1992-1993	75	23	48	30	22	35.9	8.9	14	0	0	22
DS204	1993-1994	75	29	45	25	19	35.6	8.4	5	0	0	19
	1994-1995	75	31	45	23	17	35.5	8.0	6	0	0	17
	1995-1996	75	32	45	23	17	na	na	na	0	0	17
Total for all permit hunts	1987-1988	150	33	37	22	33	35.3		--	0	0	33
	1988-1989	150	29	43	28	42	35.9		7	0	0	42
	1989-1990	150	32	33	33	50	36.8		10	0	0	50
	1990-1991	150	29	47	19	28	34.6		4	0	0	28
	1991-1992	150	29	43	28	42	36.2		17	0	0	42
	1992-1993	150	27	45	27	41	35.9	8.7	10	0	0	41
	1993-1994	150	31	42	27	40	35.9	8.5	10	0	0	40
	1994-1995	150	36	43	19	28	35.2	7.9	7	0	0	28
	1995-1996	150	32	47	21	32	na	na	na	0	0	32

Table 4 Delta Controlled Use Area sheep hunter residency and success, 1987-1994

Hunt no.	Regulatory year	Successful					Unsuccessful					Total hunters
		Local[a] resident	Nonlocal resident	Nonres	Unk	Total (%)	Local resident	Nonlocal resident	Nonres	Unk	Total (%)	
D1103	1987-1988	12	9	0	1	22 (42)	9	20	0	1	30 (58)	52
	1988-1989	3	10	0	0	13 (27)	19	13	1	2	35 (73)	48
	1989-1990	12	13	2	0	27 (51)	10	16	0	0	26 (49)	53
	1990-1991	6	8	1	0	15 (31)	9	22	2	0	33 (69)	48
	1991-1992	9	21	2	0	32 (39)	15	33	3	0	51 (61)	83
	1992-1993	11	8	0	0	19 (39)	15	14	2	1	32 (61)	51
	1993-1994	12	6	2	1	21 (42)	11	14	1	3	29 (58)	50
DS203	1994-1995	7	4	0	0	11 (27)	12	16	2	0	30 (73)	41
D1104	1987-1988	7	4	0	0	11 (30)	17	9	0	0	26 (70)	37
	1988-1989	13	15	1	0	29 (50)	18	11	0	0	29 (50)	58
	1989-1990	12	10	1	0	23 (49)	11	12	1	0	24 (51)	47
	1990-1991	8	4	0	0	12 (24)	19	17	1	0	37 (76)	49
	1991-1992	14	3	0	0	17 (38)	19	9	0	0	28 (62)	45
	1992-1993	11	9	2	0	22 (38)	22	14	0	0	36 (62)	58
	1993-1994	7	11	0	1	19 (36)	14	20	0	0	34 (64)	53
DS204	1994-1995	7	8	1	1	17 (35)	17	15	0	0	32 (65)	49
Total for all permit hunts	1987-1988	19	13	0	1	33 (37)	26	29	0	1	56 (63)	89
	1988-1989	16	25	1	0	42 (40)	37	24	1	2	64 (60)	106
	1989-1990	24	23	3	0	50 (50)	21	28	1	0	50 (50)	100
	1990-1991	14	12	1	0	27 (28)	28	39	3	0	70 (72)	97
	1991-1992	23	24	2	0	49 (38)	34	42	3	0	79 (62)	128
	1992-1993	22	17	2	0	41 (38)	37	28	2	1	68 (62)	109
	1993-1994	19	17	2	2	40 (39)	25	34	1	3	63 (61)	103
	1994-1995	14	12	1	1	28 (31)	29	31	2	0	62 (69)	90

[a] Local is a hunter who resides in the Game Management Unit.

Table 5 Delta Controlled Use Area sheep harvest percent by transport method, 1987-1995

Permit hunt no.	Regulatory year	Percent of harvest								
		Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
D1103[a]	1987-1988	6	0	0	0	0	0	88	6	52
	1988-1989	10	0	4	0	0	2	79	4	48
	1989-1990	8	0	0	2	0	0	87	4	53
	1990-1991	8	0	8	0	0	0	75	8	48
	1991-1992	12	0	5	0	0	0	76	7	59
	1992-1993	5	0	5	0	0	0	84	5	49
	1993-1994	19	0	0	0	0	0	71	10	50
DS203	1994-1995	27	0	0	0	0	0	64	9	42
	1995-1996	20	0	7	0	0	0	67	7	51
D1104	1987-1988	18	3	0	30	0	16	32	0	37
	1988-1989	38	0	3	12	0	14	31	2	58
	1989-1990	43	0	0	13	0	13	32	0	47
	1990-1991	38	0	0	34	0	4	24	0	50
	1991-1992	26	2	0	45	0	4	23	0	47
	1992-1993	41	0	0	41	0	5	14	0	56
	1993-1994	63	0	0	21	0	5	5	5	53
DS204	1994-1995	35	0	0	59	0	0	6	0	49
	1995-1996	na	na	na	na	na	na	na	na	na
Total for all permit hunts	1987-1988	11	1	0	12	0	7	65	3	89
	1988-1989	25	0	4	7	0	8	53	3	106
	1989-1990	24	0	0	7	0	6	61	2	100
	1990-1991	23	0	4	17	0	2	49	4	98
	1991-1992	18	1	3	20	0	2	53	4	106
	1992-1993	24	0	2	22	0	2	46	2	105
	1993-1994	40	0	0	10	0	3	40	8	103
	1994-1995	32	0	0	36	0	0	29	4	91
	1995-1996	na	na	na	na	na	na	na	na	na

[a] No motorized vehicles or pack animals are allowed during Hunt 1003.

Table 6 Delta Controlled Use Area sheep harvest chronology percent by time period, 1990-1994

Hunt no.	Regulatory year	Harvest dates							
		8/10-/16	8/17-8/23	8/24-8/30	8/31-9/6	9/7-9/13	9/14-9/20	Unk	*n*
D1103[a]	1990-1991	60	27	7	--	--	--	7	15
	1991-1992	48	39	9	--	--	--	4	23
	1992-1993	63	37	0	--	--	--	0	19
	1993-1994	62	33	5	--	--	--	0	21
	1994-1995	73	18	9	--	--	--	0	11
D1104[b]	1990-1991	--	--	38	15	15	23	8	13
	1991-1992	--	--	42	26	11	21	0	19
	1992-1993	--	--	46	36	18	0	0	22
	1993-1994	--	--	63	26	5	5	0	19
	1994-1995	--	--	41	29	18	12	0	17
Total for all permit hunts	1990-1991	32	14	21	7	7	11	7	28
	1991-1992	26	21	24	12	5	10	2	42
	1992-1993	29	17	24	20	10	0	0	41
	1993-1994	33	18	33	13	3	3	0	40
	1994-1995	29	7	29	18	11	7	0	28

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

Table 7 Hunter satisfaction ratings with Delta Controlled Use Area (DCUA) management for Dall sheep hunts D1103/DS203 and D1104/DS204, based on hunter responses to mail-out questionnaires

Date	% Satisfied with hunt[a]	Mean satisfaction rating	% Agree with DCUA harvest goals[b]	% Agree with DCUA aesthetic goals[c]	*n*
1993	80.6	3.2	85.5	95.2	63
1994	92.9	2.7	94.9	96.8	62
1995[d]	81.6	3.3	95.9	90.2	51

[a] Based on hunters scoring satisfaction from 1-5 on scale of 1 (very satisfied) to 10 (extremely disappointed).
[b] Harvest Goals = Mean annual harvest of 35 full-curl rams with a mean horn size of more than 36 inches, and a mean age exceeding 8 years.
[c] Aesthetic Goals = Provide aesthetically pleasing hunting conditions by managing hunter numbers, hunter access, and transportation means so that most hunters are satisfied with the aesthetic quality of their hunt.
[d] Preliminary results.

APPENDIX A 1995 Delta Controlled Use Area sheep hunter survey

August 8, 1995

Dear Delta Controlled Use Area Sheep Hunter:

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

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

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

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

Sincerely,

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

Enclosures

DELTA CONTROLLED USE AREA
1995 SHEEP HUNTER SURVEY

1. Name:_____

2. Address:_____

3. When did you hunt (Month/Day)? From:_____ To:_____

4. Length of hunt:_____(days)

5. What area did you hunt?
   Major drainage:_____
   Major tributaries:_____

6. How many people were in your hunting party?_____

7. How many other hunting parties did you see besides your own?_____

8. How many people were in the other parties?_____

9. How many sheep did you see?
   A. Legal rams (regardless of trophy size)_____
   B. Sublegal rams_____
   C. Ewes_____
   D. Lambs_____

10. Did you see any sheep with neckbands or eartags? Please return the enclosed map noting location of the collared sheep you saw, and list the color and number of the collar or tag if you could read it:

    _____

    _____

11. Did you hunt with a (Circle one):

    A. Rifle B. Pistol C. Bow D. Other_____

12. Do you consider the number of hunters, aircraft, or ORVs you saw to be:

		About Right	A Few Too Many	A Lot Too Many	Makes No Difference
A.	Other hunters seen	1	2	3	4
B.	Aircraft passing by	1	2	3	4

(C and D: Applicable to August 26-September 20 season only)

C.	Aircraft landing	1	2	3	4
D.	ORV traffic	1	2	3	4

13. Were any hunters from other parties stalking the same sheep you were? (Circle one)
Yes No

14. Please indicate how the following conditions affect your hunting enjoyment.

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

15. Were you satisfied with the aesthetic quality of your hunt? (Circle one) Yes No

16. If no, why not:_____
_____

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

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

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

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

Very Satisfied								Extremely Disappointed		Did Not Shoot a Ram
1	2	3	4	5	6	7	8	9	10	11

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

_____

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

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

23. If you passed up any legal rams, was it because they were: (Check any answers that apply)
A.____Not as big as you wanted
B.____Not the kind of trophy you wanted
C.____Too early in the hunt
D.____Too far away
E.____Inaccessible
F.____Already being stalked by someone else
G.____Other (explain)_____

_____

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

Very Satisfied									Extremely Disappointed
1	2	3	4	5	6	7	8	9	10

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

26. Do you agree with the DCUA management goal of providing aesthetically pleasing hunting conditions by 1) limiting the number of hunters by drawing permit to reduce crowding; and 2) restricting hunter access and transportation means by prohibiting motorized vehicles or pack animals from August 5-25? (Circle one) Yes No
Comments:_____
_____

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

Thank you for you time,

Steve DuBois
Delta Area Biologist
Division of Wildlife Conservation
(907) 895-4484

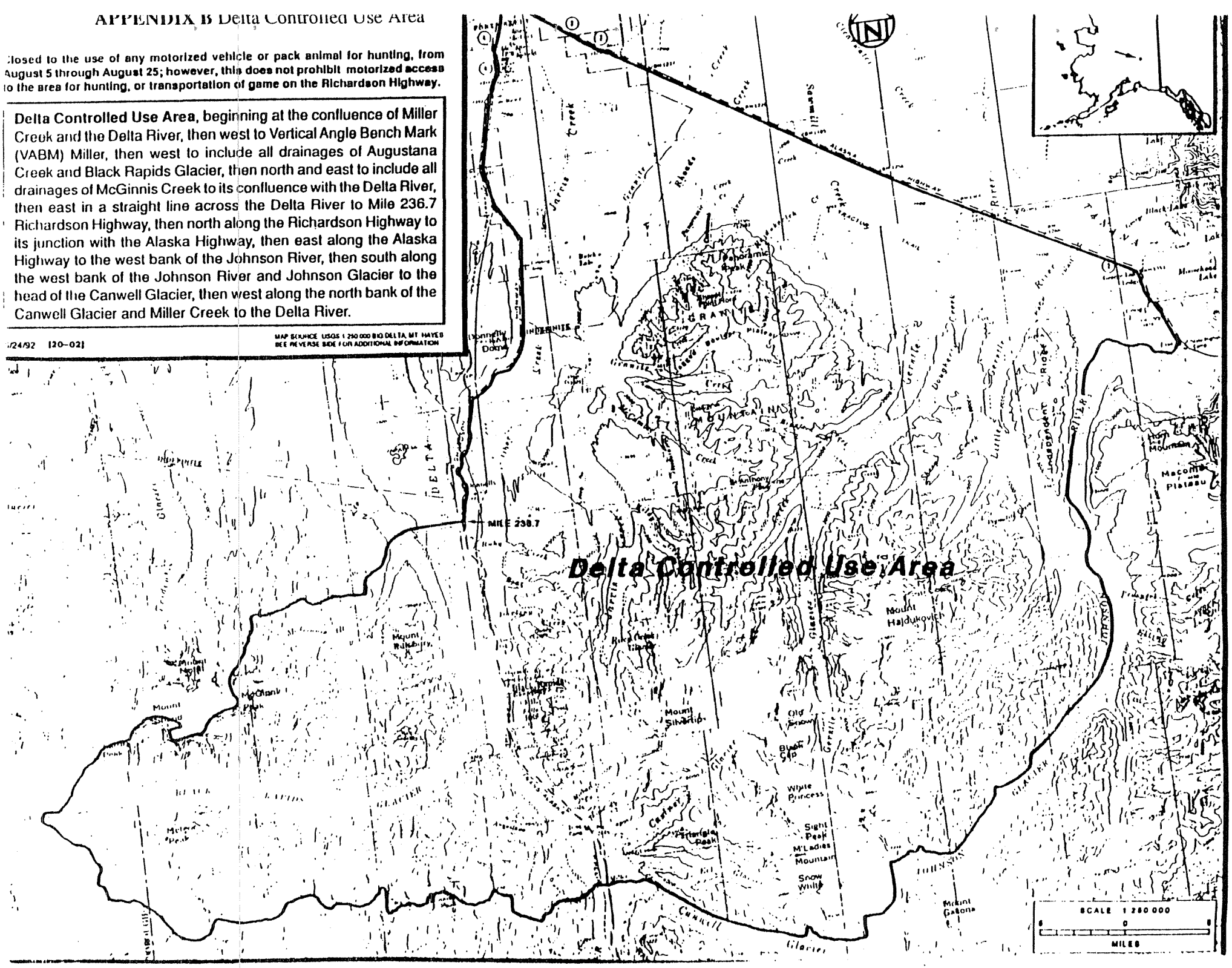
APPENDIX B Delta Controlled Use Area

Closed to the use of any motorized vehicle or pack animal for hunting, from August 5 through August 25; however, this does not prohibit motorized access to the area for hunting, or transportation of game on the Richardson Highway.

Delta Controlled Use Area, beginning at the confluence of Miller Creek and the Delta River, then west to Vertical Angle Bench Mark (VABM) Miller, then west to include all drainages of Augustana Creek and Black Rapids Glacier, then north and east to include all drainages of McGinnis Creek to its confluence with the Delta River, then east in a straight line across the Delta River to Mile 236.7 Richardson Highway, then north along the Richardson Highway to its junction with the Alaska Highway, then east along the Alaska Highway to the west bank of the Johnson River, then south along the west bank of the Johnson River and Johnson Glacier to the head of the Canwell Glacier, then west along the north bank of the Canwell Glacier and Miller Creek to the Delta River.

/24/92 [20-02]

MAP SOURCE: USGS 1:250,000 BIG DELTA, MT. HAYES
SEE REVERSE SIDE FOR ADDITIONAL INFORMATION



LOCATION

GAME MANAGEMENT UNIT: 20A (6796 mi^2, less than half of which is sheep habitat)

GEOGRAPHICAL 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 have been one of the most popular Dall sheep hunting areas in Interior Alaska because of their proximity to Fairbanks, the open general season (no drawing permits required), and the opportunity to hunt other species. Unit 20A has been managed to provide 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 1981 harvests have ranged from 49 to 163 rams/year taken by 150 to 410 hunters/year.

Research on sheep in Unit 20A has included periodic aerial surveys, a study comparing sheep in Unit 20A (poor ram horn growth) with sheep in Unit 12 (good ram horn growth) (Heimer and Watson 1986), a study from 1968 through 1988 of sheep use of the Dry Creek mineral lick, and a cooperative project between the department and the US Army to study movements and seasonal ecology of 15 radiocollared sheep on and adjacent to Fort Greely land (Spiers and Heimer 1990). Ver Hoef (pers commun, 21 May 1992) reviewed the methodology, applications, and limitations of sheep data collected at mineral licks. Whitten and Eagan (1995) evaluated sheep monitoring methods and tested a double sampling technique in 1994. A study of the causes and magnitude of lamb mortality was initiated in 1995.

Heimer and Watson (1986) summarized Unit 20A population trends. Sheep numbers were relatively high in the 1960s because of widespread predator control programs before statehood in 1959 and favorable weather conditions. Aerial wolf hunting was prohibited in 1963, and by 1970 both wolves and sheep were abundant in the Dry Creek study area. However, the sheep population declined approximately 20% during the next 5 years. A wolf control program was initiated in 1976 to provide relief for declining moose and caribou populations in Unit 20A. By fall 1978 sheep numbers stopped declining and remained relatively stable for several years (Heimer and Stephenson 1982).

Aerial sheep surveys conducted before 1978 indicated a minimum estimate of 3576 sheep in Unit 20A. Based on an assumed sightability of 70%-80%, incomplete coverage of some sheep habitat, and population growth since 1977, McNay (1990) believed that 5000 sheep was a reasonable estimate for the population in 1989. Subsequent aerial surveys in portions of Unit 20A indicated the sheep population declined between 1984 and 1991.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

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

MANAGEMENT OBJECTIVES

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

METHODS

Six aerial surveys were flown during this reporting period to monitor population status. All surveys were conducted from PA-18 or Scout aircraft, except an R-22 helicopter was used in the 1993 postharvest survey, the 1994 double sampling survey, and in the 1995 postlambing survey. Sheep were classified as lambs, "ewes," or rams based on horn size/shape and body conformation. "Ewes" included young rams that could not be distinguished from ewes, and yearlings of both sexes. In 1992 and 1993 rams were classified as legal (full-curl or both horns broomed), sublegal, or unknown. Rams were classified by horn class in the intensive helicopter search component of the double sampling survey conducted in 1994. Complete details of the 1994 double sampling survey are presented by Whitten and Eagan (1995).

1992

On 28-29 July 1992 sheep were counted and classified in approximately 153 mi^2 of suitable habitat west of the Wood River and north of the Yanert River (Fig 1:Area 5). Primary search areas included Mystic Mountain, Keevy Peak, and upper Healy and Moody Creeks. Sample units were searched by flying low-level contours and circles at 60-80 knots/hr. Total search time was 7 hours, 7 minutes (2.8 min/mi^2).

Survey conditions were good to excellent with flat light of medium to high intensity during most of the survey; however, winds and turbulence were a minor factor late in the day. The pilot (B Lentsch) has flown most Unit 20A sheep surveys during the last 12 years, providing consistency in search pattern and sightability.

1993

Two surveys were conducted in 1993, 1 postlambing and the other postharvest. The postlambing survey was conducted on 3 June and 8 June to determine whether the low lamb:"ewe" ratios

observed in recent years were the result of poor production or poor lamb survival. A very low intensity survey (1.9 hr) was conducted between the Wood River and the West Fork of the Little Delta River on 3 June. Clear skies resulted in poor visibility caused by sun glare. On 8 June, 2 pilot/observer teams counted and classified sheep in a 121 mi^2 area consisting of 71 mi^2 between Dry Creek and the Wood River and 50 mi^2 between the West Fork of the Little Delta and Dry Creek (Fig 1:Areas 1 and 2). Survey conditions were good to excellent with bright light and light/moderate turbulence. Temperatures ranged from 30° to 40° F and clouds were scattered. Total search time was 6 hours and 5 minutes (3 min/mi^2).

A postharvest survey was conducted from an R-22 helicopter on 23 September and 24 September. Approximately 200 mi^2 between the West Fork of the Little Delta River and the Wood River (Fig 1:Areas 1-4) were surveyed in approximately 4.4 hours. Conditions were overcast to partly sunny with calm winds on 23 September and bright sun and occasionally gusty winds on 24 September. Mottled snow cover hampered sightability throughout most of the survey area.

1994

A postlambing survey was conducted on 4 June in a 187 mi^2 area between the West Fork of the Little Delta and the Wood Rivers (Fig 1:Areas 1-4).

The 1994 double sampling survey employed a double sampling technique and covered all sheep habitat within Unit 20A except that portion within the Delta Controlled Use Area. The area was divided into 50 sample units ranging from 19-29 mi^2 each. The entire study area was surveyed at 1.9 min/mi^2 from PA-18 aircraft, and sheep were classified as adults or lambs. Seventeen randomly selected sample units were then resampled at an average intensity of 2.7 min/mi^2 from an R-22 helicopter with pilot and observer. Sheep were classified as lambs, "ewes," and rams by horn curl class. The high intensity helicopter counts were conducted as soon as possible (usually less than 30 min) after the low intensity fixed-wing surveys. We used the software program MOOSEPOP to estimate population size and composition (Gasaway et al. 1986).

1995

On 7 June 1995 a postlambing survey was conducted between the Wood River and the West Fork of the Little Delta (Fig 1:Areas 1-3). The survey was conducted by a pilot and observer in an R-22 helicopter.

Harvest and hunter effort were monitored with harvest report cards.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The Unit 20A sheep population, excluding the Delta Controlled Use Area, has declined considerably since 1984 and includes only 1612-2272 sheep (90% CI).

The 1992 survey revealed 222 sheep and only 5 lambs/100 "ewes." Although directly comparable data do not exist, the low sheep numbers and low lamb numbers indicated continuing declines in Unit 20A population size.

The 1993 postlambing survey conducted on 8 June produced a lamb:"ewe" ratio of 12:100, indicating that low natality rates and/or high perinatal and neonatal mortality were important factors in the population decline. In the 1993 postharvest survey, 248 sheep were counted and classified. Again, 9 lambs:100 "ewes" indicated continuing low recruitment and probable declines for the sheep population. The total count represented a 29% decline from the number of sheep counted in the same area in 1991 (508). After the 1993 surveys, managers estimated 1000-3000 sheep in Unit 20A.

In the 1994 postlambing survey, 60% fewer sheep were observed than in the same area in 1984. Lamb:100 "ewe" ratios had improved since 1993 to 34:100. The sample included 211 "ewes," 72 lambs, and 125 rams.

The 1994 double sampling population estimate of 1942 (+/-17%, 90% CI) sheep verified the magnitude of the decline in sheep numbers in Unit 20A. However, greatly improved lamb:ewe ratios (50 lambs:100 "ewes") indicated the decline has ended.

The 1995 postlambing survey data support the conclusion that the population is recovering. We counted 586 sheep, compared with 440 in the same area the previous year. Lamb:"ewe" ratios were 35:100. Yearlings were discerned from ewes in this survey and yearling:ewe (not including "ewe-like" animals) ratios were 24:100. The lamb:ewe ratio, not including "ewe-like" animals was 44:100.

Population Composition

Composition data reflect low lamb numbers through 1993 and improvement in 1994 and 1995 (Table 1). Rams continue to be well represented. On average, 18% of rams were full curl or larger during the reporting period. Composition data also indicate low numbers of class I and II rams (half curl or smaller) which is consistent with recent years of low lamb recruitment.

Distribution and Movements

Sheep are distributed throughout the mountains of Unit 20A. In addition, a small number of sheep are occasionally seen in the foothills in the vicinity of Jumbo Dome, Molybdenum Ridge, Needle Rock, the Totatlanika River canyon, and Rex Dome. During summer sheep densities in Unit 20A are highest between the Wood River and the West Fork of the Little Delta River. Densities decrease east and west of this core area. From early May to early July, sheep distribution is largely influenced by their use of mineral licks.

In a study of 15 radiocollared sheep in eastern Unit 20A (Spiers and Heimer 1990), winter ranges tended to lie within summer ranges. Older rams traveled greater distances than ewes and young rams; the greatest distances traveled by these collared sheep were made by 2 radiocollared rams that moved approximately 12 miles between Whistler Creek and Trident Glacier.

MORTALITY

Harvest

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

Board of Game Actions and Emergency Orders. The Board of Game did not change any seasons or bag limits for sheep in Unit 20A during this reporting period.

Hunter Harvest. Reported sheep harvest in Unit 20A steadily increased from 102 rams in 1985 to 163 in 1989 (Fig 2). After 1989 harvests began to decrease and have continued to decline throughout this reporting period.

Above average yearling recruitment in 1980 and 1981 probably contributed to the high harvest from 1986 through 1989 (McNay 1990). However, yearling recruitment since 1981 has been moderate, and harvests decreased after 1989. Because of the weak cohorts that we have documented from 1991 through 1993, we expect harvest to be fairly low through 2001 as rams in those weak cohorts mature and become legal to hunt.

Harvest and hunting pressure are highest in western and southern Unit 20A where sheep habitat is most accessible (Table 2).

Mean horn length of harvested rams has ranged from 34 inches to 35 inches since 1984 when the bag limit was changed from 7/8-curl to full-curl rams (Table 3). Only 1% of the rams harvested since 1986 have had horns ≥ 40 inches long.

Hunter Residency and Success. Success rates are much higher for nonresidents than for resident hunters (Table 4). During this reporting period, nonresident success ranged from 55%-88%, while resident success ranged from 19%-21%. Overall success rates ranged from 27% in 1992 to 33% in 1994.

Harvest Chronology. Roughly half of all sheep harvested in Unit 20A are taken during the first 10 days of the season (Table 5). Harvest tends to taper off as the season progresses.

Transport Methods. The Wood River and Yanert Controlled Use Areas are closed to the use of motorized vehicles, except aircraft, for big game hunting and transportation throughout the sheep hunting season. These areas contain approximately half of the Dall sheep range in Unit 20A. Accordingly, most of the successful sheep hunters during the last 8 years have used airplanes (50%-60%) or horses (19%-30%) as transportation to their hunt (Table 6). Although many sheep hunters used 3- or 4-wheelers, ORVs, and highway vehicles, their success rates were lower.

HABITAT

Assessment

No significant disturbance or destruction of sheep habitat occurred in Unit 20A through this reporting period. The Division of Wildlife Conservation will coordinate with Habitat Division to assess factors affecting sheep habitat.

CONCLUSIONS AND RECOMMENDATIONS

We are currently meeting 3 of our 5 objectives for sheep in Unit 20A. We continue to meet our objective of providing the greatest sustainable annual opportunity to hunt Dall sheep by maintaining a resident and nonresident open season for full-curl rams from 10 August through 20 September. The restriction to full-curl rams also allows us to meet our objective to maintain naturally regulated ewe and subadult ram segments of the population. The objective to provide the opportunity to view and photograph sheep under natural conditions is easily met with access into many areas of sheep habitat.

However, with our current estimates of 2000 sheep in Unit 20A, we are not meeting our objective to manage for a sheep population of approximately 5000 sheep. The decline was likely due to several years of relatively severe winters, causing reduced production and increased predation. Overharvest is not a concern because hunting is restricted to the taking of old rams. Changes in seasons and bag limits are, therefore, not recommended. However, we expect harvests to remain low as weak cohorts from the last few years mature and become legal to hunt. Recent improvements in recruitment will not result in increased harvests until after the year 2001.

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Table 1 Dall sheep composition data for Unit 20A. Numbers given are per 100 "ewes," which includes young rams not distinguishable from ewes and all yearling sheep.

Year	Rams	Full curl	Lambs	Sample size
1984	39	--[a]	38	1313
1991	47	--[a]	18	698
1992	62	6	5	222
1993[b]	42	6	12	364
1993[c]	47	11	9	387
1994[b]	60	--[a]	34	408
1994[d]	42	6	50	1425
1995[b,d]	54	--[a]	35	586

[a] Data not available.
[b] Post lambing.
[c] Post harvest.
[d] Ratios are per 100 true ewes.

Table 2 Distribution of sheep harvest, Unit 20A, 1989-1994

Area	Uniform location code	1989		1990		1991		1992		1993		1994	
		Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters	Harvest	Hunters
Rex Dome	(0102)	4	14	3	5	9	13	1	1	1	7	0	1
Healy Creek	(0103)	20	66	10	44	17	76	9	42	8	28	9	32
Moody Creek	(0104)	8	27	11	38	7	19	4	22	4	9	1	7
Yanert	(0105-0109)	16	56	22	64	18	68	16	52	6	27	13	36
Totatlanika River	(0202, 0200, 0201)	7	34	2	28	4	33	2	15	1	18	0	12
Tatlanika River	(0302, 0300)	9	14	1	2	3	9	1	4	1	4	0	4
Total west and south of Wood R drainage[a]		64	211	49	181	58	218	33	136	21	93	23	92
Wood River West	(0402, 0403)	24	47	13	39	6	14	3	22	4	10	10	10
Wood River East	(0404)	28	51	17	46	6	19	1	7	7	11	3	9
Wood River South	(0405)	5	7	4	6	0	3	1	6	0	3	1	11
Total Wood River[a]	(all 0400s)	62	113	38	103	19	47	8	40	12	28	16	32
W Fork Little Delta	(0603, 0604)	6	10	6	13	2	8	0	0	0	2	1	2
Buchanan Creek	(0602)	0	2	0	1	4	5	0	0	3	3	0	0
E Fork Little Delta	(0605)	5	1	8	18	8	17	10	25	4	10	3	10
Total Little Delta[a]	(all 0600s)	12	7	16	36	16	37	11	28	9	20	8	17
Dry Creek	(0505, 0507)	11	20	15	27	9	17	9	16	7	17	2	5
Delta Creek	(0702)	8	15	3	15	5	8	0	3	1	2	0	0
McGinnis Glacier	(0800, 0802)	0	1	0	2	1	2	0	0	0	0	0	0
Unknown 20A	(000, 100)	6	13	3	15	1	8	1	7	0	6	0	4
Total Unit 20A		163	410	124	379	109	338	62	230	50	166	49	150

[a] Includes harvest for which no specified area was given.

Table 3 Historic sheep harvests and hunter participation, Unit 20A, 1968-1994

Year[a]	Reported harvest	Total hunters	Percent success	Mean horn length (inches)[b]
3/4 curl				
1968	138	366	38	33.1
1969	97	262	37	32.9
1970	119	269	44	33.6
1971	133	376	35	33.8
1972	120	359	33	32.5
1973	78	246	32	31.3
1974	101	232	43	31.8
1975	97	217	45	32.3
1976	112	248	45	32.3
1977	116	233	50	32.3
1978	98	248	40	31.8
7/8 curl				
1979	86	226	38	33.4
1980	88	214	41	34.9
1981[a]	116	252	46	34.9
1982	112	189	59	34.0
1983	121	297	41	33.7
Full curl				
1984	105	292	36	34.0
1985	102	292	35	34.0
1986	136	357	38	34.2
1987	142	354	40	35.0
1988[c]	154	404	38	34.7
1989[d]	163	410	40	34.3
1990[d]	124	379	33	34.4
1991[d]	109	338	32	34.5
1992	62	230	27	34.0
1993	50	166	30	34.1
1994	49	147	33	34.9

[a] The boundary of Unit 20A was different prior to 1981, but has remained the same since 1981.
[b] Includes broomed horns.
[c] Data from harvest printout 30 Jan 1989.
[d] Data from harvest summary book.

Table 4 Dall sheep hunter residency and success, Unit 20A, 1984-1994

	Successful					Unsuccessful					
Year	Unit[a] res	AK[b] res	Nonres	Unk	Total	Unit[a] res	AK[b] res	Nonres	Unk	Total	Total hunters
1984	--	78	27	0	105	--	177	7	3	187	292
1985	44	65	36	1	102	143	177	10	3	190	292
1986	59	90	36	10	136	141	196	13	12	221	357
1987	61	80	49	13	142	100	166	9	37	212	354
1988[c]	43	72	45	37	154	125	175	3	72	250	404
1989[d]	78	110	52	1	163	158	223	19	5	247	410
1990[d]	49	73	46	5	124	167	235	12	8	255	379
1991[d]	50	76	33	0	109	146	207	15	7	229	338
1992	20	35	24	3	62	102	147	20	1	168	230
1993	18	26	22	2	50	66	99	15	2	116	166
1994	14	22	22	5	49	59	85	3	13	101	150

[a] Includes all of Unit 20.
[b] Includes unit residents.
[c] Data from harvest printout 30 Jan 1989.
[d] Data from harvest summary books.

Table 5 Sheep harvest chronology percent by time period in Unit 20A, 1984-1994

	Harvest dates			
Year	10-20 Aug	21-31 Aug	1-10 Sep	11-20 Sep
1984	56	18	13	13
1985	52	23	15	9
1986	38	29	25	8
1987	49	29	13	10
1988	50	26	15	9
1989[a]	--	--	--	--
1990[b]	60	21	7	4
1991	56	20	16	5
1992[b]	47	29	19	3
1993[b]	56	18	18	6
1994[a]	53	25	10	12

[a] Data not readily available in this format. However, 45% of sheep harvested in 1989 were taken by 19 Aug. An additional 36% were taken by 2 Sep.
[b] Remainder—unknown/other.

Table 6 Unit 20A sheep harvest percent by transport method, 1985-1994

Regulatory year	Method of transportation							
	Airplane	Horse	Boat	3- or 4-wheeler	ORV	Highway vehicle	Unk	*n*
1985	56	27	1	1	3	12	0	96
1986	48	29	0	1	6	16	0	127
1987	50	30	0	2	5	13	0	131
1988	62	20	0	1	5	12	0	142
1989	55	20	0	5	4	15	1	160
1990	56	23	0	4	6	10	1	122
1991	57	19	1	6	3	8	6	109
1992	52	24	0	6	6	8	3	62
1993	50	28	0	4	0	16	2	50
1994	49	29	0	6	4	8	4	49

LOCATION

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

GEOGRAPHICAL DESCRIPTION: White Mountains area

BACKGROUND

Dall sheep in the White Mountains provide the public with opportunities to view and hunt sheep relatively close to Fairbanks with access from the road, by air, or by boat. Because the sheep population is relatively small (500 sheep) and harvest is low (< 7 sheep/yr), these sheep have received relatively little attention and surveys have been infrequent.

The sheep population in the White Mountains has fluctuated widely during the last 22 years. Biologists flew aerial surveys 8 times since 1970 (Table 1). According to these surveys, the population was high in 1970 (285 sheep counted) but had declined 56% (124 sheep counted) by 1977. The observer in both surveys, AC Smith (ADF&G biologist), believed this dramatic decline was real and not an artifact of survey conditions or techniques (AC Smith, pers commun, 26 Aug 1977). He stated that important factors contributing to this decline were probably deep snow during winter 1970-1971 and increased wolf predation related to lack of caribou west of the Steese Highway after 1971. The number of sheep observed during surveys has increased from 1977 through 1995. However, some of the fluctuations in numbers of sheep observed during surveys are due to differences in area covered, survey intensity, and sheep sightability, rather than actual changes in population size.

The number of legal rams has generally decreased since 1970, largely due to restrictions in the definition of "legal." "Legal" rams included 3/4-curl or larger rams from 1970 to 1978; 7/8-curl rams from 1979 to 1985; 7/8-curl rams for Unit 25 and full-curl rams for Unit 20 in 1986; and full-curl rams since 1987.

The only research project during recent years has been a study (1983-1988) of 10 radiocollared sheep to identify their distribution, movements, and seasonal use areas as part of a cooperative study between the Bureau of Land Management (BLM) and ADF&G (Durtsche et al. 1990). Previous population studies were conducted by the US Fish and Wildlife Service as far back as 1950 (Gross 1963).

Most sheep habitat in the White Mountains area lies within the White Mountains National Recreational Area (WMNRA) and the Steese National Conservation Area (SNCA), which were established by the Alaska National Interest Lands Conservation Act in 1980 and are managed by BLM. Increases in 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 to provide for the 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 OBJECTIVES

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

- Cooperate with the Bureau of Land Management and potentially affected interest groups to protect sheep habitat (Boudreau 1995).

METHODS

To estimate population size and composition, biologists conducted 3 aerial surveys of sheep in the White Mountains during this reporting period. Observers classified sheep as lambs, "ewes," or rams based on horn size/shape and body conformation. "Ewes" included young rams that could not be distinguished from ewes, and yearlings of both sexes. Rams were classified in 1992, 1994, and 1995 as legal (full-curl or both horns broomed) or sublegal because of the difficulty viewing rams adequately to judge horn size. Observers searched alpine and subalpine sheep habitat by flying low-level contours and circles at 60-80 knots/hour in Supercubs and an Aviat Husky.

1992

From 1 August to 4 August, Pilot W Lentsch and BLM biologist J Herriges surveyed all known sheep habitat in the White Mountains for 11.8 hour (J Herriges, pers commun, 21 Aug 1992).

1993

No fall aerial composition surveys were conducted.

1994

During spring 1994 department staff met with staff from BLM and FWS Yukon Flats Refuge to discuss White Mountains sheep. A product of this meeting was a cooperative agreement between the 3 agencies to survey sheep annually. The FWS agreed to survey Mount Schwatka and Mount Victoria, and BLM and the department agreed to divide up the remaining area of sheep habitat.

On 4 August, Toby Boudreau, Jim Herriges (BLM), and Mark Bertram (FWS) conducted the White Mountains sheep survey. Toby Boudreau (PM) and Jim Herriges (AM) observed from a PA-18 piloted by W Lentsch (Tamarack Air). Mark Bertram observed from an Aviat Husky on floats, piloted by Mike Vivian (FWS). The combined survey time was 10.3 hour. All sheep habitat was surveyed except for the area around Mount Prindle. The Mount Prindle area was not surveyed because of strong winds and associated turbulence (J Herriges, pers commun, 31 Oct 1994).

1995

On 1 August, Toby Boudreau and Jim Herriges (BLM) started the White Mountains sheep survey. Mark Bertram (FWS) then completed the survey on 11 August. Toby Boudreau observed from a PA-18 piloted by Marty Webb (Webb Air) and Jim Herriges observed from a PA-18 piloted by W Lentsch (Tamarack Air). Mark Bertram observed from an Aviat Husky on floats, piloted by Mike Vivian (FWS). The combined survey time was 11.1 hour. All known sheep habitat was surveyed (T Boudreau, pers commun, 12 Dec 1995).

We monitored harvest through harvest ticket report cards.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We estimate the White Mountains area includes approximately 400-450 sheep, which is the highest estimate since the surveys began. During aerial surveys in 1994 and 1995, observers counted 344 and 409 sheep, respectively (Table 1). Although high search intensity (10.3 and 11.1 hr, respectively) should have resulted in high sightability during these surveys, sheep in this area sometimes use habitat well away from escape terrain, including timber and shrub-covered areas near mineral licks. Therefore, we adjusted our estimate upward to account for sheep not observed.

Population Composition

Recruitment of lambs was variable (15 to 35 lambs:100 "ewes") between 1991 and 1995 (Table 1). In 1992 recruitment was very low (15:100). Extreme weather conditions during winter 1991-1992 was the main cause of this low recruitment in 1992. This low recruitment accounts for most of the decrease in the number of sheep counted in 1992 (324) versus 1991 (345). Other biologists also documented low lamb:"ewe" ratios during spring 1992 in the Interior including Unit 20A (5:100, Eagan 1993) and the Delta Controlled Use Area of Unit 20D (11:100, DuBois 1993).

Since 1992 the lamb:ewe ratio increased to 35:100 in 1994 and was 29:100 in 1995. These ratios are similar to ratios observed in previous years (Table 1).

Since 1991, the ram:"ewe" ratio has been stable between 35 and 37:100 (Table 1). Total number of rams has fluctuated slightly with overall counts and the 1995 count indicates a slight increase. The number of legal rams counted per survey since 1991 is small (6-9) with most of the fluctuations in total rams from the sublegal ram segment of the population.

Some caution should be used in interpreting composition data from aerial surveys in the White Mountains area. Survey areas have varied throughout the years because weather often prevents portions of sheep habitat from being surveyed. Because ram groups and ewe/lamb groups often occupy different ranges during summer, the area surveyed affects composition. In addition, sheep are distributed differently in September-October than in June-August, so the survey date should be noted. Composition data from aerial surveys of sheep underestimate true lamb:ewe and ram:ewe ratios because the "ewe" category contains yearlings and young rams.

Distribution and Movements

Sheep in the White Mountains area are in small, widely scattered groups throughout approximately 534 mi^2 of alpine habitat near Victoria Mountain, Mount Schwatka, Mount Prindle, Lime Peak (Rocky Mountain), and White Mountains proper areas. Because this area is geographically isolated from other sheep populations (ADF&G 1976), sheep in the White Mountains area may have relatively unique gene pools (Durtsche et al. 1990).

The seasonal movements and distribution of sheep described in the remainder of this section were taken primarily from a study of 10 radiocollared sheep between 1983 and 1988 by Durtsche et al. (1990). Movement from wintering areas to lambing areas usually occurred between late May and mid June, with most lambs being 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 associated themselves with one of several bands. Separate bands used disjunct ranges most of the year, intermingled with other bands during prerut and rut, then returned to their favored areas postrut. Bands of ewes often used the same range as bands of rams although not at the same time. Rams shifted notably away from easy access points during the sheep hunting season.

Although some mixing occurs, sheep in the White Mountains are in 2 main areas, Lime Peak/Mount Prindle and Victoria Mountain/Mount Schwatka.

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

MORTALITY

Harvest

Season and Bag Limit. The sheep hunting season was 10 August to 20 September throughout this reporting period. The bag limit was one full-curl ram (includes rams at least 8 years old or both horns broomed) (Table 2).

Hunter Harvest. During the last 5 years (1990-1994), 26 sheep have been reported harvested from the White Mountains area. The highest reported harvest in any year is 6 (1992 and 1994) (Table 3).

Dall sheep in the White Mountains area tend to have more massive horns than sheep in other portions of the Interior. The horns tend to have much bigger bases and seem more likely to be broomed. Since 1990, horn size of harvested sheep has ranged from 30.0 to 41.5 inches long (avg = 36.1) with 13- to 15.19-inch bases (avg = 14.0 inches). Fifty-seven percent (15/26) of these sheep had at least 1 broomed horn. We calculated mean horn length and included broomed horns (Table 3). Since 1989 sheep harvest reports have asked how many horns were broomed. This has facilitated better horn length measurements.

During the last 5 years, the reported ages of harvested rams have ranged from 7 to 13 years old ($\bar{x}$ = 9.5 yr, n = 25).

Hunter Residency and Success. White mountain sheep are almost entirely hunted by Alaska residents. Nonresidents have not reported hunting sheep in the White Mountains area since 1984 (Table 4). The success rate for hunters for the last 5 years combined was 16% (24/152). During the last 5 years, successful hunters reported spending an average 6 days, whereas unsuccessful hunters spent an average of 5 days hunting sheep in the White Mountains area (Table 5).

Harvest Chronology. Sixty-nine percent (18/26) of the sheep harvested since 1990 were taken during the first 11 days of the season (Table 6). It is not possible to determine whether the timing of the hunt influences the probability of success because unsuccessful hunters are not asked to report when they hunted. It is also difficult to identify trends in harvest because of the relatively low number of sheep harvested from this area.

Transport Methods. Main access points for planes are a small airstrip on Lime Peak and gravel bars and several private strips along Beaver Creek. Float planes can land on several small lakes north of Mount Schwatka and sometimes on Beaver Creek. Ground access is primarily from trails and mining roads off the Steese Highway. In 1988 BLM established ORV restrictions throughout the WMNRA and SNCA. With these restrictions, most of the sheep range in the White Mountains area is closed to the use of ORVs. However, ORVs weighing < 1500 lb are allowed in most of the area between the Steese Highway and Mount Prindle, which provides good access to sheep habitat.

Hunters accessing White Mountains sheep by airplane composed 83% of successful hunters. ORVs were the most common means of transportation for unsuccessful sheep hunters (Table 7). Hunters using ORVs and highway vehicles were usually unsuccessful. Only 4 hunters have reported success using either an ORV or a highway vehicle since 1984. The use of 3- or 4-wheelers for hunting has increased from an average of 2 hunters per year before 1990 to an average of 13 from 1990 to 1994; no one was successful.

Other Mortality

Natural mortality of sheep in the White Mountains area is probably caused primarily by weather and predation. Deep snow has been implicated as an important cause of sheep mortality in some years (Heimer and Watson 1986). The record snowfall of 1991-1992 caused the low lamb:ewe ratio and drop in overall numbers in 1992. The winters of 1992-1993, 1993-1994, and 1994-1995 were relatively average for snowfall and did not adversely affect populations in the White Mountains.

Little is known about predation rates or predator populations in the White Mountains area. McNay (1989) estimated 87 wolves reside in Unit 25C. One radiocollared ewe was killed by wolves in winter 1983-1984, and golden eagles have been seen on Lime Peak.

Sheep in the White Mountains frequently travel through forested areas because of scattered, low-elevation sheep habitats and the scarcity of rugged escape terrain in the alpine areas (ADF&G 1976). Although these forested areas may provide some escape cover from eagles, traveling through these areas probably increases sheep susceptibility to predation by terrestrial predators.

HABITAT

Assessment

Important features of sheep habitat include summer range, winter range, travel routes between the 2 ranges, mineral licks, lambing areas, and escape terrain. Protection of these features is important to the long-term welfare of sheep in the White Mountains area because the relatively low-elevation, discontinuous alpine areas offer limited sheep habitat and few alternatives. Mineral licks have been identified at Mount Schwatka (Jefferson Creek), Lime Peak (Mascot Creek), Mount Prindle (Convert Creek), along Beaver Creek, and possibly at Victoria Mountain (B Durtsche, pers commun).

Caves have been used by sheep in the White Mountains area for many years, perhaps for relief from hot weather. In 1950 LE Powell (ADF&G files) wrote that "A cave on the eastern slope of the White Mountains had considerable sheep sign in it. The entrance was approximately 25' high and 14' wide. A water hole 25' inside the cave was inaccessible to sheep because it was sunken in shear walls below ground level. The floor of the cave was covered with an inch of old sheep droppings. No prominent or recently used trails were found in the immediate area." In 1982, 5 rams were seen leaving a cave during a "hot and buggy day" (E Crain, pers commun).

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

CONCLUSIONS AND RECOMMENDATIONS

Our goal to provide the opportunity to hunt sheep in the White Mountains under aesthetically pleasing conditions is being met. Human use of sheep in the White Mountains area is relatively low, and it is unnecessary to limit the number or distribution of hunters. However, to maintain aesthetically pleasing conditions, we should carefully monitor mineral exploration, trail development, access, and use of ORVs. Nonconsumptive use of sheep, such as viewing, will probably increase during the next few years as BLM promotes recreational use of the area.

We are meeting our management objective to provide for the sustained opportunity to harvest full-curl rams from a population of at least 250 sheep. We have maintained a resident and

nonresident open season for a full-curl ram from 10 August to 20 September. Our current population estimate of 425-450 sheep exceeds our minimum population objective.

We are also meeting our objective to work cooperatively with BLM and other potentially affected groups to protect sheep habitat. Mineral licks are important year-round use areas and any activity that limits sheep from these areas should be closely examined and discouraged if necessary. ORV users have emerged as a potential problem by rapidly extending the trail system in areas where use is permitted and prohibited, including sheep habitat (Durtsche et al. 1990).

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Table 1 Composition of sheep counted during aerial surveys in the White Mountains area, 1970-1995

	Rams					Lambs			Total	Count time
Date	Legal[a]	Sublegal	Total	Rams: 100 "ewes"	"Ewes"[b]	Lambs	100 "ewes"	Nonlambs	sheep	(hr)
28 Aug 1970	19	25	44	26	171	70	41	215	285	5.9
5-8 Aug 1977	13	25	38	58	66	20	30	104	124	6.5
29 Jun-3 Jul 1982	15	30	45	58	77	10	13	122	132	9.6
17-29 Jun 1986	17	42	59	45	132	49	37	191	240	14.6
4-10 Aug 1989	6	50	56	42	132	31	23	188	237[c]	3.6
30 Sep-3 Oct 1991	9	72	81	37	220	53	24	301	345	8.8
1-4 Aug 1992	8	68	76	35	215	33	15	291	324	11.8
4 Aug 1994[d]	8	64	72	36	201	71	35	273	344	10.3
1-11 Aug 1995	6	78	88[e]	35	248	73	29	336	409	11.1

[a] "Legal" rams = 3/4-curl in 1970 and 1977, 7/8-curl in 1982 and 1986, full curl in 1987.

[b] "Ewes" includes unidentified young rams and yearlings of both sexes.

[c] Total number includes 18 sheep that were not classified.

[d] Numbers include sheep observed during Jul 12-13 1994 ground survey of Mount Prindle, which was not surveyed in Aug due to severe turbulence.

[e] Total rams includes 4 rams that could not be classified because of severe winds in the area.

Table 2 Sheep seasons and bag limits in the White Mountains, 1983-1995

Year	Season	Bag limit	Legal horn size[a]	
			Portion in Unit 20	Portion in Unit 25
1983	10 Aug-20 Sep	1 ram with:	7/8-curl horn or larger	7/8-curl horn or larger
1984 1985 1986	10 Aug-20 Sep	1 ram with:	Full-curl horn or larger	7/8-curl horn or larger
1987 to present	10 Aug-20 Sep	1 ram with:	Full-curl horn or larger	Full-curl horn or larger

[a] Full-curl and 7/8-curl restrictions also allow harvest of rams with both horns broken.

Table 3 Continued

Table 3 Characteristics of sheep reported harvested in the White Mountains area, 1983-1988

Year	Age (yr)	Horn Broomed?	Horn Length (in)	Horn Base (in)	Days hunted
1983[a]	--	N	36.00	12.00	15
	--	N	37.50	14.00	15
	--	Y	35.00	12.50	7
1984	11	Y	34.00	15.00	8
	7	Y	35.50	13.00	8
1985	7	N	34.25	14.00	8
	8	Y	32.50	15.50	7
	6	N	32.00	13.00	5
	8	N	37.25	15.25	4
	14	N	33.50	14.00	5
1986	8	Y	28.00	15.00	15
	10	N	37.50	14.00	6
	8	Y	35.00	--	6
	9	Y	35.00	13.00	10
	10	N	32.00	11.00	10
1987	9	Y	36.00	15.00	7
	8	N	37.50	14.50	5
1988	13	Y	34.50	14.00	2
1989	11	1[b]	43.00	14.50	4
	10	0	38.25	14.00	1
	6	0	38.25	14.50	4
	8	0	38.00	14.87	2
	15	2	33.00	14.00	3
	12	0	34.50	13.25	3
1990	7	0	31.50	14.00	3
	9	1	41.50	14.00	8
	10	2	39.00	15.00	2
	11	2	39.13	13.50	6
1991	11	2	37.00	14.13	7
	9	2	34.00	13.00	2
	8	0	35.50	14.50	7
	7	0	38.50	14.00	5
	10	1	41.00	13.00	2
1992	--	2	--	13.75	1
	11	0	34.00	13.00	10
	9	0	40.50	15.19	4
	11	--	30.00	14.13	8
	10	2	35.00	14.00	12
	11	0	37.50	15.00	1
1993	8	0	33.00	14.00	2
	9	2	31.00	14.50	3
	8	0	37.75	13.50	5

Table 3 Continued

Year	Age (yr)	Broomed?	Horn Length (in)	Horn Base (in)	Days hunted
	9	1	35.50	14.00	5
	10	1	35.00	13.75	7
1994	9	1	35.00	13.75	3
	10	1	36.00	14.00	3
	13	2	35.50	14.00	9
	9	0	34.50	13.75	10
	9	0	36.00	14.00	6
	10	1	39.38	13.88	3

[a] Age data not available.
[b] Number of broomed horns

Table 4 Sheep hunter residency[a] and success for the White Mountains area, 1984-1994

	Successful hunters				Unsuccessful hunters				Total hunters	
Year	Res	Nonres	Unspec	Total	Res	Nonres	Unspec	Total	No.	% Success
1984	0	2	0	2	21	0	1	22[b]	24	8
1985	5	0	0	5[c]	12	0	0	12[d]	17	29
1986	4	0	1	5	4	0	1	5	10	50
1987	2	0	0	2	11	0	0	11[c]	13	15
1988	1	0	0	1	8	0	6	14[c]	15	7
1989	6	0	0	6	6	0	2	8	14	43
1990	4	0	0	4	13	0	1	14	18	22
1991	3	0	0	3	19	0	0	19	22	14
1992	6	0	0	6	29	0	0	29	35	17
1993	5	0	0	5	37	0	3	40	45	11
1994	6	0	0	6	25	0	1	26	32	19
Total	42	2	1	45	185	0	15	200	245	

[a] Resident of Alaska.
[b] Includes 1 coded as unspecified locations in Unit 20 that could have been from Tanana Hills.
[c] Does not include 1 hunter in Unit 20F.
[d] Includes 2 coded as 27Z that could have been from Tanana Hills.

Table 5 Mean number of days hunted for sheep in the White Mountains area, 1984-1994

	Successful		Unsuccessful		
Year	No. hunters	Mean no. days	No. hunters	Mean no. days	Total no. hunters
1984	2	8	22[a]	7	24
1985	5[b]	6	12[c]	4	17
1986	5	9	5	6	10
1987	2	6	11[b]	4	13
1988	1	2	14[b]	4	15
1989	6	3	11	4	17
1990	4	5	14	4	18
1991	3	5	18	6	21
1992	6	6	29	4	35
1993	5	4	22	6	27
1994	6	6	26	5	32
1984-1994	45	6	184	5	229

[a] This table calculated only for hunters who report the number of days they hunted and does not include all hunters. Includes 1 coded 20Z that could have been from Tanana Hills. Also includes 2, 25-day hunts.

[b] Does not include 1 hunter from Unit 20F.

[c] Total no. hunter indicates total no. hunters reporting days hunted, not total hunted. Includes 2 coded 27Z that could have been from Tanana Hills.

Table 6 Harvest chronology for sheep in the White Mountains area, 1984-1994

	Harvest dates			
Year	10-20 Aug	21-31 Aug	1-10 Sep	11-20 Sep
1984	2	0	0	0
1985	3	1	1	0
1986	1	2	1	1
1987	2	0	0	0
1988	0	1	0	0
1989	4	0	0	2
1990	1	1	1	1
1991	4	0	0	1
1992	6	0	0	0
1993	3	2	0	0
1994	4	0	2	0
1984-1992	30	7	5	5

Table 7 Transport methods for sheep hunters in the White Mountains area, 1984-1994

Year	Airplane	3- or 4-wheeler	ORV	Highway vehicle	Other\unknown
Successful:					
1984	2	0	0	0	0
1985[a]	5	0	0	0	0
1986	3	0	1	0	1
1987	2	0	0	0	0
1988	1	0	0	0	0
1989	5	0	0	0	1
1990	4	0	0	1	0
1991	3	0	0	0	1
1992	5	0	0	0	1
1993	4	0	1	0	0
1994	5	0	0	1	0
Total	39	0	2	2	4
Unsuccessful:					
1984[b]	8	6	3	2	3
1985[c]	4	1	4	3	0
1986	0	1	3	1	0
1987[a]	6	2	1	0	2
1988[a]	4	1	3	2	4
1989	1	1	4	3	2
1990	7	8	2	1	1
1991	3	15	0	4	1
1992	10	10	1	5	3
1993	8	17	3	5	4
1994	4	12	1	4	1
Total	55	74	25	30	21

[a] Does not include 1 hunter from Unit 20F.
[b] Includes 1 coded as 20Z that could have been from Tanana Hills.
[c] Includes 1 coded as 27Z that could have been from Tanana Hills.

LOCATION

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

GEOGRAPHICAL DESCRIPTION: Tanana Hills

BACKGROUND

Dall sheep populations inhabiting the Tanana Hills may be characterized as low density and disjunct. These populations are at low densities because of the physical geography of the Tanana Hills, which is atypical Dall sheep habitat (Kelleyhouse and Heimer 1989). Because the Tanana Hills were not glaciated during the most recent glacial advance and there has been little uplift, they are at fairly low elevation and have rolling rather than rugged physiography (i.e., there is a limited amount of escape terrain). In an effort to maintain sheep habitats in the Tanana Hills, where forest succession occurs to the top of most hills, ADF&G continues to support wildfire management plans that should increase the extent of this marginal sheep habitat over time.

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

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

METHODS

The currently high aesthetic qualities of hunting sheep in the Tanana Hills exist because of limited hunter use of this small sheep resource. Sheep may be hunted without permit in the Glacier Mountain Controlled Use Area southwest of Eagle and west of the Taylor Highway (use of motorized vehicles prohibited) and in the Charley and Seventymile River drainages. Within the Mount Harper complex in Units 20D and 20E, sheep may be hunted only under terms of limited drawing permits. Four permits are issued each year. Harvest is restricted to full-curl rams only.

We monitored harvest through drawing permit and general harvest report cards. We analyzed data on harvest success, hunt area, hunter residence and effort, transportation type used to the hunt area, and animal horn size and age.

Composition and size of the Glacier Mountain sheep population was estimated by ground-based survey 11-15 July 1993. A high grade aerial survey around Glacier Mountain was conducted on 25 June 1995. Population composition of the Mount Harper sheep population was estimated by an intensive aerial survey on 26 July 1993.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The last complete survey of sheep habitat in the Charley, Goodpaster, Seventymile and Fortymile drainages was conducted in 1982, resulting in a population estimate of 365 sheep. Under normally prevailing environmental conditions in Interior Alaska, recruitment and mortality are roughly balanced and sheep populations stable (Heimer 1988). Between 1982 and 1990 climatic conditions were mild to average. The National Park Service (NPS) conducted 4 aerial surveys for Dall sheep between 1983 and 1990 within the Yukon-Charley Rivers National Preserve (YCNP) (hunt areas 1107 and 1108) (Ulvi and Knuckles 1990). Based on their data, the area's sheep population increased between 1983 and 1990, possibly by as much as 10% annually. I suspect the Mount Harper and Glacier Mountain populations also benefited from the favorable climatic conditions during this period. Adverse weather conditions prevailed during winter 1991-1992, spring 1992 and during winter 1992-1993. The Glacier Mountain sheep population was comparable with the 1981 and 1982 level but was probably higher during the late 1980s. Based on survey results, the Mount Harper sheep population also declined during the early 1990s.

Population Composition

Composition survey results for Mount Harper are presented in Table 1. Before 1993, the last year composition estimates were obtained was 1982. Comparing results between the 2 surveys, I found the Mount Harper sheep population has declined in all sex and age categories (23%-39%). The recent decline is probably even higher because the population was probably even higher in the late 1980s than in 1982.

The walkabout survey around Glacier Mountain in 1993 determined the sheep population to be about 1982 levels. Lamb recruitment in 1993 and 1995 was slightly below average compared with historical levels. In 1995, 45 sheep were classified in 45 minutes of survey.

Distribution and Movements

There are no data that indicate distribution and movements are different than reported by Kelleyhouse and Heimer (1990).

MORTALITY

Harvest

Season and Bag Limit. The open season for resident and nonresident hunters in Units 20D and 20E is 10 August to 20 September; the bag limit is 1 ram with full-curl or longer horns. A harvest ticket is required for the remainder of Unit 20E. A lottery permit is required to hunt the Mount Harper area. Hunters using the Glacier Mountain Controlled Use Area (GMCUA) may not use motorized vehicles from 5 August through 20 September, but participation is not limited by a lottery-permit requirement.

Board of Game Actions and Emergency Orders. During spring 1992 the Board of Game changed the hunt requirements for the Charley and Seventymile River areas from a lottery permit to a general hunt. Seasons and bag limits remained the same.

Hunter Harvest. Eight hunters reported taking 3 rams in the Tanana Hills outside of the Mount Harper permit area during 1994. The mean horn length was 33.7 inches (Table 2). Twenty-one hunters took 8 rams during 1993, the first year following removal of the lottery permit restriction for most of the area. Average horn length was 34.0 inches. Average horn length and age for the past 5 years were 34.1 inches and 8.8 years. No harvest occurred in the Mount Harper hunt area during 1993 and 1994 (Table 3). All 4 permit recipients hunted in 1995 and each took a ram. Since 1988, 31% of the Mount Harper permittees have not hunted. Only 20% of the permittees for the Mount Sorenson and Charley River hunts actually participated between 1988 and 1992, averaging 0.2 sheep/year. Participation in sheep hunting in these areas increased the first year following removal of the permit requirement but declined during the second year. Because these areas are very remote, expensive to access, and difficult to hunt, harvest will continue to have no limiting effects on the sheep population.

Hunter Residency and Success. Five state resident (includes 3 unit residents) and 3 nonresident hunters harvested 3 rams (38% success) during the general sheep season in Unit 20E. In 1994, 3 state residents hunted Mount Harper but none was successful. Three state residents and 1 nonresident participated in the 1995 Mount Harper drawing hunt and all were successful. The overall number of hunters in the Tanana Hills during 1994 was 11, and the harvest was 3 rams. The 1994 annual success rate of 27% is typical for the Tanana Hills.

Harvest Chronology. During 1994 in the Tanana Hills all 3 sheep were harvested during the first week of the season. The timing of sheep harvest varies annually in the area, possibly because many hunters also wish to hunt caribou and do not begin their hunt until the caribou are accessible. Also, hunters may not feel compelled to hunt early because competition is so low in this area.

Transport Methods. In the Mount Harper permit area and within the Mount Sorenson and Charley River areas, which are remote, all hunters traveled to the area using aircraft. In the GMCUA, all successful hunters reported walking into the area. In past years, hunting by horseback has been common among successful hunters. Mechanized transportation is prohibited for sheep hunting in this area.

Other Mortality

Most Dall sheep mortality in the Tanana Hills is attributable to natural factors. Predation by wolves, grizzly bears, and golden eagles occurs, and scarcity of escape cover may enhance predator effectiveness. During the late 1980s the area's wolf population was increasing by about 25% annually. Before 1991, winter severity was mild to average, and the sheep populations in the Tanana Hills may have increased during that favorable period. Following 1991, the sheep population declined, probably due to the combined effects of adverse weather and predation.

HABITAT

Assessment

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

Portions of the Tanana Hills included in the YCNP will be protected from most human disturbance. With Mount Harper's mineral potential, in the past it has been subjected to mining operations. Any full-scale development of the area must entail sufficient measures to minimize disturbance of sheep and destruction of sheep escape cover or winter range.

Over 30 years of wildfire suppression has caused lower elevation winter ranges and travel routes to become cloaked in spruce forest. The implementation of the Alaska Interagency Fire Management Plan-Fortymile Area should result in a near natural fire regime throughout this area. Tanana Hills sheep populations should benefit from this plan.

CONCLUSIONS AND RECOMMENDATIONS

Based on surveys conducted in the early 1980s and in 1990, the sheep population in the Tanana Hills increased during the 1980s. Beginning in 1991, adverse weather conditions and predation caused the population to decline. Harvests have been low for the past 15 years, with little effect on the population. The management objective of maintaining aesthetically pleasing hunting conditions is being met. Harvest is not expected to increase significantly due to the difficult hunting conditions found in these areas. The Tanana Hills sheep population tends to be widely dispersed and often occurs below treeline.

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

Sex/age class	1982	1993	% Change
Legal rams[a]	18	11	39
Sublegal rams[b]	22	15	32
Unclassified rams	--		--
Total rams	40	26	35
Ewes[c]	39	30	23
Lambs	8	4	50
Yearlings	--	--	--
Unidentified	--	--	--
Total other sheep	47	34	28
Total sheep	87	60	31
Legal rams:100 ewes	46	37	
Sublegal rams:100 ewes	56	73	
Total rams:100 ewes	103	87	
Lambs:100 ewes	21	13	
Lambs % of total	9	7	

[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.

Table 2 Unit 20E annual sheep harvest, 1990-1994

Year	Rams	$\bar{x}$ Horn length	$\bar{x}$ Age	Ewes	Total sheep	No. hunters
1990[a]	1	36.0	11.0	0	1	4
1991[a]	3	33.7	8.3	0	3	13
1992[a]	1	33.0	10.0	0	1	5
1993[b]	8	34.0	8.8	0	8	21
1994[b]	3	33.7	8.0	0	3	8

[a] Includes the Glacier Mountain Controlled Use Area (GMCUA) only.
[b] Includes the old 1107 and 1107 permit areas at GMCUA.

Table 3 Tanana Hills annual sheep harvest data by permit hunt, 1990-1995

Hunt no./area	Year	Permit issued	Did not hunt	Unsuccessful hunters	Successful hunters	$\bar{x}$ horn length	Total harvest
1106	1990	4	2	1	1	39.8	1
	1991	4	1	1	2	37.0	2
	1992	4	2	0	2	34.5	2
	1993	4	1	3	0	--	0
	1994	4	1	3	0	--	0
	1995	4	0	0	4		4
1107[a]	1990	4	4	0	0	--	0
	1991	4	3	1	0	--	0
	1992	4	2	2	0	--	0
1108[a]	1990	4	4	0	0	--	0
	1991	4	2	1	1	37.3	1
	1992	4	3	1	0	--	0

[a] Permit hunts 1107 and 1108 were changed to general season hunts in spring 1992.

LOCATION

GAME MANAGEMENT UNITS: 23 (44,00 mi.^{2}) and 26A (53,000 mi.^{2})

GEOGRAPHICAL DESCRIPTION: Western Brooks Range

BACKGROUND

Dall sheep are indigenous to northwest Alaska. For centuries, Inupiat residents in this area hunted sheep for subsistence uses. Now, nonlocal residents and nonresident hunters also hunt sheep in this area.

We know little about the historic abundance of sheep in northwest Alaska although we think they periodically declined to very low densities. Sheep in Units 23 and 26A are at the northwestern margin of their range in Alaska. Consequently, these populations may be less robust and more prone to fluctuations in population size because of adverse weather conditions than populations inhabiting areas with better range conditions. In addition, long-term local residents think the abundance of predators, such as wolves, has substantially affected sheep numbers and distribution. Predator numbers have fluctuated widely during the last 50 years in response to subsistence hunting, the presence of reindeer and caribou, and the effects of aerial wolf hunting.

In Units 23 and 26A, sheep occur in relatively small, discrete subpopulations. Most of these subpopulations are accessible by aircraft and snow machines. Sheep habitat in northwestern Alaska provides easy hunting. In addition, since 1990 high natural mortality through starvation, wolf predation, and disease has occurred in Units 23 and 26A. In response to low population numbers, the department and the National Park Service (NPS) have closed most of Units 23 and 26A to both sport and subsistence sheep hunting. Population monitoring continues to be a high priority for both agencies.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Baird Mountains

1 Maintain a posthunt (fall and winter) population of 450-600 adult sheep.

2 Maintain a minimum ratio of 7 to 10 7/8 curl and larger rams per 100 "ewes" ("ewe" defined as adult female, yearling of either sex, or 1/4-curl ram).

DeLong Mountains

1 Evaluate survey area boundaries and establish management objectives based on sheep biology.

2 Maintain a minimum ratio of 7 to 10 7/8-curl-and-larger rams per 100 "ewes."

METHODS

Aerial fixed-wing surveys were conducted annually in a 711 mi^2 (1841 km^2) portion of the Baird Mountains. These surveys have been completed cooperatively with NPS since 1986. However, the trend count area and survey techniques were not standardized until 1988. During the reporting period, the area was surveyed on 2-4 July 1992, 12-16 July 1993, and 10-13 July 1994. For comparative purposes, we will report survey data from 5-10 July 1995, even though it was collected after the reporting period ended. For density calculations, "area" is defined as the trend count area, not necessarily all available sheep habitat.

Surveys in the Baird Mountains were timed to coincide with the formation of large ewe-lamb bands on the Kilyaktalik Peaks and suitable weather conditions in these areas. We used 3 Piper PA-18 aircraft with experienced observers and pilots for the sheep counts. Survey intensity was 3 to 4 minutes/mi^2. We recorded locations of sheep on USGS 1:250,000 topographic maps. Observers classified groups using the following composition categories: lambs, "ewes" (adult females, yearlings of either sex, and 1/4 curl rams), 1/2 curl rams, 3/4 curl rams, 7/8 curl rams, and full-curl rams. No effort was made to evaluate the sightability of sheep. After completion of the Baird Mountain count area in 1995, Bureau of Land Management (BLM) staff surveyed an adjacent area in the Squirrel River drainage.

We standardized 2 survey areas and search techniques in the DeLong Mountains. The Kugururuk River/Trail Creek trend count area is 367 mi^2 (950 km^2) and Wulik Peaks sheep trend count area is 224 mi^2(580 km^2). Radiotelemetry data shows the seasonal movement of sheep in the Delong Mountains is less pronounced than in the Baird Mountains (Ayres 1986), making the timing of the surveys in the DeLong Mountains less critical. We completed all sheep surveys by July 19 during this reporting period. The Delong Mountain and Wulik Peaks trend count area were surveyed after the Baird Mountain trend count area.

We collected harvest information using statewide harvest reports (for the fall hunt in the DeLong Mountains), registration permit hunt reports (for the fall and winter hunts in the Baird Mountains), and subsistence registration permit reports (for the winter hunt throughout Unit 23).

RESULTS AND DISCUSSION

POPULATION SIZE, STATUS AND TREND

Population Size

Baird Mountains. The total number of sheep counted in the Baird Mountain trend count area ranged from 456 sheep in July 1992 to 351 sheep in July 1995 (Table 1). Total numbers are lower than the count of 981 sheep in 1989. We estimate the Baird Mountain trend count area includes 85%-90% of the sheep population. We surveyed surrounding areas in 1986 and 1991; these surveys support our population estimates. Small groups of sheep outside the trend count area have regularly been located at the head of the Squirrel River drainage. Additional search efforts in

July 1995 by BLM located 32 sheep (20 ewes, 11 lambs and 1 ram) in this area.

Sheep density in the Baird Mountains declined steadily during the reporting period reaching a low of 0.36 adult sheep/mi^2 by July 1995 (Table 1). This is the lowest density estimate since standardized surveys were initiated in 1986. The scarcity of sheep in the mountains was reflected by smaller group sizes and changes in distribution. Even before the recent decline began in 1991, the sheep population in the Baird Mountains was at low density compared with Dall sheep populations in Alaska (Singer et al. 1984) and the southern Yukon Territory (Burles et al. 1984). In these comparative studies, "area" included all potential sheep habitat. If we used a similar definition in Unit 23, sheep densities would be lower.

Many biologists believe weather is the primary influence on sheep population trends (Nichols and Smith 1971). However, weather does not fully explain the low lamb production for this population. No significant weather events similar to the severe conditions in 1990-91 have occurred during the reporting period. Weather conditions have been characterized by typical temperatures and summer precipitation, with slightly higher than average snowfall in 1993-94 and 1994-95. Even though snowfall was higher than normal, wind-blown ridges and winter travel corridors used by sheep remained clear of snow. Sheep accessed vegetation throughout the winter.

Predators may have restricted sheep to areas of escape terrain containing poor forage. Burles (1984), in his study of a reduced sheep population in southwestern Yukon Territory, considered high predator pressure and disturbance possible factors contributing to low lamb production in the absence of severe winter conditions. Wolf numbers have been increasing throughout the region since 1989 when rabies epidemics in wolf packs reduced their numbers. In recent years local residents and department staff have observed wolf packs comprising over 20 animals. Considering the mild terrain in the Baird Mountains, large numbers of wolves could be very effective at deterring sheep from traveling very far from escape terrain. Sightings of golden eagles, another potential predator, were common during the surveys.

Alternatively, poor lamb production may be influenced by slow recuperation of poor body condition of ewes from the severe winter in 1990-91. Nichols (1978) and Heimer (1978) found that ewes in poor physical condition may only give birth every other year. Ewes that barely survived the winter of 1991-92 may not have recovered sufficiently to come into estrus for several years thereafter.

DeLong Mountains. Sheep density in the DeLong Mountains is comparable to sheep density in the Wulik Peaks and Baird Mountains (Figure 1). Densities ranged from 0.70 adult sheep/mi^2 in 1983 to 0.30 adult sheep in 1995 (Table 2). Unlike the Baird Mountains survey area where most potential sheep habitat is surveyed, population data for the DeLong Mountains is restricted to a small area in the Kugururuk/Trail Creek drainages. We are becoming familiar with the habitat characteristics of the count area but are not sure the count boundaries include areas representative of the entire DeLong Mountains. The low number of sheep counted in 1994 followed by an unnatural increase in numbers of sheep observed in 1994 to 1995 indicates movement of rams and ewes into or out of the count area, or high sightability errors during the surveys.

The DeLong Mountain sheep population has declined slowly since 1983. The impact of the severe 1990-91 winter is difficult to assess since we do not have previous survey data for comparison. Considering public reports and our own observations, we think winter conditions in 1990-91 had less impact on sheep in the DeLong Mountains and Wulik Peaks than on sheep in the Baird Mountains. Slightly cooler temperatures in the northern portion of the unit and sheep habitat at higher elevations in the DeLong Mountains may have caused less freezing rain late in the fall of 1990. Observations of disease-related adult mortality was highest in the DeLong Mountain trend count area (Dau 1992).

The Wulik Peaks count area was modified during the reporting period. We deleted areas where we have not observed sheep since we began surveys in 1983. Areas known to regularly contain lamb and ewe bands were added (Phil Driver, pers commun). Density estimates and population trends in the Wulik Peaks mimic those in the DeLong and Baird Mountains (Tables 1-3). Of the 3 trend count areas in Unit 23 and 26A, sightability of sheep is probably the lowest in the Wulik Peaks count area. Gray and white substrates, caves, and rugged spires along ridges makes detection of sheep in this area difficult. Previous studies show that sheep in small groups, typically solitary rams, are most likely missed by survey observers (Strickland et al., 1992). This may account for the low number of 7/8+ rams observed in 1994 and 1995.

Population Composition

Since 1990 lamb production throughout Unit 23 has been low. In 1991 and 1994 virtually no lambs survived until July (Figure 2). The absence of lambs in 1991 was attributed to the preceding severe winter. No obvious event or set of conditions explains the absence of lambs in 1994. Possible explanations include disease, poor short-term weather conditions such as temperature and precipitation events during lambing, long-term effects and slow recovery from starvation, predation, or combinations of these factors.

In the Baird Mountains "ewes" declined dramatically in 1991 and continued to decline from 1992 through 1995. In addition to natural mortality, the decreases may be an expression of changing ratios as "ewe-like" rams enter adult ram categories, especially when few yearlings are entering the population. With low recruitment, the composition of the "ewe" group throughout the unit is shifting toward middle and older age ewes.

Ram numbers throughout the unit are declining. We attribute the major increase in ram:"ewe" ratios to the lack of recruitment into the "ewe" category rather than an increase in ram survivorship from reduced hunting pressure. An opposite trend in ram:"ewe" ratios occurs in the DeLong Mountains and Wulik Peaks, where hunting seasons were not closed after the severe winter to 1990-91. Continuation of hunting could be a factor contributing to the opposite trend in ram:"ewe" ratios. Although the season was reduced in the 1993-94, 20 rams were harvested from the Delong Mountains/Wulik Peaks area, a number similar to the average harvest before the winter of 1991.

MORTALITY

Harvest

Seasons and Bag Limits.

Regulatory Year 1992-93

Unit/Bag Limit	Hunt Type	Subsistence/Resident Open Seasons	Nonresident Open Seasons
Unit 23, that portion south and east of the Noatak River and west of the Cutler and Redstone Rivers (excluding the Upper Noatak River Canyon/ Sekuiak Bluffs, R = registration permit and H = harvest ticket):			
Residents One ram with full curl horn or larger	R	10 Aug.-20 Sep.	
OR one sheep	R	1 Oct. -30 Apr	
Nonresidents One ram with full curl horn or larger	R		10 Aug.-20 Sep.
Remainder of Unit 23			
Residents One ram with full curl horn or larger	H	10 Aug.-20 Sep.	
OR one sheep	H	1 Oct. -30 Apr.	
Nonresidents One ram with full curl horn or larger	H		10 Aug.-20 Sep.
Unit 26A			
Residents One ram with full curl	H	10 Aug.-20 Sep.	

horn or larger			
Nonresidents One ram with full curl horn or larger	H		10 Aug.-20 Sep.

Regulatory Year 1993-94

Unit/Bag Limit	Hunt Type	Subsistence/Resident Open Seasons	Nonresident Open Seasons
Unit 23, that portion south and east of the Noatak River and west of the Cutler and Redstone Rivers (excluding the Upper Noatak River Canyon/ Sekuiak Bluffs, R = registration permit and H = harvest ticket):			
Residents		CLOSED By emergency order	
Nonresidents			CLOSED By emergency order
Remainder of Unit 23			
Residents One ram with full curl horn or larger	H	1 Sep..-20 Sep. Early closure by emergency order	
Nonresidents One ram with full curl horn or larger	H		1 Sep.-20 Sep. Early closure by emergency order
Unit 26A			
Residents One ram with full curl horn or larger	H	1 Sep.-20 Sep. Early closure by emergency order	
Nonresidents One ram with full curl horn or larger	H		1 Sep. -20 Sep. Early closure by emergency order

Regulatory Year 1994-95

Unit/Bag Limit	Hunt Type	Subsistence/Resident Open Seasons	Nonresident Open Seasons
Unit 23, that portion south and east of the Noatak River and west of the Cutler and Redstone Rivers (excluding the Upper Noatak River Canyon/ Sekuiak Bluffs, R = registration permit and H = harvest ticket):			
Residents One ram with full curl horn or larger	R	CLOSED	
OR one sheep	R	CLOSED	
Nonresidents One ram with full curl horn or larger	R		CLOSED
Remainder of Unit 23			
Residents One ram with full curl horn or larger	H	10 Aug.-20 Sep. CLOSED West of Howard Pass by emergency order	
OR one sheep	H	1 Oct. -30 Apr. CLOSED West of Howard Pass by emergency order	
Nonresidents One ram with full curl horn or larger	H		10 Aug.-20 Sep. CLOSED West of Howard Pass by emergency order
Unit 26A			
Residents One ram with full curl	H	10 Aug.-20 Sep. CLOSED West of	

horn or larger		Howard Pass by emergency order	
Nonresidents One ram with full curl horn or larger	H		10 Aug.-20 Sep. CLOSED West of Howard Pass by emergency order

Board of Game Actions and Emergency Orders. At the 1993 spring meeting the Board of Game passed 3 proposals that affected Unit 23 and 26A sheep seasons. Horn size restrictions for fall hunts were changed from 7/8-curl to full-curl rams for Units 23 and 26A. The Baird Mountains were redefined from "*that portion of the unit south and east of the Noatak River*" to "*that portion south and east of the Noatak River, and west of the Cutler and Redstone Rivers (excluding the Upper Noatak River Canyon/Sekuiak Bluffs).*" The resident-only Baird Mountain winter general hunt was changed to a registration permit hunt prohibiting the use of aircraft.

Emergency orders were issued in 1993 after public review of the July trend count data. Both the fall and winter seasons were closed in the Baird Mountains. The fall season in the Delong Mountains of Units 23 and 26A west of Howard Pass was shortened from 10 August-20 September to 1 September-20 September. In 1994 and 1995 all sheep hunting west of Howard Pass and the Cutler/Redstone rivers in Units 23 and 26A was closed by emergency order.

From 1991 to 1995 federal public lands in Unit 23 were closed to sheep hunting from 1 Oct.-30 Apr. except for residents of Unit 23 living north of the Arctic Circle. Following the state's emergency closures, federal emergency orders closed the Baird Mountains to federally qualified hunters on federal lands from 1993 to 1995. Federal lands west of Howard Pass and the Cutler and Redstone rivers were closed throughout the year to all hunters in 1995. The only difference in season and bag limits that now exists between state and federal regulations is that federal regulations define legal rams as having at least 7/8 curl while state regulations define legal rams as having a full curl during the fall season.

The continued use of emergency orders to manage harvest in Unit 23 and 26A is by public request. The Kotzebue Advisory Committee asked to be allowed to review annual survey data and participate in decisions regarding changes in seasons and bag limits. There is almost unanimous agreement for the need to continue the season closures for 3-5 years. Concern that re-opening the sheep season will be a difficult process has led to continued management by emergency order. The local public and federal and state agencies agree on the target population size to be attained in the Baird Mountains trend count area.

Hunter Harvest. As a result of the emergency closures, no sheep were reported harvested in the Baird Mountains during the report period. In the Delong Mountains and upper Noatak drainage, the fall harvest declined in 1992-93 and 1993-94 by over 60% (Table 4). This was partly influenced by shortened seasons. Winter harvest of rams in the DeLong Mountains. increased in 1993. We attribute this increase in harvest to displacement of local sport hunters from shortened and closed fall seasons. All hunts west of Howard Pass and the Cutler /Redstone rivers were

closed by emergency orders in 1994-95.

In Unit 26A, 5 rams were taken during the 1992-93 season, 1 in the western end of Unit 26A (north side of Delong Mountains) and 4 in the Nanushuk-Shanin Lake area. A similar pattern was seen in 1993-94. Two rams were taken in western Unit 26A and 6 taken in the eastern portion. In 1994-95, 13 rams were taken all in eastern Unit 26A (the season was closed west of Howard Pass). The harvest in eastern Unit 26A is consistent with previous harvest levels.

Hunter Residency and Success. Most sheep reported harvested in Unit 23 during the fall season were taken by nonlocal residents and nonresidents (Table 5). In contrast, sheep harvested during the Unit 23 winter season were taken almost exclusively by local residents. Hunter success rates during the winter season were 42% for 1992-93 and 67% for 1993-94. There were no successful hunters in 1994-95. Five hunters attempted to take sheep in the upper Noatak in 1994-95, the only area open for sheep hunting in Unit 23.

Resident and nonresident hunters participated at similar levels in the Unit 26A fall hunt (Table 6). Success rates ranged from 20% to 46%.

Transport Methods. Nearly all sheep hunters used aircraft to access hunting areas during the fall season (Table 7). In contrast, during the winter season resident sheep hunters used snow machines exclusively.

Other Mortality

As previously reported, starvation probably caused the Baird and Delong Mountain sheep populations to decline during the winters of 1990-91 and 1991-92. With wolf populations relatively high in the Noatak River drainage, wolf predation has undoubtedly contributed to the decline in sheep populations. The primary effect of wolf predation will be to extend the duration of low sheep numbers in Units 23 and 26A. Other predators include golden eagles, but their effects on sheep have not been quantified.

In July 1992, 9 sheep carcasses were observed during and shortly after sheep surveys. Eight carcasses were found in the Kugururuk River /Trail Creek trend count area and 1 in the Squirrel River drainage. Field necropsies indicate the sheep died from an acute respiratory disease (Dau 1992). Carcasses found in both the Baird and DeLong mountains indicate disease was widespread and may have caused significant mortality in sheep throughout the units. No further outbreaks have been observed or reported since July 1992.

Caribou in the Western Arctic Herd may be affecting Unit 23 and 26A sheep populations. This herd numbered over 415,000 caribou in 1990 and 450,000 in 1993 (ADF&G unpub. data). Possible effects of caribou include: removal of forage through ingestion, degradation of range through trampling, increased insect harassment; and inducement of locally high predator populations in areas containing sheep. Large numbers of caribou overwintering in the Baird Mountains and DeLong Mountains in 1994-95 may have reduced wolf predation on sheep and moose, thereby providing a positive short-term effect. However, increases in resident wolf populations in response to abundant prey create a negative long-term effect.

CONCLUSIONS AND RECOMMENDATIONS

Given the low density and discrete distribution of subpopulations of sheep in northwestern Alaska, especially in relation to wolf/caribou densities and the frequency of severe winters, it is unlikely managers can maintain stable sheep populations at modest densities in Units 23 and 26A. Considering the gentle terrain and vulnerability of sheep to hunting, managers should implement conservative hunting regulations to avoid magnifying naturally caused declines in sheep populations. When setting goals for sheep population size, the public and managers should consider levels needed for repopulation of previously occupied areas.

Four years of low lamb production will affect total numbers and composition for many years. We expect the number of sheep in older age classes to diminish until the 1995 cohort begins to replace the older animals. Based on the ages of harvested rams, it may be 2002 before rams in this cohort reach full curl (7 years old). To avoid overharvesting older rams in the population, full and 7/8+ curl hunting should be based on both the current numbers of rams and the potential recruitment of adult rams.

No major changes are recommended for the count areas. The Baird Mountain trend count area should not be enlarged unless either of the following occurs: the composition of sheep found outside the area differs from the population in the trend count area or the number of sheep outside the trend count area exceeds 10% of the sheep counted within the area. Periodically, the distribution of sheep outside the trend count area needs to be assessed.

Movement of sheep into and out of the Wulik Peaks and Kugururuk/Trail Creek trend count areas may compromise estimates of ram:ewe ratios and population trends. However, the 2 areas are useful for estimating lamb:ewe ratios. For the next several years, total numbers of sheep and lamb:ewe ratios will be critical for monitoring the recovery of the population. We recommend surveying areas adjacent to the DeLong Mountains and Wulik Peaks trend count areas to determine if the count areas accurately reflect the size and composition of the DeLong Mountain sheep population.

Since the 1991-92 regulatory year, Units 23 and 26A sheep seasons have been either shortened or closed by emergency order. When sheep populations recover to the level of a harvestable surplus, managers will need to closely regulate harvests. We recommend establishing registration hunts with quotas announced for the fall seasons in Units 23 and 26A and for the winter seasons in the Delong Mountains west of Howard Pass. Harvest overlays and reporting procedures should be simplified before reopening sheep hunting seasons.

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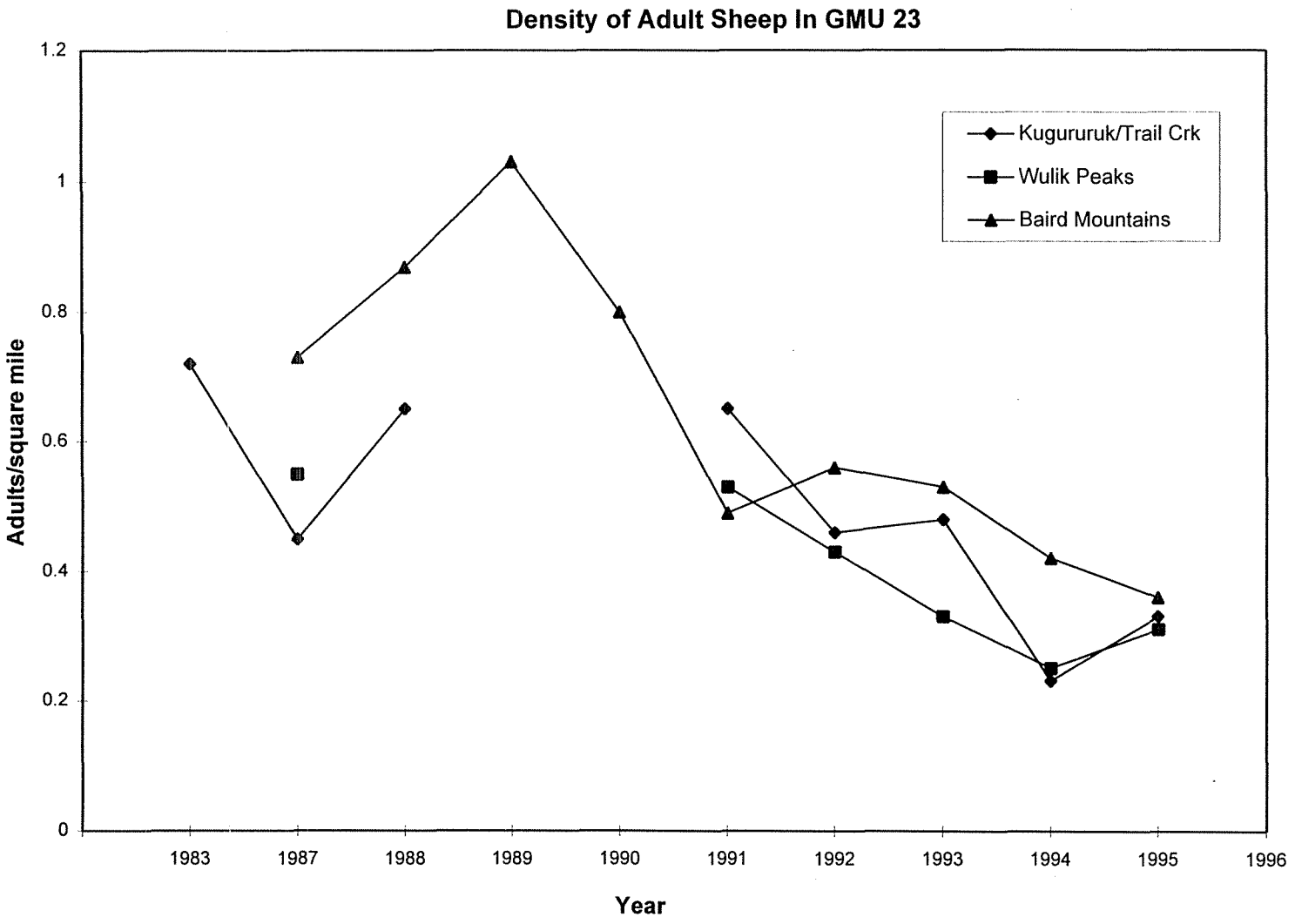

Figure 1. Density of adult sheep in Unit 23 and 26A trend count areas from 1983 to 1995.

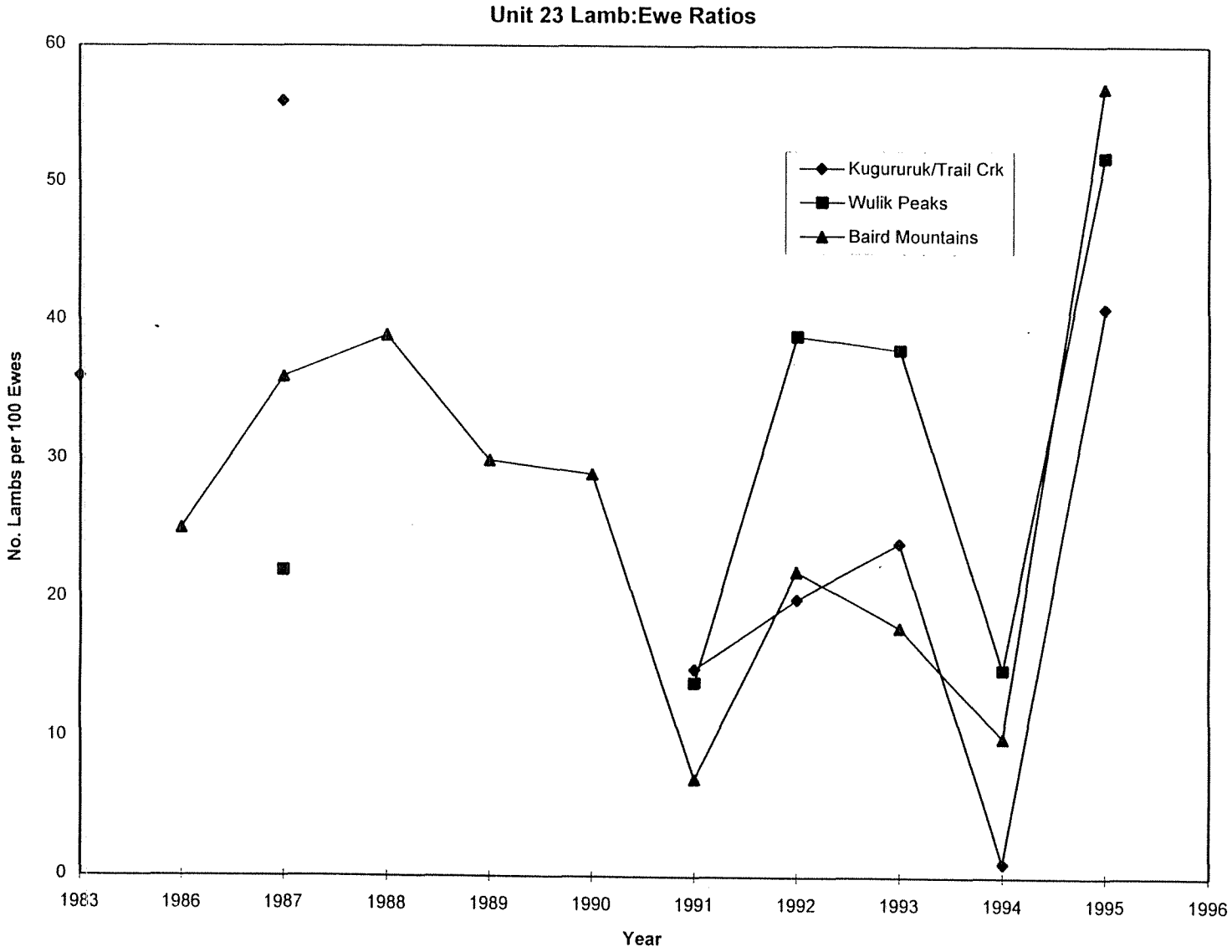

Figure 2. Lamb: "ewe" ratios in Unit 23 and 26A trend count areas. "Ewe" includes adult females, yearlings, and 1/4 curl rams.

Table 1 Summary of fixed-wing Dall sheep surveys in the Baird Mountains, Unit 23, 1986-95

	Number of sheep - Baird Mountains									
Classification	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Rams 1/2+	145	129	136	162	105	108	130	123	93	90
Rams 7/8+	47	50	35	51	32	35	42	37	1	23
"Ewes"[a]	416	393	484	574	466	239	267	256	204	166
Lambs	105	143	187	170	133	17	59	47	20	95
Unknown	4	0	5	75	14	36	0	0	0	0
Total Sheep	670	665	812	981	718	400	456	426	317	351
Total Adults[b]	561	522	620	736	571	347	397	379	297	256
Lambs:100 "Ewes"	25	36	39	30	29	7	22	18	10	57
Rams:100 "Ewes"	35	33	28	28	23	45	49	48	46	54
Rams 7/8+: 100 Ewes	11	13	7	9	7	15	16	14	20	14
Adults/ mi^2	0.79	0.73	0.87	1.03	0.80	0.49	0.56	0.53	0.42	0.36

[a] "Ewes" defined as adult females, yearling of either sex, and 1/4 curl rams.
[b] "Adult" defined as all sheep excluding lambs and unknowns.

Table 2 Summary of fixed-wing Dall sheep surveys in Units 23 and 26A, 1983-1995

	Kugururuk River/Trail Creek[a]						
Classification	1983[b]	1987[c]	1991	1992	1993	1994	1995
Rams 1/2 + (all)	95	77	81	72	63	27	38
Rams 7/8 +	54	49	38	26	16	12	13
Ewes[d]	171	90	159	99	112	93	137
Lambs	61	50	24	20	27	1	56
Unknown	9	0	1	0	0	0	0
Total	336	217	265	191	202	121	231
Adults[e]	266	167	240	171	175	120	175
Lambs:100 Ewes	36	56	15	20	24	1	41
Rams:100 Ewes	56	86	51	73	56	29	28
Rams7/8+:100 Ewes	32	54	24	26	14	13	9
Area (mi^2)	367	367	367	367	367	520[f]	520
Adults/mi^2	0.72	0.45	0.65	0.46	0.48	0.23	0.33

[a] Data collected using fixed-wing aircraft except where noted.
[b] Helicopter used to conduct surveys during 1983.
[c] Incomplete survey; several large ewe bands observed in count area but not included in counts.
[d] Rams 7/8+ are included in Rams 1/2+ total.
[e] "Ewe" defined as adult female, yearling of either sex, and 1/4 curl ram.
[f] "Adult" defined as all sheep excluding lambs and unknowns.

Table 3 Summary of fixed-wing Dall sheep surveys in the Wulik Peaks,Units 23 and 26A, 1983-1995

	Wulik Peaks					
Classification	1987	1991	1992	1993	1994	1995
Rams 1/2 + (all)	26	38	27	27	9	15
Rams 7/8 +[b]	8	17	7	11	7	0
Ewes[c]	88	78	67	48	47	54
Lambs	19	11	26	18	7	28
Unknown	0	10	0	0	0	0
Total	133	137	120	93	63	97
Adults[d]	119	116	94	75	56	69
Lambs:100 Ewes	22	14	39	38	15	52
Rams:100 Ewes	30	49	40	56	19	28
Rams 7/8+:100 Ewes	9	22	10	23	15	0
Area (mi^2)	217	217	217	240	240	240
Adults/mi^2	0.55	0.53	0.43	0.33	0.25	0.31

[a]Data collected using fixed-wing aircraft except where noted.
[b] Rams 7/8+ are included in Rams 1/2+ total.
[c] "Ewe" defined as adult female, yearling of either sex, and 1/4 curl ram.
[d] "Adult" defined as all sheep excluding lambs and unknowns.

Table 4. Summary of Unit 23 Dall sheep harvests[a] (R=rams, E=ewes, U=unknown sex)

	General season harvest[b]				Winter season harvest										
					Bairds Mountains			DeLong Mountains			Unknown			Total	Total
Year	Bairds	Delongs	Unk	Total	R	E	U	R	E	U	R	U	U		harvest
1971-72			16	16											16
1972-73			26	26											26
1973-74			13	13											13
1974-75			19	19											19
1975-76			17	17											17
1976-77			22	22											22
1977-78			34	34											34
1978-79			35	35											35
1979-80			25	25											25
1980-81			16	16											16
1981-82	3	10	0	13											13
1982-83	10	11	0	21	2	2	5	0	0	0	0	0	0	9	30
1983-84	12	8	0	20	0	0	0	0	0	0	0	0	0	0	20
1984-85	8	8	3	19	2	2	0	0	0	0	0	0	0	4	23
1985-86	28	8	1	37	10	7	3	0	0	1	0	0	0	21	58
1986-87	9	14	0	23	8	4	0	0	2	0	0	0	0	14	37
1987-88	18	19	0	37	3	6	0	1	1	0	0	0	0	11	48
1988-89	17	20	0	37	6	3	0	0	0	0	1	0	0	10	47
1989-90	19	26	0	45	5	2	0	7	2	0	0	0	0	16	61
1990-91	17	16	0	33	4	0	1	0	0	0	0	1	0	6	39
1991-92[d]	0	10	0	10	0	0	0	1	0	0	0	0	0	1	11
1992-93[d]	0	7	0	7	0	0	0	1	4	2	0	0	0	7	14
1993-94[d]	0	9	0	9	0	0	0	11	1	2	0	0	0	14	23
1994-95	-	-	-		0	0	0	0	0	0	0	0	0	0	0

[a] does not include unreported harvest; DeLong Mountains includes upper Noatak drainage.
[b] August 10 - September 20; 3/4+ curl rams only through 1977/78, 7/8+ curl rams only after 1978/79.
[c] October 1 - April 30; season established during 1982/83; limit 1 sheep ("ewe" defined as adult female,yearling of either sex, 1/4 ram, or lamb).
[d] Baird Mountains fall and winter hunts closed by emergency order; DeLong Mountain fall hunt Sept. 1-20; DeLong Mountains winter hunt October 1 - April 30.
[e] Unit 23 closed west of Howard Pass and Cutler/Redstone Rivers remainder of the unit open. Fall bag limit changed from 7/8 curl ram to one full curl.

Table 5 Number, success, and residency of Dall sheep hunters in Unit 23, 1992-95

	1992-93[a]		1993-94[a]		1994-95[b]	
	Fall DeLong	Winter Season	Fall DeLong	Winter Season	Fall DeLong	Winter Season
Successful	7	7	9	14	0	0
Unsuccessful	14	5	7	4	1	4
Total	21	12	16	18	1	4
Unit Resident	5	12	3	17	1	4
Non Unit Resident	6	0	5	1	9	0
Nonresident	8	0	6	0	6	0
Unknown	2	0	2	0	2	0
Horn length (in.)	32.8	29.1	33.7	28.4	-	-

[a] 1992-94 Baird Mountains fall and winter hunts closed by emergency order; DeLong Mountain fall hunt Sept. 1-20; DeLong Mountains winter hunt October 1 - April 30.

[b] In 1994-95 sheep hunting in unit 23 was closed west of Howard Pass and Cutler/Redstone Rivers. Fall bag limit changed from 1 7/8 curl ram to 1 full curl ram.

Table 6 Number, success, and residency of Dall sheep hunters in Unit 26A, 1992-95

	1992-93			1993-94			1994-95[a]		
	Succ.	Unsucc.	Total	Succ.	Unsucc	Total	Succ.	Unsucc	Total
State Resident	2	16	18	1	7	8	5	11	16
Nonresident	3	4	7	6	4	10	8	4	12
Unknown	0	0	0	1	2	3	0	0	0
Total	5	20	25	8	13	21	13	15	28

[a] In 1994-95 the season was closed west of Howard Pass by emergency order.

Table 7. Method of transportation for total sheep hunters in Unit 23 during 1992-95

	1992-93			1993-94			1994-95		
	Fall Season			Fall Season			Fall Season		
Transportation Method	Baird Mts.	Delong Mts.	Winter	Baird Mts.	Delong Mts.	Winter	Baird Mts.	Delong Mts.	Winter
Airplane	-	19	0	-	15	0	-	0	0
Snowmachine	-	0	12	-	0	14	-	0	4
Boat	-	1	0	-	0	0	-	1	0
ATV	-	0	0	-	0	0	-	0	0
Unknown	-	1	0	-	1	0	-	0	0
Total	-	21	12	-	16	14	-	1	4

LOCATION

GAME MANAGEMENT UNIT: 24 (eastern portion), 25A, 26B, and 26C (49,600 mi^2)

GEOGRAPHICAL DESCRIPTION: Eastern Brooks Range

BACKGROUND

Dall sheep are throughout the mountains of the eastern Brooks Range. Highest densities occur in northern drainages, where weather and habitat conditions provide the most favorable winter range. Sheep have been generally abundant during the last several decades. Although systematic surveys have been sporadic in most areas, available data as well as observations by hunters familiar with the area indicate relatively high populations occurred during the 1980s, followed by declines in recent years.

Human use of sheep in the eastern Brooks Range increased steadily during the 1980s but stabilized during the last few years. Existence of the Arctic National Wildlife Refuge (ANWR), opening of the Dalton Highway to commercial and general public use, and loss of sport hunting opportunity in Gates of the Arctic National Park have all contributed to increased human activity.

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

MANAGEMENT DIRECTION

MANAGEMENT GOALS

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

MANAGEMENT OBJECTIVES

- In cooperation with FWS, continue to monitor sheep population status using trend indicator areas.
- Manage for a harvest of Dall sheep rams with full-curl or larger horns.
- Monitor effects of the full-curl minimum size limit that took effect in fall 1993.
- Work with ADF&G Subsistence Division and FWS to manage subsistence sheep harvests.

METHODS

Surveys completed during the reporting period include annual ground composition counts in Atigun Gorge and in the Hulahula and Chandalar drainages. In these June surveys FWS and ADF&G personnel.used spotting scopes.

In addition, in September 1992 ADF&G and FWS biologists captured and radiocollared 26 ewes and 6 rams in the Hulahula and East Fork Chandalar drainages. These sheep are being radiotracked periodically as part of a cooperative study to define sheep populations and establish areas for trend counts. Since 1988 approximately 60 sheep have been radiomarked in a continuing effort to understand sheep population identity and other aspects of sheep ecology in the area. We gathered data on harvest, hunter effort, horn size, and hunting methods from mandatory harvest reports.

In late 1992 a sheep hunter questionnaire was sent to all people who reported hunting sheep in the northern and eastern Brooks Range in 1991 and 1992. The survey included questions about hunting areas, availability of large rams, the hunting experience, and aspects that determined the quality of their hunt. We sent questionnaires to 750 hunters and received 439 usable responses.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Current population size is unknown, but both survey data and anecdotal reports from the public suggest that sheep numbers declined during the late 1980s and early 1990s. Poor recruitment caused by severe weather and possibly increased predation seem to have contributed to the decline. Heimer (1985) estimated there were 13,000 sheep in the eastern Brooks Range in 1985. Numbers have declined by approximately 40% since the mid-1980s in the Hulahula drainage and have probably declined similarly elsewhere in the area.

Population Composition

Composition surveys show considerable variation in occurrence of lambs among areas and years, but lamb:ewe ratios in early summer populations have been generally low since 1992. Exceptions were the Atigun area in 1994, where there were 40 lambs:100 ewes and the Hulahula in 1995, where there were 28 lambs:100 ewes (Table 1). Lamb occurrence was only 31 lambs:100 ewes in the Hulahula drainage in 1992, and no lambs were observed in the East Fork drainage in 1994 (Table 2). Poor lamb survival is closely associated with severe winters and cold spring weather, especially in the northern drainages where sheep populations are relatively dense.

Distribution and Movements

Movements of radiomarked sheep show that major drainages inhibit 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 is generally similar to that observed in other areas, although movements of sheep near the East Fork of the Chandalar are relatively

extensive, perhaps due to less stable weather patterns and changes in range availability (FWS, unpubl data).

MORTALITY

Harvest

Season and bag limit.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Units 25A and 26C Resident Hunters: One 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: One ram with full-curl horn or larger.	10 Aug-20 Sep 1 Oct-30 Apr	10 Aug-20 Sep
Remainder of Unit 24, and Unit 26B, including Gates of the Arctic National Preserve: One ram with full-curl horn or larger.	10 Aug-20 Sep	10 Aug-20 Sep

Board of Game Actions and Emergency Orders. Regulatory changes during this reporting period included changes in the boundaries of the Arctic Village Management Area and in the horn size limit for the Brooks Range.

By the early 1990s increased hunting pressure and a decline in sheep numbers resulted in a decline in hunter success (Table 6). Although increased hunting pressure on rams was not responsible for declining sheep numbers, the public and ADF&G agreed that adopting a full curl, rather than 7/8 curl, minimum horn size would be a slightly more conservative regulation, while not reducing the opportunity to harvest rams over the long term. The Board of Game passed this regulation, which took effect in fall 1993.

The Arctic Village Sheep Management Area was established by the Federal Subsistence Board (FSB) in 1991 in response to concerns of Arctic Village residents. Nonlocal sheep hunters are excluded from the area. The original northern boundary was Cane Creek. In 1995 the FSB extended the boundary northward to include the Red Sheep Creek drainage. An effort to monitor aircraft and hunting activity near the Red Sheep Creek airstrip was initiated by FWS in August 1995. The results indicate that hunting activity by nonlocal residents would not interfere with hunting by local residents.

Hunter Harvest. Harvest of sheep and average horn size in Units 25B, 26B (excluding the Dalton Highway Corridor), and 26C are given in Table 3. The eastern Brooks Range has experienced a long-term increase in the number of hunters and harvest that began in the early 1970s. Harvest seems to have plateaued and declined somewhat during the last few years, although participation remains high. From 1987 to 1992 the total reported harvest exceeded 200 each year. After 1992 harvest declined, with 129 sheep reported taken in 1994.

Permit Hunts. Participation in sheep registration hunt 1195 has been open to all Alaska residents since 1990-1991. Reporting by local residents is limited, but interviews with residents of Kaktovik and Arctic Village indicate 30 to 40 sheep are taken by local residents each year. Permit holders have reported taking 2 to 14 sheep annually since 1990-1991, approximately 50% of which are ewes (Table 4).

Hunter Residency and Success. Most sheep hunters using the eastern Brooks Range were Alaskan residents, although a large number of nonresidents also use the area (Table 5). Nonresident hunters have a higher success rate. This has been a consistent pattern for several years (Golden 1990).

From 1985 to 1989 overall hunter success ranged from 60% to 67%. The success rate declined somewhat in 1990 and 1991 to just over 50%, indicating legal rams were becoming more difficult to find. Hunter success has ranged from 36% to 45% since 1992. Current success rates continue to meet the goal of maintaining a success rate of at least 40%.

Harvest Chronology. Most sheep hunting in the eastern Brooks Range occurs during August when weather is most favorable. From 80% to 90% of the sheep harvest occurs before 1 September (Table 6). Most of the remaining harvest occurs in September, with a few sheep reported taken during October.

Transport Methods. Aircraft are the primary means of transportation for most hunters, being used in 80% to 90% of successful hunts (Table 7). The remaining harvest involves the use of horses, boats, and, in the Dalton Highway area, highway vehicles.

CONCLUSIONS AND RECOMMENDATIONS

Management goals and objectives for eastern Brooks Range sheep continue to be met in most parts of the area. Declines in sheep numbers and availability of legal rams have caused a reduction in hunter effort, success and harvest. The smaller number of sheep hunters has reduced problems associated with crowding, although the number of hunters continues to be high in the most accessible areas in Unit 26B.

Sheep numbers have stabilized after a significant decline during the late 1980s and early 1990s. The proportion of full-curl rams in the population is increasing because of the full- curl regulation passed in 1993 (Table 1). This regulation was expected to temporarily reduce the harvest of rams for 1 or 2 years as rams that could have been taken at 7/8-curl reached the new legal limit. The time required for the adjustment in ram age structure accounts in part for the low harvest in 1993 and 1994.

The results of the 1992 sheep hunter questionnaire provided insight into a variety of sheep hunter attitudes (Whitten 1994). Responses showed successful hunters were generally satisfied with their sheep hunting experience in the eastern Brooks Range. Although the definition of trophy quality varied among hunters, and was related to the overall hunting experience, most hunters viewed relatively large horns as an important part of trophy quality. Sixty-one percent of all hunters defined trophy sheep as full-curl or larger rams. Under the previous 7/8-curl regulation, 82% of the rams taken would have been legal under a full-curl regulation, indicating strong selectivity for large rams. The results of the questionnaire as well as hunter comments to the department and Board of Game demonstrated widespread support for the full-curl regulation.

The staff of the Arctic National Wildlife Refuge continues to provide valuable support and has played a major role in annual population monitoring. Continued cooperative efforts will be important to future success in conducting composition and trend surveys.

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Table 1 Atigun drainage, Unit 26B, ground sheep composition counts and estimated population size, June 1985-1994

Regulatory yr	Rams: Full curl (%)	Rams: 3/4-full curl	Rams: 1/2-3/4 curl	Rams: < 1/2 curl	Ewes[a]	Lambs (%)	Sheep/hr	Total sheep observed	Estimated population size
1985-1986	1 (0.4)	10	18	18	165	42 (16.5)	--	254	--
1986-1987	0 (0.0)	19	20	13	137	47 (19.9)	--	236	--
1987-1988	3 (0.8)	16	29	11	221	80 (22.2)	--	360	--
1988-1989	0 (0.0)	19	37	15	253	40 (11.0)	--	364	--
1989-1990[b]	0 (0.0)	18	23	8	165	69 (24.4)	--	283	--
1990-1991	2 (0.0)	22	19	10	318	122 (24.8)	--	493	--
1991-1992	0 (0.0)	12	15	7	309	39 (10.2)	--	382	--
1992-1993	1 (0.4)	19	22	5	206	24 (8.6)	--	277	--
1993-1994	5 (1.4)	16	21	10	225	89 (24.3)	--	366	--
1994-1995	0 (0.0)	9	18	5	247	28 (9.1)	--	307	--

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

[b] Counts prior to 1990 occurred in Atigun Gorge; during and after 1990 counts along the Dalton Highway were included.

Table 2 Sheep composition counts in the Hulahula and East Fork Chandalar drainages, June 1992-1995

Area	Rams: Full curl (%)	Rams: 3/4-full curl	Rams: 1/2-3/4 curl	Rams: < 1/2 curl	Ewes[a]	Lambs (%)	Sheep/hr	Total sheep observed
Hulahula								
1992	1 (0.2)	28	26	4	318	10 (3.0)	n/a	387
1993	12 (1.0)	242	87	40	709	171 (14.0)	n/a	1219
1994	6 (0.7)	99	47	18	595	99 (11.5)	n/a	863
1995	25 (2.2)	160	111	24	631	179 (15.8)	n/a	1130
East Fork								
1992	4 (1.8)	17	6	0	155	34 (16.0)	n/a	216
1993	20 (5.6)	37	29	6	219	45 (12.6)	n/a	356
1994	16 (8.1)	24	23	13	121	0 (0.0)	n/a	197
1995	15 (9.5)	25	7	5	89	17 (10.8)	n/a	158

Table 3 Units 25A, 26B (excluding Dalton Highway corridor), and 26C sheep harvest[a], 1985-1994

Regulatory yr	Rams	$\bar{x}$ Horn length (inches)	% ≥ 40"	Ewes[b]	Total sheep
1985-1986	170	34.9	n/a	n/a	170
1986-1987	185	35.4	n/a	n/a	185
1987-1988	223	34.8	n/a	n/a	223
1988-1989	208	35.1	n/a	n/a	208
1989-1990	258	35.0	10	1	259
1990-1991	265	34.6	9	3	268
1991-1992	234	34.3	7	0	234
1992-1993	174	34.1	2	0	174
1993-1994	122	34.6	2	0	122
1994-1995	129	34.3	4	0	129

[a] Excludes permit hunt harvest.

[b] There was no legal harvest of ewes except in Permit Hunt 1195. Presumably, these ewes were incorrectly reported.

Table 4 Units 25A and 26C sheep harvest data by permit hunt, 1985-1994

Hunt no./Area	Regulatory yr	Permits issued	% did not hunt	% unsuccessful hunters	% successful hunters	Rams	$\bar{x}$ horn length (inches)	% ≥ 40"	Ewes (%)	Unk	Total harvest
1195	1985-1986	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12-30[a]
	1986-1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12-30[a]
	1987-1988	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30-40[b]
	1988-1989	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30-40[b]
	1989-1990	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30-40[b]
	1990-1991	69	46.4	66.7	33.3	7	n/a	n/a	6 (46.1)	1	14[c]
	1991-1992	9	n/a	n/a	n/a	1	n/a	n/a	1 (50.0)	0	2[c]
	1992-1993	n/a	n/a	n/a	n/a	3	n/a	n/a	1 (25.0)	4	8[c]
	1993-1994	20	60.0	5.0	35.0	3	n/a	n/a	3 (42.9)	1	7[c]
	1994-1995	7	100	n/a	n/a	0	n/a	n/a	0 (0)	0	0[c]

[a] Estimates based on interviews with residents of Kaktovik (S Pedersen, ADF&G, pers commun).

[b] Estimates based on interviews with residents of Kaktovik and Arctic Village (S Pedersen, ADF&G, pers commun).

[c] Based on written reports received; does not include most of the 30-40 sheep estimated to have been taken in Kaktovik and Arctic Village.

Table 5 Units 25A, 26B, 26C, and eastern Unit 24 sheep hunter[a] residency and success, 1985-1994

Regulatory yr	Successful						Unsuccessful						Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
1985-1986	2	109	80	4	195	(62.5)	1	98	13	5	117	(37.5)	312
1986-1987	0	126	79	9	214	(60.0)	2	120	14	7	143	(40.0)	357
1987-1988	0	156	104	14	274	(67.1)	0	116	10	8	134	(32.9)	408
1988-1989	1	109	99	35	244	(63.2)	0	107	18	17	142	(36.8)	386
1989-1990	5	154	114	4	277	(59.8)	1	157	24	4	186	(40.2)	463
1990-1991	13	138	115	16	282	(55.5)	3	200	16	7	226	(44.5)	508
1991-1992	3	138	102	8	251	(53.3)	2	192	25	1	220	(46.7)	471
1992-1993	7	97	86	3	188	(45.0)	7	206	20	4	230	(55.0)	418
1993-1994	2	91	46	0	137	(36.2)	1	219	21	2	242	(63.8)	379
1994-1995	1	79	43	7	129	(36.9)	0	155	16	2	176	(57.7)	305

[a] Excludes hunters in permit hunts.
[b] Local resident is a resident of eastern Unit 24 or Units 25A, 26B, or 26C.

Table 6 Units 25A, 26B, 26C, and eastern Unit 24 sheep harvest[a] chronology percent by time period, 1985-1994

Regulatory yr	Harvest periods									*n*
	8/1-8/4[b]	8/5-8/11	8/12-8/18	8/19-8/25	8/26-9/1	9/2-9/8	9/9-9/15	9/16-9/22	9/23-9/29[b]	
1985-1986	8.8	38.3	22.3	16.5	6.7	4.7	1.0	0.5	1.0	191
1986-1987	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1987-1988	0	0	41.0	20.9	19.8	7.5	7.5	1.5	1.5	261
1988-1989	0.4	35.9	26.4	18.2	6.5	7.3	3.0	0.8	0.8	223
1989-1990	0.4	23.0	27.4	24.4	12.8	6.2	2.5	1.8	0.4	268
1990-1991	1.2	17.8	42.2	18.2	12.0	6.2	1.9	0.0	0.4	258
1991-1992	0.0	23.5	35.4	18.9	12.7	4.1	2.4	2.8	1.2	243
1992-1993	0.0	20.7	35.1	18.6	14.4	5.3	0.5	2.7	1.1	188
1993-1994	0.0	22.0	41.6	13.9	12.4	3.6	2.2	0.0	4.4	137
1994-1995	0.8	22.8	53.7	8.1	7.3	0.8	2.4	1.6	2.4	123

[a] Excludes permit hunt harvest and a few sheep "reported" taken in Oct or Nov or where the date was not reported.
[b] Sheep reported taken before 10 Aug or after 26 Sep were presumably incorrectly reported.

Table 7 Units 25A, 26B, 26C, and eastern Unit 24 sheep harvest[a] percent by transport method, 1985-1994

Regulatory yr	Percent of harvest								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	*n*
1985-1986	82.6	3.6	1.0	1.0	0.0	0.5	5.6	5.6	195
1986-1987	89.7	3.3	0.5	1.5	0.0	0.0	2.3	2.8	214
1987-1988	85.6	2.0	0.8	0.0	0.0	0.0	6.0	5.6	250
1988-1989	85.4	3.3	1.2	0.0	0.0	0.0	6.2	3.7	240
1989-1990	86.0	3.6	1.8	0.0	0.0	0.0	7.6	1.1	277
1990-1991	80.8	3.9	1.8	0.0	3.5	0.0	7.4	2.5	282
1991-1992	81.3	4.4	1.2	0.0	0.0	0.0	10.0	3.2	251
1992-1993	83.0	1.6	0.5	0.0	0.0	0.0	13.3	1.6	188
1993-1994	80.3	3.6	1.5	0.0	0.0	2.2	12.4	0.0	137
1994-1995	91.9	0.8	0.0	0.0	0.0	0.0	4.9	2.4	123

LOCATION

GAME MANAGEMENT UNIT: 24 (24,150 mi^2)

GEOGRAPHICAL DESCRIPTION: Brooks Range within Gates of the Arctic National Park and west of Dalton Highway Corridor

BACKGROUND

Dall sheep in Gates of the Arctic National Park (GAAR) are managed somewhat differently than in most areas of Alaska. Federal law mandates subsistence use as the highest priority consumptive use when harvest is allowable.

In GAAR, subsistence by local residents of GAAR and its federally defined subsistence zone is the only consumptive human use permitted. Accordingly, an Alaska Department of Fish and Game (ADF&G) management goal for Dall sheep in GAAR is to provide opportunity for human subsistence use. Another secondary ADF&G management goal for Dall sheep is to provide the opportunity to view and photograph sheep. However, the department's primary goal is to protect, maintain, and enhance the sheep population and its habitat in concert with other components of the ecosystem.

Before 1981 all of Unit 24 was open to general sheep hunting, with an average harvest of 50 rams. The take by Numamuit hunters was unrecorded but estimated at less than 50 per year. The current 5-year average harvest for the entire unit (including the eastern part) is 47 sheep. All sheep taken by hunters from Anaktuvuk Pass are included in this report, but some of those sheep came from the headwaters of the Anaktuvuk River in Unit 26.

Within Unit 24, distribution of Dall sheep is limited to suitable habitats in the Brooks Range. The population showed signs of growth between surveys conducted in 1982 and 1987 (Adams 1988) although only 4 count units were surveyed. Management goals for sheep in the John, Alatna and Wild River drainages south of the park provide for diversified human recreation. Sheep inhabiting Unit 24 east and within the Dalton Highway Corridor are covered in the Eastern Brooks Range report.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Provide an opportunity for subsistence uses of Dall sheep in the GAAR and general use outside the park.
- Provide the opportunity to hunt Dall sheep under aesthetically pleasing conditions in the remainder of Unit 24.

MANAGEMENT OBJECTIVES

- Maintain an annual subsistence harvest of up to 50 sheep in the GAAR and a general harvest of full-curl rams in the Wild, Alatna, and John River drainages.

- Maintain or increase the sheep population in Unit 24.

METHODS

We monitored subsistence harvest this reporting period by interviewing hunters, issuing permits, and sending out questionnaires after the close of the hunt. General harvest information was obtained through the statewide harvest ticket system. The NPS surveyed sheep in the Upper John River drainage with a helicopter in 1987 and attempted to survey the Itkillik using a Supercub in 1992. A Robinson-22 helicopter was used during July 1993 to survey sheep in parts of the GAAR. Mountain ranges were subdivided into counting units and searched at an intensity of 1.1-1.4 minutes/mi^2 by flying contour transects 100-200 ft above the ground. Most surveys were flown during the morning hours when winds were not blowing. Survey block No.1 was the Nunamuit Mountains, block No. 2 was Mt. MacVicar to Masu Creek, block No. 3 was the Grizzly Mountains, and block No. 6 was the Till Creek area.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Singer (1984) reported 4417 sheep in the GAAR; no areawide surveys have been conducted since that time. Adams (1988) surveyed only 728 mi^2 but found 12% more sheep than Singer's survey in the same area. Singer (1984) found densities from 0.9-2.0 sheep/mi^2 and Adams (1988) found densities from 1.1-2.7 sheep/mi^2. In 16.7 hours of survey time, I found 617 sheep in an 817 mi^2 area. Densities ranged from 0.5-0.8 sheep/mi^2. At this time the population size is unknown, but available data indicate there are now fewer sheep in the GAAR than in the 1980s.

Population Composition

Population composition varies from year to year depending on lamb production, yearling recruitment, and adult mortality. These parameters are directly influenced by weather, natural predation, and hunting management (Heimer 1988). Mature rams with full-curl horns made up 39% of the total rams counted (Table 1). The lamb:"ewe" ratio was 30:100, lower than reported earlier by Singer (1984) or Adams (1988) (50:100 and 47:100, respectively). Low lamb:"ewe" ratios were also reported from other areas of Alaska. In the eastern Brooks Range ratios ranged from 18-40:100, with even lower ratios in the western Brooks Range (Ken Whitten, pers commun). Sheep surveyors in 1993 found only 12:100 "ewes" in the central Alaska Range.

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Units 24 and 26A, those portions within the Gates of the Arctic National Park; 3 sheep.	1 Aug-30 Apr	No open season
Remainder of Units 24, 26A, and 26B, including the Gates of the Arctic National Park; 1 ram with full-curl horns or larger.	10 Aug-20 Sep	10 Aug-20 Sep

Board of Game Actions and Emergency Orders. The Board of Game changed the bag limit in the general hunt to 1 ram with full-curl horns or larger, beginning with the fall 1993 hunting season. The Board of Game deleted the requirement of harvest tickets for the subsistence sheep hunt and also removed the hunt from the state regulations since they felt it was adequately covered by the federal subsistence regulations.

Hunter Harvest. The subsistence harvest over the last 5 years has averaged 23 sheep. Most of these sheep have been adults. Rams are preferred, making up 82% of the harvest (Table 2).

The harvest from the lower John, Alatna, and Wild rivers has averaged 8 rams during the past 5 years (Table 4). The mean age and horn length (Table 5) cannot be used to make generalizations about the population due to small sample size.

Permit Hunts. Since 1988 ADF&G has solely managed the Gates of the Arctic National Park subsistence hunt. This has allowed better collection of data than in previous reports (Osborne 1989). The system presently works well with good harvest data.

Hunter Residency and Success. Although residents of Anaktuvuk Pass, Bettles/Evansville, Wiseman, Alatna, Allakaket, Ambler, Hughes, Kobuk, Nuiqsut, and Shungnak are allowed to participate in the subsistence hunt, hunters from Anaktuvuk Pass harvest most of the sheep taken. Success rates are not particularly relevant in the subsistence hunt because of community hunting and sharing traditions (Osborne 1989).

In the rest of the unit most of the hunting is by state residents (Table 4). The 5-year average success rate for the area is 38% (range 30%-57%).

Transportation Methods. There are no roads in the report area; aircraft are the major transportation means (Table 6). Occasionally people use boats. Most of the sheep taken in the

Gates of the Arctic National Park subsistence hunt are by snowmachine or "Argos" off-road vehicles.

Other Mortality

There are no data which indicate changes in natural mortality from those reported by Osborne (1989).

CONCLUSIONS AND RECOMMENDATIONS

The primary ADF&G management goal of protection, maintenance, and enhancement is presently being achieved throughout most of the sheep habitat in GAAR. Most of the park is used sparingly by viewers and photographers and rarely by subsistence hunters. The secondary goal of providing for subsistence uses of Dall sheep is being achieved. No long-term decline in the number of sheep taken by subsistence residents and no obvious declines in sheep populations attributable to harvest by humans have been reported. However, no systematic sheep population monitoring program exists in Unit 24, so subtle declines in local populations may be unnoticed. Joint efforts to establish population monitoring programs for populations affected by human-use should be undertaken cooperatively by the NPS and ADF&G.

To ensure subsistence harvest information is collected, we will continue to send a questionnaire at the end of the season to all hunters registered for the hunt. In cooperation with NPS, work is planned to set up a harvest monitoring scheme to accurately sex and age all animals taken over the next 2 years. This, in conjunction with a sheep census, would allow ADF&G to model the population in the main subsistence hunting area.

The state season, deleted by the Board of Game, should be reinstated since there is private land not covered by federal regulations within the park boundaries.

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Table 1 Dall sheep survey Gates of the Arctic National Park, Game Management Units 24 and 26, 19-22 July 1993

			Number of sheep							
			Rams by horn size							
Count Area	mi^2	minutes	4/4	3/4	2/4	1/4	Unk	"Ewes"	Lambs	Total
011	43.6	70	0	0	0	0	0	0	0	0
012	62.3	80	5	2	2	0	0	54	13	76
013	40.1	50	0	0	1	0	0	30	7	38
014	55.1	75	9	11	5	0	0	21	3	49
015	51.4	65	1	0	0	0	0	23	3	27
016	40.8	77	8	4	4	0	2	4	1	23
Subtotal	293.3	417	22	18	12	0	2	132	27	213
021	38.9	28	6	1	2	0	1	2	0	12
022	65.9	75	2	0	4	0	1	20	7	34
023	48.6	55	5	2	3	0	0	9	5	24
024	37.5	53	4	1	0	0	0	1	0	6
025	15.3	20	0	1	3	1	0	0	0	5
Subtotal	206.2	231	17	5	12	1	2	32	12	81
031	45.7	60	0	3	2	2	0	19	4	30
032	26.6	30	0	3	0	2	0	14	3	22
033	51.9	57	5	8	2	6	0	29	7	57
034	50.1	45	3	0	1	0	0	14	4	22
Subtotal	174.5	192	8	14	5	10	0	76	18	131
062	44.2	60	3	0	3	0	1	25	9	41
063	66.5	63	7	4	3	0	2	48	21	85
064 (part)	32.9	43	5	1	2	0	0	43	15	66
Subtotal	143.6	166	15	5	7	0	3	153	45	192
Totals	817.6	1006	62	42	36	11	7	393	102	617

Table 2 Gates of the Arctic National Park subsistence sheep harvest, 1989-1994

Regulatory year	Harvest			
	Rams	Females	Yearlings	Total harvest
1989-1990	19	8	0	27
1990-1991	18	2	2	22
1991-1992	20	3	0	23
1992-1993	16	4	2	22
1993-1994	15	0	0	15
1994-1995	6	5	0	26[a]

[a] Fifteen sheep sex unknown.

Table 3 Gates of the Arctic National Park subsistence sheep hunter residency, 1989-1994

Regulatory year	Permits		Successful hunters	Location						
	Issued	Returned		Anaktuvuk	Bettles	Coldfoot	Wiseman	Ambler	Nuiqsut	Allakaket
1989-1990	32	32	12	21	2	0	8	0	1	0
1990-1991	46	46	11	33	3	5	5	0	0	0
1991-1992	34	34	12	27	2	0	5	0	0	0
1992-1993	44	36	13	28	2	0	9	1	0	
1993-1994	32	29	8	12	9	0	7	1	0	3
1994-1995	23	22	5	16	1	0	6	0	0	0

Table 4 Unit 24 west hunter[a] residency and success, 1989-1994

Regulatory year	Successful				Unsuccessful				Total hunters
	Unit resident	Nonlocal resident	Nonresident	Total	Unit resident	Nonlocal resident	Nonresident	Total	
1989-1990	0	7	0	7	2	12	0	14	21
1990-1991	1	6	1	8	2	2	2	6	14
1991-1992	0	4	7	11	6	17	0	23	34
1992-1993	2	9	0	11	1	10	3	14	25
1993-1994	0	6	3	9	5	15	1	21	30
1994-1995	0	3	3	6	0	5	1	6	12

[a] Excludes Gates of the Arctic National Park

Table 5 Unit 24 (west) sheep harvest[a], 1989-1995

Regulatory year	Mean horn length	% over 40"	Mean age	Total rams
1989-1990	37.7	14	10.3	7
1990-1991	34.6	0	9.2	8
1991-1992	36.5	18	9.7	11
1992-1993	35.9	0	9.4	11
1993-1994	33.6	21	11.2	9
1994-1995	36.5	0	10.8	6

[a] Excludes Gates of the Arctic National Park

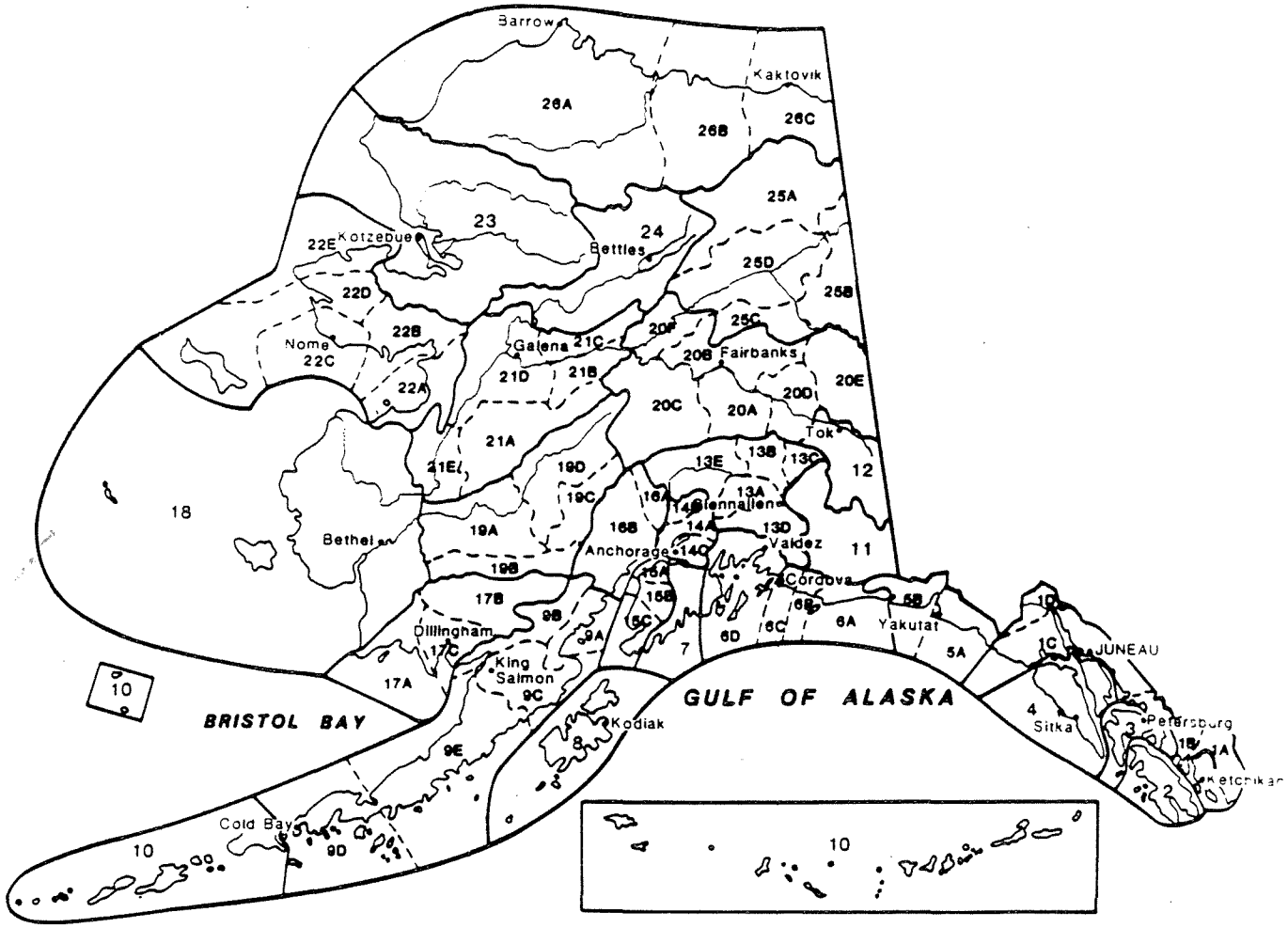
Table 6 Unit 24 (west) sheep harvest[a] percent by transport method, 1989-1995

Regulatory year	Percent of harvest						Total
	Airplane	Horse	Boat	3 or 4-wheeler	Highway vehicle	Unknown	
1989-1990	100	0	0	0	0	0	7
1990-1991	88	0	12	0	0	0	8
1991-1992	100	0	0	0	0	0	11
1992-1993	73	0	17	0	0	0	11
1993-1994	66	0	33	0	0	0	9
1994-1995	73	0	0	0	0	17	6

[a] Excludes Gates of the Arctic National Park

NOTES

Alaska's Game Management Units



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. Seventy-five percent of the funds for this report are from Federal Aid.

PAT COSTELLO