

Progress Report - 2000:
Demography and Home Ranges of Dall's Sheep
in Gates of the Arctic National Park, Alaska

GAAR-01-01
July 10, 2001

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Summary

Sheep surveys and a 3-year sheep radiocollaring project were initiated to monitor and assess Dall's sheep population dynamics in the central Brooks Range near Anaktuvuk Pass, Alaska in March of 1998. This project was established with the following objectives: identify Dall's sheep bands and determine band sizes; determine home ranges and seasonal movement patterns of the identified sheep bands; assess local harvest of the bands; develop an economical annual trend count survey program; and continue the exchange of information regarding Dall's sheep populations in the central Brooks Range with Anaktuvuk Pass residents.

Eighteen Dall's sheep (15 females and 3 males) were captured with a net-gun and radiocollared in March of 1998 to the east and west of Anaktuvuk Pass. In the subsequent 2 years, additional Dall's sheep were captured to replace those that had died or had radiocollar failure during the previous year. In 1999, this meant collaring 3 sheep and in 2000 we collared 5. Of the 8 radiocollars that needed to be replaced, 6 were due to mortality and 2 were due to radiocollar failure. Cause of death could only be determined for 2 of the sheep mortalities. One sheep died from stress after being trapped in snow 3 weeks after capture. The second sheep was likely harvested by a human.

During the first year of this study (March 1998 – March 1999), 19 radiotracking flights were conducted. In the second year of the study, 19 flights were taken from April 1999 – March 2000. Thus far, in the third year of the study, 11 radiotracking flights have been flown. Radiotracking flights have occurred in every month of the year. Data from all flights are included in this report. The length of time between radiotracking flights has been dictated by scheduling and weather. As a result, time between sheep relocations has varied greatly (range = 6 – 69 days) making movement speeds based on sequential sheep locations or calculations of daily movement rates inconsequential. However, the maximum distances between any two relocation points for individual sheep ranged from 4 miles to 8 miles (6.5 km to 12.9 km) with a mean ($\pm$ SE) of 6.0 ± 0.24 miles (9.7 ± 0.40 km). Sheep home ranges determined using minimum convex polygons (MCP) ranged from 7.9 mi^2 to 45.1 mi^2 (20.4 km^2 to 116.7 km^2). Mean home range size was $23.4 \pm 1.9 \text{ mi}^2$ ($60.6 \pm 5.5 \text{ km}^2$). In some instances home range boundaries fell along obvious geographical barriers, in other instances, no obvious barrier exists. Preliminary data indicates 3 subpopulations within our radiocollared sample.

Aerial surveys have been conducted in July of the past 3 years. Survey conditions were good in 1998 extremely poor in 1999 and poor in 2000. A total of 475 mi^2 were surveyed in 1998 and a total of 386 sheep were observed. Age and sex composition during the 1998 survey were 27 lambs: 100 ewe-like sheep and 35 rams ($> \frac{1}{2}$ curl): 100 ewe-like sheep. In 1999, 422 mi^2 were surveyed and 186 sheep were observed. Age and sex composition during 1999 was 34 lambs: 100 ewe-like sheep and 25 rams: 100 ewe-like sheep. In 2000, 322 mi^2 were surveyed and 460 sheep were observed. Age and sex composition during 2000 was 34 lambs: 100 ewe-like sheep and 35 rams: 100

ewe like sheep.

Ground-based sheep composition counts, conducted concurrently with the fixed-wing surveys, were attempted in 1998 near a known mineral lick. During 1999, the ground-based sheep observation was modified into 3 hiking transects surveyed immediately following the 1999 aerial survey. In both situations, field efforts were ineffectual due to a combination of low sheep densities in surveyed areas and poor weather conditions. A new area was sampled along the John River in 2000 and sheep and weather conditions cooperated to provide some encouraging results. A total of 74 sheep were observed. For comparison to aerial survey work, 38 lambs: 100 ewe-like sheep and 17 rams: 100 ewe-like sheep were noted. An advantage of the ground based survey is the greater degree of accuracy with which sheep can be classified into sex and age classes. This survey type holds promise for future work.

The regulations for a community harvest quota of 60 sheep for the community of Anaktuvuk Pass went into effect in July 1997. In the 1996-97 season, 7 hunters reported taking 11 sheep (10 rams and 1 ewe). During the 1997-1998 hunting season, 9 hunters reported taking 16 sheep (10 rams and 6 ewes). In the 1999 – 2000 season, 10 hunters reported taking 17 sheep (13 rams and 4 ewes). Thus far in the 2000 – 2001 season, 8 hunters have reported taking 12 sheep (4 rams, 7 ewes, and 1 lamb)

Plans for FY-01

Radiotracking will continue through the year to document sheep movements during the breeding season, winter, lambing season and summer. Aerial surveys will be conducted during the last half of June, after lambing and before the local sheep hunting season begins.

Introduction

The National Park Service (NPS) is mandated by the Alaska National Interest Lands Conservation Act (ANILCA) (Section 201(4)(a)) "to protect...populations of...Dall sheep" (Section 201(4)(a)), "to provide the opportunity for continued subsistence uses" (Section 801(4)), and "[to conserve] natural and healthy populations" (Section 815(1)). Dall's sheep can be legally hunted throughout Gates of the Arctic National Park and Preserve by qualified subsistence users; sport hunting for sheep is permitted in the Preserve.

A widespread decline in populations of Dall's sheep (*Ovis dalli*) occurred in Gates of the Arctic National Park and Preserve and throughout the Brooks Range during the late 1980's through the mid-1990's. (Brubaker 1998, Adams 1987, F. Mauer, US Fish and Wildlife Service, personal communication, J. Dau, Alaska Department of Fish and Game, personal communication). The widespread decline was attributed to a series of hard winters with deep snow, which made forage hard to reach and made the sheep vulnerable to predation.

During the mid-1990's, local shortages of caribou migrating through the Anaktuvuk Pass region created a desire by local residents to increase the Dall's sheep harvest in order to meet subsistence needs. This shift in focus among harvest species was to the extent that an emergency subsistence sheep hunt was opened in Gates of the Arctic National Park and Preserve for local residents in July 1995. The increased emphasis on sheep as a subsistence species and anecdotes of a perceived sheep population decline, led the park to conduct a statistically valid Dall's sheep population survey in 1996. The 1996 survey results emphasized the need to develop an economical population trend survey and a way to assess sheep harvest so that the sheep population can be more closely monitored.

We began to address the information need in 1997 as we worked with Anaktuvuk Pass residents to develop a community harvest reporting system, and in 1998 with a sheep radiotracking project and sheep surveys. This report covers our progress, and is divided into 5 parts: the sheep capture and physical measurements of captured sheep; radiotracking conducted from April 1998 through Nov. 2000; sheep surveys in June 1998, July 1999, and July 2000; a brief summary of harvest reporting from 1995-2000; and an overview of plans and recommendations for the future.

Funding for this project was provided by the National Park Service (NPS), Gates of the Arctic National Park and Preserve. We thank pilots Don Glaser, Sandy Hamilton, Dennis Miller, Buster Points, Jim Rood, Rick Swisher and Hollis Twitchell for fixed-wing aircraft support. We thank helicopter pilots Jonathan Larravee and Rick Swisher, and net-gunner Barry Minor. Steve Arthur of the Alaska Department of Fish and Game acted as biologist / animal handler during the first year of capture work and fitted Dall's sheep with radiocollars, gathered physical measurements and took blood samples.

Goals and Objectives

The goal of the Dall's sheep radiotracking project and sheep trend surveys is to ensure healthy populations of Dall's sheep in the Central Brooks Range near the community of Anaktuvuk Pass and to establish an economical and accurate procedure to monitor the sheep population in this area. To obtain these goals, we are pursuing the following objectives:

- identify Dall's sheep sub-populations and determine band sizes;
- determine home ranges, seasonal movement patterns, and range fidelity of the identified sub-populations;
- assess areas of local harvest;
- develop an economical and accurate annual trend survey technique; and
- continue the exchange of information regarding Dall's sheep populations in the Central Brooks Range with Anaktuvuk Pass residents.

Study Area

The study area is located in the northern part of Gates of the Arctic National Park and Preserve, east and west of the village of Anaktuvuk Pass (68° 08'N, 151° 45'W) and is roughly bisected by the continental divide.

The climate zone at this latitude is arctic; precipitation is low and yearly averages are 5-9 inches (13-25 cm). Snow fall averages 35-50 inches (89-127 cm). Yearly temperatures fluctuate from an average July maximum of 65°F (18°C) to an average February minimum of -10°F (-23°C) (National Park Service 1986). The predominant vegetation communities in the study area are *Dryas*-sedge-lichen tundra and *Dryas*-mixed herb-lichen tundra on well-drained ridges and mountain sides. Moist to wet tussock tundra predominates in the valleys; *Eriophorum vaginatum* is the primary tussock-former (Viereck et al. 1992).

I. Capture and Radiocollaring

Methods:

Prior to initiation of the field portion of this study and deployment of radiocollars on Dall's sheep, residents of the community of Anaktuvuk Pass village were visited by Patty Rost (NPS) and Rachel Brubaker (NPS). Proposed aspects of this sheep project were discussed and concerns of this project were solicited. Two major issues of concern were apparent during these discussions. The first concerned radiocollaring sheep and the second issue raised was the use of drugs in wildlife that potentially could be harvested and consumed by humans. Partially as a result of these discussions, the NPS agreed to reduce the number of radiocollared sheep from a desired 30 individuals to 18. In addition, the NPS committed to capture methods for Dall's sheep that did not entail the use of drugs. Non-objection or support for the project vastly outweighed objections among Anaktuvuk Pass residents.

Sheep captures were accomplished with a net-gun fired from the shoulder using a helicopter (Robinson R-44) as a platform. In 1998, the helicopter was piloted by Jonathan Laravee and in 1999 and 2000 the ship was piloted by Rick Swisher. Barry Minor was the net-gunner during all capture seasons. Both helicopter pilots and the net-gunner were associated with Quick Silver Air, Fairbanks, AK. In 1998, 19 adult Dall's sheep were captured from March 24-26 and 18 of these were equipped with radiocollars with a 4-hour delay mortality mode (ATS, Minneapolis, Minnesota). On 27 March 1999, 3 sheep were captured and fitted with radiocollars to replace animals that had died in the previous year and to maintain the study population at 18 animals. On March 8, 2000 an additional 5 sheep were captured and radiocollared to replace 3 animals that had died during the previous year and to replace 2 collars that had ceased to function. All collars were attached with a canvas webbing spacer intended to deteriorate in approximately 3 years after exposure to environmental conditions. Similar canvas spacers have been used with success on grizzly bears under similar environmental conditions (H. Reynolds, AK Dep. Fish & Game, personal communication).

Fixed wing aircraft (Piper Supercubs) were employed during the capture operation to provide safety support and as spotter planes with the intention of locating sheep bands and thereby improving the overall efficiency of the capture operation. Weather limited their usefulness however and in all years, the helicopter located the majority of sheep bands as well as conducted the capture. On locating a group of sheep, but prior to pursuit, the helicopter deposited the biologist on the ground. The helicopter was used to herd the animal to terrain suitable for a capture attempt. Capture efforts were discontinued if the pursuit of an individual exceeded approximately 3 minutes, if the animal moved to where there was no suitable terrain for capture, or more often, if the animal refused to move. Many of the captures required no herding and most captures were completed very quickly.

Immediately following a capture, the netgunner left the helicopter, restrained the captured sheep and positioned it so the airway was clear with the head elevated to prevent inhalation of material from the digestive tract. The sheep was blindfolded, restrained with leg hobbles, and removed from the net. Meanwhile, the helicopter pilot recorded the capture location on a GPS unit, returned for the biologists and shuttled them to the capture site. A blood sample was taken from the jugular or cephalic vein. The sheep was aged by counting horn annuli (Geist 1971) and by assessing incisor wear, weighed, and a series of physical measurements were made. Physical measurements included horn length, body length, chest girth, neck circumference, jaw length, metatarsus length. The radiocollar was then placed on the sheep, and the animal was released. No drugs were used in capture and handling.

Blood samples were drawn from 19 animals in 1998, 2 animals in 1999, and 5 animals in 2000. Each evening blood samples were spun down in a centrifuge and frozen. The serum was sent to the Alaska Department of Fish and Game and eventually to the

Wyoming State Veterinarian Laboratory. Blood samples were screened for evidence of exposure to: Infectious bovine rhinotracheitis virus, bovine viral diarrhea virus, parainfluenza 3 virus, respiratory syncytial virus, epizootic hemorrhagic disease virus, bluetongue virus and 5 serovars of *Leptospira interrogans*. Additional blood samples have been saved and may be useful for future disease and genetic analyses. In addition to blood samples, fecal pellets and throat swabs were obtained for sheep radiocollared during march of 2000 to screen for internal parasites and pathogenic strains of *Pasteurella* spp. respectively.

A letter was obtained from the Nunamiut Corp. providing permission to land a helicopter on corporation lands if necessary during the collaring operation (1997, 1998, 1999). Collection permits for animal capture were obtained from the Alaska Department of Fish and Game (Permit numbers 97-03, 98-041, 99-059, 00-029).

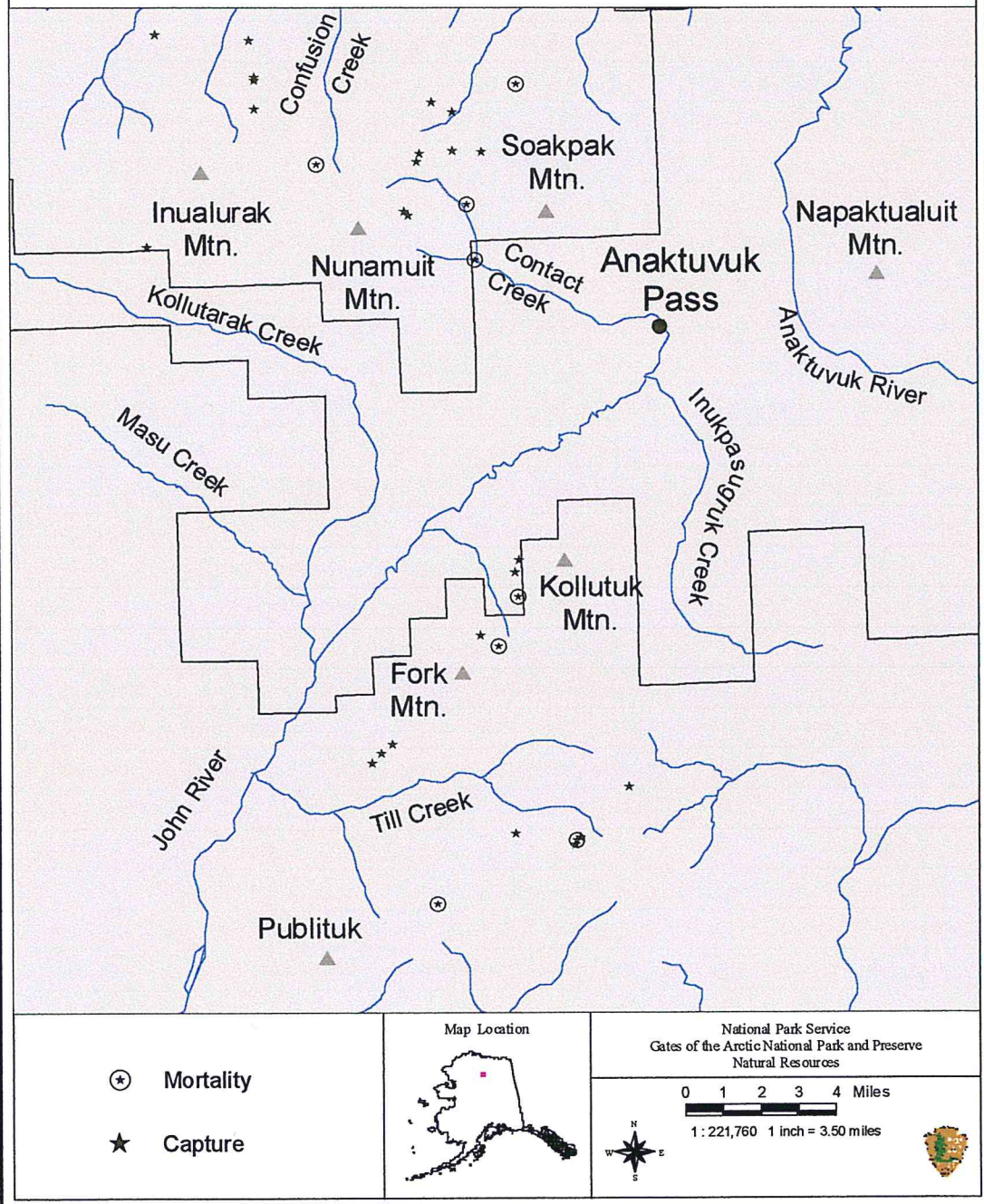
Results and Discussion:

Initial capture distribution for radiocollared sheep was 9 ewes and 3 rams in the upper John River drainage (in the Kollutuk and Till tributaries), 1 ewe in Kollutarak Creek, and 5 ewes in Contact Creek. In 1999, 3 ewes were captured in the upper Akmagolik Creek area. In 2000, 3 sheep were captured in upper Confusion Creek (1 ram and 2 ewes) and 2 sheep were captured in upper Contact Creek (1 ram and 1 ewe) (Fig. 1). All sheep captured and radiocollared were adults. All animals were active and appeared healthy and un-stressed when released. In 1998, one animal died within 3 weeks of being captured. In 1999 and 2000, all newly captured sheep survived for at least a minimum of 5 months after being captured (Fig. 1).

A summary of age and sex as well as physical characteristics of captured sheep is provided in Table 1. The average mass (mean $\pm$ SE) of female sheep was 114 ± 5 lbs. (50 ± 2.1 kg). For comparison, weights for 2 populations of radiocollared Dall's sheep in interior Alaska in march of 1999 and march of 2000 averaged 121 ± 2.7 lbs (Burch and Lawler, unpublished information). Weights were not obtained for male sheep since the combination of greater weights and considerably more vigorous struggles made weighing these animals a dangerous task. Age at capture for radiocollared sheep in Gates of the Arctic National Park and Preserve averaged 8.4 years for males and 7.2 years for females (sheep age was estimated from horn annuli and tooth wear).

Blood samples were taken from sheep captured for this study ($n=27$). All results were negative for exposure to Infectious bovine rhinotracheitis virus, bovine viral diarrhea virus, parainfluenza 3 virus, respiratory syncytial virus, epizootic hemorrhagic disease virus, bluetongue virus and 5 serovars of *Leptospira interrogans*. Results from the throat swabs did not reveal any pathologic strains of *Pasteurella* spp. Lung worm larvae were found and are typical of those found in other wild sheep populations. Eggs of larvae of several gastro-intestinal parasites were found and these also were typical of free ranging sheep. These results do not indicate a potential health problem to the sheep population or to humans consuming sheep.

Fig 1. Locations of Dall's sheep Captures and Mortalities
Gates of the Arctic National Park and Preserve, Alaska



Plot date: February 12, 2001 d:\gaar\sheep\gis\projects\01\location.apr

Table 1. Physical characteristics and current status of Dall's sheep captured for radiocollaring in Gates of the Arctic National Park and Preserve, Alaska.

Capture Date	Sheep ID	Wgt. (lbs.)	Sex	Age*	Horn Length		Annuli		Hindfoot Length	Body Length	Chest Girth	Jaw Length	Neck Circ.	Tooth Wear	General Condition	Fate
3/24/98	801	87	F	7	27.0	27.0	6.0	6.0	26.4	147.0	91.0	20.2	36.0	Very little		Alive
3/24/98	802	108	F	7	24.0	23.0	6.0	6.0	27.9	152.0	98.0	26.4	41.0	Very little		Dead
3/24/98	803	116	F	7	25.0	23.5	6.0	6.0	26.2	158.0	96.0	18.4	39.0	Moderate		Alive
3/24/98	804		M	10			9.0 ^a	8.0 ^a						Moderate		Dead
3/24/98	805		M	7			6.0	6.0						None		Alive
3/25/98	806		F	7	32.0	29.5	6.0	6.0					43.0	Moderate		?
3/25/98	807		F	5	26.0	27.0	4.0	4.0					38.0	Slight		Alive
3/25/98	808		F	6	21.5	18.5	5.0	5.0					38.0	Very little		Alive
3/25/98	809		F	4	18.5	17.8	3.0	3.0					38.0	None		Dead
3/25/98	810		M	8	75.0	75.0	7.0	7.0					49.0	Moderate		Alive
3/25/98	811		F	4	25.0	21.0	3.0	3.0					41.0	None		Alive
3/25/98	812		F	8	28.0	27.0	7.0	7.0					44.0	Moderate		Dead
3/25/98	813		F	9	28.0	26.5	8.0	8.0					46.6	Moderate		Alive
3/26/98	814	124	F	9	34.0	32.0	8.0	7.0		153.0	106.0		47.0	Heavy		Alive
3/26/98	815		F	8	24.0	22.0	7.0	7.0		147.0			42.0	Moderate		Alive
3/26/98	816	130	F	8	27.5	28.0	7.0	7.0		147.0	103.0		42.0	Moderate		Dead
3/26/98	817	105	F	9	30.0	29.0	8.0	7.0		150.0	95.0		40.0	Moderate		Dead
3/26/98	818	102	F	10	27.0	26.0	9.0	9.0		140.0	98.0		45.0	Very worn		Dead
3/26/98	819		F													Alive
3/27/99	820	90	F	4	19.0	14.5	3.0	3.0	28.5		94.0		39.5	Light	Good	Alive
3/27/99	821	115	F	10	27.5	30.5	9.0	9.0	27.5		105.0		41.0	Heavy	Thin / boney	Alive
3/27/99	822	125	F	7	25.3	25.0	6.0	5.0	29.5		96.5		41.0	Moderate to heavy	Thin / boney	Alive
3/8/00	823	148	M	8	54.2	57.0	8.0	8.0	29.5		109.0		56.0	Light	Very good	Dead
3/8/00	824	145	F	9	26.0	25.5	8.0	9.0	29.0		128.0		43.0	Moderate	Excellent	Alive
3/8/00	825	105	F	6	24.2	15.5	6.0	6.0 ^a	27.5		99.0		40.0	Light	Excellent	Alive
3/8/00	826	150	M	9	64.0	64.0	8.0	8.0	32.0		112.0		53.0	Light	Excellent	Alive
3/8/00	827	130	F	7	24.0	26.5	6.0	7.0			104.5		44.0	Light	Excellent	Alive

* Age at capture. Sheep were aged by counting horn annuli as described by Geist (1971).

^a Broomed horn tips.

II. Radio-tracking

Methods:

Radio-tracking flights were scheduled twice monthly but we experienced great difficulty maintaining this schedule due to the unpredictability of weather in the Central Brooks Range. Flights were spaced a minimum of 5 days apart to avoid problems with independence with consecutive locations (White and Garrott 1990).

Animal locations were obtained from a fixed-wing aircraft (Piper PA-18 Super Cub or a Cessna 185). Each location was logged in the aircraft GPS. At each location the date, latitude and longitude, time, size of the group with the collared animal, group age-sex composition, terrain characteristics, snow cover, distance to escape terrain, and elevation were recorded. In many instances, particularly in the winter, visual observations of sheep were not possible. In these situations, only a general location for the sheep was recorded.

Dall's sheep mortalities (Fig. 1) were initially investigated from the fixed-wing aircraft. At the earliest opportunity, sites were visited by snow machine or helicopter. Information regarding probable cause of death and age and condition of sheep at the time of death was collected. If possible, a tooth was collected from each dead sheep to allow for comparison of cementum annuli to the horn annuli aging technique.

All radio-locations were entered into a Geographic Information System (GIS) for data management (ArcView GIS version 3.2, ESRI). This GIS system, along with the Animal Movement Extension (Hoogie and Eichenlaub 1997) was used to determine home range size using minimum convex polygons, and maximum distances moved between relocation flights. ArcView was also used for map production for graphical interpretation of the data such as home range overlap. Dall's sheep distribution within the study area may be examined during times of the year that correspond to periods assumed to be important to the life history of the species. Although some authors define multiple seasonal ranges for mountain sheep (Geist 1971) we limited our seasonal ranges to 5; spring (lambing), summer, fall, rut, and winter. Lambing in Dall's sheep occurs from May through the early part of June (Rachlow and Bowyer 1998, Nichols 1999). During summer months (July and August) plant production may influence sheep distribution. By September, production in most plants in the Brooks Range has ceased and factors other than green forage may influence sheep distribution. Rut was assumed to occur during November and December (Geist 1971, Nichols 1999). Following the rut, we assumed sheep moved onto winter ranges.

Radio-tracking pilots for this study have been Don Glaser, Sandy Hamilton, Dennis Miller, Buster Points, Jim Rood, and Hollis Twitchell. Observers include Rachel Brubaker, Jane Bryant, John Burch, Nikki Guldager, Mike Haubert, Jim Lawler and Merry Maxwell.

Results and Discussion:

Since the start of this study (April 1998) a total of 49 radio-tracking flights have been conducted. Nineteen flights were conducted during the first year of the study (March 1998 – March 1999). In the second year of the study, 19 flights were taken from April 1999 – March 2000. Thus far, in the third year of the study, 11 radiotracking flights have been flown. We have utilized information from all radio-tracking flights for this report. Not all sheep were located on every flight and some collars appear to be functioning intermittently. Each sheep was located on average of 28 times. Although sheep have been located during each month of the year, some months are better represented than others and some animals are better represented than others (Table 2). Therefore, current delineation of Dall's sheep home ranges (Fig. 2a and 2b) and seasonal ranges (Fig. 3 - 7) can only be viewed as preliminary. However, it appears that we have 3 distinct subpopulations collared within our study area that occupy ranges with minimum overlap. One subpopulation occurs on the east side of the John River and 2 occur on the west side. At this time, none of the radiocollared animals have crossed any of the major drainages in the study area such as the John River, Anaktuvuk River or the Kollutarak River. Of particular interest are the 2 subpopulations to the west of the John River since no obvious geographical barrier exists. Encampment Creek, which appears to delineate these 2 subpopulations, is a small drainage that could be easily forded so it is improbable that it is acting as a barrier. In addition, this drainage does not exist in the southern end of the home ranges, yet there is little mixing of these 2 subpopulations. This suggests factors other than geography may be important in separating subpopulations of Dall's sheep. It should be noted that residents of Anaktuvuk Pass and commercial airline pilots that regularly fly over this area have observed Dall's sheep crossing the John River (B. Miller, Wrights Air Service, personal communication).

Examination of seasonal distribution of Dall's sheep (Fig. 3 – 7) do not indicate large scale movements to distinct ranges, rather certain areas appear to constitute Dall's sheep habitat year round. However, during some seasons, Dall's sheep distribution appears to be more clumped than in other seasons. This is most evident in the winter distribution of sheep to the east of the John River (Fig. 3). This is also true of the rutting distribution of Dall's sheep (Fig. 7) but in this case, the lumped distribution may be due to the small number of radio-tracking flights flown during this season. Of particular interest during the lambing and summer season is use of the area near Publituk (Fig. 4). Although few of the radiocollared sheep utilized this area (sheep 809, 811 and 813) and those that did only did so for a short time, large numbers of ewes with lambs were observed here. On 23 June, 1999 one group of 66 Dall's sheep was observed in this area (55 ewes and 11 lambs). On 29 July, 1999 3 group of Dall's sheep were observed here within a ¼ mile of each other. The first group contained 41 sheep (29 ewes and 12 lambs), the second contained 45 sheep and the third contained 15 sheep. Unfortunately, due to turbulent flying conditions, it was only possible to get a sex and age composition in one of the 3 groups. Given this anecdotal information, this area appears to be an important lambing area, although not necessarily for those sheep presently radiocollared.

Analysis of the radio-tracking data for each collared animal included presence of lamb, average group size, average elevation, the distance between the two extreme points in each range, and minimum convex polygon areas (Table 3). The length of time between sequential radio-tracking flights has varied greatly (range of 6-69 days). Therefore, estimates of minimum, maximum and average movement distances and rates are of marginal value. The farthest distance between any two relocation points for an individual sheep ranged from 4 to 8 miles (6.5 – 12.9 km); the average ($\pm$ SEM) distance moved between radio locations was 6.0 ± 0.24 miles (9.7 ± 0.4 km); median distance was 6.0 miles (9.7 km). Sheep home ranges determined using minimum convex polygons (MCP) ranged from 7.9 mi² to 45.1 mi² (20.4 km² to 116.7 km²). Mean home range size was 23.4 ± 1.9 mi² (60.6 ± 5 km²).

Since the initiation of this study, there have been 6 sheep mortalities (Fig. 1). The first mortality occurred within 2 weeks of capture. A ewe estimated to be 8-years-old died in the Till Creek drainage, apparently mired in deep snow. This animal was necropsied by University of Alaska Fairbanks veterinarian, John Blake. Results from this necropsy revealed signs of capture myopathy, a muscle degeneration caused by stress. Whether this stressed was caused by the radiocollaring capture operation or from foundering in deep snow is uncertain. Large quantities of blood in the snow near a second sheep, a 7-year-old ewe, indicate this animal was killed by a predator but we were unable to determine the species of predator. A third collar was cut off and was found under a rock indicating this animal had been harvested by a person. This collar had been on a 9-year-old ewe. We were unable to visit the sites of three mortalities until long after the sheep had died and were therefore unable to determine the cause of death of a 10-year-old ram, a 4-year-old ewe or a 10-year-old ewe.

Table 2. Seasonal distribution of relocations for Dall's sheep radiocollared in Gates of the Arctic National Park and Preserve, Alaska from March 1998 through December 1999. Relocations consisted of visual observations of specific collared sheep and general locations of collared sheep if no visual confirmation was possible.

Sheep #	Winter				Lambing		Summer		Fall		Rut		Total
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.	
801	2	4	3	6	4	4	3	4	3	5	3	1	42
802				2	3	2	1	1	1	3	1		14
803	1	2	1	3	3	2		1	1	3	2		19
804	1	2	1	3	3	2	1	1	1	3	2		20
805	2	4	3	6	6	5	3	4	4	5	3	1	46
806	2	4	3	5	6	6	3	3	4	3	2	1	42
807	2	4	3	6	6	7	4	4	4	4	3	1	48
808	2	4	3	6	6	7	4	4	4	5	3	1	49
809				2	3	2	1		1				9
810	2	4	3	6	6	7	4	4	4	5	3	1	49
811	2	4	3	6	6	6	4	4	4	5	3	1	48
812					1								1
813	2	4	3	6	6	7	4	4	4	5	3	1	49
814	2	4	3	5	5	5	4	4	3	4	3	1	43
815	2	4	2	5	5	7	3	4	4	5	3	1	45
816	1	2	1	4	5	3	3	3	3	3	2		30
817	2	4	1	3	5	4	3	3	3	3	2		33
818	1	2	1	3	4	1	1	1	1	4	2	1	22
820	1	2	3	4	2	4	3	3	3	2	1	1	29
821	1	2	3	4	2	4	3	3	3	2	1	1	29
822	1	2	3	4	2	4	2	3	3	2	1		27
823			1	2		2		1					6
824			1	2		2	1	1	1	2	1		11
825						1		1	1	2	1		6
826			1	2		3		1	1	2	1		11
827				1		2	1	1	1	2	1		9
Total	29	58	46	96	89	99	56	63	62	79	47	13	737

Table 3. Summary statistics gathered during radio-tracking flights for Dall's sheep in Gates of the Arctic National Park and Preserve, 1998 –2000.

Sheep #	Year Caught	Avg. Group size	Avg. Elev. (ft)	Lamb ^a	Max. Dist. (km) ^b	MCP (km ²) ^c	Sample (n) ^d	
							Vis.	Loc.
801	98	5	3900	98, 00	7.0	61.6	22	44
802	98	13	1800	98	6.5	23.6	7	14
803	98	11	3100		6.5	20.4	10	19
804**	98	3	2900		7.5	51.5	13	20
805**	98	5	3800		7.8	85.3	31	46
806	98	9	3600	98, 99	12.2	85.5	29	42
807	98	6	3700		11.9	112.5	30	48
808	98	10	3700	98, 00	11.1	42.2	34	49
809	98	6	2800		9.5	40.1	3	9
810**	98	5	3900		7.2	31.3	37	49
811	98	8	3900	98	12.8	54.9	33	48
812*	98							1
813	98	9	4000	98	9.2	66.3	32	49
814	98	6	3500	98, 99	12.9	116.7	28	43
815	98	6	3600	99	8.8	64.0	24	45
816	98	7	3700	98, 99	11.0	69.4	17	30
817	98	8	3600	99	9.6	60.5	17	33
818	98	7	3200	98	10.5	52.5	10	21
820	99	11	4450	99	11.3	102.7	18	29
821	99	11	4500	99	9.8	54.0	20	29
822	99	6	5000	99, 00	7.0	47.5	14	27
823**	00	5	4700		7.2	77.4	5	6
824	00	6	4000	00	12.2	55.5	10	11
825	00	17	4100		10.9	32.5	3	6
826**	00	3	4200		12.6	63.1	6	11
827	00	9	4300	00	9.5	44.2	6	9
Avg.		7.6	3800	NA	9.7	60.6	18	28

* Animal died soon after radiocollaring.

** Ram

^a Number indicates the year a ewe was observed with a lamb.

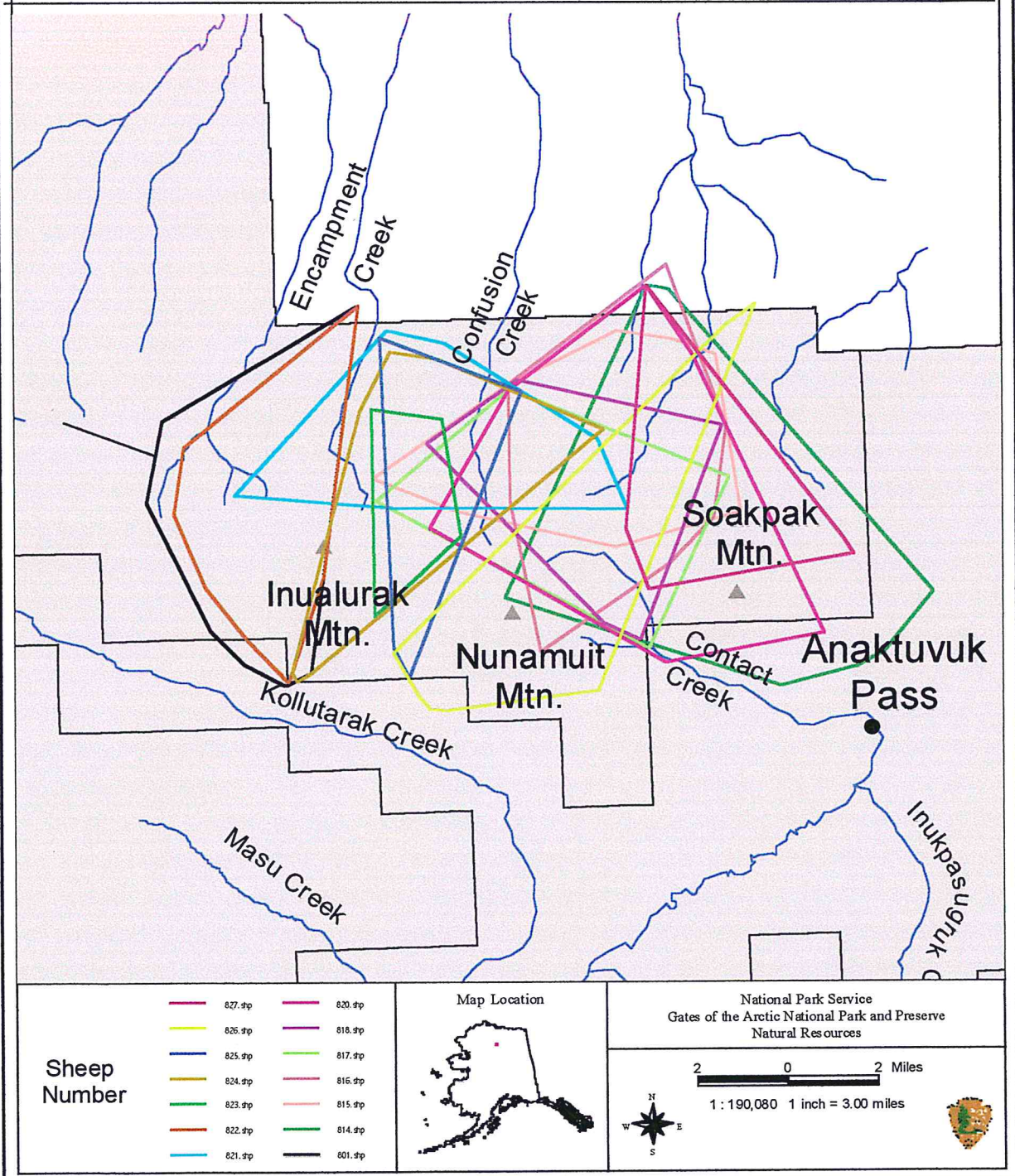
^b Maximum distance in a straight line across an animals home range.

^c Area encompassed by a minimum convex polygon drawn around relocation points.

^d Sample sizes given are for the number of times a specific animals radiocollar was radio-tracked and either a visual observation was made of the radiocollared animal or a more general location was obtained based on the strength of the radio signal.

Fig. 2a. Dall's Sheep Home Ranges NW of Aanaktuvuk Pass

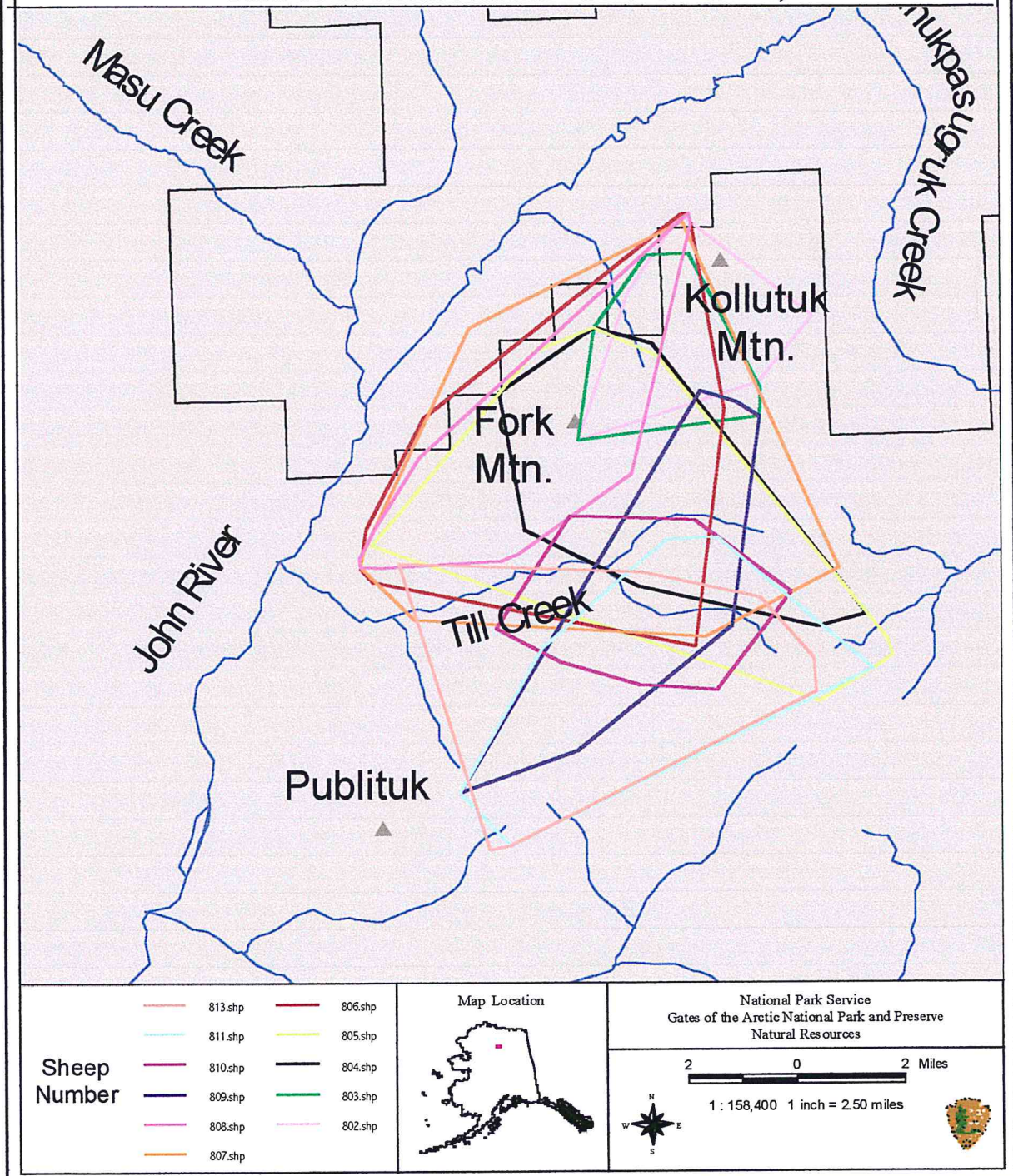
Gates of the Arctic National Park and Preserve, Alaska



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Fig. 2b. Dall's Sheep Home Ranges SE of Anaktuvuk Pass

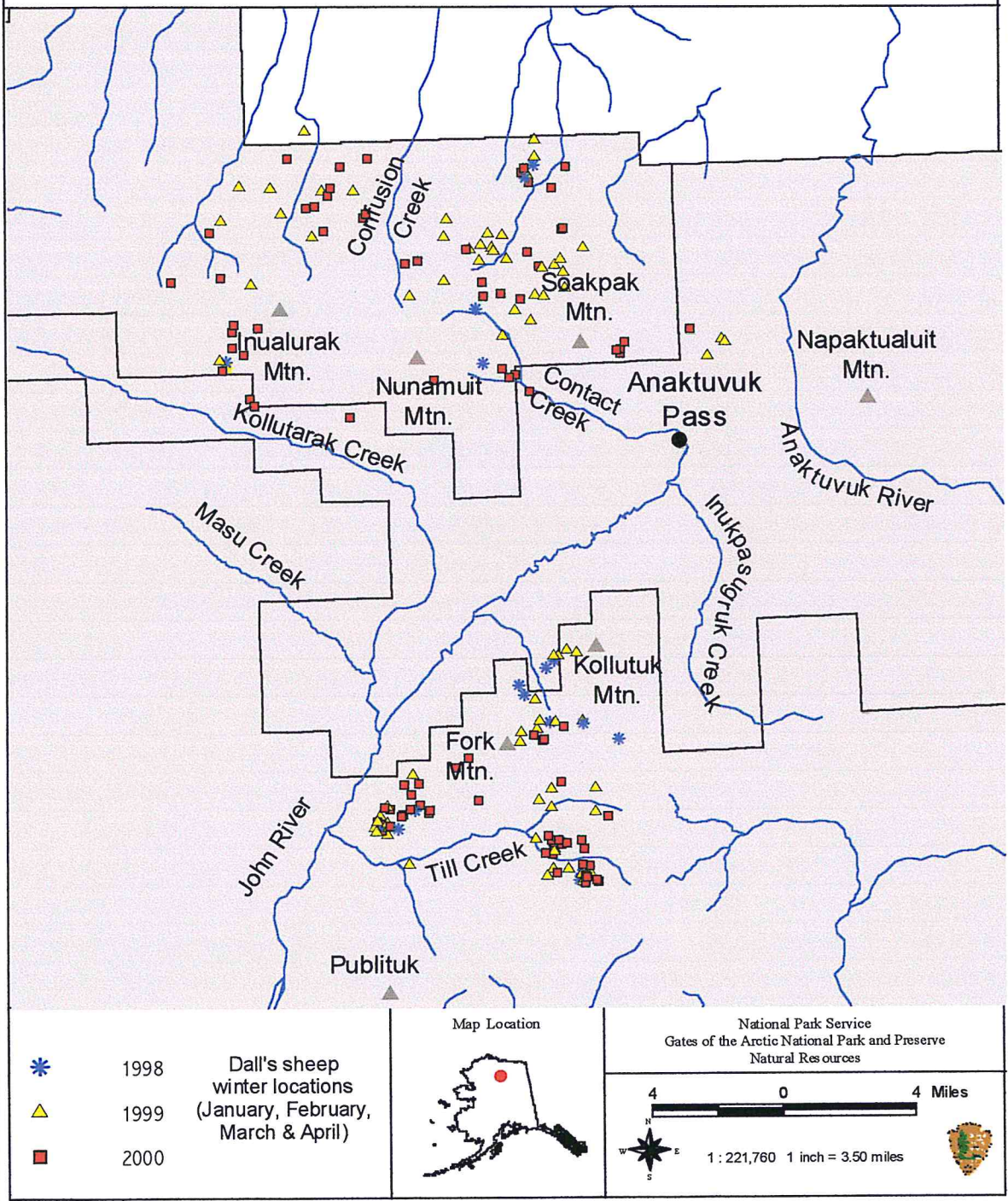
Gates of the Arctic National Park and Preserve, Alaska



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Fig. 3. Winter distribution of Dall's Sheep near Anaktuvuk Pass, Alaska, 1998 - 2000.

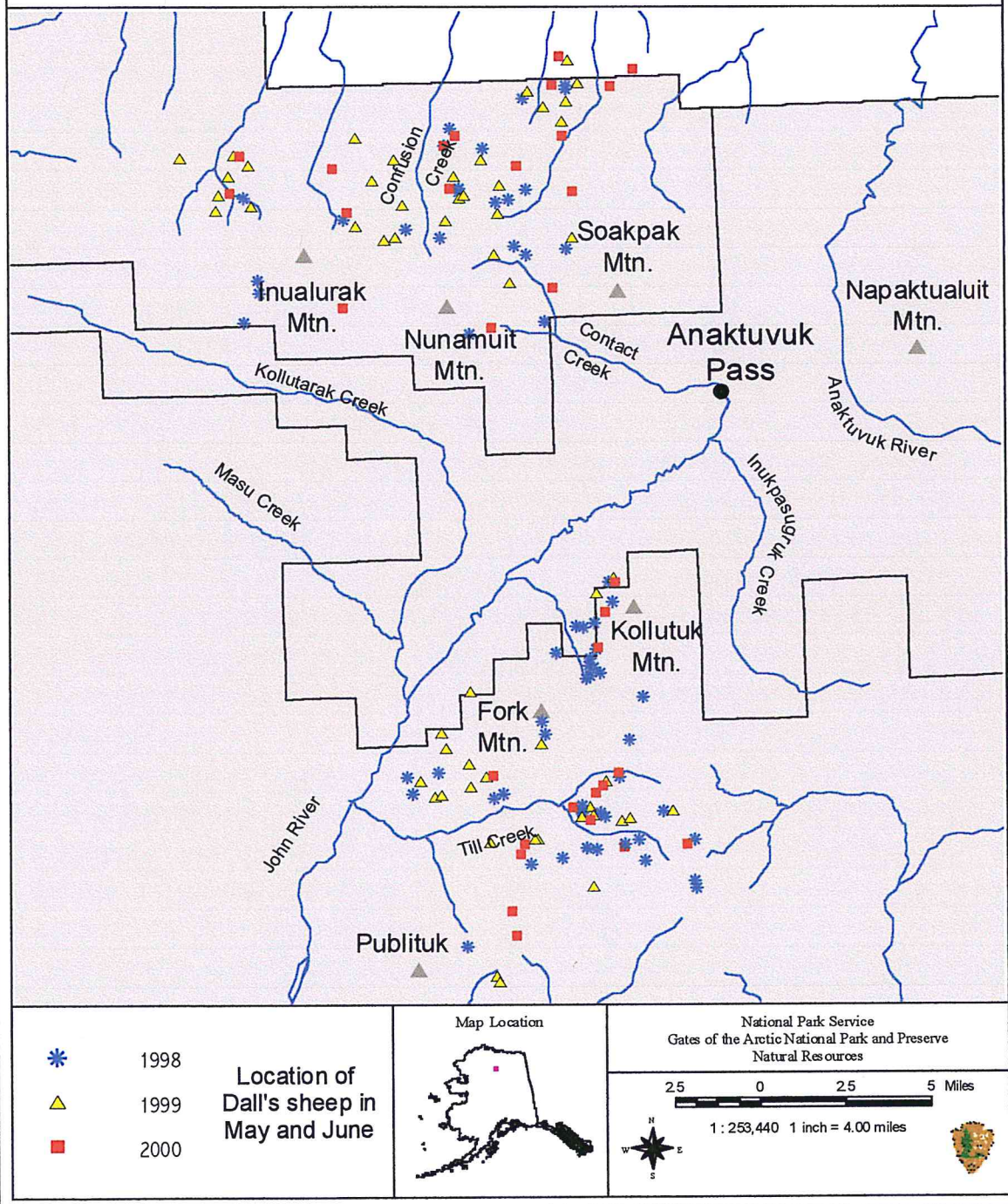
Gates of the Arctic National Park and Preserve, Alaska



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Fig. 4. Lambing distribution of Dall's sheep near Anaktuvuk Pass, Alaska, 1998 - 2000.

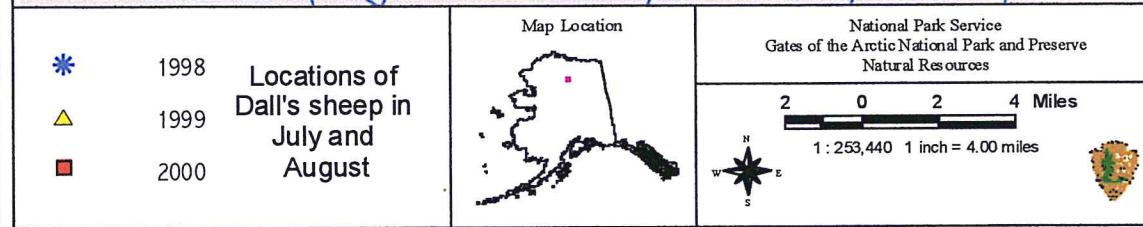
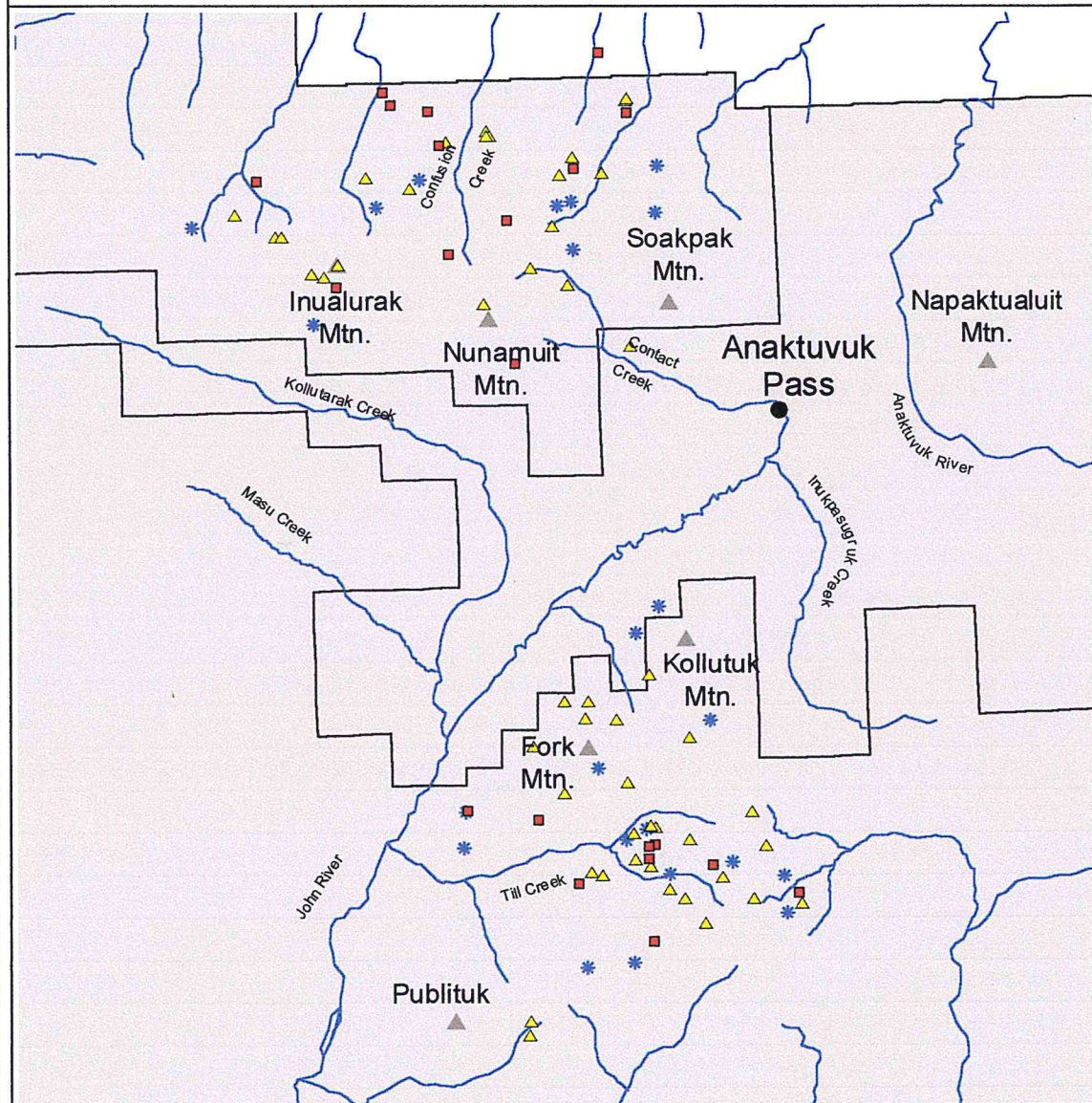
Gates of the Arctic National Park and Preserve, Alaska



Plot date: February 26, 2001 d:\gaar\sheep\gis\projects\01\location.apr

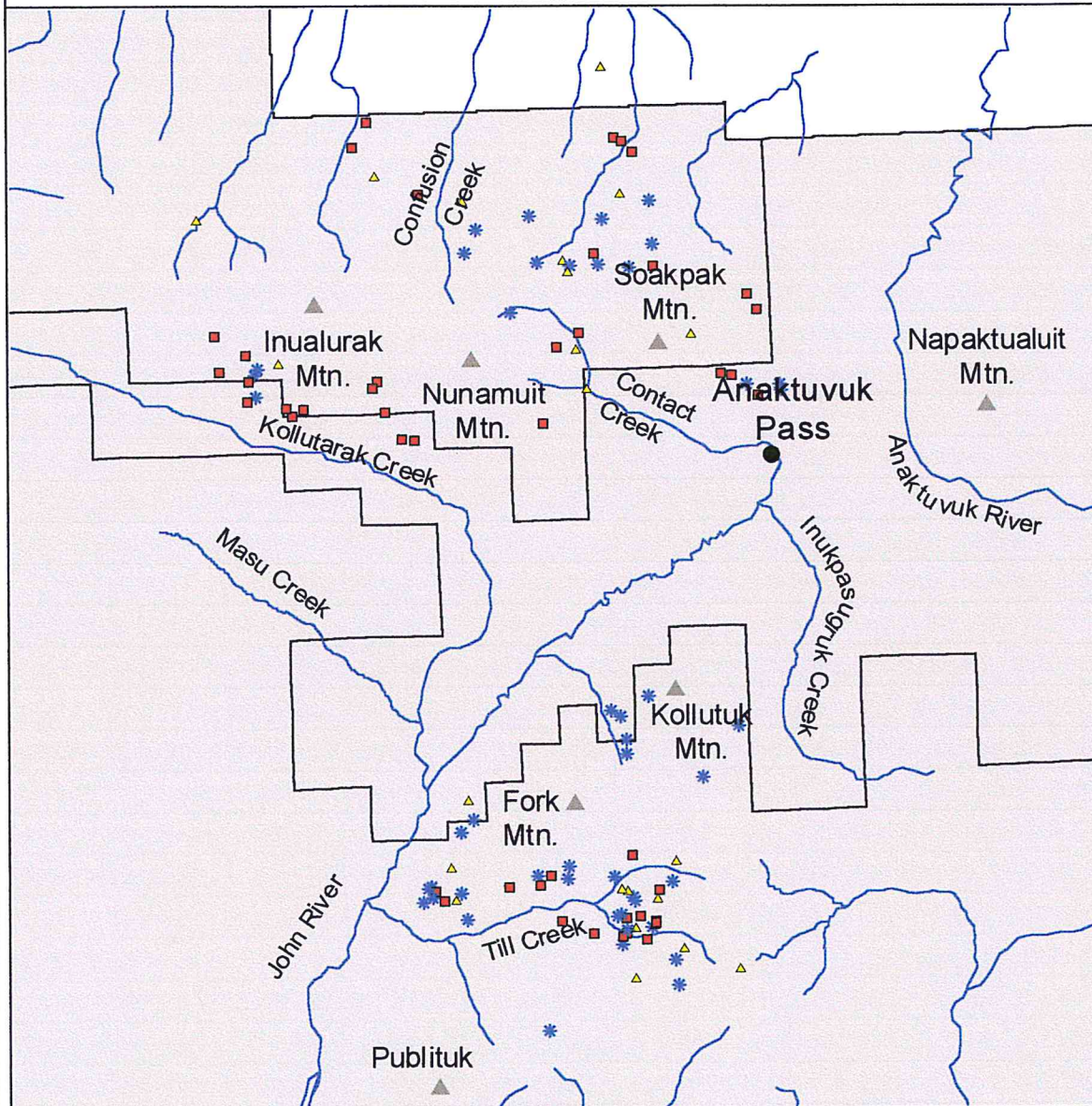
Fig. 5. Summer distribution of Dall's sheep near Anaktuvuk Pass, Alaska, 1998 - 2000.

Gates of the Arctic National Park and Preserve, Alaska



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**Fig. 6. Fall distribution of Dall's sheep near
Anaktuvuk Pass, Alaska, 1998 - 2000**
Gates of the Arctic National Park and Preserve, Alaska



- * 1998 Location of Dall's sheep in September and October.
- ▲ 1999
- 2000

Map Location



National Park Service
Gates of the Arctic National Park and Preserve
Natural Resources

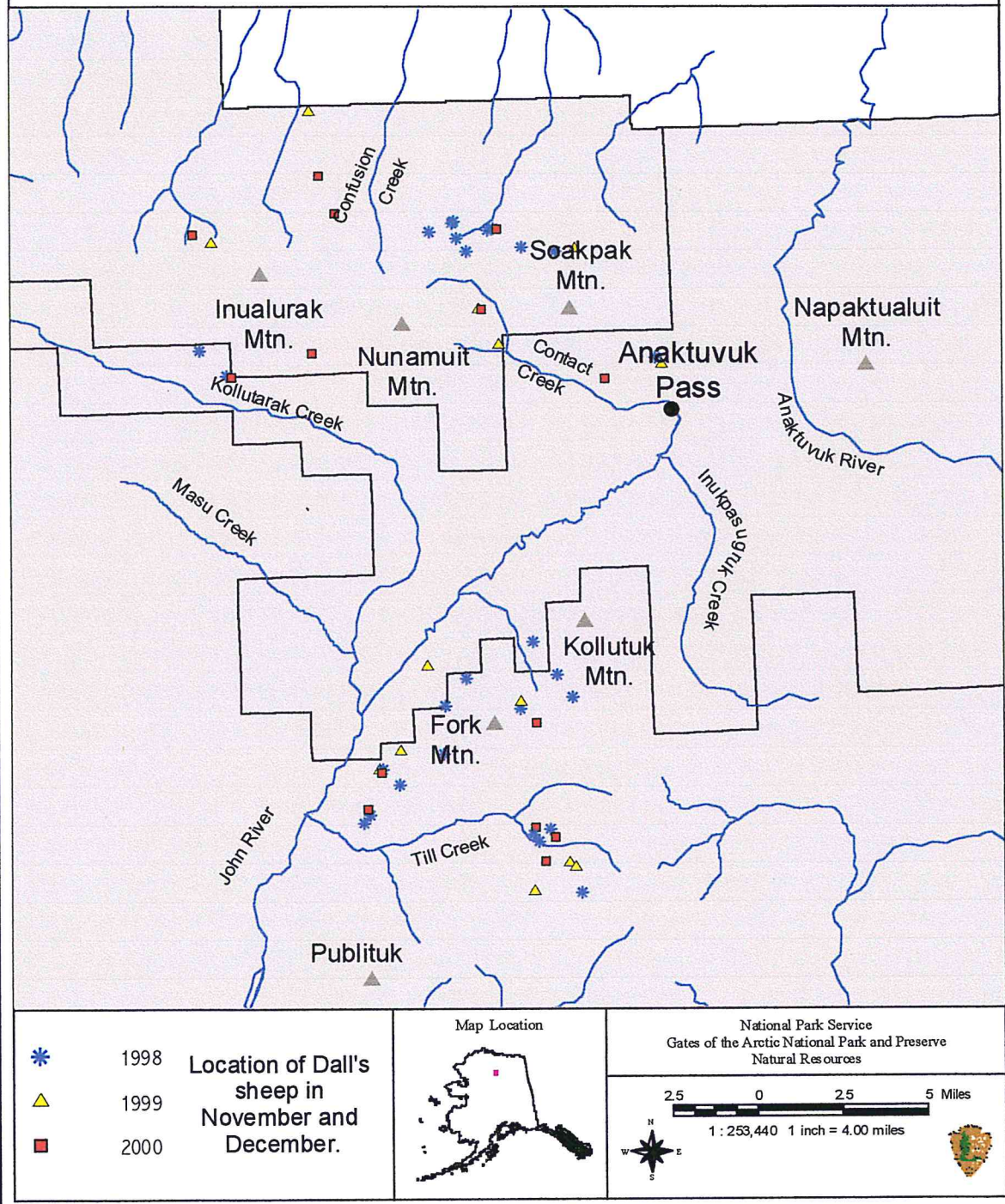
2 0 2 4 Miles

1 : 253,440 1 inch = 4.00 miles



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**Fig. 7. Rutting distribution of Dall's sheep near
Anaktuvuk Pass, Alaska, 1998 - 2000**
Gates of the Arctic National Park and Preserve, Alaska



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III. Sheep trend count surveys in GAAR, 1998 and 1999

1. AERIAL SURVEY:

Annual population surveys provide insights into population trends, and changes in age and sex distribution of Dall's sheep populations. In areas where sheep are hunted, they are particularly useful in evaluating the effects of harvest on local Dall's sheep bands. Annual sheep surveys near Anakuvuk Pass, Alaska were initiated in 1998 with the goal of tracking long-term population trends of Dall's sheep bands in this important subsistence area.

Methods

Many factors went into the selection of the area currently being surveyed for Dall's sheep (Fig. 8). This area can be surveyed in a reasonably short amount of time (3 days) thereby minimizing the potential for animals to move between survey units. Included within the survey units are many of the subsistence hunting areas important to the people of Anaktuvuk Pass. The area chosen for this survey included the annual ranges of all the radiocollared sheep (Fig. 2). Survey unit boundaries were those used in a sheep survey in 1996 (Brubaker 1998), and in previous surveys (Adams 1988, Singer 1984). Retention of old boundaries facilitated comparisons between surveys.

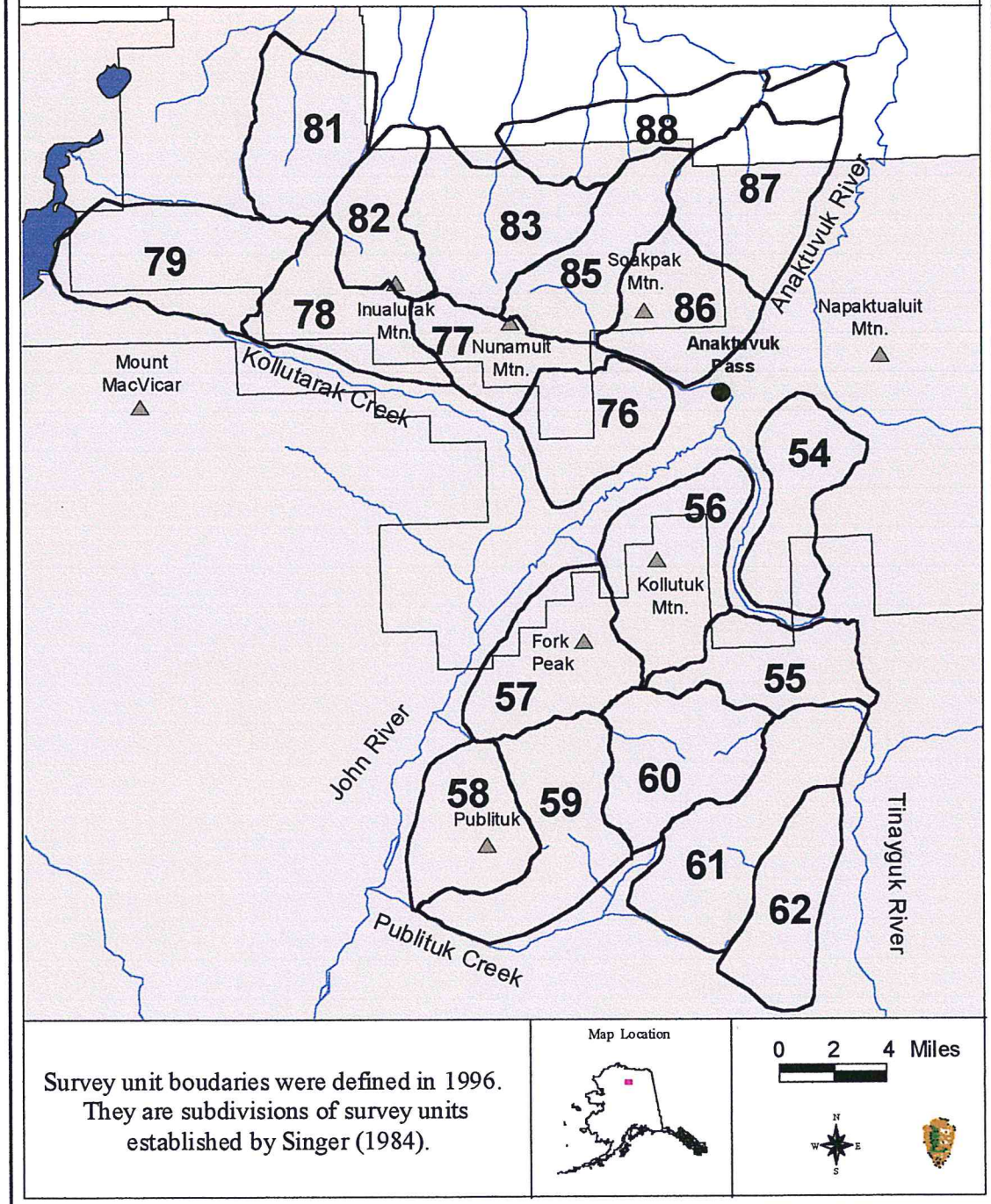
Sample units were surveyed at relatively low intensity with a fixed wing aircraft (Piper PA-18 Super cub with pilot and 1 observer). The pilot and observer searched for sheep by contouring around terrain features in such a manner as to thoroughly cover an area. Typically this required 2 – 3 contour elevations around a given feature. Actual flight times per mi^2 varied within and between sample units, depending on the complexity of the terrain, but probability of sighting a sheep was considered uniform throughout the survey. The aircraft would circle groups of sheep as necessary to obtain accurate classification counts. Sheep were classified as rams, ewe-like, or lambs. Rams included all animals with greater than 1/2 curl horns. The ewe or "ewe like" category included rams smaller than 1/2 curl and all ewes. Lambs were sheep less than 1 year of age and were conspicuous because of their small size. Locations of sheep were marked on 1:63,360 scale USGS maps and numbers and classifications were recorded on a data sheet. Jim Rood was the survey pilot in 1998 and Don Glaser was the survey pilot in 1999 and 2000. Jim Lawler served as the observer during these 3 surveys.

RESULTS AND DISCUSSION

Aerial surveys for this study have been conducted during the summer of the past 3 years (Table 4). Survey conditions were good in 1998, extremely poor in 1999 and poor in 2000. A total of 475 mi^2 (1230 km^2) were surveyed between 28 June and 1 July 1998 during 23 hours of flight time and a total of 386 sheep were observed. The 1999 total count was 186 sheep observed during 17 hours of flight time from 10 July through 13 July but only 450 mi^2 (1165 km^2) were surveyed. In 2000, the total count was 460 sheep from 29 June to 1 July in 13 hours of flight time and 344 mi^2 (891 km^2) were surveyed.

Fig. 8. Survey units used for aerial Dall sheep surveys

Gates of the Arctic National Park and Preserve



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During 1996 a sheep survey was conducted near Anaktuvuk Pass as part of a separate study using both fixed-wing aircraft and a helicopter. Observers in fixed wing aircraft classified sheep as adults or lambs. Helicopter surveyors during the 1996 survey classified sheep as ewes, lambs, yearlings, or rams but did not survey all the units surveyed during the 1998 and 1999 surveys. In addition, units excluded from the 1998 and 1999 survey were included in the 1996 survey. Although differences in methodology preclude direct comparison of the 1996 data with those from 1998, 1999 and 2000, sex and age ratios during the 1996 survey were as follows: 47 lambs:100 ewes, 25 yearlings:100 ewes and 43 rams:100 ewes. If one assumes that all yearlings in the 1996 survey would have been classified as ewe-like under the system currently in use, ratios become 38 lambs: 100 ewe-like sheep and 34 rams:100 ewe-like sheep. Age and sex composition during the 1998 survey was 27 lambs:100 ewe-like sheep and 35 rams:100 ewe-like sheep. During the 1999 survey 34 lambs:100 ewe-like sheep and 25 rams:100 ewe-like sheep were observed. The results from the 2000 aerial survey were 33 lambs: 100 ewe-like sheep and 32 rams: 100 ewe-like sheep. These ratios indicate relatively good lamb production during the winter of 1999 - 2000.

Given the number of sheep observed during the 2000 survey, and the lamb: ewe ratios during the past 3 years, the low total sheep count during the 1999 season appears to have been a result of either poor visibility (due to poor weather conditions) or movement of sheep between survey units rather than an actual decline in the sheep population. A large amount of variation in Dall's sheep survey results is not unique to this study (J. Burch, National Park Service, personal communication; K. Fox, National Park Service, unpublished data; B. Shultz, National Park Service, unpublished data). In 1998 weather conditions were optimal with good lighting and light winds. In 1999, high winds precluded low-level flight in many areas. In addition to affecting the overall count, the possibility exists that certain age and sex classes of sheep were underrepresented during 1999 the survey. Sheep sexually segregate for much of the year and females will often form maternal and nonmaternal bands immediately after lambing (Geist 1971). If one of these classes of sheep tend to utilize more rugged terrain, they would be under represented in the 1999 survey since high winds prevented access to such areas. Conditions were poor enough in 1999 to prevent completion of the survey before the sheep hunting season began for the residents of Anaktuvuk Pass. Disruption of hunting activity was considered unacceptable and as a result, the survey was terminated before all units were surveyed. Although weather conditions were less than optimal in 2000, the decisions of where and when to fly particular survey units was done in a much more conservative fashion. As a result, fewer survey units were flown but those that were flown were more thoroughly covered than in 1999.

Although consistency has been difficult to achieve with these surveys, they should not be abandoned. On the contrary, results from multi-year data sets can track population trajectories much better than can occasional surveys. Less reliance is placed on single events and yearly anomalies are buffered. Better results on all surveys can be

improved by allocating sufficient time to ensure good weather conditions for the completion of the survey prior to the hunting season. Care must be taken to ensure that survey methods do not vary between years and consistency can be improved by employing the same pilot and observer each year. Adherence to these suggestions will improve the comparability of results.

Table 4. Summary of June / July Dall's sheep surveys in Gates of the Arctic National Park and Preserve, AK, 1996, 1998 and 1999.

UNIT No.	area mi ²	2000				1999				1998 unclassified				1996		
		ewe- like	rams	lambs	TOTAL	ewe- like	rams	lambs	TOTAL	ewe- like	rams	adults	lambs	adults	lambs	TOTAL
54	21.3					0	0	0	0	0	0	0	0	2	1	3
55	19.8	22	15	10	47	6	4	0	10	5	8	0	4	11	3	14
56	27.7	37	2	13	52	18	0	7	25	48	0	0	9	16	9	25
*57	28.0	0	0	0	0	6	10	1	17	8	0	0	1	32	8	40
58	20.9	35	10	12	57	30	1	10	41	16	0	31	13	19	9	28
59	27.8	57	24	23	104	9	11	3	23	66	19	0	18	8	1	9
60	25.7	32	7	10	49					15	8	0	2	76	21	97
61	30.8	32	8	8	48	1	1	0	2	12	13	0	7	18	0	18
62	19.8	0	0	0	0	3	0	2	5	0	0	0	0	6	2	8
76	20.7	0	6	0	6	0	2	0	2	2	6	0	0	15	1	16
77	15.3	0	0	0	0	4	0	2	6	11	3	0	0	29	14	43
78	20.7	0	0	0	0	0	1	0	1	5	2	0	3	13	3	16
79	31.9					5	0	1	6	21	1	0	5	29	11	40
81	24.3					1	0	0	1	0	0	0	0	0	0	0
82	16.6	11	0	7	18	0	0	0	0	0	0	0	0	8	4	12
83	27.8	53	8	10	71	11	0	6	17	0	0	0	0	15	6	21
85	20.8	0	8	0	8	20	0	7	27	16	0	0	3	19	12	31
86	21.6					2	1	0	3	3	1	0	1	20	3	23
87	26.8					0	0	0	0	0	0	0	0	0	0	0
88	26.7					0	0	0	0	0	0	0	0	1	0	1
TOTAL	475.3	279	88	93	460	116	31	39	186	228	61	31	66	337	108	445

* Survey of this unit during the 1999 survey was not completed due to high winds.

2. Ground Survey:

INTRODUCTION

Gates of the Arctic National Park and Preserve is both a park in which hunting is permitted and a wilderness area. Monitoring of wildlife populations is necessary in order to fulfill park mandates and to ensure stability of wildlife populations within this area. Aerial surveys, although effective and efficient, may conflict with Park visitors perception of wilderness and wilderness values. This potential conflict led to the goal of developing ground based survey methods within Gates of the Arctic National Park and Preserve. Conceptually, in addition to reducing impacts on visitor experiences within the Park and Preserve, ground based surveys would allow greater discrimination in sexing and aging sheep. We attempted to achieve this goal using 3 methods. During the 1998 field season, a known mineral lick near Anaktuvuk Pass, Alaska was monitored for sheep. In 1999, 3 routes through known sheep habitat were hiked and sheep were counted and classified along the way. In 2000, the John River was floated and sheep were surveyed during day hikes into selected areas.

METHODS

From 27 - 30 June, 1998, a mineral lick area on the John River, within the aerial survey study area, was accessed by foot. Groups of sheep had been observed in the area during radio-tracking flights and during the concurrent aerial survey. Composition counts were conducted using a Questar telescope, so that ewes could be differentiated from yearlings and young rams, and more accurate lamb:yearling:ram:ewe ratios could be estimated. Ground surveyors were Denny DiFolco, Donna DiFolco, Elvin Dayton, and Rachel Brubaker.

Immediately following the 1999 aerial survey, 3 teams of observers hiked routes near Anaktuvuk Pass through known sheep habitat. Two routes were chosen to go through the aerial survey units to the west of Anaktuvuk Pass and one route was selected to go to the east of Anaktuvuk Pass (Fig. 9). Routes were hiked beginning on the afternoon of 14 July and concluded on the afternoon of 19 July. Sheep encountered along these routes were enumerated and classified by sex and age. Observers during this survey were John Burch, Josh Ernst, Jim Lawler, Chris McKee, Jessie Reakoff, and Todd Rinaldi.

The John River was floated from 3 July to 7 July 2000 from Anaktuvuk Pass to Hunt Fork Lake. Hikes were taken on 2 days in known sheep habitat during the course of the float trip and potential sheep habitat was scanned during the course of the float trip (Fig. 10). One of the day hikes occurred in the Kollutuk drainage on 4 July and the other occurred on Publituk on 6 July. Sheep encountered were classified by sex and age. Observers on this survey were John Burch and Jim Lawler.

RESULTS AND DISCUSSION

A total of five sheep (3 ewes, 1 half-curl ram, 1 lamb) were observed by ground crews during the 1998 mineral lick survey. Groups of sheep observed from the air could not be accessed by foot before the sheep moved to other areas. This small sample size

does not allow for any conclusions regarding population structure during 1998.

During the 1999 survey, a total of 50 sheep were observed along the 49 miles (79 km) of terrain covered by the 3 survey crews. Of this total, 28 animals were adult ewes, 10 animals were lambs, 6 animals were yearling and 6 animals were rams. Of the rams observed 3 were quarter-curl rams, 1 was a half-curl ram, 1 was a seven eighths -curl ram, and 1 was a full curl ram. Ratios of adult ewes to other age and sexes classes were as follows: 36 lambs:100 ewes, 21 yearlings:100 ewes, and 21 rams:100 ewes.

The foot survey during 1999 encountered difficulties with weather beginning on the evening of 15 July with heavy rain and fog. By the evening of 16 July, rain had turned to snow and fog persisted. The evening of 17 July saw 3-4 inches of snow covering the ground at high elevations and periods of dense fog moving in and out. By 18 July, partial clearing had occurred but snow persisted at high elevations. Therefore, as a result of the weather, sightability of sheep was extremely poor. In addition, hiking routes did not cover the amount or type of terrain anticipated to adequately sample the sheep populations due to treacherous hiking conditions at the higher elevations.

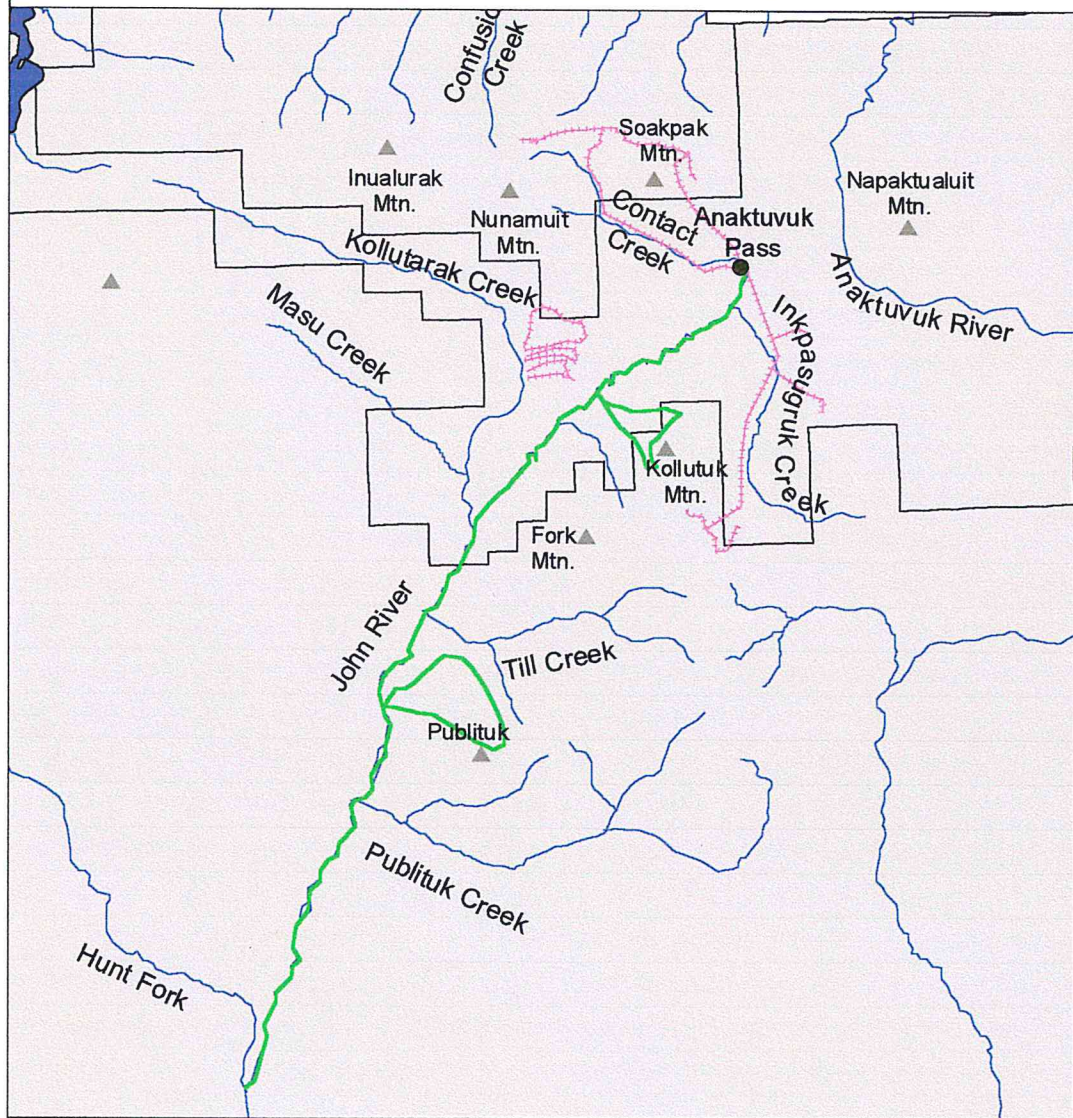
Weather varied during the course of the 2000 survey from relatively good to rainy, foggy and windy. Seventy four total sheep were observed during the 2000 survey. Thirty eight miles (60.5 km) of terrain were covered by floating and 20 miles (32 km) of terrain were covered by hiking. Traveling conditions were good throughout the survey both for foot travel and for floating. Sex and age distribution of sheep observed were 44 ewes, 18 lambs, 4 yearlings, 3 half-curl rams, 1 three quarter-curl ram, 1 seven eighths-curl ram, and 3 full-curl rams. Ratios of adult ewes to other sex and age classes were 41 lambs: 100 ewes, 9 yearlings: 100 ewes, and 18 rams: 100 ewes.

RECOMMENDATIONS

Ground-based surveys are attractive because they can provide accurate sex and age classification data. However in low density sheep areas, it is difficult to get sufficient sample sizes to provide meaningful population structure information. Entire groups of sheep can be missed and this can be particularly problematic where sheep are segregating by sex, age or presence of lambs. Ground surveys have not been successful in Gates of the Arctic National Park and Preserve due low sheep densities, poor access and poor weather. If ground surveys are to continue, the most promising method would be a combination of hiking and a John River float/hiking trip. Adding additional hiking routes and people to cover these routes would have the dual benefit of increasing sample size as well as increasing the likelihood that all sex and age classes of sheep are appropriately sampled during the survey. Given good weather and sheep location information from the aerial survey, this method has the potential of being successful. Regardless of methods used, effort should concentrate in areas of highest known sheep density. Given this criteria, Publituk and Publituk Creek would be good candidates for inclusion in future survey efforts. Results from this survey would be most useful in evaluating the relative success of yearly lambing since anecdotal observations indicate this area is predominately used by ewes.

Dall's sheep ground surveys, 1999 and 2000

Gates of the Arctic National Park and Preserve



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IV. Dall's sheep harvest by residents of Anaktuvuk Pass, Alaska

INTRODUCTION

Regulations regarding the subsistence harvest of Dall's sheep by the residents of Anaktuvuk Pass, Alaska were altered in 1997. Spring hunting of Dall's sheep was eliminated to more accurately reflect subsistence harvest patterns by the community of Anaktuvuk Pass. Current regulations allow residents of Anaktuvuk Pass to hunt Dall's sheep from July 15 – Dec. 31. Harvest regulations changed from a personal bag limit of 3 sheep per person to a community harvest quota of 60 sheep, no more than 10 of which may be ewes and a daily possession limit of 3 sheep per person, no more than 1 of which may be a ewe. To ensure these limits were not exceeded, a voluntary reporting process was initiated by the National Park Service beginning in July 1997.

METHODS

Residents of Anaktuvuk Pass voluntarily report their harvest to Mike Haubert, the Anaktuvuk Pass Ranger of Gates of the Arctic National Park and Preserve residing in the community. Information collected includes the number, sex and age class of sheep harvested. Dates harvested are recorded as well as general location and condition of the sheep.

RESULTS AND DISCUSSION

A summary of sheep harvested during the past 4 seasons is provided in Table 5. During the 1998 season 6% of the harvest occurred in both July and October ($n=1$), 31% occurred in August ($n=5$) and 56% occurred in September ($n=9$). In 1999, 41% of the harvest occurred in July ($n=7$), 29% occurred in August ($n=5$), 24% occurred in November ($n=4$), and the remaining harvest occurred in October (6%; $n=1$). During 2000, 25% of the sheep harvest occurred in July ($n=3$), 25% in September ($n=3$), 42% in October ($n=5$) and 8% in November ($n=1$). Records of harvest dates were not recorded during the 1997 season.

Previous estimates of sheep harvest for the community of Anaktuvuk Pass placed the harvest at approximately 20 –30 sheep. Based on these estimates, Dall's sheep harvest by the community of Anaktuvuk Pass may be underreported. Alternatively, previous estimates were too high and residents harvest fewer Dall's sheep than previously thought. A final possibility is Anaktuvuk hunters are having greater success with harvesting caribou than in previous years and therefore are harvesting fewer Dall's sheep.

Table 5. Dall's sheep harvest for the community of Anaktuvuk Pass, Alaska. Records have been maintained since the initiation of a community harvest quota of 60 Dall's sheep.

Harvest Year	Number of Sheep Harvested			
	rams	ewes	lambs	Total
1997	10	1		11
1998	10	6		16
1999	13	4		17
2000	4	7	1	12
Totals:	37	18	1	56

Schedule

- Year 1: April 1998: Radiocollared 18 sheep
April - July 1998: Radio-tracked sheep
June/July 1998: Fixed-wing and ground-based trend surveys.
April - July 1998: Progress Report # 1.
August 1998 - February 1999: Radio-tracking.
- Year 2: March 1999: Replaced radiocollars from two mortalities + added 2 more
collars = 4 new radiocollars.
March 1999 - February 2000: Radio-tracking
June 1999: Fixed-wing sheep population survey
March 2000: Progress Report #2
- Year 3: March 2000: Replaced lost radiocollars
March 2000 - February 2001: Radio-tracking
June 2000: Fixed-wing sheep population survey
February 2001: Progress Report #3
- Year 4+: Evaluate the number of active radiocollars and determine value of continuing
project.
March 2001 - February 2002: Radio-tracking
June 2001: Fixed-wing sheep population survey
February 2002: Final Report

BUDGET

FY-02 retrieve radiocollars and continue annual aerial survey: \$15,000

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