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Interrelationships of Dall Sheep and Predators in the Central Alaska Range

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RESEARCH PROGRESS REPORT

STATE: Alaska **STUDY:** 6.13

COOPERATORS: Alaska Chapter, Foundation for North American Wild Sheep, University of British Columbia

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TITLE: Interrelationships of Dall Sheep and Predators in the Central Alaska Range

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PERIOD: 1 July 1998–30 June 1999

SUMMARY

Dall sheep (*Ovis dalli*) populations in much of the Alaska Range declined during the early 1990s, mainly because of poor lamb production during 1990–1993. Coyotes (*Canis latrans*) are a major predator of Dall sheep lambs in the Central Alaska Range (CAR) (Scotton 1997), yet little is known of coyote ecology in Alaska. Furthermore, recent studies in Canada indicated that coyote predation on Dall sheep may be influenced by fluctuations in populations of snowshoe hares (*Lepus americanus*), which are the main prey of coyotes at northern latitudes (Todd et al. 1981; O'Donoghue et al. 1997). Currently, the snowshoe hare population in the CAR is high, and a decline is expected to occur during the next few years. This study was designed to allow managers to better understand the importance of coyote predation to sheep populations and the effects on predation by changes in populations of alternate prey. In particular, the study will assess reproduction and cause-specific mortality rates of Dall sheep lambs and ewes. Populations and movements of coyotes in the area will be assessed, as will changes in these parameters that may occur in response to changing hare populations. During FY99, 6 coyotes, 20 Dall sheep ewes, and 24 lambs were captured and radiocollared. We assessed movements and survival of radiocollared animals by aerial radiotracking. We examined remains of animals that died to determine the cause of death. Three ewes died from predation (2 by wolves [*Canis lupus*] and 1 by a brown bear [*Ursus arctos*]) during March and April. Eleven lambs died during May and June; the most common cause was eagle predation (5 lambs were probably killed by golden eagles [*Aquila chrysaetos*]). Other causes of death included coyote predation (2 lambs), bear predation, falling, and starvation (1 each). The study is planned to continue through FY01 (FY = 1 July–30 June).

Key words: *Canis latrans*, coyote, Dall sheep, mortality, *Ovis dalli*, reproduction, population ecology, predator-prey relationships, survival.

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BACKGROUND

Dall sheep are widespread throughout most mountain ranges in Alaska. Sheep populations have been surveyed at irregular intervals in many parts of the state for several decades, although precise estimates of population size are not available for most areas. However, surveys during the 1990s indicated sheep populations in much of the Alaska Range and Brooks Range were below levels that occurred during the 1970s and 1980s (Whitten 1997).

Spring or summer surveys to assess lamb production and survival were conducted annually from 1993–1997 in the CAR. Lamb survival and recruitment in this area were very low during the recent sheep decline, but causes of lamb mortality are largely unknown. A recent study indicated that coyote predation was an important source of mortality for lambs (Scotton 1997). Previous authors (e.g., Murie 1944; Heimer and Stephenson 1982) suggested that wolf predation on adult sheep might be important to some sheep populations. Wolf numbers in the CAR were reduced by a control program during 1993 and 1994. Greatly varying opinions have been published regarding the effects of predator control on sheep populations. Heimer and Stephenson (1982) suggested sheep populations responded positively to predator reductions in the late 1970s, while Gasaway et al. (1983) concluded that sheep did not respond to predator reduction.

Little is known about the occurrence or behavior of coyotes in Alaska. Studies elsewhere have indicated that coyotes avoid wolves, and in some cases, the presence of wolves may restrict coyote movements and populations (Thurber et al. 1992). Populations of coyotes at northern latitudes fluctuate in response to changes in populations of hares (Todd et al. 1981; O'Donoghue et al. 1997) and coyotes may increase their use of larger prey when hares are scarce (Todd et al. 1981). O'Donoghue et al. (1997) suggested that coyote predation on Dall sheep might increase during the low phase of the hare cycle, but no data are available to test this hypothesis.

OBJECTIVES

Job 1: Estimate annual pregnancy and birth rates for adult ewes.

Job 2: Estimate lamb survival to yearling age class and determine causes of mortality.

Job 3: Estimate annual survival and determine causes of mortality of adult ewes.

Job 4: Monitor movements of coyotes in relation to sheep distribution to determine proportion of coyotes that forage in sheep habitat.

Job 5: Assess spatial and temporal variability in coyote predation on lambs.

Job 6: Assess trends in sheep population and reproductive success over time.

Job 7: Analyze and publish results.

STUDY AREA

The CAR study area encompasses approximately 500 km^2 and is bounded by the West Fork Little Delta River, Wood River, Virginia Creek, and the northern foothills of the Alaska Range. Elevations range from 700–2500 m. The terrain consists of rugged mountains, dissected by narrow valleys and streams. Vegetation includes spruce (*Picea glauca* and *P. mariana*) and birch (*Betula papyrifera*) trees at lower elevations, dwarf birch (*B. nana*) and willow (*Salix* spp.) shrubs at middle elevations, and grasses, sedges, and forbs at higher elevations. Nonvegetated areas, including rock slopes, cliffs, ridges, and gravel bars are common throughout the area. Human activity in the area includes sport hunting for caribou (*Rangifer tarandus*), moose (*Alces alces*), and Dall sheep during late summer and fall. Several private hunting camps and airstrips are present. The area is roadless, and access is by air, horseback, snowmachine, or ATV. During recent years, an increasing amount of mineral exploration has occurred, with access occurring primarily by helicopter.

METHODS

Job 1: Approximately 20 adult ewes will be captured each year during late March or early April, using a net-gun fired from a low-flying helicopter. Ewes will be weighed and a blood sample obtained for pregnancy determination by analysis of serum progesterone levels (Ramsey and Sadleir 1979; Goodrowe et al. 1996). All ewes captured during 1999 will be radiocollared. During 2000, additional radio collars will be deployed to maintain at least 20 radiocollared ewes in the study population. During May, radiocollared ewes will be located daily (weather permitting) to determine the proportion that give birth.

Job 2: Lambs of radiocollared ewes and other ewes will be captured by hand and radiocollared using techniques described by Scotton (1997). We plan to capture 20–30 lambs each year. Survival will be determined by daily radiotracking flights during May, weekly flights during June, and biweekly flights during the remainder of the year (Scotton 1997). Causes of mortality will be determined by examining remains of dead lambs.

Job 3: Radiocollared ewes will be located by aerial radiotracking at 2-week intervals throughout the year. Carcasses of ewes that die will be examined to determine the probable causes of death.

Job 4: We will attempt to capture and radiocollar 10 coyotes each year. Using an R-22 helicopter, we will dart coyotes to capture them. Radiocollared coyotes will be located during our tracking flights to assess survival of collared sheep. We will analyze movements of radiocollared coyotes to determine the proportion of coyotes that forage in sheep habitat. Movements of coyotes during spring will be monitored to locate dens and determine reproductive success. Additional radiotracking will be in conjunction with other ongoing studies in the area. If sufficient data on wolf movements in the area are available, we will compare home ranges of coyotes and wolves to determine interspecies relationships.

Job 5: Losses of lambs to coyote predation will be compared across the study area and among years to determine if loss rates vary spatially or temporally. Losses also will be compared to distributions of coyote family groups to determine if coyote predation on sheep varies among individuals.

Job 6: Sheep populations in the study area will be assessed each June by aerial surveys. All potential sheep habitat will be searched by helicopter (Scotton 1997; Whitten 1997), and observers will record the number, age, and sex of all sheep that are seen.

Job 7: I will prepare progress reports annually; a final report is scheduled for June 30, 2001. Final results will be submitted for publication in scientific journals.

RESULTS

Job 1: Twenty adult ewes were captured and radiocollared during 15–17 March 1999. Blood samples were obtained and sent to the University of Alaska Fairbanks for progesterone analysis. Results of those tests are pending. Three collared ewes had died as of 1 May, all due to predators. At the start of lambing season, 17 collared ewes were alive. Of these, 13 (76%) were known to produce lambs (some lambs might not have been observed because they died soon after birth). Because of adverse weather during early May, the first observations of radiocollared ewes were obtained on 12 May. On this date, 11 ewes were without lambs, 1 ewe was seen with a lamb, and 5 ewes were located in lambing habitat but could not be seen due to rugged terrain. Four of these 5 ewes were subsequently seen with lambs on the next observations during 13 and 15 May, so we assumed these ewes had given birth on 12 May. The remaining ewe was never seen with a lamb. Radiotracking flights were conducted daily, except for 5 days (not sequential) during the remainder of May. We assumed lambs were born on the first day they were observed, unless the ewe was not seen the previous day. For these lambs, the birth date was assumed to be the previous day. Twelve ewes produced lambs during May, 1 did not have a lamb on 1 June but was accompanied by a lamb on 10 June, and 4 ewes were never seen with lambs. Excluding the lamb born in June, for which birth date was not determined, mean birth date was 14 May, and 10 of the 13 lambs we observed were born on or before 16 May. The remaining 2 lambs were born on 18 and 19 May.

Job 2: We captured and radiocollared 24 lambs during 13–23 May. Six lambs were from radiocollared ewes and 18 were from uncollared ewes. As of 30 June, 11 lambs had died. Five deaths were due to eagle predation (golden eagles were the only large raptors common in the area, so all deaths due to raptors were assumed to be caused by golden eagles), 2 were killed by coyotes, and 1 death was caused by an unknown predator, most likely a brown bear. One lamb evidently starved to death shortly after capture. Although it is possible that the capture event contributed to this death, the ewe was observed waiting nearby during the brief (<5 min) handling procedure and tracks indicated that the lamb had left the site with the ewe, but died approximately 1 km away. Necropsy indicated that the lamb had no milk in its stomach, and probably had not fed after its birth. One lamb died as the result of a fall. Necropsy revealed no wounds due to a predator, but remains of 2 eagle kills were found at the site, and a well-used perch was located nearby. Thus, it is possible that an eagle was chasing the lamb at the time it fell. Cause of death of one additional lamb could not be determined. This collar was located in steep, rocky terrain, but the site could not be visited.

Job 3: One ewe was killed by predators, most likely wolves, during March, approximately 2 weeks after she was captured. Another ewe was killed during April, probably also by wolves, and a third was killed by a brown bear around 1 May. No additional deaths had occurred as of 30 June. Survival of the remaining ewes will be monitored during FY00.

Job 4: Four coyotes (2 males, 2 females) were captured and radiocollared in March 1998. One male, captured on the northwest corner of the study area, dispersed almost immediately. The other 3 were captured in the West Fork of the Little Delta River and were monitored opportunistically during radiotracking flights conducted as part of ongoing wolf research (Study 14.17) during most of FY99. One female died of undetermined causes midsummer. The remaining male and female were recaptured during February 1999, and their collars were replaced (the new collars should last for the duration of the study). The male left the West Fork and moved to Dry Creek, where he evidently paired with a female that was captured and collared in March 1999. This pair was usually found in a small area along Dry Creek during most of June, but no den was found. The West Fork female remained in the West Fork area and was subsequently seen with a male that was not collared. This pair established a den and produced at least 3 pups that were observed at the den in late May (Laura Prugh, University of British Columbia, personal communication). During February 1999 an adult male coyote was captured in Dry Creek during efforts directed at capturing wolves. This coyote subsequently moved into Sheep Creek and paired with a yearling female, who was captured in March 1999. This pair showed no signs of establishing a den. A yearling male was captured with the female in Sheep Creek, but this coyote moved extensively through the study area until contact was lost during June 1999. Most likely, this coyote dispersed from the area. Also in March 1999, 2 additional yearling coyotes were captured in the same area of Sheep Creek, but died as a result of dart penetration during an experimental trial of a different brand of darts (PneuDart™). We have discontinued use of these darts and will continue to use Palmer Cap-Chur™ darts, which have proved reliable. In May, University of British Columbia graduate student Laura Prugh began work on a project to gather data on coyote foraging ecology and prey populations in the area. We have been assisting with some logistical support because this information will directly benefit our project.

Job 5: Locations of lamb deaths due to coyote predation were recorded. Coyotes were located by aerial radiotracking, and home ranges will be compared to distributions of lamb mortalities.

Job 6: On 10–11 June, a sheep survey was conducted using an R-22 helicopter with both pilot and observer recording and classifying sheep. We surveyed a total of 253 mi^2 during a period of 9.5 hours, for a survey intensity of 2.25 min/mi^2. This was similar to last year's effort of 2.20 min/mi^2. Results of the survey are shown in Tables 1 and 2. We saw 776 sheep, with overall ratios of 51.8 lambs and 69.5 rams per 100 ewes (counts of ewes excluded yearlings but probably included some young rams). During the June 1998 survey, we found 754 sheep in units surveyed during both years, with ratios of 41.1 lambs and 59.8 rams per 100 ewes. Although the number of ewes seen in areas surveyed annually during 1994–1999 (sections I–III) declined from 287 during 1998 to 268 during 1999, this year's counts of lambs and rams were the highest recorded since 1984 (Table 2). Concurrent radiotracking flights indicated that 16 radiocollared ewes were present within surveyed units during the survey. We sighted 12 (75%) of these collared ewes. It is possible that some collared sheep were seen but not identified as being collared. Thus, the sightability of 75% probably is an underestimate.

DISCUSSION

Work on all aspects of the project is proceeding as planned. Although we were unable to radiocollar 10 coyotes, the 5 coyotes currently radiocollared represent 3 pairs, and their combined home ranges include much of the area occupied by radiocollared sheep. Snow-tracking surveys planned for this winter as part of Laura Prugh's graduate research should help to locate additional coyotes that may be present in the study area. Helicopter darting using Palmer darts proved to be an effective method of capturing coyotes. This was accomplished most efficiently when conducted during the March flights to capture ewes. Current plans are to attempt to radiocollar at least 5 additional coyotes during March 2000.

Winter 1998–1999 was relatively mild, with light snow that had disappeared from higher elevations by March. However, a series of storms deposited several inches of snow during the last week of April. Evidently, this did not reduce lambing success, and the lamb:ewe ratio we observed was the highest for this area since 1984. This, and the abundance of young rams that we observed, indicate the population is growing. Although the predation losses we recorded seem high, this may be the result of a relatively small sample of radiocollared lambs. Data from additional years are needed before we can assess the effects of predation.

Similarly, the loss of 3 ewes to predators during the first 6 weeks of radiotracking was surprising. However, this period corresponded with the end of winter, when ewes probably were in the weakest condition and most susceptible to predation. Predation rates probably vary among seasons and years.

Termination of wolf research in the study area (Study 14.17) will reduce our ability to assess relationships between wolves and coyotes. However, the concurrent graduate research project concerning coyote foraging ecology in response to changing prey populations will greatly enhance our understanding of various factors that may influence the effects of coyote predation on sheep. Thus, collaborating with this research will help us achieve our objectives.

LITERATURE CITED

GASAWAY WC, RO STEPHENSON, JL DAVIS, PEK SHEPHERD, AND OE BURRIS. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. *Wildlife Monograph* 84.

GOODROWE KL, B SMAK, N PRESLEY, AND SL MONFORT. 1996. Reproductive, behavioral, and endocrine characteristics of the Dall's sheep (*Ovis dalli dalli*). *Zoo Biology* 15:45-54.

HEIMER WE AND RO STEPHENSON. 1982. Responses of Dall sheep populations to wolf control in Interior Alaska. Biennial symposium northern wild sheep and goat council. 3:320–330.

MURIE A. 1944. The wolves of Mount McKinley. US Department of the Interior, National Park Service. *Fauna* Series 5.

O'DONOGHUE M, S BOUTIN, CJ KREBS, AND EJ HOFER. 1997. Numerical responses of coyotes and lynx to the snowshoe hare cycle. *Oikos* 80:150–162.

RAMSAY MA AND RMFS SADLEIR. 1979. Detection of pregnancy in living bighorn sheep by progestin determination. *Journal of Wildlife Management* 43:970–973.

SCOTTON BD. 1997. Estimating rates and causes of neonatal lamb mortality of Dall sheep in the Central Alaska Range. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Study 6.12. Grants W-24-4 and W-24-5. Juneau, Alaska.

THURBER JM, RO PETERSON, JD WOOLINGTON, AND JA VUCETICH. 1992. Coyote coexistence with wolves on the Kenai Peninsula, Alaska. *Canadian Journal of Zoology* 70:2494–2498.

TODD AW, LB KEITH, AND CA FISCHER. 1981. Population ecology of coyotes during a fluctuation of snowshoe hares. *Journal of Wildlife Management* 45:629–640.

WHITTEN KR. 1997. Estimating population size and composition of Dall sheep in Alaska: assessment of previously used methods and experimental implementation of new techniques. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Research Final Report. Study 6.11. Grants W-24-3, W-24-4, and W-24-5. Juneau, Alaska.

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Table 1 Results of helicopter sheep survey in the Central Alaska Range, 10–11 June 1999

Sample unit[b]	Section[c]	Area (mi^2)	Time	Min/Mi^2	Ewes	Lambs	Yrlgs	Ram class[a] 1	2	3	4	Total rams	Total	Lambs:100 Ewes	Rams:100 Ewes	% Rams	% Rams, Class 4
36	0	28.7	36	1.25	5	0	3	0	2	0	0	2	10	0.0	40.0	20.0	0.0
51	0	26.0	7	0.27	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0
32	1	29.0	101	3.48	80	47	17	32	22	12	12	78	222	58.8	97.5	35.1	15.4
33	1	30.3	72	2.38	39	21	17	7	1	4	1	13	90	53.8	33.3	14.4	7.7
30	2	25.9	71	2.74	24	12	14	12	14	9	7	42	92	50.0	175.0	45.7	16.7
31	2	22.3	58	2.60	66	24	17	6	8	1	0	15	122	36.4	22.7	12.3	0.0
28	3	26.3	60	2.28	15	11	1	8	6	0	0	14	41	73.3	93.3	34.1	0.0
29	3	21.8	72	3.30	43	23	9	13	10	5	4	32	107	53.5	74.4	29.9	12.5
50A	3	21.0	31	1.48	0	0	0	6	5	4	1	16	16	0.0	0.0	100.0	6.3
27	4	21.6	60	2.78	39	23	10	4	0	0	0	4	76	59.0	10.3	5.3	0.0
50B	4	8.5	20	2.34	1	0	0	0	0	0	0	0	1	0.0	0.0	0.0	0.0
Total		261.4	588	2.25	312	161	88	88	68	35	25	216	777	51.6	69.2	27.8	11.6

[a]Ram classes: 1=<1/2 curl; 2=1/2–3/4; 3=3/4–7/8; 4=full curl.

[b]Sample units designate areas that were surveyed continuously or with only brief interruptions (to refuel helicopter) during 1998 and 1999.

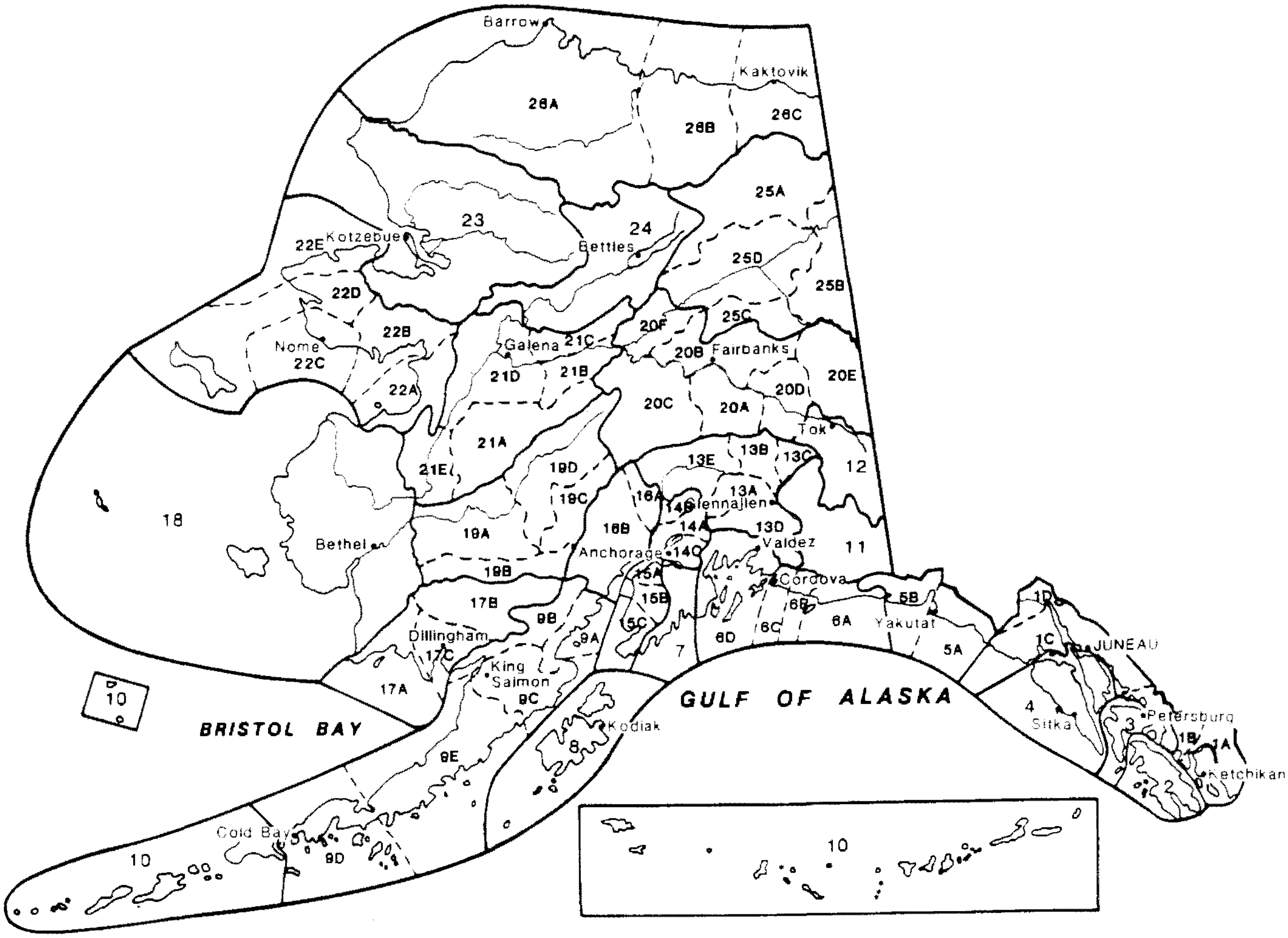
[c]Sections 1–3 indicate areas surveyed during 1994–1997; section 4 was surveyed during 1998–1999 and some years prior to 1994; section 0 was surveyed during 1998–1999.

Table 2 Comparison of annual sheep surveys for the Central Alaska Range sections 1–3

Year[a]	Date	Ewes	Lambs	Yearlings	Rams	Total	Lambs:100 Ewes	Rams:100 Ewes	Hours	Min/Mi^2
1984	11–12 July	605	231		266	1102	38	44	10.3	
1991	22–25 July	374	68		195	639	18	52	10.3	
1994	4 June	211	72		125	442	34	59	4.8	1.5
1995	7 June	249	109	61	167	586	44	67	5.8	1.8
1996	9 June	267	137	95	158	657	51	59	6.0	1.9
1997	17 June	212	85	93	177	567	40	83	7.3	2.3
1998	17 June	287	117	69	192	686	41	67	6.2	2.2
1999	10–11 June	267	138	75	210	690	52	79	7.8	2.6

[a]In 1984, 1991, and 1994, surveys were conducted using a Piper Supercub; yearlings were classified as ewes. During 1995–1998, surveys were conducted using a R-22 helicopter; yearlings were separated from ewes.

Alaska's Game Management Units



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