Moose

Management Report

of survey-inventory activities

1 July 1999–30 June 2001

Carole Healy, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation

December 2002

ADF&G

Please note that population and harvest data in this report are estimates and may be refined at a later date.

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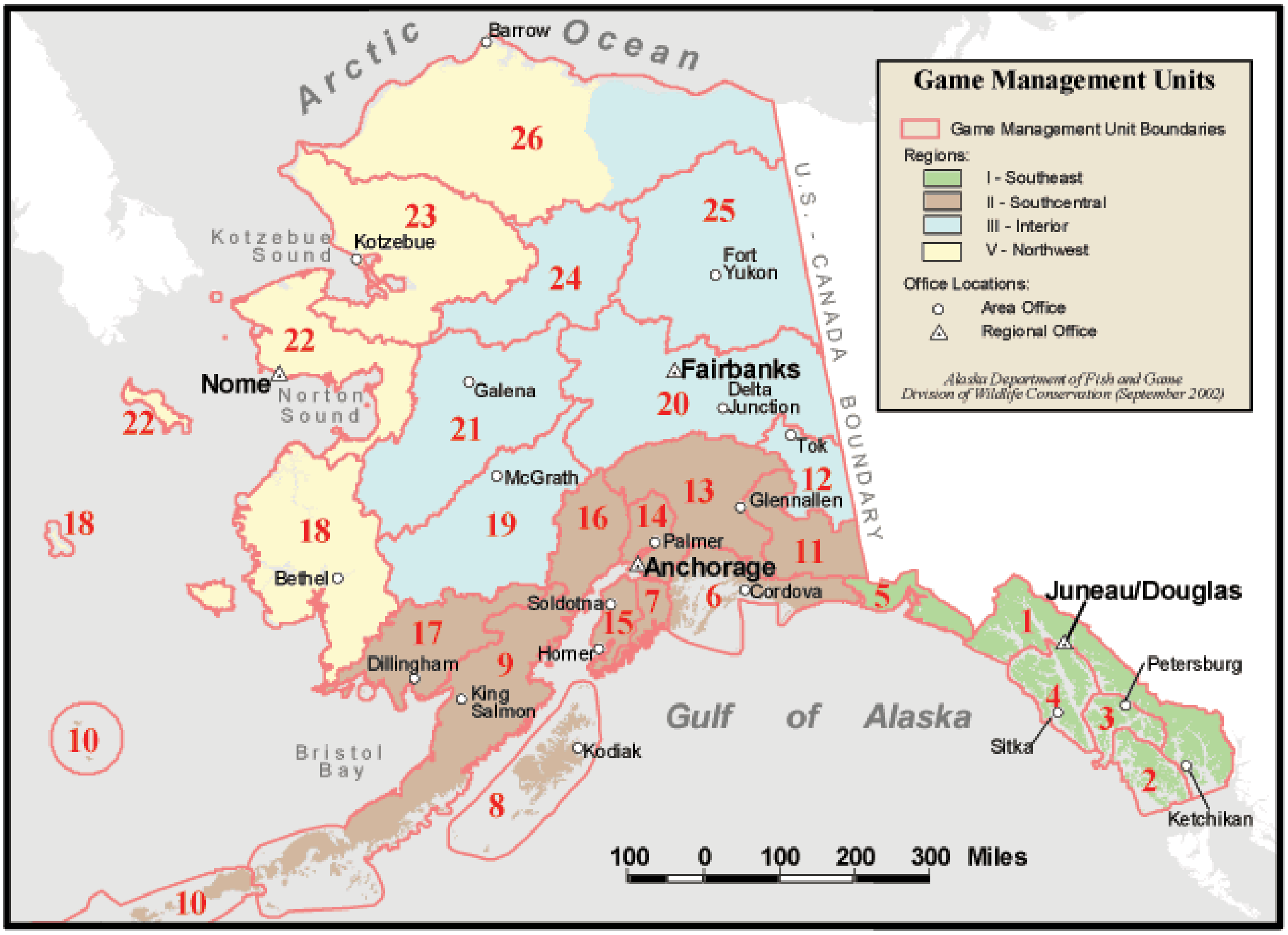

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MOOSE MANAGEMENT REPORT

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Alaska Department of Fish and Game
Division of Wildlife Conservation
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JUNEAU, AK 99802-5526

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 1A (5,300 mi^2) and 2 (3,600 mi^2)
GEOGRAPHIC DESCRIPTION: That portion of Unit 1 lying south of Lemesurier Point, including all drainages into Behm Canal and excluding all drainages into Ernest Sound. Unit 2: Prince of Wales Island and adjacent islands south of Sumner Strait and west of Kashevarof Passage.

BACKGROUND

Most of the Unit 1A moose population is localized in the Unuk River drainage and appears stable. Heavy timber in a narrow valley with braided river channels makes moose observation difficult. The best population estimates are based on track densities and distribution in fresh snow complimenting aerial surveys. Good habitat is limited and moose numbers are low. The harvest is sporadic, ranging from 0–8 per year. Unit 1A moose are believed to be *Alces alces andersonii*, and likely emigrated from interior British Columbia via the Unuk River valley.

The United States Forest Service (USFS) prepared a vegetative type map of the Chickamin River valley, resulting from 1962 and 1963 field investigations (Burris 1964). The study suggested that sufficient forage was present to support moose. Measuring boards were installed to determine snow depth to ascertain if winter conditions were suitable for moose. The Chickamin supported a few moose before supplemental transplants in 1963 and 1964. These moose were captured on the Chickaloon Flats near Anchorage (Burris 1964). A short-term increase followed the release and several bulls were harvested during open hunting seasons. Chickamin moose populations subsequently declined and we have received no reports of moose there in recent years; recent aerial surveys suggest no moose remain there. Moose are occasionally reported from other parts of Unit 1A including Revillagigedo Island and along the Cleveland Peninsula.

Although present-day rumors suggest that moose occurred sporadically on Prince of Wales Island in Unit 2 as far back as the 1940's, ADF&G received its first plausible report of moose in the unit in 1987 when USFS staff reported a cow and calf near Snakey Lakes. During fall 1991 a cow moose was struck by a highway vehicle near Control Lake. In June 1993 a USFS employee photographed a cow moose walking along the 30 Road, located roughly 0.5 miles south of Ratz Harbor. One bull was poached near Hollis in fall 1996. Additional reports indicate that a population of moose, of unknown size and composition, inhabits the central portion of Prince of Wales Island. Currently there is no open moose hunting season in Unit 2.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

The following moose management objectives for Unit 1A are based on biological data and input from the public.

	Plan Objective	1999	2000
Post-hunt numbers	35	Unknown	Unknown
Annual hunter kill	3	1	1
Number of hunters	20	20	27
Hunter-days of effort	90	104	109
Hunter success	15%	5%	4%

METHODS

Moose surveys are flown each winter (December–February) when weather and snow conditions become favorable.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Data are insufficient to make a quantitative determination of Unit 1A moose population trends during the past 5 years. However, moose populations appear to be stable at a low density and carrying capacity is estimated to be low. Healthy brown bear, black bear, and wolf populations probably account for substantial mortality in this area, particularly on calves.

Increasing reports of moose in Unit 2 may indicate a growing moose population, or simply be a function of increased human access into once remote areas. No population data are available for Unit 2.

Population Composition

Only a few thorough Unuk River moose surveys have ever been completed. Crude population estimates are based on track density and distribution rather than relying only on the number or composition of moose observed. A complete survey was flown under ideal light and snow conditions during February 2001. A total of 16 moose were observed during one hour of flying, enumerating 11 cows, 3 bulls, and 2 calves. Additional track distribution in fresh snow suggested the total moose population is between 35–50 moose within the Alaska portion of the drainage.

A survey during February 2000 along the Chickamin drainage, under ideal survey conditions, confirmed there are no moose in the area.

Distribution and Movements

Moose are not restricted from moving between Canada and the US along mainland drainages. However, moose have never been marked or collared in this area, and consequently we know little about their seasonal movement along the Unuk. Some of the best habitat along the river occurs upstream in Canada and likely supports a significant number of moose outside of Unit 1A. Some of those moose undoubtedly spend time on the US side of the border.

MORTALITY

HARVEST

Season and bag limit	Resident and nonresident hunters
Unit 1A	Sept. 15–Oct. 15 (General hunt only)
One bull by registration permit only	
Unit 2	No open season.

Board of Game Actions and Emergency Orders. No regulatory changes were made by the Board of Game during this report period.

Hunter Harvest. The Unit 1A 8-year mean harvest is 3 bulls. One moose was harvested during each of the past 2 years**.** The antler spreads for the bulls in 1999 and 2000 measured 19.5 inches and 25 inches, respectively. The lack of participation and poor weather conditions during fall 1999 explain the low harvest.

Permit Hunts. During fall 1999, 34 individuals obtained Unit 1A moose registration permits, of which 20 hunted. This was the lowest number of registered hunters during the past 8 years and well below the long-term average ($\bar{x}$ = 60.1, range 34–81). Also in 1999, only 20 hunters reported going afield, which is the lowest hunter effort since the start of the Unit 1A registration hunt (range 20–48).

During fall 2000, 51 individuals obtained registration permits and 27 actually hunted.

Hunter Residency and Success. Unit 1A moose hunters continue to be primarily Ketchikan and Metlakatla residents. Several of these hunters own cabins on the Unuk River. All successful hunters were Ketchikan residents (Table 2). Total hunter days were much lower during this report period than previous years, probably due to poor weather conditions during the hunting seasons.

Harvest Chronology. Both moose harvested during the 2-year report period were taken during the first week of the season (Table 2).

Transport Methods. Most hunters used boats to access the Unuk River in 1999 and 2000 (Table 4).

OTHER MORTALITY

The extent of wolf, black bear, and brown bear mortality on adult and calf moose in Unit 1A is unknown.

CONCLUSIONS AND RECOMMENDATIONS

Access is difficult to the small Unit 1A moose population on the Unuk River drainage and the hunt attracts few hunters, most of which are local residents. Due to limited suitable habitat carrying capacity is low. Most moose harvested are young bulls with relatively small antlers, which have historically averaged about 30 inches in width. Winter weather, snow conditions, and abundant predators are likely limiting the moose population, and consequently we do not expect moose numbers to exceed current levels.

The Unit 1A registration permit provides accurate hunt-based data. The harvest and hunter effort during this report period was lower compared to recent years. It is probable that reduced hunter effort and poor weather during the season is to blame for the low harvest rather than a reduced number of moose along the Unuk.

We will continue to gather information about this moose population and we anticipate proposals to the Federal Subsistence Board asking to convert this hunt to favor federally qualified rural residents only.

We will continue to document Unit 2 moose sightings and we recommend that Unit 2 remain closed to moose hunting.

LITERATURE CITED

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Table 1 Unit 1A moose harvest data by permit hunt, regulatory years 1993 through 2000

Hunt	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Harvest						Total harvest
						Males	(%)	Females	(%)	Unk	(%)	
RM022	1993	62	17	42	3	3	(100)	0	(0)	0	(0)	3
	1994	81[a]	33	41	6	6	(100)	0	(0)	0	(0)	6
	1995	78	33	43	2	2	(67)	1[b]	(0)	0	(0)	3
	1996	63	27	32	4	4	(100)	0	(0)	0	(0)	4
	1997	59	27	28	4	4	(100)	0	(0)	0	(0)	4
	1998	53	24	26	3	3	(100)	0	(0)	0	(0)	3
	1999	34	14	19	1	1	(100)	0	(0)	0	(0)	1
	2000	51	24	26	1	1	(100)	0	(0)	0	(0)	1
	Average	60	25	32	3	3	(96)	0	(0)	0	(0)	3

[a] One permit not returned
[b] Illegal cow kill

Table 2 Unit 1A moose hunter residency and success, regulatory years 1993 through 2000

Year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	
1993	3	0	0	3	(7)	39	3	0	42	(93)	45
1994	4	2	0	6	(13)	39	2	0	41	(87)	47
1995	2	2	0	2	(4)	36	6	1	43	(96)	45
1996	4	0	0	4	(11)	27	5	0	32	(89)	36
1997	3	1	0	4	(13)	27	1	0	28	(87)	32
1998	3	0	0	3	(10)	24	2	0	26	(90)	29
1999	1	0	0	1	(5)	16	3	0	19	(95)	20
2000	1	0	0	1	(4)	26	0	0	26	(96)	27
Average	2.6	0.6	0	3	8.4	29.3	2.8	0	32.1	91.6	35.1

[a] Local resident hunters reside in Unit 1A.

Table 3 Unit 1A moose harvest chronology, regulatory years 1993 through 2000

Year	15–21 Sept	(%)	22–28 Sept	(%)	29 Sept–5 Oct	(%)	6–15 Oct	(%)	*n*
1993	0	(0)	0	(0)	1	(33)	2	(67)	3
1994	1	(17)	1	(17)	0	(0)	4	(66)	6
1995	1	(50)	0	(0)	1	(50)	0	(0)	2
1996	2	(50)	0	(0)	0	(0)	2	(50)	4
1997	1	(25)	0	(0)	2	(50)	1	(25)	4
1998	2	(67)	0	(0)	0	(0)	1	(33)	3
1999	1	(100)	0	(0)	0	(0)	0	(0)	1
2000	1	(100)	0	(0)	0	(0)	0	(0)	1

Table 4 Unit 1A moose harvest percent by transport method, regulatory years 1993 through 2000

Year	Harvest percent by transport method										*n*
	Airplane	(%)	Boat	(%)	Highway vehicle	(%)	Off-road vehicle	(%)	Unk	(%)	
1993	1	(33)	2	(67)	0	(0)	0	(0)	0	(0)	3
1994	1	(17)	5	(83)	0	(0)	0	(0)	0	(0)	6
1995	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
1996	1	(25)	3	(75)	0	(0)	0	(0)	0	(0)	4
1997	0	(0)	4	(100)	0	(0)	0	(0)	0	(0)	4
1998	2	(67)	1	(33)	0	(0)	0	(0)	0	(0)	3
1999	0	(0)	1	(100)	0	(0)	0	(0)	0	(0)	1
2000	0	(0)	1	(100)	0	(0)	0	(0)	0	(0)	1

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 1B (3,000 mi^2)

GEOGRAPHIC DESCRIPTION: Southeast Alaska mainland, Cape Fanshaw to Lemesurier Point

BACKGROUND

HABITAT DESCRIPTION

Isolated populations of moose (*Alces alces*) occur in Unit 1B and are believed to be the *andersonii* subspecies. They emigrated from interior British Columbia via the Coast Range and the Stikine River valley around the turn of the 20th century.

Moose occur in several areas of Unit 1B, with concentrations near Thomas Bay and along the Stikine River. Suitable habitat adjacent to Bradfield Canal has not been colonized, but moose do occur around Virginia Lake, Mill Creek, and Aaron Creek. LeConte Glacier and Bay divide Unit 1B for moose management purposes north and west of the Stikine River.

The Thomas Bay moose population is isolated from populations in Canada by the Coast Mountains. These moose occupy an area that was heavily logged from the late 1950s through the early 1970s. The Thomas Bay moose population may decline significantly as conifer re-growth in clearcuts matures and reduces forage production.

Moose inhabiting the Alaska portion of the Stikine drainage represent the westernmost tip of a mainland population emanating from Canada. The Alaska portion of this population was estimated at 300 animals in 1983 (Craighead et al. 1984). Since 1983 most winters have been mild and the moose population, based on harvest records and subjective impressions, appeared to increase until 1989.

HUMAN USE HISTORY

Moose are indigenous but recently established in Unit 1B. Since the mid-20th century, isolated populations of moose on the American side of the Stikine River valley and at Thomas Bay have been hunted for food and trophies.

Regulatory history

From 1959 to present, the Stikine River moose season has generally been from September 15 through October 15 with a one-bull limit. From 1972 to 1974, however, the harvest of antlerless moose was allowed by permit only. From 1990 to 1992 a harvest ticket was required to hunt moose on the Stikine, and since 1993 a registration permit (RM038) has been required. Antler restrictions were implemented on the Stikine in 1995, defining a legal bull as having a spike-fork, 50-inch antler spread, or 3 or more brow tines on at least one side.

From 1959 to 1981 the Thomas Bay season was bulls-only and typically 31 days long, September 15 through October 15. Since 1978 the use of motorized land vehicles to hunt moose has been prohibited at Thomas Bay. From 1980 to 1994 the moose season was from October 1 through 15. Since 1984 a registration permit has been required to hunt moose, and antler restrictions were implemented defining a legal bull as having a spike, fork, or at least 50-inch antlers. In 1993, the antler restriction was amended to include bulls with 3 or more brow tines on at least one side. Since 1995 the season has been September 15 through October 15.

Action by the Board of Game effective July 1, 1995 put all of Units 1B and 3 and that portion of Unit 1C south of Point Hobart under one registration permit hunt (RM038). A legal moose for this registration permit hunt is a bull with spike/fork or 50-inch antlers or 3 brow tines on at least one antler.

Historical harvest patterns

Average annual harvest of Stikine River moose from 1952 through 1959 was 26. During the 1960s the average harvest was 28, during the 1970s it was 26 and in the 1980s it was 39. The 1971 and 1972 harvests included 18 and 22 cows, respectively. From 1990 to 1998 the average annual harvest was 20, however in 1994 the moose season was closed by emergency order in that portion of Unit 1B south of LeConte Bay and Glacier due to a lack of mature breeding bulls in the population.

The average annual harvest of bulls from Thomas Bay during the 1950s was 5, in the 1960s it was 8, in the 1970s it was 10, in the 1980s it was 18 and from 1990–1998 the annual harvest of bulls was 21. A scarcity of calves prompted closure of the season in 1982 and 1983.

Historical harvest locations

The vast majority of moose harvested in the unit are taken either from in the Stikine River drainage or at Thomas Bay. In recent years the distribution of moose in Unit 1B appears to be expanding, fed by source populations on the Stikine and at Thomas Bay.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

The following moose management objectives for Unit 1B are based on biological data and input from the public.

Stikine River

	Plan Objective	1999	2000
Post-hunt numbers	300	N/A	N/A
Annual hunter kill	30	20	14

Number of hunters	250	185	165
Hunter-days of effort	1,750	1,454	1,302
Hunter success	12%	11%	8%

Thomas Bay

	Plan Objective	1999	2000
Post-hunt numbers	200	N/A	N/A
Annual hunter kill	20	20	6
Number of hunters	160	107	104
Hunter-days of effort	675	746	753
Hunter success	12%	19%	6%

METHODS

Late winter surveys were flown along the Stikine River valley. Hunters and harvested moose were checked in the field during the Stikine River and Thomas Bay hunts. Field data was used to reconcile written hunter reports. Since 1997 hunters in Unit 1B have been asked on registration permits to report the number of moose (by sex and age class), wolves, and bears they observed during the hunting season.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In 1983 the Stikine River population was estimated at 300 moose and increasing (Craighead, et al. 1984). Post-1983 harvest levels and subjective impressions suggested the Stikine population slowly increased and then began to decrease in 1988. The percentage of calves surviving to late winter declined from 1980 to 1989 and remained low until 1994. In 1995, 1996, and 1998 the percentage of calves surviving to late winter increased to 18%, 22%, and 24%, respectively (Table 1). Hunters took 57 bulls in 1988 and the kill dropped each succeeding year to a low of 3 in 1994 (taken under a federal permit; the state season was closed by emergency order in 1994).

The Thomas Bay population was estimated at 180 moose the late 1970s (ADFG files, Petersburg). Based on increased harvest and observed habitat utilization the current population is probably larger.

The Thomas Bay population in northern Unit 1B now appears to be stable at a high density. The Stikine River population, although increasing from 1994 through 1999, now appears to be decreasing and at moderate density.

Population Composition

Table 1 shows the results of all Stikine River valley surveys since 1989/90. Dense coniferous forest, variable snowfall, and inclement weather make adequate surveys difficult. No attempt was made to differentiate between bulls and cows, but adults and calves were differentiated during late winter aerial surveys.

Information on the number of moose observed by hunters on registration hunt reports provides some of the limited information on population composition in the unit. In 1999 a total of 292 hunters reported observing a total of 1770 moose in Unit 1B, including 561 bulls, 866 cows, and 343 calves, for a bull to cow ratio of 65:100, and a calf to cow ratio of 40:100. In 2000, 269 hunters reported observing a total of 1884 moose, including 612 bulls, 903 cows, and 369 calves, for a bull to cow ratio of 68:100, and a calf to cow ratio of 41:100.

Distribution and Movements

Moose have been observed crossing Dry Straits between Farm Island on the Stikine River delta and Mitkof Island. At low tide this strait can be crossed easily and moose are reported to move in both directions. Radio telemetry of Stikine moose found no evidence of extensive seasonal migration (Craighead et. al., 1984). Rutting surveys in 1995 and 1996 identified Dry Wash, Andrew Island, and Barnes Lake as important rutting areas on the Stikine River. Moose appear to be well distributed in the Alaska portion of the Stikine River valley and Thomas and Farragut bays. Moose seem to be absent from the Bradfield Canal area although several river valleys appear to have suitable habitat.

MORTALITY

Harvest

Season and Bag Limit	Resident and nonresident hunters
Unit 1B	Sept. 15–Oct. 15 (General hunt only except in Stikine Drainage)
1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on one side by registration permit only	

Game Board Actions and Emergency Orders. No Board of Game actions were taken or emergency orders issued regarding Unit 1B moose during the report period.

Hunter Harvest. In 1999 the unit-wide harvest was 40 moose and in 2000 it was 20. In 1999, 185 hunters harvested 20 moose on the Stikine portion of Unit 1B. In 2000, 165 hunters harvested 14 moose in the Stikine River drainage (Table 2). In 1999, 107 hunters (Table 3) harvested 20 moose at Thomas Bay, including 3 from Farragut Bay. In 2000, 104 hunters harvested 6 moose at Thomas Bay, including 2 from Farragut Bay.

Hunter Residency and Success. In 1999, 90% and of all successful hunters on the Stikine River were Petersburg or Wrangell residents (Table 4), and in 2000 it was 93%. The overall success rate for Stikine River moose hunters was 11% in 1999 and 8% 2000.

Petersburg residents continued to dominate the Thomas Bay and Farragut Bay moose hunts (Table 5). In 1999, 95% and in 2000, 100% of all successful hunters at Thomas Bay and Farragut Bay were Petersburg residents The overall success rate for Thomas Bay and Farragut Bay moose hunters was 19% in 1999 and 6% in 2000.

Harvest Chronology. Harvest chronology for Unit 1B moose has varied. In general, most bulls are killed during the first half of the season and the success rate declines throughout the season (Table 6). In 1999, the largest percentage of the annual harvest at Thomas Bay occurred during the third and first weeks of the season, respectively. The largest percentage of the annual harvest on the Stikine occurred during the first and last week of the season, respectively.

In 2000, the largest percentage of the annual harvest at Thomas Bay occurred during the first and second weeks of the season, respectively. The largest percentage of the annual harvest on the Stikine occurred during the third and fourth weeks of the season, respectively. Most hunters are in the field early in the season, and except for weekends, effort tends to drop off as the season progresses. Inclement weather does not appear to slow hunting effort early in the season.

Guided Hunter Harvest. No guided hunts are currently offered in the unit.

Transport Methods. During the report period all successful hunters reported using boats to access the areas they hunted in the unit (Table 7). Motorized land vehicles are prohibited for moose hunting in the Thomas Bay hunt and the Stikine Wilderness. Motorized land vehicles may be used in Thomas Bay for any purpose except moose hunting.

Other Mortality

Wolves, black bears, and brown bears are moose calf predators and wolves and brown bears take adult moose. The extent of predation on these moose herds is unknown, but it appears that in some years few calves are recruited into the Stikine herd. Hunters reported increased signs of wolf activity at Thomas Bay during the 1999 season.

HABITAT

Assessment

Moose populations at Thomas Bay responded favorably to the initial increase in available browse resulting from extensive clearcut logging between 1958 and 1975. Since that time the dense, closed-canopy forests resulting from natural regeneration of second growth stands has reduced available understory browse vegetation.

In 1991 the U.S. Forest Service (USFS) cleared a 100-acre plot along the Patterson River to investigate the feasibility of improve moose habitat. Re-growth has been browsed heavily during the summer leaving little winter forage in this area.

Stikine River moose range lies mostly within the USFS Stikine/LeConte Wilderness area and the Stikine drainage. Moose habitat in this area, identified by Craighead et. al. (1984), is designated wilderness and cannot be artificially manipulated for improvement. Nineteen transects were surveyed in 1984 to determine the condition and availability of moose winter browse in the Stikine River corridor (Craighead et. al. 1984). The transects were revisited in June 1991 and in June 1997. Preferred browse species were identified as willow (*Salix* spp.) and red osier dogwood (*Cornus stolonifera*). The total percent of available browse that was heavily utilized in June 1997 included 62.2% *Salix* spp. and 63.9% *Cornus* spp. (Elze and Posner 1997). In 1991 the percentage in the heavy use category was 15.8% for *Salix* spp. and 13.8% for *Cornus* (Stoneman 1992). In 1997 the majority of plants recorded were in the heavily used category compared to 1991 when most plants were in the zero to moderately use categories (Stoneman 1992).

No habitat assessment surveys were conducted during this report period.

Enhancement

It is estimated that pre-commercial thinning of second growth stands will extend the habitat value of clearcuts for an estimated 20–30 years. In March 1997, ADF&G implemented a plan to enhance moose habitat on state land at Thomas Bay. Phase 1 of the plan called for reopening 10 miles of logging roads that were impassable due to dense vegetative growth and downed trees. Road clearing operations were completed in June 1998. Phase two of the plan called for treating 380 acres of dense second growth primarily by pre-commercial thinning and partial strip clearing. The thinning of 4 second-growth units totaling 380 acres was completed in October 1998.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Thomas Bay moose populations responded favorably to the initial increase in available browse resulting from extensive clearcut logging between 1958 and 1975, but the dense, closed canopy forests caused by the natural regeneration of second-growth stands is decreasing the amount of available browse. As a result the quality of the habitat has been declining. The loss of habitat and the resulting decline in available food is of great concern to biologists and hunters. Left untreated, the young, second growth conifer stands will shade and eventually eliminate understory browse vegetation, further reducing moose-carrying capacity. The only way to prevent further decline of moose habitat will be to institute habitat manipulation procedures.

For genetic or environmental reasons moose in the unit do not develop antler configurations that are predictable relative to age, therefore, some modification of the existing antler restrictions may be justified. Moose in the unit rarely achieve 50-inch antler spreads, and in Thomas Bay in particular the population appears to contain a surplus of illegal bulls in excess of that need to ensure timely breeding of cows.

CONCLUSIONS AND RECOMMENDATIONS

None of the Stikine management objectives were met in 1999 and 2000. Hunter-days of effort increased from the previous report period, but it remained below the management objectives during this report period. Hunter success was only slightly below the management objective in 1999 but fell well short of the objective in 2000. We believe the Stikine moose population was increasing from 1994 until 1999, but it now appears to be decreasing.

In Thomas Bay the moose harvest equaled the management objective in 1999 but fell well below the objective in 2000. The number of hunters declined from the previous report period and did not meet the management objectives in either 1999 or 2000. Although hunter-days of effort also declined from the previous report period, they met or exceeded the objective in both 1999 and 2000. Hunter success exceeded the management objective in 1999 but was well below the objective in 2000. The Thomas Bay moose population currently appears stable at a high level.

We recommend Units 1B and 3, and the extreme southern portion of Unit 1C continue to be managed by a common registration permit hunt. We also recommend that for the time being, the season dates remain from September 15 through October 15 with a bag limit of one bull with spike/fork or 50" antlers or at least 3 brow tines on one antler. Because moose found in Units 1B and 3 do not display antler characteristics that are predictable relative to age, some modification of the existing antler restrictions or lengthening of the season may be justified in the future.

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Table 1 Unit 1B Stikine area aerial moose surveys, regulatory years 1989 through 2000

Yr month/day	Adults	Calves	(%)	Unidentified	Total moose	Moose/hour
1989						
07/27	45	14	(23)	2	61	31
03/02	27	2	(7)	0	29	16
03/08	61	5	(8)	0	66	36
1990						
07/20	23	3	(11)	2	28	22
07/25	10	1	(9)	0	11	10
07/27	30	0	(0)	0	30	12
08/11	8	3	(23)	2	13	6
08/18	26	3	(10)	0	29	12
12/15[a]	70	12	(15)	0	82	50
02/20[a]	38	6	(14)	0	44	34
03/05[a]	89	5	(5)	0	94	32
05/19[b]	0	0	(0)	2	2	2
1991						
03/03[c]	6	0	(0)	0	6	18
1992						
12/19[a]	59	12	(16)	2	73	21
03/25[a]	73	7	(9)	0	80	34
1993						
02/10[a,d]	46	4	(8)	0	50	39
1994						
03/02	34	0	(0)	0	34	
04/08	30	1	(3)	0	31	
1995						
02/25	76	17	(18)	0	93	26
1996						
3/08	122	35	(22)	0	157	47
1997						
	No data	-	-	-	-	-
1998						
2/24	103	32	(24)	0	135	44
1999	No data					
2000						
2/17[e]	2	2	(50)	0	4	4
3/22	9	2	(18)	0	11	8
6/11	11	7	(39)	0	18	9

[a] Helicopter survey.
[b] River stage high, full leaf out in lower river, moose not visible.
[c] Helicopter survey aborted due to weather.
[d] Farm Island to 15 Mile Island only, then abandoned due to weather.
[e] Poor survey conditions on lower river, US/Canada boarder to Kakwan Point only

Table 2 Unit 1B (Stikine) moose harvest, regulatory years 1989 through 2000

Year	Hunter harvest reported					
	M	(%)	F	(%)	Unk.	Total
1989	38	(100)	0	(0)	0	38
1990	36	(97)	1	(3)	0	37
1991	24	(96)	1	(4)	0	25
1992	18	(95)	1	(5)	0	19
1993	14	(100)	0	(0)	0	14
1994[a]	3	State season closed by	emergency order			3
1995	5	(100)	0	(0)	0	5
1996	18	(100)	0	(0)	0	18
1997	17	(100)	0	(0)	0	17
1998[b]	24	(100)	0	(0)	0	24
1999	20	(100)	0	(0)	0	20
2000	14	(100)	0	(0)	0	14

[a] Taken under federal permits; state season closed by emergency order.

[b] Includes 1 DLP and 2 Illegal kills.

Table 3 Unit 1B (Thomas and Farragut bays) moose harvest, regulatory years 1989 through 2000

Year	Hunter harvest reported						
	M	(%)	F	(%)	Illegal	Unk.	Total
1989	20	(100)	0	(0)	0	0	20
1990	25	(100)	0	(0)	0	0	25
1991	15	(100)	0	(0)	0	0	15
1992	27	(96)	1	(4)	1	0	28
1993	27	(100)	0	(0)	0	0	27
1994	11	(100)	0	(0)	0	0	11
1995[a]	15	(100)	0	(0)	0	0	15
1996[b]	24	(94)	1	(6)	0	0	25
1997	18	(100)	0	(0)	0	0	18
1998	24	(100)	0	(0)	1	0	24
1999	20	(100)	0	(0)	2	0	20
2000	6	(100)	0	(0)	0	0	6

[a] Includes one moose harvested in Port Houghton.

[b] Includes DLP.

Table 4 Unit 1B (Stikine) moose hunter residency and success, regulatory years 1989 through 2000

	Successful						Unsuccessful						
Year	Local[a] resident	Nonlocal resident	Non-resident	Unk.	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Unk.	Total	(%)	Total hunters
1989[b]	23	15	0	0	38	(13)	170	106	7	0	283	(87)	321
1990[b]	36	0	1	0	37	(12)	215	27	1	0	243	(88)	280
1991[b]	23	1	1	0	25	(12)	146	34	5	5	190	(88)	215
1992	16	2	0	1	19	(8)	183	24	3	1	211	(92)	229
1993	14	0	0	0	14	(10)	121	6	0	0	127	(90)	141
1994[c]	State season closed by emergency order				3								
1995	5	0	0	0	5	(4)	91	6	0	0	97	(96)	102
1996	18	0	0	0	18	(14)	105	7	0	0	112	(86)	130
1997	16	1	0	0	17	(12)	117	8	0	0	125	(88)	142
1998	23	1	0	0	24	(13)	154	9	0	0	163	(87)	187
1999	18	2	0	0	20	(11)	147	18	0	0	165	(89)	185
2000	13	1	0	0	14	(8)	137	12	2	0	151	(92)	165

[a] Residents of Petersburg and Wrangell.

[b] Unsuccessful hunter data expanded to correct for non-reporting hunters.

[c] Three moose taken under federal permits.

Table 5 Unit 1B (Thomas and Farragut bays) moose hunter residency and success, regulatory years 1989 through 2000

Year	Successful					Unsuccessful					
	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
1989[b]	18	2	0	20	(14)	119	7	0	126	(86)	146
1990[b]	23	2	0	25	(15)	126	10	1	137	(85)	162
1991[b]	14	1	0	15	(12)	96	12	0	108	(88)	123
1992[b]	25	2	1	28	(25)	77	6	0	83	(75)	111
1993[b]	26	1	0	27	(20)	103	4	1	108	(80)	135
1994	11	0	0	11	(9)	108	9	0	117	(91)	128
1995	14	1	0	15	(11)	108	8	0	116	(89)	131
1996	23	2	0	25	(16)	107	15	1	123	(84)	148
1997	18	0	0	18	(12)	116	11	1	128	(88)	146
1998	23	1	0	24	(19)	91	12	0	103	(81)	127
1999[c]	19	1	0	20	(19)	79	8	0	87	(81)	107
2000	6	0	0	6	(6)	91	5	2	98	(94)	104

[a] Residents of Petersburg and Wrangell.

[b] Includes illegal kill.

[c] Includes two illegal kills.

Table 6 Unit 1B moose harvest chronology, regulatory years 1993 through 2000

Area	Year	15–21 Sept.	22–28 Sept.	29 Sept.–5 Oct.	6–15 Oct.
Thomas Bay	1993	0	0	19	8
	1994	0	0	9	2
	1995	8	3	2	2
	1996	11	5	3	6
	1997	5	4	6	3
	1998	9	6	5	4
	1999	5	4	7	4
	2000	3	2	1	0
Stikine	1993	5	1	4	4
	1994	State season closed by emergency order			
	1995	3	1	0	1
	1996	6	6	2	4
	1997	7	3	3	4
	1998	12	5	3	4
	1999	6	3	4	7
	2000	3	1	5	5

Table 7 Unit 1B successful moose hunter transport methods by area, regulatory years 1990 through 2000

Area	Year	Airplane	Boat	Highway vehicle	3- or 4-wheeler	Horse	Unknown	Total
Thomas Bay	1990	1	22	0	2	0	0	25
	1991	1	14	0	0	0	0	15
	1992	0	27	0	0	1	0	28
	1993	4	23	0	0	0	0	27
	1994	1	9	0	0	0	1	11
	1995	3	11	1	0	0	0	15
	1996	0	25	0	0	0	0	25
	1997	0	18	0	0	0	0	18
	1998	2	22	0	0	0	0	24
	1999	1	18	0	0	0	1	20
	2000	0	6	0	0	0	0	6
Stikine	1993	1	13	0	0	0	0	14
	1994		state season closed by EO					
	1995	0	5	0	0	0	0	5
	1996	2	16	0	0	0	0	18
	1997	0	17	0	0	0	0	17
	1998	2	22	0	0	0	0	24
	1999	0	20	0	0	0	0	20
	2000	0	14	0	0	0	0	14

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 1C (7,600 mi^2)
GEOGRAPHICAL DESCRIPTION: That portion of the Southeast Alaska mainland from Cape Fanshaw to the latitude of Eldred Rock.

BACKGROUND

Moose are relative newcomers to many parts of Southeast Alaska, with many of the populations becoming established in the early-to-mid 1900s. Some areas, such as the Gustavus Forelands, did not have moose present until the 1960s. It is likely that coastal mountains inhibited the movement of moose into these areas. Once moose discovered these unexploited areas, the presence of high quality habitat led to rapid expansions of new populations. In three of the four moose management areas in this subunit, moose moved in naturally, while in one area they were introduced.

Taku River: The arrival date of moose in the Taku River drainage is not documented, but Swarth (1922) states that a moose was killed at the mouth of the Stikine River "some years" prior to 1919. If moose appeared at the same time on the Taku (which is a reasonable assumption given the proximal location and similar and ecological makeup), then presumably they first occurred in the lower part of the river near the turn of the century. In 1960, ADF&G biologists observed 38 moose along the Taku River, and 27 moose were harvested there that year.

Moose occur on the Whiting and Speel rivers south of the Taku. These animals may have originated from the Taku herd, from immigration into the Whiting drainage from the Canadian mainland, or from some other source. In recent years moose and their sign have been seen regularly in the Port Houghton area. These moose probably moved across the Fanshaw Peninsula from the Farragaut Bay/Thomas Bay population to the south.

Berners Bay: This moose population, one of the most popular herds to hunt in the Juneau area, did not occur naturally. Fifteen calves from the Anchorage area were released in Berners Bay in 1958, and a supplemental release of 6 more calves occured in 1960. In June 1960, 3 cows with a single calf each were observed, indicating that cows had bred at about 16 months of age. The first limited open season was held in 1963, when 4 bulls were killed. Since that time, the annual harvest has ranged from 5 to 23 animals. Managing the Berners Bay moose herd has been a challenging task for ADF&G. The geography of the area allows for little to no immigration or emigration, resulting in a closed population with limited habitat. Because of this, ADF&G has used a variety of hunts, changing the harvest from bulls only to bulls and cows, in an attempt to balance the herd's sex ratio and limit the population size within the carrying capacity of the habitat. The use of a habitat capability model as well as moose browse surveys in the early 1980's helped shape the present management strategy of keeping the post-hunt population at no more than 90 moose observed during aerial surveys to assure the herd does not exceed a level the habitat can support.

Chilkat Range: Moose were first documented in western Unit 1C in 1962 on the Bartlett River. In 1963 moose were observed in the Chilkat Mountain range; these animals probably originated from the Chilkat Valley population near Haines. In 1965 moose were sighted for the first time along the Endicott River and St. James Bay areas. Moose probably followed the Endicott River to Adams Inlet shortly thereafter, because they were common in Adams Inlet by the 1970's. Because of thick timber stands along the Endicott and the difficulty of gathering reliable aerial survey data, our understanding of the Chilkat Range moose population is mostly limited to hunter reports and hunter harvest.

Gustavus Forelands: The first sightings of moose in the Gustavus area occurred in 1968. It is likely moose migrated to this area via the Excursion River drainage. Twenty years passed before the first moose was harvested at Gustavus in 1988, evidence that moose took a while to populate this area. Since then, the population has expanded rapidly to become the largest in the unit, accounting for the highest harvest. The number of animals in this herd has reached a level that is not sustainable, given limited winter range. Because of this concern ADF&G began a moose browse study on the forelands in 1999, and used resultant data to convince the Board of Game in 2000 to adopt a drawing permit hunt for cow moose.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

In 1998 we revised Unit 1C moose management objectives based on recent hunt and survey information. We separated the Gustavus Forelands herd from moose in the remainder of the Chilkat Range because of its discrete nature. Below is a list of the newly drafted management objectives:

1. Taku drainage: Maintain a post-hunting population of 100 moose, an annual harvest of 10, and a hunter success rate of 20%;
2. Berners Bay: Maintain a post-hunting population of 90 moose, an annual harvest of 18, and a hunter success rate of 90%;
3. Chilkat Range: Maintain a post-hunting population of 200 moose, an annual harvest of 20, and a hunter success rate of 22%;
4. Gustavus Forelands: Maintain a population of 250, an annual harvest of 40, and a hunter success rate of 33%.

METHODS

Aerial surveys were conducted throughout most of the subunit during the report period. Survey flights were accomplished both years at Berners Bay and Gustavus Forelands, and in the Taku

River drainage in 2000 only. Only the upper section of the Endicott River within the Chilkat Range was surveyed, although we did conduct an aerial survey of Adams Inlet in Glacier Bay National Park (GBNP), where we believe some Endicott River moose over-winter. One registration permit hunt (RM046) and 2 drawing permit hunts (DM041 and 042) were used to manage moose hunting effort in Unit 1C. Berners Bay moose were managed under one bull-only hunt and a separate antlerless hunt. The remainder of Unit 1C (excluding that area south of Pt. Hobart) was managed under the registration permit hunt. Since 1995, the area south of Pt. Hobart has been included in the antler-restriction hunt conducted in Units 1B and 3 (RM038), and all moose taken there were included in the management report covering those areas. A condition of all drawing and registration hunts required successful hunters to bring in incisors from harvested moose for aging. Other data collected from the permit hunt reports included the hunt length, hunter residency, hunt location, commercial services used, and transport means (for all hunters), and date of kill (for successful hunters).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Taku: Little information is available regarding the number of moose in the Taku River drainage. A winter 2000 aerial survey enumerated 37 moose (Table 1), but the fall 2000 harvest of 23 moose was the highest since 26 moose were killed in 1985. We have never counted many moose along the Alaska portion of the Taku, suggesting that the main wintering area for these moose is in Canada. In spite of our low survey numbers, hunters have had reasonable success hunting moose on the Taku. It is likely that most moose harvested along the Taku spend a majority of the year (including winter) in Canada, and animals moving downriver from Canada during the hunting season supplement the local population. Some of the Alaska harvest undoubtedly comes from across the border, but we cannot quantify this illegal take. Aerial surveys conducted by Canadian biologists along the lower Tulsequah River in Canada during February 2000 enumerated 213 moose, with a bull to cow ratio of 98:100. If we consider these animals as part of the same population that are hunted along the Alaska portion of the Taku River, then our present harvest objectives for the Taku appear sustainable. Recently there has been no harvest on the lower Taku in Canada (Karen Diemert, pers. comm.). South of the Taku River on the Alaska mainland, a few moose have been harvested in the Port Houghton area over the years. These moose are an extension of the population using Thomas and Farragut bays south of the Fanshaw Peninsula, and are distinct from other Unit 1C moose populations. Most of the effort directed at Port Houghton moose comes from Petersburg.

Berners Bay: The Berners Bay moose population appears to be near the estimated carrying capacity, between 100 and 150 animals, and is being maintained with selective harvests to adjust the bull to cow ratio (Table 1). Berners Bay surveys in 1999 and 2000 enumerated 108 and 79 moose, respectively. The 1999 count was the highest in recent history, the result more of ideal survey conditions rather than an increase in the moose population. The 2000 count of 79 moose was more typical of the previous 10-year period (Table 1). Since 1993 we have issued up to 20 drawing permits annually for Berners Bay, with the number and sex of moose to be taken determined by aerial survey results.

Chilkat Range: The status of the Chilkat Range moose population is unknown, as surveys have not been conducted due to limited snow cover and dense forest canopy. We did conduct a survey of the upper Endicott River and Adams Inlet in 2000 (Table 1) and counted 125 moose, but nearly all of these animals were in Glacier Bay National Park (GBNP). Moose in the Adams Inlet area of GBNP likely cross Endicott Gap and move to the Endicott River during the spring and summer, supplementing the herd along the west side of Lynn Canal. How many of these animals are available to hunters on non-park lands is unknown. Based on harvest records and anecdotal information from hunters, the number of moose in the Chilkat Range appears to be stable.

Gustavus Forelands: Based on winter aerial surveys in 1999 and 2000, the Gustavus Forelands moose population is either stable or increasing (Table 1). We believe an influx of moose from GBNP is supporting the increasing harvest on state land here. Both the total number of moose and the number of calves in the herd indicate a rapidly expanding population. Improving habitat conditions due to isostatic rebound on lands where glaciers have recently retreated have stimulated moose productivity.

Population Composition

Although we conducted thorough aerial surveys of 3 of the 4 Unit 1C moose populations during the report period, we were only able to get reliable composition data in Berners Bay in 1999. The other surveys provided us with overall moose numbers and a breakdown of adults and calves, but we could not quantify bulls due to the late timing of the surveys and advanced antler drop (Table 1). This is often the case in Southeast Alaska, where adequate snow conditions for observing moose do not usually occur until mid-winter. We collected lower jaws from each harvested moose from successful hunters, providing us with the age structure of the harvest (Tables 2 & 3).

Taku: During a February 2001 aerial survey we counted 37 moose on the Taku River drainage. We were unable to quantify bulls due to antler drop, but did enumerate 5 calves and 7 cows (Table 1). This count is comparable to previous counts dating back to the early 1980’s.

The mean age of harvested moose was 2.0 years during the report period, compared to 2.5 years for 1997 and 1998. This continuing harvest of young bulls indicates a healthy population with good recruitment.

Berners Bay: A November 1999 aerial survey allowed us to gather fairly reliable composition data. We calculated a bull to cow ratio of 17 bulls to 100 cows, and a calf to cow ratio of 16 calves to 100 cows. The ratio of bulls to cows is the lowest in the last 10 years, but may be partly due to some of the bulls having shed their antlers; 3 bulls were seen during the survey with only one antler. The percent calves in the herd was the second lowest since 1990.

Mean age at harvest of Berners Bay moose was 4.2 years for males and 2.8 years for females, during the report period. This compares to a mean age of 2.9 years for males and 3.7 years for females during the previous report period.

Chilkat Range: A February 2001 aerial survey did not allow us to differentiate bull and cow moose. Because of strong winds and turbulent flying conditions, we were unable to spend the time necessary to positively quantify calves.

The mean age of harvested moose was 2.9 years, similar to the mean of 3.1 years from the previous report period.

Gustavus Forelands: We conducted only one aerial survey at Gustavus during the report period. This survey was flown in February 2001, preventing us from differentiating bulls and cows. We were able to differentiate calves, and calculated the percent calves in the herd at 22%, an indication that this moose herd is still expanding.

The mean age at harvest was 2.2 years compared to 1.7 during the previous report period. The harvest of young bulls is a further reflection of a growing herd.

Distribution and Movements

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 1(C), Berners Bay drainages	Sept. 15–Oct. 15 (General hunt only)
1 moose by drawing permit only; up to 20 permits may be issued	
Unit 1(C), that potion south of Point Hobart, including all Port Houghton drainages	Sept. 15–Oct. 15 (General hunt only)
1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on one side by registration permit only	
Remainder of Unit 1(C)	Sept. 15–Oct. 15 (General hunt only)
1 bull by registration permit only	

Game Board Actions and Emergency Orders. At the fall 2000 Board of Game meeting, the Board adopted a department proposal to increase the number of Berners Bay drawing permits from 20 to 30. The board also adopted a proposal to allow ADF&G to implement a drawing hunt for up to 10 cow moose on the Gustavus Forelands beginning in fall of 2001. Emergency orders

(EOs) were issued to close the season early in the Gustavus area during both years of the report period. In both years the bull guideline harvest level (40 in 1999 and 45 in 2000) was met during the first week of October.

Hunter Harvest. The Berners Bay drawing permit hunt was managed for a harvest of 15 moose from 1993–95. In 1996 the take increased to 17 as a result of a Fish and Wildlife undercover operation (Table 4). The permit allocation remained at 15 (8 bulls and 7 cows) for both years of the previous report period, and was increased to 18 permits in 1999 and 20 permits in 2000. Hunter success was 100 percent in 1999 and 88 percent in 2000. In 2000, hunters with bull permits had a higher success rate (100%) than those with cow permits (83%), although the reverse was true the following year with 80% successful bull hunters and 100% successful cow hunters. All bull permittees hunted in both years, compared to 75% of the antlerless moose permit holders in 1999 and 80% in 2000.

The balance of Unit 1C was managed under registration permit, with biologists keeping the kill within a guideline harvest level rather than a strict quota. The Chilkat Range harvest ranged from 6 to 28 from 1990–98 (Table 5), with the 1998 harvest of 28 the highest ever recorded. The 1999 harvest was 11, and in 2000 the harvest was 14. In both years considerable rainfall during the hunting season caused moose to move to higher, forested ground, making them difficult for hunters to locate.

The Gustavus Forelands harvest has climbed dramatically, reaching 48 animals in 1998 before the season was closed by EO. In both 1999 and 2000 the season was again closed by EO after meeting the guideline harvest level.

The Taku harvest ranged between 14 and 20 from 1990–98. The 1997 harvest of 6 was the lowest in the past 10 years, due to few moose being seen rather than a decline in hunting effort (Table 4). The 1999 harvest climbed to 17 and went even higher in 2000 with 23 moose taken. This is the highest harvest recorded in the Taku drainage since 1985 when 26 moose were harvested.

Unit 1C moose harvest outside of Berners Bay continues to increase, largely due to the influence of Chilkat Range and Gustavus Forelands hunts. These areas accounted for 44 of 65 moose harvested in Unit 1C in 1997, and 76 of 105 moose in 1998 (Table 5). During the same period, harvest in the Taku area has remained at or below historic levels (Table 5). Coupled with the Berners Bay harvest, the total Unit 1C moose harvest is at a historic high.

Permit Hunts. Over 1,600 applications were submitted for the Berners Bay permit drawing hunt during 1999, and in 2000 1,700 were submitted. This is a large increase over the previous report period when an average of 1,246 applications were submitted for these permits. The proximity of Berners Bay to Juneau and the high hunter success rate explains the popularity of this hunt. In 1999, 94% of Berners Bay hunters were successful, and in 2000 100% of the permittees who hunted got a moose.

Since the registration permit format was implemented for Unit 1C (except Berners Bay), more than 200 permits have been issued annually (Table 4). In 1999, a total of 476 permits were issued, followed by 455 in 2000. The increase in interest stems mainly from the popularity of the

Gustavus hunt; roughly 46% of hunting permittees went to Gustavus. As in most hunts, not all the permittees actually participated in a hunt. In 1999 only 301 of the 476 permittees actually hunted, and 296 of 455 permittees hunted in 2000.

Hunter Residency and Success. Most moose harvested in Unit 1C continue to be taken by residents of the subunit (Table 6). During the report period, residents of the subunit took 165 of 191 harvested moose, 8 were taken by other Southeast residents, 12 were taken by Alaska residents from outside of Southeast Alaska, and 6 were taken by nonresidents. Southeast moose hunting areas are not readily accessible via highway vehicles, and residents from elsewhere in Alaska have better moose hunting opportunities closer to home. Nonresidents eager to take moose focus on areas with larger moose populations and a better chance of getting a trophy animal. Twenty-six percent of all Unit 1C hunters were successful in 1999, and in 2000 the success rate climbed to 35%. Hunters at Gustavus and the Taku River shared equal success (Table 5), while Chilkat Range hunters did not fare as well.

Harvest Chronology. Similar to recent years, the 1999 and 2000 moose harvest was heavily weighted toward the early part of the season. This is partly because nearly all hunters participate on opening day, and hunt less as the season goes on. Also, the Gustavus hunt, which attracts the majority of hunters in the subunit, has been closed by EO in early October during each of the past two years. Generally about 30% of the Gustavus Forelands harvest takes place in the first 3–4 days of the hunt.

Transport Methods. The type of transport used by successful hunters varies by hunt area, and difficulties with the logistics of access would be expected.

Taku: In the Taku hunt 100% of hunters used boats for access in 1999, and 91% used boats in 2000 (Table 7). Most hunters used boats equipped with jet units to reach this area, and many hunters have access to cabins in the upper part of the drainage.

Berners Bay: In Berners Bay all successful hunters used boats for access (Table 7). Access in this area is essentially all by airboat.

Chilkat Range: Hunters in the Chilkat Range used both airplanes and boats for access. In 1999, 73% of the successful hunters flew into their hunt area, while the remaining 27% used boats for access. In 2000, airplane and boat access was evenly divided (Table 7). Generally, most airplane access to this area is in the upper Endicott River, while most boat access takes place at St. James Bay.

Gustavus Forelands: Successful Gustavus Forelands hunters use a variety of access methods. During the report period an average of 12% of the hunters used airplanes for access, 18% used boats, 2% used ATV's, 38% used highway vehicles, and 30% walked to their hunting area. The high percentage of hunters who walk only are residents of Gustavus.

Other Mortality. Winters were mild during both report years, so known natural mortality was limited to a few wolf kills on the Gustavus Forelands. Other mortality included 3 cow moose that were taken illegally during the 2000 Gustavus hunt, and a cow and calf moose that were killed in wolf snares there.

Habitat. A Gustavus browse monitoring project initiated in 1999 was maintained through this report period and will continue. The project monitors willow utilization by moose on winter range. Preliminary data analysis suggests that the moose population is higher than the range can support. Data generated by this study was used by the Board of Game in its decision to adopt a proposal to allow a cow moose hunt at Gustavus.

CONCLUSIONS AND RECOMMENDATIONS

Taku: All Taku River management objectives were surpassed during both years of the report period. In 1999 a total of 17 moose were harvested with a hunter success rate of 25%. The 2000 harvest was 23 moose with a hunter success rate of 33%. Both years are well above the management objectives of a 10-moose harvest and a hunter success of 20%. Based on aerial surveys we did not meet the 100-moose population objective. However, we believe that most Taku moose spend the winter in Canada, thereby making this management objective difficult to measure.

Berners Bay: We did not meet management objectives for the number of moose harvested (18) during either year of the report period, when 15 moose were killed annually. However, we did meet the objective for 90% hunter success each year, with 94% and 100% of the hunters harvesting moose in 1999 and 2000, respectively. We met the population objective of 90 post-hunt animals each year, with the 108 moose surveyed in 1999 and 79 moose in 2000 indicating there were well over 90 moose present.

Chilkat Range: We did not meet any management objectives for the Chilkat Range during the report period. Harvest objectives call for an annual kill of 20 moose and a hunter success rate of 22%. The 1999 harvest was only 11 moose with a success rate of 11%, while in 2000 the harvest was 14 moose with a success rate of 13%. The mean annual harvest during this report period was the lowest since 1993–1994, and the hunter success rate was the lowest of the past 5 report periods. Reasons for this decline in harvest and success are not known because we have no population information in this area. Although we have a harvest objective of 200 moose in this area, we are unable to conduct reliable surveys to quantify the population.

Gustavus Forelands: We were able to meet the harvest management objectives in both years of the report period, and only by issuing emergency orders to close the season were we able to prevent higher harvests. In 1999 the harvest was 42 moose, and 47 moose were taken in 2000, both surpassing the objective of 40 moose. The objective for a 33% hunter success rate was met in 2000 when 37% of all hunters killed a moose, but was not met in 1999 when only 29% of hunters were successful. The population objective of 250 moose was met, given that we saw 207 animals on our survey and estimated there were 250–300 present.

Rising effort and harvest on the Gustavus Forelands increases the importance of acquiring consistent aerial survey data for moose in that portion of the subunit. Acquiring additional browse utilization information as well as herd composition data are priorities here. Implementation of a cow hunt during the next report period to lower the productivity of that herd is advised.

We believe that a continuation of the permit registration system should accommodate current population objectives throughout Unit 1C, and we will continue to collect jaws from harvested moose for age analysis. Areas supporting the most critical winter browse should be analyzed, even cursorily, to estimate the status of moose populations in relation to carrying capacity. This is particularly true in the Gustavus area where habitat information complements our aerial survey information to help us anticipate management decisions.

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Table 1 Unit 1C aerial moose survey data, regulatory years 1990 through 2000

Year	Bulls	Cows	Calves	Unknown	Total moose	Count time (hrs)	Bulls per 100F	Calves per 100F	Calves % in herd	Moose per hour
					Berners Bay 1990–2000					
1990	14	53	18	0	85	2.6	26	34	21	33
1991	---	---	11	50	61	1.2	---	---	18	50
1992	14	61	8	0	83	2.8	23	13	10	29
1993	---	---	12	45	67	2.8	---	---	18	24
1994	17	45	13	0	75	2.0	38	29	17	38
1995–1996					No survey					
1997	6	11	12	31	60	2.1	---	---	20	29
1998	14	9	10	37	70	2.6	---	---	14	27
1999	14	11	13	70	108	2.4	17.3	16	12	45
2000	---	10	12	57	79	2.4	---	---	15	33
					Chilkat Range 1968–2000					
1968	1	2	1	0	4		50	50	25	
1975	0	3	2	0	5		0	67	40	
1986	3	10	6	0	19	1.5	30	60	32	
1987–1991					No survey					
1992	---	---	11	79	97	1.3	---	---	13	75
1993–1995					No survey					
1996	---	---	---	20	20	---	---	---	---	
1997					No survey					
1998	6	15	16	35	72	1.1	---	---	22	64
1999					No survey					
2000	---	6	6	113	125	1.7	---	---	---	75
					Taku River1978–2000					
1978	3	30	15	---	49	3.4	10	50	31	14
1983	2	40	12	---	54	1.7	5	30	22	32
1986	2	42	1	---	45	1.8	5	2	2	25
1987					No survey					
1988	2	16	4	---	22	1.6	13	25	18	14
1989–1997					No survey					
1998	---	1	1	3	5	---	---	---	---	---
1999					No survey					
2000	---	5	7	25	37	2.1	---	---	19	18

--- Incomplete survey data due to timing of survey.

Table 1 continued

Year	Bulls	Cows	Calves	Unknown	Total moose	Count time (hrs)	Bulls per 100F	Calves per 100F	Calves % in herd	Moose per hour
					Gustavus Forelands 1998–2000					
1998	---	48	54	131	185	1.9	---	---	29	95
1999					No survey					
2000	---	45	45	117	207	3.7	---	---	22	57

Table 2 Unit 1C moose age at harvest, Berners Bay, regulatory years 1990 through 2000

Year							Age	Class								Total	%	Mean
	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	kill	aged	age
								Males											
1990	0	0	3	0	1	1	0	0	0	0	0	0	0	0	0	0	5	100	3.5
1991	0	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	5	100	3.3
1992	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	5	20	3.5
1993	0	1	2	1	1	1	1	0	0	0	0	0	0	0	0	0	7	100	4.3
1994	0	2	1	2	0	1	0	0	0	0	0	0	0	0	0	1	8	88	4.7
1995	0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	7	100	1.7
1996	0	5	1	0	0	1	0	0	0	0	0	0	0	0	0	0	7	100	1.7
1997	0	2	1	5	0	0	0	0	0	0	0	0	0	0	0	0	8	100	2.4
1998	0	2	3	0	0	0	0	0	2	0	0	0	0	0	0	0	8	88	3.4
1999	0	3	1	3	1	0	1	0	0	1	0	0	0	0	0	0	10	100	3.8
2000	0	0	2	2	3	0	0	0	0	0	0	1	0	0	0	0	8	100	4.6
								Females											
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	---
1991	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	5	100	1.8
1992	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	75	1.7
1993	0	1	0	2	0	0	1	0	1	1	0	1	0	0	0	0	7	100	5.9
1994	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	7	71	6.6
1995	0	1	1	1	2	0	0	1	0	0	0	0	0	0	0	0	6	100	3.5
1996	0	0	1	0	2	0	0	0	1	0	1	0	0	1	0	0	7	100	6.1
1997	0	1	0	3	2	0	0	0	0	0	1	0	0	0	0	0	7	100	4.0
1998	0	2	3	1	0	0	0	0	0	0	0	0	0	1	0	0	7	100	3.4
1999	0	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	5	100	2.3
2000	0	0	1	1	3	0	1	0	0	0	1	0	0	0	0	0	7	100	3.3

Table 3 Unit 1C moose age at harvest, excluding Berners Bay, regulatory years 1990 through 2000[1]

								Age	Class								Total	%	Mean
Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	kill	Aged	Age
									Chilkat Range										
1990	0	6	1	1	0	1	0	0	0	0	0	0	0	0	0	0	16	69	2.3
1991	0	3	0	2	0	0	0	0	1	0	0	0	0	0	0	0	6	100	3.3
1992	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	9	56	2.9
1993	0	5	0	2	3	0	1	0	0	0	1	0	0	0	0	0	17	71	3.8
1994	0	3	0	1	0	0	0	2	0	0	1	0	0	0	0	0	7	100	4.8
1995	0	3	3	2	0	0	2	1	1	1	0	0	0	0	0	0	14	93	4.4
1996	0	3	4	5	1	3	1	0	0	4	0	0	0	0	0	0	21	98	4.1
1997	0	5	0	3	1	1	0	1	0	1	0	0	0	0	0	0	13	92	3.3
1998	0	10	2	7	1	0	2	2	1	0	0	0	0	0	0	0	28	89	2.9
1999	0	5	3	0	1	1	0	0	0	0	0	0	0	0	0	0	11	91	2.5
2000	0	1	3	6	1	0	1	0	0	1	0	0	0	0	0	0	14	93	3.2
									Gustavus Forelands										
1990	0	1	2	2	1	0	1	0	0	0	0	0	0	0	0	0	8	88	3.5
1991	0	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	6	83	3.1
1992	0	1	2	1	1	1	0	1	0	0	0	0	0	0	0	0	11	64	3.9
1993	0	3	5	4	0	1	0	0	0	0	0	0	0	0	0	0	13	100	2.8
1994	0	7	4	1	1	3	0	0	1	0	0	0	0	0	0	0	20	85	3.1
1995	0	4	9	3	2	1	0	0	0	0	0	0	0	0	0	0	21	90	2.8
1996	0	18	5	4	1	1	0	0	0	0	0	0	0	0	0	0	30	97	2.2
1997	1	11	9	2	2	0	2	0	0	0	0	0	0	0	0	0	31	86	2.0
1998	2	24	10	5	3	0	0	0	0	0	0	0	0	0	0	0	48	92	1.4
1999	3	20	10	2	1	2	0	0	1	0	0	0	0	0	0	0	42	93	2.2
2000	0	23	8	9	4	2	0	0	0	0	0	0	0	0	0	0	47	98	2.2

[1] Does not include 2 cow moose taken illegally in Gustavus in 2000.

Table 3 continued

Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	Age 7.5	Class 8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% Aged	Mean Age
									Taku River										
1990	0	9	2	1	0	0	0	0	0	0	0	0	0	0	0	0	20	60	2.3
1991	0	5	4	1	0	0	0	1	0	0	0	0	0	0	0	0	14	78	3.1
1992	0	3	3	1	1	1	1	0	0	0	0	0	0	0	0	0	19	53	3.4
1993	0	3	4	1	3	1	0	0	0	0	0	0	0	0	0	0	15	73	2.9
1994	0	8	3	2	1	0	0	0	0	0	0	0	0	0	0	0	16	88	2.2
1995	0	7	4	0	1	1	1	0	0	0	0	0	0	0	0	0	14	100	2.6
1996	0	10	3	0	0	0	1	0	0	0	0	0	0	0	0	0	15	93	2.1
1997	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	6	83	3.1
1998	0	11	0	2	0	0	0	0	0	0	0	0	0	0	0	0	13	100	1.8
1999	1	9	4	1	0	0	0	0	0	0	0	0	0	0	0	0	17	88	1.8
2000	0	15	3	3	1	0	1	0	0	0	0	0	0	0	0	0	23	100	2.2

Table 4 Unit 1C moose hunter effort and success, regulatory years 1990 through 2000[1]

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits issued[1]	NR hunters	Total days	Avg. days	NR hunters	Total days	Avg. days	NR hunters	Total days	Avg. days
					Berners Bay					
1990	5	5	14	2.8	0	0	0.0	5	14	2.8
1991	10	10	20	2.0	0	0	0.0	10	20	2.0
1992	10	9	23	2.6	0	0	0.0	9	23	2.6
1993	15	14	29	2.1	1	7	7.0	15	36	2.4
1994	15	14	38	2.7	0	0	---	14	38	2.7
1995	15	13	40	3.1	1	6	6.0	14	46	3.3
1996	17	14	35	2.5	0	0	---	14	35	2.5
1997	15	15	42	2.8	0	0	0	150	42	2.8
1998	15	15	29	1.9	0	0	0	15	29	1.9
1999	18	16	43	2.7	0	0	0	16	43	2.7
2000	20	15	42	2.8	2	13	6.5	17	55	3.2
					Chilkat Range					
1990	331	16	57	3.6	94	267	2.8	106	350	3.3
1991	316	6	17	2.8	37	143	3.9	43	160	3.7
1992	317	9	41	4.6	62	234	3.8	71	275	3.9
1993	352	17	69	4.1	62	259	4.2	79	328	4.2
1994	346	7	15	2.1	47	173	3.7	54	188	3.5
1995	380	13	34	2.6	96	375	3.9	109	409	3.8
1996	396	17	31	1.8	65	308	4.7	82	339	4.1
1997	489	13	42	3.2	92	370	4.2	105	412	3.9
1998	441	28	85	3.0	58	190	3.3	86	275	3.2
1999	476	11	47	4.3	81	374	4.6	92	421	4.6
2000	455	14	47	3.4	82	326	4.0	96	373	3.9
					Gustavus Forelands					
1990[2]	---	8	26	---	NA	NA	---	NA	NA	---
1991	---	6	21	3.5	29	163	5.6	35	184	5.3
1992	---	11	38	3.5	36	163	4.5	47	201	4.3
1993	---	13	59	4.5	45	229	5.1	58	288	5.0
1994	---	20	96	4.8	64	281	4.4	84	377	4.5
1995	---	21	90	4.3	69	294	4.3	90	384	4.3
1996	---	30	115	3.8	65	331	5.1	95	446	4.7
1997	---	31	125	4.0	73	279	4.1	104	404	4.1
1998	---	48	139	3.0	71	255	3.7	119	394	3.4
1999	---	42	173	4.1	103	528	5.1	145	701	4.8
2000	---	47	183	3.9	85	396	4.7	132	579	4.4

[1] Total permit numbers include hunters without effort information. RY 2000 does not include 2 illegal cows and 1 duplicate permit.

Table 4 Continued

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits issued	NR hunters	Total days	Avg. days	NR hunters	Total days	Avg. days	NR hunters	Total days	Avg. days
					Taku River					
1990	---	20	89	4.5	94	339	4.0	114	424	4.0
1991	---	14	52	3.7	88	358	4.1	102	410	4.0
1992	---	19	79	4.2	104	409	3.9	123	488	4.0
1993	---	16	40	2.7	77	318	4.4	93	358	4.1
1994	---	17	40	2.4	70	323	4.8	87	363	4.3
1995	---	14	48	3.4	71	254	3.6	85	302	3.6
1996	---	15	57	4.4	85	320	3.8	100	377	3.8
1997	---	6	25	5.0	85	365	4.5	91	390	4.5
1998	---	14	49	3.5	47	219	4.7	61	268	4.4
1999	---	16	40	2.5	48	146	3.0	64	186	2.9
2000	---	23	49	2.1	45	162	3.6	68	211	3.1

[1] Number of registration permits shown for the Chilkat Range is the total number of permits issued for all of Unit 1C excluding Berners Bay; only permittees who hunted may be categorized to specific hunt areas.
[2] Effort information for unsuccessful hunters at Gustavus Forelands is combined with the Chilkat Range for 1990.

Table 5 Unit 1C moose historical harvests, number of hunters, and percent success, regulatory years 1990 through 2000

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% success
			Berners Bay			
1990	5	0	0	5	5	100
1991	5	5	0	10	10	100
1992	5	4	0	9	9	100
1993	7	7	0	14	15	93
1994	8	6	0	14	14	100
1995	7	6	0	13	14	93
1996	7	7	0	14	14	100
1997	8	7	0	15	15	100
1998	8	7	0	15	15	100
1999	10	5	0	15	16	94
2000	8	7	0	15	15	100
			Chilkat Range			
1990	16	0	0	16	106[1]	23
1991	6	0	0	6	47	13
1992	11	0	0	11	42	26
1993	17	0	0	17	90	19
1994	7	0	0	8	56	14
1995	13	0	0	13	109	12
1996	17	0	0	17	82	21
1997	13	0	0	13	105	12
1998	28	0	0	28	86	33
1999	11	0	0	11	100	11
2000	14	0	0	14	105	13
			Gustavus Forelands			
1990	8	0	0	8	n/a	n/a
1991	6	0	0	6	35	17
1992	9	0	0	9	47	19
1993	13	0	0	13	58	22
1994	19	0	0	19	84	23
1995	21	0	0	0	90	23
1996	30	0	0	29	95	31
1997	30	1[1]	0	31	104	29
1998	47	1[1]	0	48	118	40
1999	41	1[1]	0	42	146	29
2000	46	3[1]	0	49	132	37

[1]Documented illegal kills.

Table 5 continued

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% success
			Taku River			
1990	20	0	0	20	114[2]	18
1991	14	0	0	14	102	14
1992	19	0	0	19	123	15
1993	16	0	0	16	93	17
1994	17	0	0	17	87	18
1995	14	0	0	14	85	16
1996	15	0	0	15	97	15
1997	6	0	0	6	91	15
1998	14	0	0	14	61	23
1999	16	0	0	16	65	25
2000	23	0	0	23	69	33

[1.] Twelve of 106 hunters were assigned to the Chilkat Range (based on proportion hunting in each area), as they reported no specific area within Unit 1C.

[2] Twelve of 114 hunters were assigned to the Taku River (based on proportion hunting in each area) as they reported no specific area within Unit 1C.

Table 6 Unit 1C annual moose kill by community of residence, regulatory years 1990 through 2000

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
				Berners Bay					
1990	5	0	5	0	0	0	0	0	0
1991	10	0	9	0	0	0	1	0	0
1992	9	0	9	0	0	0	0	0	0
1993	14	0	13	0	0	0	1	0	0
1994	14	0	13	0	0	0	1	0	0
1995	13	0	11	0	0	0	0	2	0
1996	14	0	14	0	0	0	0	0	0
1997	15	0	13	1	0	0	0	0	1
1998	15	0	12	1	0	1	1	0	0
1999	15	0	14	0	0	0	1	0	0
2000	15	0	14	0	0	1	0	0	0
				Chilkat Range					
1990	16	0	13	0	0	0	3	0	0
1991	6	0	6	0	0	0	0	0	0
1992	9	0	8	0	0	0	1	0	0
1993	17	0	11	0	0	0	5	1	0
1994	7	0	6	0	0	0	0	1	0
1995	13	2	10	0	0	0	0	1	0
1996	17	0	14	0	0	0	0	3	0
1997	13	0	12	0	0	0	0	1	0
1998	28	1	20	0	0	0	1	6	0
1999	11	0	7	0	0	0	0	2	1
2000	14	1	10	1	0	0	0	1	1
				Gustavus Forelands					
1990	8	7	1	0	0	0	0	0	0
1991	6	6	0	0	0	0	0	0	0
1992	11	10	0	0	0	0	0	0	1
1993	11	2	0	0	0	0	0	0	0
1994	20	15	4	0	0	0	0	0	1
1995	21	13	7	0	0	0	0	1	0
1996	30	22	7	0	0	0	0	0	1
1997	31	20	7	1	0	0	0	2	1
1998	48	27	16	1	0	0	1	2	1
1999	42	21	13	0	0	0	1	6	1
2000	49	29	15	0	0	0	1	3	1

Table 6 continued

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
					Taku River				
1990	20	0	18	1	0	1	0	0	0
1991	14	0	13	0	0	1	0	0	0
1992	19	0	15	0	0	2	0	1	1
1993	15	0	12	0	0	2	1	0	0
1994	17	0	10	0	0	2	0	2	0
1995	14	0	12	1	0	0	0	1	0
1996	15	1	14	0	0	0	0	0	0
1997	6	0	5	1	0	0	0	0	0
1998	14	0	13	1	0	0	0	0	0
1999	17	0	16	1	0	0	0	0	0
2000	28	0	21	1	1	0	0	0	0

Table 7 Unit 1C successful moose hunters transport methods, regulatory years 1993 through 2000

	Airplane		Boat		3 or 4 wheeler		Hwy vehicle		Foot	
Year	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
					Berners Bay					
1993	0	---	14	(100)	0	---	0	---	0	---
1994	0	---	14	(100)	0	---	0	---	0	---
1995	1	(8)	12	(92)	0	---	0	---	0	---
1996	1	(7)	13	(93)	0	---	0	---	0	---
1997	0	---	15	(100)	0	---	0	---	0	---
1998	0	---	15	(100)	0	---	0	---	0	---
1999	0	---	15	(100)	0	---	0	---	0	---
2000	0	---	15	(100)	0	---	0	---	0	---
					Chilkat Range					
1993	5	(29)	12	(71)	0	---	0	---	0	---
1994	0	---	7	(100)	0	---	0	---	0	---
1995	5	(38)	8	(62)	0	---	0	---	0	---
1996	9	(53)	8	(47)	0	---	0	---	0	---
1997	6	(46)	7	(54)	0	---	0	---	0	---
1998	9	(32)	19	(68)	0	---	0	---	0	---
1999	8	(73)	3	(27)	0	---	0	---	0	---
2000	7	(50)	7	(50)	0	---	0	---	0	---
					Gustavus Forelands					
1993	1	(8)	4	(31)	1	(8)	4	(31)	3	(23)
1994	1	(5)	3	(15)	0	---	11	(55)	5	(25)
1995	3	(14)	7	(33)	0	---	2	(10)	0	---
1996	1	(3)	7	(23)	3	(10)	4	(13)	12	(40)
1997	0	---	9	(31)	0	---	4	(14)	16	(55)
1998	0	---	10	(21)	0	---	21	(44)	17	(35)
1999	5	(12)	9	(22)	1	(2)	14	(34)	12	29
2000	5	(11)	6	(13)	1	(2)	20	(43)	14	(30)
					Taku River					
1993	4	(25)	11	(69)	0	---	0	---	1	(6)
1994	3	(18)	14	(82)	0	---	0	---	0	---
1995	2	(14)	12	(86)	0	---	0	---	0	---
1996	6	(33)	12	(67)	0	---	0	---	0	---
1997	0	---	6	(100)	0	---	0	---	0	---
1998	0	---	14	(100)	0	---	0	---	0	---
1999	0	---	17	(100)	0	---	0	---	0	---
2000	2	---	21	(100)	0	---	0	---	0	---

Table 8 Unit 1C moose hunters commercial services use, regulatory years 1991 through 1998

Year	Unit residents		Other AK residents		Non-residents		Total use			Non-	
	No	Yes	No	Yes	No	Yes	No	Yes	Transport	guided services	Other services
					Berners Bay						
1991	6	2	0	0	0	0	6	2	0	0	2
1992	9	1	0	0	0	0	9	1	0	0	1
1993	13	0	1	0	0	0	14	0	0	0	0
1994	11	0	1	0	0	0	12	0	0	0	0
1995	13	0	1	0	0	0	14	0	0	0	0
1996	12	1	0	0	0	0	12	1	1	0	0
1997	13	0	1	0	0	1	14	1	1	0	0
1998	12	0	2	1	0	0	14	1	0	0	1
1999	15	1	0	0	0	0	15	1	0	0	0
2000	15	0	2	0	0	0	17	0	0	0	0
					Chilkat Range						
1992	88	6	12	4	0	1	100	11	10	1	0
1993	37	2	20	7	0	0	57	10	5	3	2
1994	26	5	19	0	0	0	45	4	0	0	0
1995	72	2	29	0	0	0	101	2	2	0	0
1996	56	5	13	0	0	0	64	5	5	0	0
1997	66	4	13	0	1	3	80	7	7	0	0
1998	70	1	11	4	0	0	81	5	5	0	0
1999	74	7	4	2	0	1	78	10	10	0	0
2000	57	5	11	1	0	2	68	8	8	0	0
					Gustavus Forelands						
1992	8	0	0	0	0	0	8	0	0	0	0
1993	55	4	3	0	0	0	58	4	4	0	0
1994	81	1	0	0	1	0	82	2	2	0	0
1995	80	0	10	0	0	0	90	0	0	0	0
1996	78	3	12	1	0	1	95	5	5	0	0
1997	81	2	7	0	1	2	89	4	1	2	1
1998	104	2	9	0	1	0	114	2	2	0	0
1999	107	2	5	1	1	0	113	3	3	1	0
2000	100	3	4	0	3	0	107	3	3	0	0
					Taku River						
1992	56	8	8	2	0	0	64	10	7	0	3
1993	61	7	71	7	0	0	132	14	12	2	0
1994	50	4	23	3	0	0	73	7	7	0	0
1995	70	5	9	0	0	0	79	5	3	0	2
1996	71	5	3	1	0	2	74	8	2	2	4
1997	60	6	4	0	0	0	64	6	5	0	1
1998	53	3	4	0	0	0	57	3	3	0	0
1999	53	1	6	0	1	0	56	1	1	0	0
2000	53	1	3	0	0	0	56	1	0	1	0

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 1D (2,700 mi^2)

GEOGRAPHICAL DESCRIPTION: That portion of the Southeast Alaska mainland lying north of the latitude of Eldred Rock, excluding Sullivan Island and the drainages of Berners Bay.

BACKGROUND

Most Unit 1D moose inhabit the Chilkat River watershed and the Chilkat Peninsula. Within this area there is an estimated 200–250 mi^2 of summer range and 110–120 mi^2 of winter range, including 80 mi^2 of preferred winter range. Small areas of moose habitat are also located in the Chilkoot, Katzehin, and Warm Pass valleys, and along the western shore of Lynn Canal (ADF&G 1990).

Moose immigrated to the Chilkat River Valley from drainages in Canada around 1930. Moose populations peaked in the Chilkat Valley in the mid 1960s, when as many as 700 animals may have been present (ADF&G 1991). By the early 1970s the moose population had sharply declined to 400–500 animals, possibly because of overutilization of the range and overharvest. Survey data collected during the mid 1980s suggested that the herd had declined to 400 animals. Recent surveys suggest that the moose population is now between 300 and 400 animals.

Unit 1D residents have expressed concern over the decrease in moose numbers, the subsequent decline in hunting opportunity, and the "stampede" nature of registration permit hunts with low harvest quotas. Harvest objectives have been formulated based on survey data and harvest trends. Regulations were introduced (a spike-fork/50-inch/3 brow tine requirement) to slow the pace of the hunt, but these were preempted when a Tier II subsistence hunt was implemented by the Board of Game (BOG) for the 1990 season. Widespread dissatisfaction with the allocation of 20 Tier II permits and concern over the status of the herd contributed to local opposition to holding a hunt in 1991, and no permits were issued that year. In 1992 the season was closed by emergency order before Tier II permits were issued.

In March 1993 the BOG authorized a Tier II antler restriction hunt for Unit 1D. This hunt allowed more hunter opportunity while affording protection to bulls that did not meet antler requirements. The objective is to spare a large proportion of the young and middle-aged bulls from harvest to strengthen the breeding age segment of the population while still allowing many local hunters the opportunity to harvest a moose.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Population management objectives identified by staff for Unit 1D are as follows:

1. Maintain a post-hunt population of 350 moose;
2. Maintain a post-hunt bull-to-cow ratio of 25:100;
3. Allow for 200 hunters expending 600 hunter days; and
4. Reach a harvest of 25 moose with a hunter success rate of 12%.

METHODS

Chilkat River valley aerial surveys were conducted in February 2000 and December 2000 (Table 1). Areas covered included the Chilkat River valley from Murphy Flats to Turtle Rock, and the Klehini, Takhin, Tsirku, Kelsall, and Chilkoot river valleys.

Each year, prior to the moose hunt we held an informational meeting in Haines to discuss the identification of legal and non-legal moose. We showed the video “Is This Moose Legal?” to help hunters interpret the spike-fork/50-inch/3 brow tine regulation used to manage the Unit 1D hunt.

In 1999 and 2000 we maintained a moose check station in Haines and required hunters to check in harvested moose within 2 days of the kill. Incisors were collected from harvested moose as a condition of the Tier II permit. All permittees were also required to turn in a hunt report card specifying if they hunted, hunt duration, hunt location, transport means (for all hunters), and date of kill (for successful hunters). We also collected data on antler measurements and configurations.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We conducted winter surveys in February and December 2000. During the February survey, 75 moose were counted under poor viewing conditions (Table 1). In December 2000, under excellent viewing conditions, 222 moose were enumerated and approximately half were classified by age and sex. We believe moose in the Chilkat Valley number between 300 and 400 animals.

Population Composition

We did not obtain complete sex and age composition information during the February 2000 survey. Bulls had shed their antlers and visibility was poor because of patchy snow cover. We classified most adult moose as sex unknown, and listed only those adults accompanied by calves as females (Table 1). Our December 2000 survey was flown earlier than the previous winter and under better visibility conditions, and we were able to classify approximately half of the moose we saw. We classified as calves 15.7% of the moose seen on this survey, similar to percentages seen in previous years. The minimal bull-to-cow ratio was determined to be 18:100. Mean age at harvest was 4.1 years during this report period, a decrease from the mean age of 5.6 and 4.2 years during the previous 2 report periods.

It is interesting to compare the age at harvest from the 1980s to the post-Tier II era (1993) and to the present. While the mean age was less than 4 years old for the seasons during 1983 through 1989 (when any bull was legal), the mean age was greater than 5 years old from 1993 through 1995 (immediately after the antler restriction regulation was implemented). The mean age has been around 4 years old during 1996–2000. The age distribution of animals harvested from 1993–1995 is skewed towards older animals, most likely a result of the spike–fork/50–inch/3 brow tine regulation implemented in 1993, and the fact that no hunts were held during 1991 and 1992. The increase in older bulls available after 2 closed seasons provided for a harvest of older animals for a time, but since then the mean age has declined.

MORTALITY

Harvest

Season and bag limit	Resident hunters	Nonresident hunters
1 bull with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on one side by Tier II subsistence hunting permit only; up to 200 permits may be issued	Sept. 15–Sept. 30 (Subsistence hunt only)	No open season.

Game Board Actions and Emergency Orders: During both years of this report period, Unit 1D moose hunting remained open for the entire 2-week season. In addition to the limiting aspects of a spike-fork/50-inch/3 brow tine hunt, we also managed for a harvest guideline of 25 bulls.

Hunter Harvest: In this period, 1999–2000, the mean annual harvest was 19 moose, similar to 18 moose during 1997–1998, but substantially lower than the mean harvest of 27 during 1995–1996. Some of the variation in harvest is due to weather conditions changing hunting patterns, and not a reflection of the population size.

Permit Hunts: All moose hunting in Unit 1D is administered under a Tier II subsistence permit system. Two hundred permits were issued during each year (Table 3), but the number of applicants declined from 293 in 1997 to 262 in 1999. In 2000, the number of applicants increased to 301.

Hunter Residency and Success: During the report period local residents were the primary Unit 1D moose hunters, although all Alaskans were eligible to apply for this (or any other Tier II hunt). Residents of Haines or Klukwan (Table 4) took 19 of the 21 moose harvested in 1999 and 16 of the 18 moose harvested in 2000. Hunter success was 12% during this and the previous report period, a decline from the mean of 17% reported during 1995–1996 (Table 5). Successful hunters took an average of 4.1 days per kill in 1999 and 2000 (Table 3). Total hunter days expended were 1,059 in 1999 and 895 in 2000 (Table 3), nearly double the hunter days expended from 1992–1994. The increase in hunter days in recent years is partly due to the guideline harvest not being reached, allowing the season to run its two week length. This is also reflected in an increase in number of days hunted by successful hunters.

Harvest Chronology: Since 1995 the opening date of the Tier II moose season has been 2 weeks earlier than former years, beginning on 15 September rather than 1 October. Because of this earlier start date, it can be difficult for hunters to locate and positively identify a legal bull due to the presence of leaves on trees and shrubs.

Transport Methods: Most Unit 1D moose hunters use boats or highway vehicles (Table 6). During the 1999 and 2000 hunting seasons, 71% and 67% of successful hunters used boats, respectively. Nearly all of the remaining successful hunters used highway vehicles (Table 6).

Commercial Services: Only 4 hunters used commercial services during the report period (Table 7). This is not surprising because virtually all hunters reside within or very near the subunit, and are well equipped for moose hunting. Also, many hunters have hunted together for a number of years, and in some instances share transportation and camps.

Other Mortality: Unit 1D residents have suggested that the local brown bear population has increased in recent years, and that bear predation on moose calves may be partly responsible for low recruitment rates observed. Data is not available to support this contention. During this report period, aerial surveys documented calf percentages similar to those seen in recent years, and predation is not indicated as a problem. In some years deep snow undoubtedly contributes to calf mortality, although conditions during this report period were relatively mild. Deteriorating range conditions may also play a role in low calf production and survival (Hundertmark et al., 1983).

The abundance of willows adjacent to the Haines Highway has led to several moose/vehicle collisions over the years. However, we have not collected information on these kills consistently over time, nor have we been able to obtain jaws, and thus ages, from these moose. We estimate about 4 moose are struck and killed by highway vehicles in the subunit each winter.

Poaching occurs, but the number of moose lost to this activity is not known. There is some degree of unreported harvest of illegal bull moose that are shot and left by hunters, although we believe that this number is relatively small.

Habitat: Nearly all moose habitat in this subunit lies within the Haines State Forest, managed under multiple-use guidelines of the 1986 Haines State Forest Management Plan. The plan's goals include an annual timber harvest of up to 8.8 million board feet (approximately 300 to 580 acres), at a rotation rate of 125 years. While some increased browse production may occur in logged areas, the extent, duration, and value of deciduous reproduction in these areas has not been determined. The long-term usefulness of cutover areas to moose will be reduced if timber harvest occurs in high-value wintering areas, and if cutover areas are managed to produce second-growth coniferous stands rather than deciduous browse species. It is also important to note that in Southeast Alaska it has not been determined how important coniferous stands are for moose during periods of deep snow, when they may provide critical escape cover from predation and better foraging opportunities.

Habitat changes within non-forested portions of the area are also of concern. Research in the early 1980s showed a low proportion of young willow plants in shrub stands in the Chilkat River valley, and it is suspected that post-glacial land uplift (isostatic rebound) is causing permanent habitat change. Removal of decadent alder and cottonwood overstories in order to release willow, red-osier dogwood, and other browse species may counteract long-term changes, at least for awhile. There is some degree of local interest in mechanically changing vegetation in areas close to Haines, but no efforts have been made to date.

CONCLUSIONS AND RECOMMENDATIONS

The management objectives listed at the beginning of this report were adopted from the Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94 (ADF&G, 1991). We were not able to collect data needed to determine the bull-to-cow ratio due to the date of our surveys. We believe we were close to the objective of maintaining a population of 350 moose, based on our aerial survey information. The harvest objective of 25 bulls was not met. The number of hunter-days was half again higher than the objective. We met the objective of a 12% hunter success rate.

The effect of predation upon moose calf survival in this area is unknown. An apparently healthy brown bear population (as well as a less prominent black bear population) may account for substantial summer mortality, according to anecdotal accounts. Winter wolf predation does not appear to be a serious problem except when moose movements are restricted by extremely deep snow.

McCarthy (ADF&G, 1990) called for investigation into the relationship between timber harvest and moose habitat in the Chilkat River valley. Other means of converting decadent hardwood stands to encourage growth of browse species should be pursued and tried on a pilot basis, while maintaining adequate coniferous growth to serve as escape cover.

Recent surveys suggest that moose numbers in Unit 1D are no longer declining, and that the present regulatory structure supports a population concomitant with habitat capabilities. Predation, deep snows, and mediocre habitat point to the need for regular surveys to better understand the status and trend of the population.

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Table 1 Unit 1D moose aerial survey data, regulatory years 1982 through 2000

Regulatory year	Total males	Total females	Total calves	Unk	Total moose	Count time (hrs)	Bulls per 100F	Calves per 100F	Calves % in herd	Moose per hour
1982	34	115	51	---	200	4.8	30	44	36	42
1983	16	148	47	---	211	5.8	11	32	22	36
1984	15	135	37	---	187	5.2	11	27	20	36
1985	23	155	29	---	207	5.5	15	19	14	38
1986	33	93	13	---	139	3.5	36	14	14	40
1987[1]	---	---	29	174	203	---	---	---	14	53
1988[2]	---	---	31	206	252	4.4	---	---	12	57
1989	18	45	10	---	73	1.5	40	22	14	48
1990[3]	18	67	6	---	91	3.5	30	9	7	26
1991	23	138	22	---	183	7.8	17	17	13	23
1992	27	98	21	---	149	2.9	28	21	14	52
1993	---	---	19	157	176	5.8	---	---	11	31
1994	41	77	27	---	149	4.3	53	35	18	35
1995					No survey					
1996	48	121	31	7	207	3.8	40	26	16	54
1997	10	37	36	115	198	4.1	---	---	18	48
1998	20	23	25	103	171	5.2	---	---	15	39
1999[4]	---	4	4	67	75	4.9	---	---	---	15
2000	28	30	35	129	222	5.5	18	22	15.7	56

[1]Late winter survey, sex and age ratios unreliable. In a second late winter survey, a total of 215 moose (29 calves) were counted at a rate of 57 moose per hour.
[2]Late-winter survey, sex and age ratios unreliable.
[3]Numbers are for 12/14/1990 survey. A second survey, flown only in the Chilkat Valley on 3/22/1991, resulted in a total count of 28 moose in 2.9 hours.
[4]Marginal survey conditions, minimal composition information.

Table 2 Unit 1D age structure of harvested moose, regulatory years 1983 through 2000

Year	Age class 0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% aged	Mean age
1983	1	3	7	10	6	0	1	2	0	1	0	0	0	0	0	0	62	50	3.8
1984	2	15	12	2	2	1	0	0	0	0	0	0	0	0	0	0	36	94	2.3
1985	0	7	4	1	0	1	0	0	0	0	0	0	0	0	0	0	14	93	2.3
1986	Season closed																		
1987	0	3	6	7	3	1	0	0	0	0	0	0	0	0	0	0	22	91	3.2
1988	0	6	5	3	1	1	1	0	0	0	0	0	0	0	0	0	18	94	2.9
1989	0	10	5	2	2	0	0	0	0	0	0	0	0	0	0	0	18	100	2.3
1990																	19	0	---
1991–1992	Season closed																		
1993	0	2	3	3	4	2	3	1	4	0	1	0	1	0	0	0	24	100	5.1
1994[1]	0	0	0	1	1	8	2	2	0	0	0	0	1	0	0	0	17	94	5.7
1995	0	0	1	5	4	3	5	3	3	1	2	0	0	0	0	0	27	100	5.6
1996	0	5	2	3	2	4	2	2	1	1	0	0	0	0	0	0	27	78	4.0
1997	0	2	0	3	6	1	1	1	0	1	0	0	0	0	0	0	15	88	4.1
1998	0	4	2	0	7	2	0	1	0	1	2	0	0	0	0	0	19	100	4.3
1999	0	6	2	3	2	3	2	0	2	0	1	0	0	0	0	0	21	100	3.8
2000	0	2	4	1	2	3	3	0	2	0	0	0	0	0	0	0	18	95	4.1

[1]Does not include an illegally harvested bull, age 3.

Table 3 Unit 1D moose hunter effort and success, regulatory years 1983 through 2000

Year	Permits issued	Successful hunters # hunters	Successful hunters Total # days	Successful hunters Avg. # days	Unsuccessful hunters # hunters	Unsuccessful hunters Total # days	Unsuccessful hunters Avg. # days	Total hunters # hunters	Total hunters Total # days	Total hunters Avg. # days
1983	---	62			292			354		
1984	---	35	149	4.3	314	1540	4.9	349	1,689	4.8
1985	---	14	43	3.1	29	109	3.8	43	152	3.5
1986					Season closed					
1987	294	22	22	1.0	208	208	1.0	230	230	1.0
1988	259	18	18	1.0	188	188	1.0	206	206	1.0
1989	272	18	18	1.0	208	208	1.0	226	226	1.0
1990	20	19	48	2.5	1	7	7.0	20	55	28
1991–1992					Season closed					
1993	176	24	45	1.9	83	182	2.3	107	227	2.2
1994	200	17	20	1.2	130	284	2.2	147	304	2.1
1995	200	27	58	2.1	130	401	3.1	157	459	3.0
1996	181	24	70	3.3	121	735	6.1	145	805	5.7
1997	200	17	50	3.8	130	891	6.9	145	941	6.6
1998	200	19	79	4.4	146	976	6.8	164	1,055	6.5
1999	200	21	87	4.1	137	972	7.1	158	1059	6.7
2000	200	18	74	4.1	138	821	5.9	156	895	5.7

Table 4 Unit 1D annual moose kill by community of residence, regulatory years 1984–2000

Regulatory year	Total kill	Haines	Skagway	Juneau	Sitka	Other Alaska	Non-resident
1984	35	23	1	7	2	1	0
1985	14	14	0	0	0	0	0
1986				Season closed			
1987	22	22	0	0	0	0	0
1988	18	18	0	0	0	0	0
1989[1]	18	18	0	0	0	0	0
1990	19	19	0	0	0	0	0
1991–1992				Season closed			
1993	24	22	0	2	0	0	0
1994	17	17	0	0	0	0	0
1995	27[2]	26	0	1	0	0	0
1996	27[3]	23	0	0	0	1	0
1997	17	16	0	1	0	0	0
1998	19	18	0	1	0	0	0
1999	21	19	0	2	0	0	0
2000	18	16	0	1	0	1	0

[1]Includes 3 illegally harvested bulls.
[2]Includes 1 illegally harvested bull, 1 unrecovered bull, and 2 illegally harvested cows.
[3]Data are only available for 51 of the 54 moose listed for 1995/96.

Table 5 Unit 1D historical moose harvests, number of hunters, and percent success, regulatory years 1980 through 1998

Regulatory year	NR males	NR females	NR unknown	Total kill	NR hunters	Percent success
1980	48	0	0	48	342	14
1981	36	2	0	38	315	11
1982	24	1	0	25	267	9
1983	62	0	0	62	354	17
1984	35	1	0	36	349	10
1985	14	0	0	14	43	33
1986			Season closed			
1987	22	0	0	22	230	10
1988	18	0	0	18	206	9
1989	18	1	0	19	226	8
1990	19	0	0	19	20	95
1991–1992			Season closed			
1993	24	0	0	24	107	22
1994	17	0	0	17	147	12
1995	27[1]	0	0	27	157	17
1996	25	2	0	27	145	17
1997	17	0	0	17	145	12
1998	19	19	0	19	164	12
1999	21	0	0	21	163	13
2000	18	0	0	18	160	11

[1]Includes 2 illegal bulls, one unrecovered bull, and 2 cows, these show up in the total kill of 27.

Table 6 Unit 1D transport methods used by successful moose hunters, regulatory years 1987 through 2000

	Airplane		Boat		ORV		Highway vehicle		Other	
Year	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
1987	3	(14)	12	(12)	1	(5)	6	(27)	0	---
1988	0	---	16	(88)	1	(6)	1	(6)	0	---
1989	2	(11)	10	(55)	2	(11)	4	(22)	1	(1)
1990	0	---	10	(58)	0	---	7	(37)	2	(8)
1991–1992	Season closed									
1993	0	---	13	(54)	0	---	10	(45)	1	(4)
1994	0	---	13	(81)	0	---	3	(19)	0	---
1995	0	---	5	(22)	0	---	15	(65)	3	(13)
1996	3	(13)	10	(42)	0	---	10	(42)	1	(4)
1997	0	---	10	(71)	0	---	4	(29)	0	---
1998	1	(6)	11	(65)	2	(8)	3	---	0	---
1999	2	(10)	15	(71)	0	(0)	4	(19)	0	(0)
2000	0	(0)	12	(67)	2	(11)	4	(22)	0	(0)

Table 7 Unit 1D commercial services used by moose hunters, regulatory years 1993 through 2000

	Unit residents		Other AK residents		Total use		Other
Year	No	Yes	No	Yes	No	Yes	services
1993	60	1	3	1	73	2	2
1994	104	1	3	0	107	1	1
1995	97	0	3	0	100	0	0
1996	82	1	5	0	87	1	0
1997	76	2	3	0	79	2	0
1998	133	1	6	0	139	1	0
1999[1]	126	2	15	0	141	2	1
2000[2]	132	1	12	1	144	2	1

[1] Eleven percent did not report whether or not they used commercial services.
[2] Seven percent did not report whether or not they used commercial services.

Table 8 Unit 1D moose harvest by Wildlife Analysis Areas (WAA), regulatory years 1990 through 2000

Year	WAA								
	4302	4303	4304	4405	4406	4407	4408	Unknown	Total
1990	7	7	2	0	0	0	0	3	19
1991–1992			No season						---
1993	7	13	0	0	0	0	0	4	24
1994	5	10	0	0	0	0	0	2	14
1995	13	6	0	0	0	0	0	8	27
1996	8	8	0	3	0	0	0	3	22
1997	6	4	1	0	0	0	0	3	14
1998	10	2	0	0	0	0	0	6	18
1999	6	5	0	0	0	0	2	8	21
2000	6	5	0	0	0	0	2	5	18

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 3 (3,000 mi^2)

GEOGRAPHIC DESCRIPTION: Islands of the Petersburg, Kake, and Wrangell area.

BACKGROUND

Isolated populations of moose (*Alces alces*) occur on the major islands of Unit 3 and are believed to be the *andersonii* subspecies. Moose on the Unit 3 islands emigrated in the past several decades from the Stikine and possibly Thomas Bay populations on the Unit 1B mainland. Increased sightings during the 1980s and 1990s suggest that moose populations and distribution are increasing in the Unit.

HABITAT DESCRIPTION

Because Unit 3 moose appear to depend on deciduous vegetation in clearcut areas rather than the more persistent riparian or glacial forelands vegetation typical of most Southeast Alaska moose range, it is unclear whether a viable population can be sustained over the long term.

Unit 3 moose habitat consists primarily of old-growth spruce-hemlock forest and clearcut areas. Extensive clearcutting on many of the islands has resulted in early successional vegetation that may temporarily provide good moose browse. No estimate has been made of the amount or quality of moose range in the unit.

HUMAN-USE HISTORY

Regulation History

From 1960 through 1967 the Unit 3 moose season was open from September 15 through October 15 with a one-bull limit. The season was closed from 1968 until 1990 when the season reopened on Wrangell Island from October 1 through 15, with a one-bull bag limit, a spike-fork or 50” antler restriction, and a harvest ticket requirement. In 1991 the season reopened on Mitkof Island from October 1 through 15 with a one-bull bag limit, a spike-fork or 50” antler restriction, and a harvest ticket requirement. In 1993, the remainder of Unit 3 was opened from October 1 through 15 with a one-bull bag limit, a spike-fork, 3-brow tine or 50” antler restriction, and a registration permit required throughout the unit. From 1995 to present, the season dates have been September 15 through October 15.

Action by the Board of Game effective July 1, 1995 put all of Units 1B and 3 and that portion of Unit 1C south of Point Hobart under a common registration permit hunt (RM038). A legal moose for this hunt is a bull with a spike/fork or 50-inch antlers or 3 brow tines on at least one side.

Historical harvest patterns

The average annual harvest from 1990 through 1998 was 18 bulls, although during 1990 the season was open only on Wrangell Island, and during 1991 and 1992 the season was opened only on Wrangell and Mitkof islands. Between 1993 (the year the entire unit opened to moose hunting) and 1998, the average annual harvest was 22 bulls.

Unit 3 moose harvest chronology has varied. Most bulls are killed during the first half of the season and the harvest rate declines as the season progresses (Table 2). Most hunters are in the field early in the season, then effort drops except on weekends. Inclement weather does not seem to reduce hunting effort early in the season.

Historical harvest locations

In 1990, the year the season first opened in Unit 3, moose hunting was restricted to Wrangell Island and 3 bulls were killed. In 1992 and 1993, the season was opened on both Wrangell and Mitkof islands, and a total 10 and 17 bulls were harvested, respectively. Since 1993, the year all of Unit 3 was opened to moose hunting, the majority of moose harvested in the unit have come from Mitkof and Kupreanof islands.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

During the formulation of the Region I moose plan in the late 1980s (ADF&G 1990), we were unaware that by the mid 1990s a moose population would be established in Unit 3 capable of supporting an annual harvest. Harvesting a Unit 3 moose is often opportunistic, and habitat management and road construction will undoubtedly have greater effect on moose numbers and hunting opportunity compared to other factors. We cannot estimate how long Unit 3 habitat will support a viable moose population. The issue of a rebuilding Sitka black-tailed deer populations on the Unit 3 islands compounds the complexity of establishing moose management goals. Moose numbers are presently high enough to support a hunting season in Unit 3, and we intend to continue the hunt as long as it does not affect the integrity of the population. We have established the following draft goals for Unit 3 moose, which includes a crude estimate of the population size, limited knowledge of habitat utilization and moose movements, and anecdotal information from people in the field.

ADF&G first set management objectives for Unit 3 moose in 1996. Prior to that year the harvest was sporadic and we were unsure how persistent the population or harvest would be. After five years when the annual harvest increased from 8 moose to as many as 19 and hunter participation grew from 24 to nearly 400 hunters, we decided some preliminary management objectives were necessary. However, ADF&G has never tried to estimate the Unit 3 moose population by aerial survey because of the difficulty of seeing moose in a mostly forested landscape. Consequently, in succeeding years when harvest and hunter numbers continued to increase it became apparent that more moose inhabited the islands than was originally thought. Objectives were increased to match the apparent capacity of the herd to sustain the increased harvest and effort.

Unit 3:

	Plan Objective	1999	2000
Post hunt numbers	400	N/A	N/A
Annual hunter kill	40	26	31
Number of hunters	470	492	504
Hunter-days of effort	2,300	3,194	3,236
Hunter success	10%	5%	6%

METHODS

Hunters and harvested moose were opportunistically checked in the field. Additionally, hunters were required to bring antlers of harvested moose to ADF&G to verify compliance with antler restrictions. Hunters were also required to summit the lower jaw of harvested moose for aging purposes. Since 1997 hunters have been asked to report on their registration permit reports the total number of moose (by sex and age class), wolves, and bears they observed during the hunting season.

RESULTS AND DISCUSSION

Because so little is known about Unit 3 moose – their permanence or their ability to sustain a hunt – objectives have been set at current levels of harvest, effort, and success. ADF&G considers the Unit 3 hunt to be an opportunistic hunt on a population whose permanence is unknown because it relies on atypical habitat. Without information on the current population or habitat-carrying capacity, population objectives are only speculative. Without that information we have supported only hunts with self-limiting regulations (such as spike-fork/50"/3 brow-tine antler restrictions). We believe such hunts enable the population to thrive as permitted by the carrying capacity of the habitat while providing hunting opportunity. Long-term persistence of Unit 3 moose may depend upon a major habitat enhancement program or continued clearcut logging which may be detrimental to deer populations. ADF&G is currently unwilling to take such a pro-active approach. Our current objectives are to "passively manage" the hunt, keeping seasons open as long as moose appear to be abundant, noting harvest and hunter effort, but not actively attempting to increase them.

POPULATION STATUS AND TREND

Population Size

Data are insufficient to make a quantitative determination of the Unit 3 moose population. We believe Unit 3 moose numbers are at low-to-moderate density and appear to be increasing.

The Unit 3 moose population is the most enigmatic in Southeast Alaska. Numbers, distribution, sex and age ratios, calf-to-cow ratios, and other population characteristics are unknown. No surveys have ever been conducted in Unit 3. Dense forest cover and the lack of any winter concentration areas make aerial surveys impractical. Harvest data and anecdotal information collected by ADFG wildlife biologists over a period of many years continue to suggest an expanding population. Densities seem to be the greatest on Mitkof and eastern Kupreanof islands. Information is insufficient, however, to accurately estimate moose numbers in the unit. Predators, including wolves and black bears, exist on most islands in the unit, and a few brown bears exist on some islands close to the mainland, but the extent of predation is unknown.

Population Composition

No aerial surveys of moose populations have been conducted in the unit. Information on the number of moose observations reported by hunters on registration hunt report cards provides the only available information on population composition. In 1999, a total of 493 hunters reported observing a total of 1330 moose, including 410 bulls, 584 cows, and 336 calves, for a bull-to-cow ratio of 70:100, and a calf-to-cow ratio of 58:100. In 2000, 504 hunters reported observing a total of 1241 moose, including 454 bulls, 517 cows, and 270 calves, for a bull-to-cow ratio of 88:100, and a calf-to-cow ratio of 52:100.

Distribution and Movements

Moose appear to be expanding their range in Unit 3 despite the lack of deciduous riparian vegetation typical of most moose habitat in the region. Moose have been seen crossing Dry Straits between Farm Island on the Stikine River delta and Mitkof Island. At low tide this strait can be crossed easily and moose are reported to move in both directions. Moose appear to be well distributed on Mitkof, Wrangell, and Kupreanof islands. Moose have become well established, and their numbers appear to be increasing on Etolin, Zarembo, and Kuiu islands.

MORTALITY

Harvest

Season and Bag Limit	Nonresident and resident hunters
Unit 3	Sept. 15–Oct. 15 (General hunt only except in Stikine Drainage)
1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on one side by registration permit only	

Game Board Actions and Emergency Orders. No Board of Game actions were taken or emergency orders issued regarding Unit 3 moose during the report period.

Hunter Harvest. In 1999, 463 hunters harvested 26 moose in Unit 3 (Table 1). In 2000, 473 permittees harvested 31 moose, the highest harvest ever recorded.

Hunter Residency and Success. Almost all Unit 3 moose hunters are local residents from Petersburg, Kake, and Wrangell (Table 4). The overall hunter success rate was 5% in 1999 and 6% in 2000.

Harvest Chronology. In 1999, the largest percentage of the annual harvest occurred during the last and first week of the season. In 2000, the largest percentage of the annual harvest occurred during the first and last weeks of the season.

Harvest in particular WAA's. In both 1999 and 2000, the highest percentage of the annual harvest occurred in WAA # 2007 on Mitkof Island and in WAA # 5132 on Kupreanof Island, respectively.

Guided hunter harvest. No guided moose hunts are currently offered in the Unit.

Transport Methods. Hunters in Unit 3 relied on highway vehicles and boats to reach the field (Table 3).

Other Mortality

Predation by wolves on adult and calf moose has been reported in Unit 3. Substantial predation of moose calves by black bears has been documented in other areas and probably occurs in Unit 3.

HABITAT ASSESSMENT

Assessment

Little is known about what constitutes suitable and preferred moose habitat in Unit 3, or if that habitat can sustain a viable moose population over a long period of time. Recent increases in moose distribution and abundance in Unit 3 is likely linked to timber harvest. Early successional clearcuts likely contributed to the increase in moose distribution and abundance by providing temporary increases in browse availability. It is unclear whether moose will persist in Unit 3 as existing clearcuts advance in age and browse availability decreases.

Enhancement

No habitat enhancement projects specifically intended to benefit moose have been attempted in the unit. Although primarily intended as a silvicultural practice, precommercial thinning and pruning has been performed in some young second growth stands in the unit. These efforts provide a secondary benefit to moose by improving and extending habitat suitability by reducing canopy cover, which permits sunlight to reach the forest floor and increase the production of understory forage plants. These benefits are relatively short-lived, approximately 20–25 years, after which time canopy closure again results in loss of understudy vegetation.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

The long-term effects of clearcut logging will likely be detrimental to moose populations. Left untreated, the dense, closed canopy forests characteristic of young, naturally regenerating second-growth conifer stands will reduce moose carrying capacity. The only way to prevent further decline of moose habitat will be to institute additional habitat manipulation procedures.

For genetic or environmental reasons moose in the unit do not exhibit a strong correlation between age and antler configurations, therefore, some modification of the existing antler restrictions may be justified. Moose in the unit rarely achieve 50-inch antler spreads, and the population appears to contain a surplus of illegal bulls in excess of those needed to ensure timely breeding of cows.

CONCLUSIONS AND RECOMMENDATIONS

The Unit 3 moose population appears to have responded favorably to the initial increase in available browse resulting from extensive clearcut logging, but the dense, closed canopy forests caused by the natural regeneration of second-growth stands will eventually decrease the amount of available browse. The loss of habitat and resulting decline in food availability is of concern to biologists and hunters.

In 1999 and 2000, the Unit 3 moose hunt exceeded the objectives for number of hunters and days afield, but the objectives for annual harvest or success rate were not met. The Unit 3 moose population appears to be expanding.

We recommend that for the time being, Units 1B and 3 remain unified under one registration permit with season dates from September 15 through October 15, a one-bull bag limit, and a requirement for spike/fork or 50" antlers or at least 3 brow tines on one antler. Because Unit 3 moose do not display antler characteristics that correlate well with age, some modification of the existing antler restrictions or lengthening of the season may be justified in the future.

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Table 1 Unit 3 moose harvest, regulatory years 1990 through 2000

Year	Hunter harvest reported							
	M	(%)	F	(%)	Unk.	Total	Illegal	Total
1990[a]	3	(100)	0	(0)	0	3	0	3
1991[b]	10	(100)	0	(0)	0	10	0	10
1992	17	(100)	0	(0)	0	17	0	17
1993	13	(100)	0	(0)	0	13	0	13
1994	19	(100)	0	(0)	0	19	0	19
1995	13	(100)	0	(0)	0	13	0	13
1996	21	(100)	0	(0)	0	21	3	24
1997	22	(100)	0	(0)	0	20	2	22
1998	40	(100)	0	(0)	0	40	2	42
1999[c]	24	(100)	0	(0)	0	24	2	26
2000	30	(100)	0	(0)	0	30	1	31

[a] Wrangell Island only.
[b] Wrangell and Mitkof islands.
[c] Includes one DLP.

Table 2 Unit 3 moose harvest chronology in, regulatory years 1993 through 2000

Year	15–21 Sept.	22–28 Sept.	29 Sept.–5 Oct.	6–15 Oct.	Total
1993	0	0	7	6	13
1994	0	0	15	4	19
1995	4	1	5	3	13
1996	9	6	4	5	24
1997	4	7	5	6	22
1998	14	13	7	8	42
1999	7	5	5	9	26
2000	11	7	5	8	31

Table 3 Unit 3 successful moose hunter transport methods, regulatory years 1993 through 2000

Year	Airplane	Boat	Highway vehicle	3/4 wheeler	Horse	Unknown	Total
1993	1	0	12	0	0	0	13
1994	0	3	16	0	0	0	19
1995	1	1	11	0	0	0	13
1996	1	5	17	1	0	0	24
1997	0	8	13	1	0	0	22
1998	0	9	32	0	0	1	42
1999	3	5	17	1	0	0	26
2000	2	6	23	0	0	0	31

Table 4 Unit 3 moose hunter residency and success, regulatory years1993through 2000

	Successful					Unsuccessful					
Year	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
1993	12	1	0	13	(4)	305	15	3	323	(96)	336
1994	18	1	0	19	(5)	351	23	0	374	(95)	393
1995	13	0	0	13	(4)	306	18	0	324	(96)	337
1996	23	1	0	24	(7)	319	10	1	330	(93)	354
1997	22	0	0	22	(6)	329	21	0	350	(94)	372
1998	40	2	0	42	(9)	399	24	1	424	(91)	466
1999	26	0	0	26	(5)	429	32	2	463	(95)	492
2000	27	4	0	31	(6)	435	33	5	473	(94)	504

[a] Residents of Kake, Petersburg, and Wrangell.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 5 (5,800 mi^2)

GEOGRAPHICAL DESCRIPTION: Cape Fairweather to Icy Bay, eastern Gulf of Alaska coast

BACKGROUND

Moose were first documented along the lower Alsek River in eastern Game Management Unit 5 (Unit 5) in the late 1920s or early 1930s. Range expansion to the west followed, with animals documented on the Malaspina Forelands west of Yakutat Bay by the 1950s. It is believed that the glaciers and waters of Icy Bay curtailed westward movement of this moose population.

The moose population in Unit 5 grew rapidly and peaked in the early 1960s, with population estimates exceeding 2,000 animals. The population began declining toward a more realistic carrying capacity in the mid 1960s. Poor reproductive success and severe winters in 1970 and 1972 depressed moose numbers enough that Unit 5A hunting seasons were closed from 1974–1977. Since 1978 Unit 5 moose hunting has been managed under a registration permit system.

In 1991 a federal subsistence season was instituted, and ran concurrently with the state season until 1996. This federal season restricted hunting on federal public lands to local resident hunters during the first week of the season. In 1996 the Federal Subsistence Board lengthened the federal season by one week, starting it one week earlier than the state season. Although the concurrent seasons had been managed under the state's registration permit system, the new "early hunt" has been administered under a separate federal registration permit issued by the U. S. Forest Service (USFS) and the National Park Service, and prohibits hunting on federal public lands except by Yakutat residents from October 15 through October 21. Although there is a block of 9 townships of non-federal land near Yakutat where nonlocals can legally hunt during the first week of the state season that begins on October 15, local residents have always harvested the majority of moose taken on the Yakutat Forelands before October 22. Additionally they take the majority of moose killed west of the Dangerous River during the entire season (Table 4).

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

The following objectives based on existing biological data have been identified by staff with input from the public and are contained in the Strategic Plan for Management of Moose in Region I, Southeast Alaska (ADF&G, 1991). They are compared with current population estimates and use levels (these estimates include data from both state and federal hunts).

	Current report period means (1999–2000)	Plan objective
Unit 5A Yakutat Forelands		
Post-hunt moose numbers	800	1,000
Annual hunter kill	39	70
Number of hunters (annually)	130	250
Hunter–days of effort (annually)	550	1,025
Hunter success (annual)	30%	28%
Unit 5A Nunatak Bench		
Post-hunt moose numbers	54	50
Annual hunter kill	1.5	5
Number of hunters (annually)	6	10
Hunter–days of effort (annually)	28	60
Hunter success (annual)	25%	50%
Unit 5B Malaspina Forelands		
Post-hunt moose numbers	200	250
Annual hunter kill	9	25
Number of hunters	19	50
Hunter–days of effort	93	200
Hunter success	47%	50%

METHODS

Aerial surveys of parts of Units 5A and B were conducted during both years of the report period. All surveys were conducted with Cessna 185 aircraft. The preferred survey aircraft, such as a Supercub that has a lower stall speed and allows observers the ability to see and accurately identify moose sex and age classes, was not available in Yakutat. Ages of harvested moose were determined from incisors submitted by hunters under terms of the registration permit. Other data collected included the number of days hunted, hunter residency, kill date and location, and transport type. Information from federal permits was collected for successful hunters, but was not available for most unsuccessful hunters.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

After the hunting closures in the mid 1970s, the Yakutat Forelands moose population slowly increased to where it may now be near the habitat's carrying capacity. Aerial surveys suggest this population has been static since the mid 1980s. The Nunatak Bench area was closed to hunting after rising water levels from a glacial ice dam flooded much of the moose habitat there in summer 1986. Following the retreat of the Hubbard Glacier and the subsidence of the waters of Russell Fiord in fall 1986, brushy vegetation recolonized the shoreline and moose reoccupied this range. Based on 1994 surveys, the Board of Game (BOG) reopened moose hunting in this area beginning with the 1995 season. The Unit 5B (Malaspina Forelands) moose population appears healthy at moderate densities. Anecdotal evidence from Yakutat residents suggests that the brown bear and wolf populations in Unit 5B keep this moose herd in check.

Population Size. Aerial surveys were conducted of the Yakutat Forelands during regulatory year 2000, and at Nunatak Bench and the eastern portion of Unit 5B in 1999. In the Yakutat and Malaspina forelands, where the heavy coniferous forest makes it difficult to detect moose, we assume a moose sightability of about 50% (Smith and Franzman, 1979). Nunatak Bench lacks coniferous stands, resulting in much higher sightability.

We counted 365 moose on the Yakutat Forelands during a February 2001 survey (Table 1). Based on this survey, we estimate that the forelands moose population is 600–800 animals. Surveys lasted 25% longer than the previous survey in 1999, while the sighting rate declined from 56 moose per hour to 40 moose per hour. This is still comparable to the long-term sighting rate of 45 moose per hour since 1990. It is important to look critically at this moose-per-hour data by examining the survey areas as well as the time spent surveying. Longer survey times over the past 10 years correspond to lower sighting rates; this is probably due to a wider survey area including areas away from moose concentrations, thereby lowering sighting rates.

At Nunatak Bench we counted 33 moose during a 1999 survey and 54 in 2000. The 2000 count was the highest ever recorded for the area (Table 1), and probably represents a high proportion of the population.

In Unit 5B a partial survey was conducted in 1999 while in 2000 about 90% of the area was surveyed. The count of 113 animals in 2000 was the highest since 1982, but probably represents only a portion of the moose present. We estimate the moose population in 5B to be 200–250 animals.

Given the wide range of survey intensity from year to year, perhaps the best gauge of moose numbers is the number of moose observed per hour of survey time (Table 1).

Population Composition. We were unable to obtain composition data during this report period for any Unit 5 moose populations (Table 5). February 2000 surveys provided general population information, but they were not reliable for sex or age composition because they occurred after antler drop. In addition, we spent minimal time identifying calves, so calf numbers are unreliable.

Age at harvest of Yakutat Forelands moose has ranged from 2.2 years to 3.9 years since 1984 (Table 2). Mean age at harvest increased from 2.8 during the previous report period to a mean of 3.5 years during 1999–00. From 1994–1998, 34% of the bulls harvested were age 1.5 (Table 2). This age class dropped dramatically during the current report period and made up only 15% of the bulls harvested. In contrast to the relatively consistent age of moose harvested in Unit 5A, the mean age of harvested Malaspina Forelands moose has been erratic, ranging between 2.7 and 5.4 years since 1990. The limited access and resultant lower hunting pressure on the Malaspina Forelands probably allows bulls to reach an older age than those on the Yakutat Forelands (Table 2). Also, we are dealing with a smaller sample size of harvested moose in 5B. In spite of this, the distribution of ages of harvested animals in Unit 5B does not appear to follow any pattern.

The low moose harvest at Nunatak Bench has not allowed us to gather any meaningful age distribution information.

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 5A, except Nunatak Bench	Oct. 15–Nov. 15
1 bull by registration permit only; up to 60 bulls may be taken; the commissioner may close the season in that portion west of the Dangerous River when 30 bulls have been taken from that area	
Unit 5A, Nunatak Bench	Nov. 15–Feb. 15
1 moose by registration permit only; up to 5 moose may be taken	
Unit 5B	Sept. 1–Dec. 15
1 bull by registration permit only; up to 25 bulls may be taken	

Game Board Actions and Emergency Orders. There were no emergency orders issued regarding Unit 5 moose hunting during the report period. This was a change from the previous report period when, for both 1997 and 1998, Unit 5A west of the Dangerous River was closed prior to the scheduled season closing date.

Hunter Harvest. Harvest throughout Unit 5 remained relatively constant since 1988, with a total of 57–77 moose taken annually, but that changed during this report period. In 1999 only 41 moose were harvested, and the harvest declined to 37 in 2000 (Table 3). The reasons for this decline are not clear, although hunter effort, foul weather, and some loss of moose from heavy snows during the winter of calendar 1999 are likely factors. We cannot determine if there was a decline in hunter effort during this report period due to missing federal permit information. In the state hunt a mean of 130 permittees hunted during 1999 and 2000, compared to 168 per year during the previous 6 years; this lower effort contributed to fewer animals being taken. In addition, the weather during both years was extremely foul, with heavy rains falling during most of the season. These conditions hindered hunters' efforts, and pushed moose out of meadows they normally frequent during the fall, into higher, densely forested areas (Neil Barten pers. comm.). And lastly, it is likely that the heavy snows from the winter of 1999 caused some mortality to the bull population.

The harvest of 3 moose at Nunatak Bench was equivalent to the previous report period. All animals were taken in 2000 (Table 3). In Unit 5B, 18 moose were harvested during the report period compared to 23 during 1997–1998. This difference can be attributed somewhat to the lower hunting effort during 1999–2000 (Table 3).

Permit Hunts. The total number of permits (both state and federal) issued for the Yakutat Forelands hunt (RM061) reached 300 in 1997 and 303 in 1998, in part due to Yakutat residents obtaining both permits (Table 5). This caused considerable confusion for ADF&G personnel when tabulating hunting effort. During this report period we were unable to gather federal permit information, so the effort listed in Table 5 is from state permits only and should be considered well below actual hunting effort. In 1999, 114 of 157 permittees hunted moose, and 41 were successful. In 2000, 146 of 173 permittees harvested 37 moose, and one federal ceremonial moose was harvested for a potlatch. The Nunatak Bench hunt (RM059) received more than twice the hunting effort (12 hunters vs. 5) than the previous two-year period, but the number of moose harvested was identical at 3. Difficult access to this area makes it a very challenging place to hunt, and few people are willing to even attempt a hunt at Nunatak.

The Unit 5B hunt (RM062) also received less hunting pressure during this report period (36 hunters) compared to the previous two years (53 hunters). The harvest reflected this lower effort with only 18 bulls being taken compared to 23 during 1997–1998.

Staff from the Department of Public Safety/Division of Fish and Wildlife Protection and both ADF&G fisheries divisions continued to assist with permit issuance and monitoring of these permit hunts. Enforcement personnel from the USFS also helped monitor the Unit 5A hunt during the report period. Reminder cards and certified letters were used to increase compliance with reporting requirements for the state permit hunts. The federal permit process complicates matters as some hunters pick up both a state and a federal permit, while other hunters get one or the other. In addition, the federal hunt reporting requirements are not as stringent as ours, in that delinquent hunt reports are not pursued.

Hunter Residency and Success. Local residents hunt primarily in Unit 5A on the Yakutat Forelands (Table 4). Beginning with state regulations in 1987, local residents were able to hunt the first week of the season before it opened to nonlocal hunters. In 1991, federal subsistence regulations allowed local residents exclusive hunting rights on federal lands for the first week of the concurrent state and federal seasons. The 1996 implementation of a federal season preceding the state season by one week has further enhanced opportunity for local hunters. The first portion of the moose hunt traditionally accounts for a majority of the 5A harvest, and since most easily accessible land is under federal management, harvest by Yakutat residents predominates. Local hunters took 66% of the bulls harvested in Unit 5A in 1999 and 73% in 2000. The majority of moose taken by local hunters were taken during the first two weeks of the season. Later in the season, use increased by non-local hunters in areas farther from Yakutat (especially east of the Dangerous River) and in those accessible only by airplane. Nonlocal Alaskans hunting in Unit 5A took 11 moose (27% of bulls taken under registration permits) in 1999 and 8 (22%) in 2000. Most nonlocal Alaska hunters are from Juneau. Nonresidents took 3 moose in Unit 5A during the 1999 season and 2 in 2000 (Table 4).

Since 1986 the overall success of Unit 5A hunters has ranged from 19 to 32 percent (Table 3). 1999 hunter success was 35%, then 25% in 2000. The average number of days expended by Yakutat Forelands hunters reached an all time high in 1993 (Table 5), returned to historic levels during the 1997–1998 report period, then climbed back to the near record level during 2000. Care should be taken in interpreting these data without first incorporating federal hunt information.

Hunting effort expended at Nunatak Bench during the report period was substantially higher than the previous report period (28 hunter days for 12 hunters during 1999–2000 vs. 10 days for 5 hunters during 1997–1998). However, hunter success during this report period was only 25% compared to 60% during the previous two years. Nonlocal Alaskans took two of 3 moose harvested, although traditionally this hunt only attracts local hunters (Table 4).

The Malaspina Forelands hunt is less dominated by local use, as it is less convenient to hunt and inclement weather often deters local hunters from short excursions to this area. Local residents took 4 of 18 moose (22%) harvested during the report period, compared to 35% during the previous 2 years. Nonlocal state residents killed 4 of the moose during the report period, while nonresidents took the largest portion at 10 animals (56%). All nonresident hunters were guided.

Harvest Chronology. Moose harvest from Unit 5 early in the state season is relatively low, partly because only Unit 5B is open from September 1 through October 14 (Table 4), and this area typically accounts for only a small portion of the total Unit 5 harvest. Most of the Unit 5 harvest takes place during the first weeks of the 5A season, when areas adjacent to Yakutat and easily accessible by boat or highway vehicle are first open. Most of the harvest on the Yakutat Forelands took place during the first part of the state season, but unlike the previous report period the guideline harvest was not reached during either year and the season remained open until the scheduled closing date of November 15. Moose were harvested throughout the latter part of the season, but in small numbers.

Two of 3 moose taken at Nunatak Bench were harvested in November and the third was taken in January. Most moose harvested in this area are taken in January or February when they are nearer the beach and easier to access, and when days lengthen, allowing for more hunting opportunity. The Malaspina Forelands harvest is generally concentrated during the latter part of September and early October. This was the case during this report period, largely the result of nonresident hunting coincident with the beginning of the rut.

Transport Methods. Transport methods used during the current report period differed from the previous report period (Table 6). Although aircraft continue to be the most popular transportation method among successful hunters (37%), the use of highway vehicles (29%) surpassed boats (22%) as the next most popular method. Three and 4-wheelers accounted for 14% of the transportation used, and are probably underrepresented, as some hunters reporting “other” probably used off-road vehicles. Many unsuccessful hunters also use these machines for access. Habitat impacts, wounding loss, animal harassment, and fair chase ethics due to the use of 3- and 4-wheelers concern wildlife managers. Virtually every fish camp has one or more of these machines present, and although these off-road vehicles have been used in Yakutat for many years more hunters seem to be using them in a less incidental fashion and more as a primary method of access. These machines are commonly used to drag whole moose from a kill site to the nearest road. Rutted meadows from wheeled vehicles are now a common sight in Unit 5A.

Despite the importance of aircraft for hunter transportation, relatively few Yakutat residents use them. Most locals hunt with the aid of riverboats, ATV’s, or highway vehicles, while most non-resident hunters charter aircraft for access. The use of aircraft generally increases later in the season as non-local hunters begin hunting in non-roaded portions of the unit.

Commercial Services. Commercial services were used by 18% of Unit 5 moose hunters during the report period (Table 7). Nonlocal hunters were more likely to use commercial services, with transport to the field being used the most. Commercial services were used by a higher percentage of Unit 5B hunters than in Unit 5A. This undoubtedly reflects the fact that the Malaspina Forelands are more difficult to access.

Other Mortality. One male, one female, and one moose of unidentified sex were harvested under federal ceremonial permits, and one male and one female were taken under state ceremonial permits during the report period. This represents a 50% decline in the federal ceremonial harvest from the previous report period, but an increase from zero to three in the state ceremonial harvest.

The winter of 1998–1999 was severe, with deep snow persisting until late May on much of Unit 5. Anecdotal information from a local pilot suggests that many moose succumbed to wolf and bear predation during late winter and spring.

Habitat. ADF&G staff undertook no habitat assessment or enhancement procedures during the period.

CONCLUSIONS AND RECOMMENDATIONS

Complete fall sex and age composition counts of all Unit 5 moose herds need to be conducted. Age data on harvested moose should continue to be collected and carefully scrutinized.

Most management goals for Unit 5 moose hunts were not met during this report period. For example, although management goals regarding hunter success were attained during 1997 for the Yakutat Forelands (RM061) as well as the Nunatak Bench hunt (RM059), they were not reached in 1998 for either hunt (Table 3). This trend is mirrored for hunter success on the Malaspina Forelands, which was 45% and 42% in 1997 and 1998, respectively, both below the objective of 50% (Table 3). Hunter effort was below management objectives for all hunts, although for the Malaspina Forelands and the Nunatak Bench hunts, this is related primarily to difficult access.

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Table 1 Unit 5 aerial survey data, regulatory years 1984 through 2000

Year	MM	FF	Calves	Unk	Total	Count time (hrs)	MM Per 100 FF	Calves per 100 FF	Percent calves in herd	Moose per hour
					5A Yakutat Forelands					
1984	90	229	60	---	379	12.1	39	26	16	31
1985	50	168	41	---	259	11.0	30	24	16	24
1986	34	166	60	---	260	11.3	20	36	23	23
1987	---	---	83	---	322	11.2	---	---	26	29
1988	91	339	85	---	515	10.3	27	25	17	50
1989						No survey				
1990	43	309	93	---	445	6.8	14	30	21	66
1991[1]	---	---	---	---	204	8.0	---	---	---	26
1992	---	---	37	---	196	5.9	---	---	19	33
1993[2]	---	---	---	---	219	6.3	---	---	---	35
1994[3]	51	124	51	158	397	9.3	20	32	21	41
1995	14	71	78	303	466	8.5	---	---	17	55
1996	10	68	8	---	86	1.9	15	12	9	45
1997						No survey				
1998	7	17	17	333	374	6.7	---	---	---	56
1999						No survey				
2000	1	10	11	343	365	9.1	---	---	---	40
					5A Nunatak Bench					
1984	10	13	4	---	27	0.5	77	31	15	54
1985						No survey				
1986	5	4	1	---	10	0.5	125	25	10	20
1987–1993						No survey				
1994	3	18	---	---	25	0.3	16	22	16	75
1995	5	6	6	16	33	0.3	---	---	18	110
1996–1998						No survey				
1999	---	---	---	33	33	0.4	---	---	---	83
2000	---	1	1	52	54	0.8	---	---	---	69
					5B Malaspina Forelands					
1981[4]	21	88	25	---	134	3.1	24	28	19	43
1982	26	103	16	---	145	8.4	25	16	11	17
1983	---	---	21	---	66	1.8	---	---	32	37
1984–1986						No surveys				
1987[5]	---	---	14	---	69	2.8	---	---	20	25
1988–1994						No surveys				
1995	4	10	11	84	109	1.75	---	---	10	62
1996–1998						No surveys				
1999	---	---	---	38	38	0.8	---	---	---	48
2000	---	2	3	108	113	2.2	---	---	---	51

[1] NPS survey using a PA-18, from 3/1 to 3/5, 1991, from the mouth of the Doame River northwest to the Dangerous River.
[2] USFS survey using a C-185 done from 2/14 to 2/17, 1994, between Yakutat and Dry Bay.
[3] Age and sex ratios reflect flights made in a PA-18 (5.5 hrs. from 12/2 to 12/3, 1994); total numbers include flights in both PA-18 and C-185 (3.62 hrs. from 12/6 to 12/7, 1994.
[4]Bancas Point to Sitkagi Bluffs only.
[5] Sex and age ratios unreliable.

Table 2 Unit 5 age structure of harvested moose, regulatory years 1984 through 2000

Year	Age Class 0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% Aged	Mean Age
Yakutat Forelands																			
1984	2	13	11	6	7	3	2	3	0	0	0	0	0	0	0	0	49	96	3.2
1985	1	15	10	10	2	1	3	1	0	1	1	1	0	0	0	0	46	100	3.4
1986	3	10	13	8	4	9	3	1	0	2	0	0	0	0	0	0	54	98	3.6
1987	1	14	7	3	7	2	1	0	1	0	0	0	0	0	0	0	38	95	3.0
1988	0	17	16	5	2	3	1	0	1	0	1	0	0	0	0	0	47	98	2.9
1989	0	10	16	7	5	4	0	1	0	0	0	0	0	0	0	0	45	96	3.1
1990	0	16	18	14	4	3	2	0	0	0	0	0	0	0	0	0	57	100	2.9
1991	0	20	18	7	4	1	0	1	1	0	0	0	0	0	0	0	52	100	2.7
1992	0	13	5	5	3	1	2	1	0	0	0	0	0	0	0	0	50	60	3.0
1993	0	12	7	14	3	2	1	2	1	0	0	0	0	0	0	0	50	84	2.8
1994	0	23	8	6	5	4	0	3	2	1	0	1	0	0	0	0	60	90	2.9
1995	0	20	12	4	2	3	1	0	1	0	0	0	0	0	0	0	45	96	2.2
1996	0	19	12	9	5	2	5	1	0	2	0	0	0	0	0	0	60	92	2.8
1997	1	22	18	8	4	3	1	0	2	0	1	0	0	1	0	0	61	97	2.7
1998	1	15	11	10	6	2	4	1	0	2	0	0	0	0	0	0	55	95	2.9
1999	0	6	15	6	7	0	2	1	0	0	0	0	0	0	0	0	41	90	3.2
2000	0	6	6	9	7	3	2	2	1	0	0	0	0	0	0	0	37	97	3.9
5A Nunatak Bench																			
1995	No age data																		
2000	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	100	5.0
5B Malaspina Forelands																			
1990	0	5	2	3	2	1	0	1	0	0	0	0	0	0	0	0	14	100	3.2
1991	0	3	3	1	2	2	1	0	3	0	0	0	0	0	0	0	17	88	4.5
1992	0	0	5	0	0	0	0	1	0	0	0	0	0	0	0	0	7	86	3.3
1993	0	2	4	3	3	0	1	0	0	0	0	0	0	0	0	0	15	87	2.8
1994	0	0	0	1	3	1	1	0	1	0	0	0	0	0	0	0	7	100	4.9
1995	0	2	5	1	3	0	0	0	1	0	0	0	0	0	0	0	12	100	2.9
1996	0	1	2	1	2	3	1	0	0	2	1	1	0	0	0	0	16	88	5.4
1997	0	1	2	3	1	0	0	1	2	0	0	0	0	0	0	0	13	77	4.1
1998	0	1	3	3	2	0	0	0	0	0	0	0	0	0	0	0	10	90	2.7
1999	0	1	1	1	2	0	1	1	0	0	0	0	0	0	0	0	7	100	4.4
2000	0	1	1	5	1	0	0	0	1	0	0	0	0	0	0	0	11	82	3.8

Table 3 Unit 5 historical harvests, hunters, and success, regulatory years 1984 through 2000

Year	Nr MM	Nr FF	Nr unk.	Total kill	Nr hunters	Percent success
			5A Yakutat Forelands			
1984	49	0	0	49	230	21
1985	46	0	0	46	129	36
1986	54	0	0	54	198	27
1987	38	0	0	38	199	19
1988	47	0	0	47	153	31
1989	45	0	0	45	163	28
1990	57	0	0	57	178	32
1991	52	0	0	52	175	30
1992	50	0	0	50	199	25
1993	50	1[1]	0	51	204	25
1994	60	1[1]	0	61	208	29
1995	48[2]	2	0	50	185	24
1996	60	1	0	61	190	32
1997	59	1	1	61	194	30
1998	54	1	0	55	195	27
1999	41	1	0	42	114	35
2000	37	0	0	37	146	25
			5A Nunatak Bench			
1984	3	3	0	6	14	43
1985	2	0	0	2	3	67
1986–1994				Season closed		
1995–1996				No moose harvested		
1997	2	0	0	2	2	100
1998	0	1	0	1	3	33
1999	0	0	0	0	5	0
2000	2	1	0	3	7	43
			5B Malaspina Forelands			
1984	15	0	0	15	50	30
1985	13	0	0	13	62	21
1986	9	0	0	9	34	26
1987	8	0	0	8	34	24
1988	11	0	0	11	40	28
1989	12	0	0	12	44	27
1990	14	0	0	14	49	40
1991	17	0	0	17	39	44
1992	7	0	0	7	25	28
1993	15	0	0	15	31	48
1994	7	0	0	7	26	27
1995	12	0	0	12	28	43
1996	16	0	0	16	31	52
1997	13	0	0	13	29	45
1998	10	0	0	10	24	42
1999	7	0	0	7	12	58
2000	11	0	0	11	26	42

[1] Illegal kills not included in the calculation of hunter success.
[2] Includes 3 bulls harvested under ceremonial permits; not included in hunter success ratios.

Table 4 Unit 5 annual moose kill by community of residence, regulatory years 1984 through 2000

Year	Total kill	Yakutat	Juneau	Ketchikan	Sitka	Pelican	Hoonah	Petersburg	Haines	Wrangell	Other AK	Non-resident
						5A Yakutat Forelands						
1984	49	18	16	2	6	0	2	1	0	1	1	2
1985	44	28	13	0	3	0	0	0	0	0	0	0
1986	54	22	16	1	4	1	3	0	4	0	2	1
1987	38	27	7	0	1	0	0	0	0	0	2	1
1988	47	38	6	0	0	0	1	0	0	0	1	1
1989	45	40	2	0	1	0	0	0	0	0	2	0
1990	50	45	11	1	0	0	0	0	1	0	3	2
1991	52	28	15	0	2	0	0	0	1	0	5	2
1992	50	32	7	0	0	3	0	0	3	0	2	3
1993	50	31	11	0	3	1	0	0	0	0	2	2
1994	60[1]	38	14	1	0	2	0	0	0	0	3	2
1995	50[2]	35	14	0	0	1	0	0	0	0	0	0
1996	60	45	7	0	1	0	0	0	0	0	3	4
1997	61	45	13	0	0	1	0	0	0	0	1	1
1998	55	38	10	0	0	0	0	0	0	0	4	3
1999	41	27	10	0	0	0	0	0	0	0	1	3
2000	37	27	7	0	0	0	0	0	0	0	1	2
						5A Nunatak Bench						
1984–1996							(No Data)					
1997	2	2	0	0	0	0	0	0	0	0	0	0
1998	1	1	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0
2000	3	1	0	0	0	0	0	2	0	0	0	0
						5B Malaspina Forelands						
1984	15	5	1	6	0	0	0	0	0	0	0	3
1985	13	8	2	1	0	0	1	0	0	0	1	0
1986	9	3	2	0	0	0	0	0	0	0	0	4
1987	8	5	1	0	0	0	0	0	0	0	0	2
1988	11	5	3	1	1	0	0	0	0	0	1	0
1989	12	7	2	1	0	0	0	0	0	0	1	1
1990	14	9	3	0	0	0	0	0	0	0	1	1
1991[3]	17	7	4	1	0	0	0	0	0	0	3	1
1992	7	4	3	0	0	0	0	0	0	0	0	0
1993	15	3	2	1	0	0	0	0	0	0	0	9
1994	7	3	2	0	0	0	0	0	0	0	1	1
1995	12	4	3	0	1	0	0	0	0	0	0	4
1996	16	6	2	0	0	0	1	0	1	0	0	6
1997	13	4	1	0	0	0	0	0	0	0	1	7
1998	10	4	2	0	0	0	0	0	0	0	0	4
1999	7	2	0	0	0	0	0	0	0	0	0	5
2000	11	2	2	0	1	0	0	0	0	0	1	5

[1] Does not include one known illegal kill.[2] Includes 5 moose harvested under ceremonial permits, 3 bulls and 2 cows. [3] Includes one kill by hunter of unknown residency.

Table 5 Unit 5 hunter effort and success, regulatory years 1990 through 2000[1]

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits issued	Nr hunters	Total days	Avg. days	Nr hunters	Total days	Avg. days	Nr hunters	Total days	Avg. days
					5A Yakutat Forelands					
1984	---	49	132	2.7	181	978	5.4	230	1110	4.8
1985	---	44	117	2.7	84	457	5.4	128	574	4.6
1986	---	54	171	2.7	143	696	4.9	197	867	3.6
1987	---	38	109	2.9	161	948	5.9	199	1057	5.6
1988	206	47	95	2.0	106	281	2.7	153	376	2.4
1989	213	45	107	2.4	118	620	5.3	163	727	4.3
1990	213	57	110	1.9	122	497	4.2	178	607	3.5
1991	236	52	162	3.1	123	425	3.4	175	587	3.6
1992	238	50	130	2.6	149	771	6.0	199	901	4.5
1993	239	50	204	4.1	154	979	6.5	204	1183	5.9
1994	268	60	167	2.9	148	712	4.8	208	879	4.4
1995	245	45	99	2.3	140	471	3.4	185	570	3.1
1996	277	60	147	2.6	76	427	3.6	190	574	3.0
1997	300	59	154	2.8	110	453	4.1	194	607	3.1
1998	303	52	102	2.0	135	373	2.8	195	475	2.4
1999	157	41	101	2.5	73	282	4.2	114	383	3.6
2000	173	37	92	2.6	108	626	6.0	146	718	5.2
					5A Nunatak Bench					
1984	---	6	27	4.5	8	24	3.0	14	51	3.6
1985	---	2	44	22.0	1	10	10.0	3	32	10.7
1986–1994					Season Closed					
1995	19	0	0	0	3	3	1.0	3	3	1.0
1996	9	0	0	0	3	4	1.3	3	4	1.3
1997	10	2	3	1.5	0	0	0	2	3	1.5
1998	11	1	2	2.0	2	5	2.5	3	7	2.3
1999	12	0	0	0	5	14	3.5	5	14	3.5
2000	14	3	6	2.0	4	8	2.0	7	14	2.0
					5B Malaspina Forelands					
1984	---	15	40	2.7	40	191	4.8	55	231	4.2
1985	---	13	34	2.6	49	226	4.6	62	260	4.2
1986	---	9	40	4.4	27	139	5.1	36	179	5.0
1987	---	8	56	2.8	16	83	5.2	24	139	5.8
1988	58	11	39	3.5	29	120	4.1	40	159	4.0
1989	65	12	47	3.9	32	143	4.7	44	190	4.3
1990	60	14	53	3.8	35	80	2.4	49	133	2.8
1991	60	17	51	3.0	22	90	4.5	39	141	3.8
1992	52	7	22	3.1	18	61	3.4	25	83	3.3
1993	54	15	30	2.0	16	91	5.7	31	121	3.9
1994	42	7	109	15.6	19	26	1.9	26	135	6.4
1995	56	12	46	3.8	15	57	3.8	27	103	3.8
1996	55	16	71	4.4	14	75	5.4	30	146	4.9
1997	48	13	44	3.4	16	62	4.8	29	106	4.1
1998	43	10	44	4.4	14	63	4.5	24	107	4.6
1999	37	7	36	5.1	5	25	6.3	12	61	5.5
2000	46	11	54	4.9	15	71	5.1	26	125	5.0

1 Not all information is available for each hunter; calculations for any given field may only include a subset of hunters.

Table 6 Unit 5 transport methods used by successful hunters, regulatory years 1990 through 2000[1]

Year	Airplane Total	Airplane (%)	Boat Total	Boat (%)	3 or 4 wheeler Total	3 or 4 wheeler (%)	ORV Total	ORV (%)	Highway vehicle Total	Highway vehicle (%)	Foot Total	Foot (%)
5A Yakutat Forelands												
1990	29	(51)	10	(18)	7	(12)	0	---	11	(19)	0	---
1991	29	(56)	6	(12)	7	(13)	0	---	10	(19)	0	---
1992	22	(44)	8	(16)	9	(18)	0	---	11	(22)	0	---
1993	25	(50)	12	(24)	6	(12)	0	---	5	(10)	2	(4)
1994	24	(41)	15	(25)	9	(15)	0	---	9	(15)	2	(3)
1995	15	(37)	11	(27)	9	(23)	1	(3)	4	(10)	0	---
1996	13	(22)	15	(26)	10	(17)	0	---	16	(28)	4	(7)
1997	17	(44)	6	(16)	4	(11)	0	---	11	(29)	0	---
1998	16	(29)	15	(28)	8	(15)	0	---	15	(28)	0	---
1999	10	(32)	15	(48)	0	---	0	---	6	(19)	0	---
2000	12	(44)	11	(41)	0	---	0	---	4	(15)	0	---
5A Nunatak Bench												
1995	0	---	0	---	0	---	0	---	0	---	0	---
1996	0	---	0	---	0	---	0	---	0	---	0	---
1997	0	---	2	(100)	0	---	0	---	0	---	0	---
1998	0	---	1	(100)	0	---	0	---	0	---	0	---
1999	1	(25)	3	(75)	0	---	0	---	0	---	0	---
2000	0	---	7	(100)	0	---	0	---	0	---	0	---
5B Malaspina Forelands												
1990	9	(69)	4	(31)	0	---	0	---	0	---	0	---
1991	14	(82)	2	(12)	0	---	1	(6)	0	---	0	---
1992	5	(100	0	---	0	---	0	---	0	---	0	---
1993	12	(80)	0	---	3	(20)	0	---	0	---	0	---
1994	5	(71)	2	(29)	0	---	0	---	0	---	0	---
1995	8	(89)	0	---	0	---	1	(11)	0	---	0	---
1996	8	(58)	1	(7)	3	(21)	0	---	0	---	2	(14)
1997	3	(22)	4	(31)	4	(31)	1	(8)	0	---	1	(8)
1998	6	(60)	1	(10)	3	(30)	0	---	0	---	0	---
1999	2	(29)	1	(14)	4	(57)	0	---	0	---	0	---
2000	9	(82)	0	---	2	(18)	0	---	0	---	0	---

[1] Not all information is available for each hunter; calculations for any given field may only include a subset of hunters.

Table 7 Unit 5 commercial services used by hunters, regulatory years 1991 through 2000[1]

Year	Unit residents No	Unit residents Yes	Other AK residents No	Other AK residents Yes	Nonresidents No	Nonresidents Yes	Total use No	Total use Yes	Transport	Registered guide	Other Services
					5A Yakutat Forelands						
1991	11	7	0	13	0	3	11	23	19	2	2
1992	123	8	40	17	5	1	168	26	22	0	4
1993	122	11	26	18	3	2	151	31	28	2	1
1994	131	9	26	24	0	0	157	33	32	1	0
1995	111	9	21	26	3	3	135	38	36	1	0
1996	44	1	16	18	4	2	64	21	19	1	1
1997	67	5	21	13	4	7	92	24	22	1	2
1998	101	1	18	17	7	5	126	23	18	3	1
1999[2]											
2000[2]											
					5A Nunatak Bench						
1995	3	0	----	----	----	----	3	0	----	----	----
1996	3	0	----	----	----	----	3	0	----	----	----
1997	2	0	----	----	----	----	3	0	----	----	----
1998	3	0	----	----	----	----	3	0	----	----	----
1999	2	0	4	0	----	----	6	0	0	0	0
2000	3	0	3	0	----	----	6	0	0	0	0
					5B Malaspina Forelands						
1991	1	4	0	9	0	0	1	13	9	0	4
1992	2	3	3	5	0	4	5	12	5	7	0
1993	1	5	6	7	0	7	7	19	13	6	0
1994	6	0	0	8	1	1	7	9	8	1	0
1995	6	9	1	5	3	4	10	18	15	2	1
1996	3	1	2	9	0	9	5	19	11	8	1
1997	1	3	0	1	0	5	1	9	3	5	0
1998	3	1	0	2	3	4	6	7	4	5	0
1999	3	1	0	0	0	5	3	6	1	5	0
2000	2	3	2	3	0	14	4	20	6	14	0

[1] Not all information is available for each hunter, therefore the calculations for any given field may only include a subset of hunters.
[2] Data not available at time of report submittal.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: Unit 6 (10,140 mi^2)

GEOGRAPHIC DESCRIPTION: Prince William Sound and North Gulf Coast

BACKGROUND

Moose populations in most of Unit 6 originated from translocations of calves from the Kenai Peninsula, Anchorage, and Matanuska-Susitna Valley (Burris & McKnight 1973). During 1949–1958, Cordova residents successfully raised 24 captive moose calves and released them on the western Copper River Delta in Unit 6C. This small population rapidly extended eastward, first into Unit 6B and then advancing by the late 1960s into the Bering River area in Unit 6A. Moose may also have reached Unit 6A through dispersal westward from the Malaspina Glacier forelands in Unit 5A. The introduced population reached a record high of approximately 1600 in 1988 (Griese 1990), then declined to about 1227 by 1994 as part of a planned reduction (Nowlin 1998). The only moose endemic to Unit 6 are small populations in the Lowe River drainage and Kings Bay in Unit 6D. These populations never grew and today include only about 40 animals.
Harvest of the introduced population began with 25 bulls in 1960. Hunters have taken a total of 3798 moose through 1998–99. In contrast, total harvest of the endemic moose population in Unit 6D during the same period was approximately 40 moose.

Population objectives were relatively conservative in the 1970s and early 1980s because of concern about mortality during severe winters. Objectives were established at 0.9–1.2 moose/mi^2 after a severe winter in 1971–72, and remained conservative under management plans written in 1976 (Rausch 1977). In 1994, Nowlin (1995) revised objectives using new information about carrying capacity of the winter ranges (MacCracken 1992) and refined estimates of population size.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

Our primary and secondary management goals in Unit 6A (East) are to take large moose and to provide for optimum harvest. Primary and secondary goals for the remainder of Unit 6 are to provide for optimum harvest and to provide for the greatest opportunity to participate in hunting.

POSTHUNT MANAGEMENT OBJECTIVES

Our management objective for Unit 6A (East) is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 30:100. Our objective for Units 6A (West) and 6B is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 15:100 in each unit. In Unit 6C our objective is to increase the population to 400 moose by the year 2006 and maintain a minimum bull:cow ratio of 15:100.

METHODS

We conducted modified (Gasaway et al. 1986) censuses to estimate moose population size and composition. We used Piper Super Cub (PA-18) and Bellanca Scout aircraft for searches of sample units. Estimates of sex and age ratio were only derived from censuses conducted before mid-December. Population estimates were not corrected for sightability. Corrections calculated during previous censuses indicated we observed >89% of the moose present (Nowlin 1998).

Sample units for aerial censuses cover all moose habitat in Units 6A—6C. Viereck et al. (1986) described the habitat types present, and MacCracken (1992) identified types that were most important for moose. These habitat types were below 500 ft elevation in river valleys and deltas of the coastal plain and included open tall-willow (*Salix sp.*), closed tall alder-willow (*Alnus sinuata-Salix sp.*), low sweetgale-willow (*Myrica gale-Salix sp.*), woodland spruce (*Picea sitkensis*) and aquatic (wet forb-herbaceous) (Nowlin 1995).

Hunters participating in drawing or registration permit hunts were required to report. Those that fail to report were telephoned and sent no more than 2 reminder letters. Hunters participating in general moose hunts were sent a reminder letter if they failed to return their hunt report.

We summarized census and harvest data by unit, except for Unit 6A, which was divided into eastern and western portions. The eastern portion was all drainages into the Gulf of Alaska between Cape Suckling and the head of Icy Bay. The western portion was all drainages into the Gulf between Cape Suckling and Palm Point.

In 2000 we began a cooperative study funded by the U.S Forest Service's Cordova Ranger District to monitor moose habitat of the western Copper River Delta (CRD) in Unit 6C. Moose habitat on the CRD is dynamic, with some areas entering into unproductive seral stages and others supporting new growth. Hence, rather than trying to measure carrying capacity based on habitat, we examined nutritional status of moose based on rump fat thickness, which had a strong linear relationship (r^2=0.96, p=0.0001) with total body fat of pen-reared moose (Stephenson et al. 1998). A total of 12 cows were captured (half with calves) and collared during November and again in March. Rump fat thickness was measured using ultrasonography.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We conducted censuses in Units 6A West and 6B in November 1999 and 6C in February 2001. No estimates of bull:cow ratios were obtained because many bulls had shed antlers when we conducted the censuses. We could not complete a census in Units 6A East because of continually stormy weather, although we did conduct a short survey to determine calf composition in the population. Lack of snow, storms and high winds limit moose censuses almost annually in Unit 6.

Population Size

The posthunt moose population in Unit 6 during 2000–2001 was approximately 1260 moose, including 280 in Unit 6A East, 350 in 6A West, 230 in 6B, 350 in 6C, and 50 in 6D. Censuses indicated that the moose population in Unit 6C increased from 259 in 1996–1997 to 350 in 1998–1999, a result of high productivity and low winter mortality (Table 1). Moose in Unit 6B decreased because of continued low productivity. Unit 6A West apparently increased substantially, possibly because of movement from Unit 6B. However, we were unable to survey all sample units because of weather, and wide confidence intervals (Table 1) suggest a problem with accuracy. Harvest (Table 2) and calf survival (Table 1) suggest that moose in Unit 6A East declined until 1997 and have since increased.

Population Composition

Aerial surveys indicated that the proportion of calves in both Units 6A West and 6A East was 13% (Table 1). In Unit 6B continued low calf survival – 6% in 1999 and 11% in 1999 – and a declining population since 1996 has prompted conservative bull harvests and no antlerless hunts. Over the past 10 years the proportion of calves in the population has declined in Unit 6B but is showing some indication of leveling off. The proportion of calves in Unit 6C was only 10% during this reporting period, which was a record low. Low calf survival has occurred every 4–6 years in Unit 6C, followed by a rebound. A more recent survey (2002) indicated that calves were back up to 20%.

MORTALITY

Harvest

Season and Bag Limit. In Unit 6A (East), the bag limit for all hunters was 1 moose. The bull moose season during this reporting period was 1 September–31 October. Hunters were restricted to bulls with 50-inch antlers or antlers with 3 or more brow tines on at least 1 side, a regulation first implemented in 1996–1997.

In Unit 6A (West), the season for all hunters was 1 September–31 October, with a bag limit of 1 moose. Residents were allowed to take up to 20 bulls by registration permit, and nonresidents were allowed to take up to 5 bulls by drawing permit. We established an annual allowable harvest for bulls that included both hunts. When that harvest limit was reached, both hunts were closed by emergency order.

The season in Unit 6B was open during 27 August–31 October, during the reporting period for resident hunters only with a bag limit of 1 moose. We authorized a harvest of 10 bull moose by registration permit. No motorized vehicles were allowed for transportation from 15 August–31 August, with the exception of highway vehicles on the maintained surface of the Copper River Highway. Also, moose could not be taken until after 3:00 a.m. following the day on which an airboat was used for transportation. All airboats were required to display an ADF&G identification number. Airboat restrictions were in effect only while the registration permit hunt for bulls was open.

In Unit 6C the season was open for resident hunters only and was 1 September–31 October, with a bag limit of 1 moose by drawing permit. Up to 25 drawing permits were authorized, 20 for bulls and 5 for antlerless moose. During 2000–01 the 5 antlerless moose permits were administered as a federal subsistence hunt by the U.S. Forest Service's Cordova Ranger District. The general season in Unit 6D for all hunters was 1–30 September, and the bag limit was 1 bull by harvest ticket.

Board of Game Actions and Emergency Orders. We issued emergency orders to close the registration permit hunts for bull moose in Unit 6B (28 September 1999 and 11 September 2000). The purpose was to limit harvest to $\leq$10 bulls. These were normal management actions. The Board of Game reauthorized antlerless moose hunts in Units 6A–6C.

Hunter Harvest. Reported moose harvest for Unit 6 was 85 in 1999–00 and 89 in 2000–01 (Table 2). We kept harvest low in both Units 6B and 6C because of continued poor calf survival and reduced population in 6B, and to allow a planned population increase in 6C (Nowlin 1998). The harvest was increased in Unit 6A (West) during 2000–01 in response to higher numbers observed.

Composition of the moose harvest in Unit 6 was 85% males during 1999–00 and 89% males during 2000–01, which were in the desired range.

Permit Hunts. During this reporting period, Unit 6A West had 1 registration and 1 drawing permit hunt, Unit 6B had 1 registration hunt, and Unit 6C had 2 drawing hunts (Table 3). Success was very high in drawing hunts (50–100%) but lower in registration hunts (7–45%). Unlimited hunter participation and closures by emergency order when the allowable harvest is reached usually lowers success rates in registration hunts.

Hunter Residency and Success. Local residents comprised 73% of all moose hunters in Unit 6 during the reporting period (Table 4). Alaska residents from other parts of the state comprised 15–23% of hunters, while nonresidents were 12–13%. Conservative and resident-only seasons discouraged nonlocal hunters from participating.

Overall hunter success during both 1999–00 and 2000–01 was 34% and can be attributed conservative seasons and airboat restrictions.

Harvest Chronology. Most of the Unit 6 harvest over the past 2 years occurred during September (Table 5). The harvest pattern has not changed over the past 5 years.

Transport Methods. Boats, primarily airboats, were the most commonly used transport method during this reporting period (Table 6). Airplanes and highway vehicles followed them in decreasing order of importance. This pattern of use has not changed over the past 5 years.

Other Mortality

Weather and predation by brown bears and wolves were causes of calf mortality. Brown bears and radiocollared wolves were observed feeding on neonatal moose in various parts of the unit (Carnes et al. 1996, MacCracken et al. 1997, pers. obs). In addition, brown bear populations increased in Units 6A, 6B, and 6C (Crowley 2000). MacCracken et al. (1997) reported that calf survival was correlated with adverse weather conditions during the calving period in Unit 6C.

HABITAT

Preliminary results indicate that, based on rump fat thickness, moose were in moderate to excellent nutritional status in Unit 6C during 2000–01. Cows with and without calves had mean rump fat thickness of 3.7 and 7.4 cm, respectively, during November. During March those same cows had mean rump fat thickness of 1.7 and 2.8 cm, respectively, similar to cows measured by Stephenson (1995) during March 1992 and 1993. Cows with calves lost less rump fat (an average of 2.0 cm) compared to females without calves (4.6 cm) over winter ($p<0.01$). Moose body condition on the west CRD is generally better than other populations studied (Stephenson, pers. comm.), indicating adequate winter habitat at the current population level (Table 1).

Nowlin (1998) attempted to protect winter moose habitat in Unit 6A by the deliberate reduction of herd size, although nutritional carrying capacity remains unknown. We have no data on body condition or habitat suitability for Unit 6B. Anecdotal information suggests that a large area of moose habitat in Unit 6B has succeeded into woodland spruce and cottonwood, MacCracken (1992) found these habitat types were the least used for calving in Unit 6C. In addition, advancing alder and spruce along slough banks provide a network of travel corridors for predators.

CONCLUSIONS AND RECOMMENDATIONS

Population goals were achieved in all units except for Unit 6C, in which population size progressed toward our objective of 400 moose by the year 2006. We could not evaluate our objectives for bull:cow ratios because we completed no censuses before mid-December when a significant number of bulls have dropped their antlers and are difficult to distinguish from cows.

We will continue evaluating nutritional status of moose in Unit 6C. In addition, we will attempt to determine calf:cow ratio during spring, summer and fall, and bull:cow ratio in Unit 6C while radio-tracking collared cows.

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Table 1 Unit 6 moose estimated population composition and size, 1992–00.

Unit	Regulatory year	Bulls: 100 cows	Calves(%)	Adults	Population size	90% C.I.	Total moose observed
6A (East)	1992–93	-	8	384	416	373–459	378
	1995–96	-	10	253	282	249–316	162
	2000–01[a]	-	13	136	-	-	189
6A (West)	1992–93	23	12	259	295	255–334	273
	1995–96	-	14	271	316	272–361	221
	1999–00	-	13	348	412	181–643	382
6B	1992–93	19	17	271	328	268–387	203
	1994–95	22	10	266	296	244–347	182
	1996–97	-	6	289	308	249–367	167
	1998–99	-	9	266	320	243–396	286
	2000–01[a]	-	11	159	-	-	178
6C	1992–93	26	25	225	299	263–335	204
	1994–95	27	14	242	281	205–358	236
	1996–97	-	17	214	259	232–287	216
	1998–99	-	25	221	334	293–375	293
	2000–01	-	10	319	341	318–365	326

[a] Partial survey

Table 2 Unit 6 moose harvest and accidental death, 1996–2000.

		Hunter harvest									
	Regulatory	Reported					Estimated			Accidental	
Unit	year	M	(%)	F	(%)	Total[a]	Unreported	Illegal	Total	death	Total
6A (East)	1996–97	16	(100)	0	(0)	16	2	2	4	0	20
	1997–98	10	(100)	0	(0)	10	1	1	2	0	12
	1998–99	13	(100)	0	(0)	13	1	0	1	0	14
	1999–00	17	(100)	0	(0)	17	1	0	1	0	18
	2000–01	19	(100)	0	(0)	19	1	0	1	0	20
6A (West)	1996–97	24	(73)	9	(27)	33	0	2	2	0	35
	1997–98	18	(100)	0	(0)	18	0	2	2	0	20
	1998–99	19	(95)	1	(5)	20	0	2	2	0	22
	1999–00	19	(90)	2	(10)	21	1	1	2	0	23
	2000–01	28	(80)	7	(20)	35	1	1	2	0	37
6A TOTAL	1996–97	40	(82)	9	(18)	49	2	4	6	0	55
	1997–98	28	(100)	0	(0)	28	1	3	4	0	32
	1998–99	32	(97)	1	(3)	33	1	2	3	0	36
	1999–00	36	(95)	2	(5)	38	2	1	3	0	41
	2000–01	47	(87)	7	(13)	54	2	1	3	0	57
6B	1996–97	16	(73)	6	(27)	22	0	3	3	0	25
	1997–98	0	(0)	0	(0)	0	0	2	2	0	2
	1998–99	23	(100)	0	(0)	23	0	0	0	0	23
	1999–00	19	(90)	2	(10)	21	1	1	2	0	23
	2000–01	7	(88)	1	(13)	8	1	1	2	0	10

Table 2 Continued

		Hunter harvest									
	Regulatory	Reported					Estimated			Accidental	
Unit	year	M	(%)	F	(%)	Total[a]	Unreported	Illegal	Total	death	Total
6C	1996–97	18	(78)	5	(22)	23	1	1	2	0	25
	1997–98	18	(78)	5	(22)	23	1	0	1	0	24
	1998–99	19	(79)	5	(21)	24	0	0	0	0	24
	1999–00	19	(83)	4	(17)	23	1	1	2	2	27
	2000–01	20	(80)	5	(20)	25	1	1	2	3	30
6D	1996–97	1	(100)	0	(0)	1	0	0	0	0	1
	1997–98	2	(100)	0	(0)	2	0	1	1	0	3
	1998–99	0	(0)	0	(0)	0	0	1	1	0	1
	1999–00	3	(100)	0	(0)	3	0	0	0	0	3
	2000–01	2	(100)	0	(0)	2	0	1	1	0	3
Unit 6	1996–97	75	(79)	20	(21)	95	3	8	11	0	106
TOTAL	1997–98	48	(91)	5	(9)	53	2	6	8	0	61
	1998–99	75	(93)	6	(7)	81	1	3	4	0	85
	1999–00	77	(91)	8	(9)	85	4	3	7	2	94
	2000–01	76	(85)	13	(15)	89	4	4	8	3	100

[a] Totals may include moose of unknown sex and unit.

Table 3 Unit 6 moose harvest data by permit hunt, 1996–2000.

Unit/hunt no.	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6A/RM160[a]	1996–97	Bull	73	40	55	45	20	(100)	0	(0)	20
	1997–98	Bull	46	37	52	48	14	(100)	0	(0)	14
	1998–99	Bull	64	52	39	58	20	(95)	1	(5)	21
	1999–00	Bull	75	56	45	52	17	(100)	0	(0)	17
	2000–01	Bull	95	46	53	45	23	(100)	0	(0)	23
6A/DM160[b]	1996–97	Bull	5	20	0	100	4	(100)	0	(0)	4
	1997–98	Bull	5	20	0	100	4	(100)	0	(0)	4
	1998–99	Bull	5	40	33	67	2	(100)	0	(0)	2
	1999–00	Bull	5	20	50	50	2	(100)	0	(0)	2
	2000–01	Bull	5	0	0	100	5	(100)	0	(0)	5
6A/DM162	1996–97	Antlerles	15	27	18	82	0	(0)	9	(100)	9
	1997–98	No hunt									
	1998–99	No hunt									
	1999–00	Antlerles	5	40	33	67	0	(0)	2	(100)	2
	2000–01	Antlerles	15	53	43	100	0	(0)	7	(100)	7
6B/RM164	1996–97	Bull	172	37	85	15	16	(100)	0	(0)	16
	1997–98	No hunt									
	1998–99	Bull	201	33	83	17	23	(100)	0	(0)	23
	1999–00	Bull	206	36	83	14	19	(100)	0	(0)	19
	2000–01	Bull	171	37	89	7	7	(88)	1	(13)	8

Table 3 Continued

Unit/hunt no.	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6B/DM166	1996–97	Antlerless	10	20	25	75	0	(0)	6	(100)	6
	1997–98	No hunt									
	1998–99	No hunt									
	1999–00	Antlerless	5	20	50	50	0	(0)	2	(100)	2
	2000–01	No hunt									
6C/DM167	1996–97	Bull	20	10	0	100	18	(100)	0	(0)	18
	1997–98	Bull	20	5	5	95	18	(100)	0	(0)	18
	1998–99	Bull	20	5	0	100	19	(100)	0	(0)	19
	1999–00	Bull	20	5	0	100	19	(100)	0	(0)	19
	2000–01	Bull	20	5	0	100	19	(100)	0	(0)	19
6C/DM168	1996–97	Antlerless	5	0	0	100	0	(0)	5	(100)	5
	1997–98	Antlerless	5	0	0	100	0	(0)	5	(100)	5
	1998–99	Antlerless	5	0	0	100	0	(0)	5	(100)	5
	1999–00	Antlerless	5	20	0	100	0	(0)	4	(100)	4
Fed. Subsist.	2000–01	Antlerless	6	0	0	100	1[b]	(17)	5	(83)	6

[a] RM prefix was a registration hunt, DM prefix a drawing hunt.

[b] Potlatch moose

Table 4 Unit 6 moose hunter residency and success, 1996–2000.

Unit	Regulator year	Successful Local resident [a]	Nonlocal resident	Nonresident	Total	(%) [b]	Unsuccessful Local resident	Nonlocal resident	Nonresident	Total	(%) [c]	Total hunter
6A (East)	1996–97	1	0	15	16	(41)	5	6	12	23	(59)	39
	1997–98	2	1	7	10	(29)	6	4	14	24	(71)	34
	1998–99	2	0	11	13	(62)	5	0	3	8	(38)	21
	1999–00	2	3	12	17	(44)	3	2	17	22	(56)	39
	2000–01	2	5	12	19	(43)	6	4	15	25	(57)	44
6A (West)	1996–97	24	5	4	33	(57)	22	3	0	25	(43)	58
	1997–98	14	4	0	18	(55)	8	7	0	15	(45)	33
	1998–99	13	5	2	20	(61)	11	1	1	13	(39)	33
	1999–00	14	5	2	21	(57)	11	5	0	16	(43)	37
	2000–01	25	5	5	35	(51)	24	9	0	33	(49)	68
6A TOTAL	1996–97	25	5	19	49	(51)	27	9	12	48	(49)	97
	1997–98	16	5	7	28	(42)	14	11	14	39	(58)	67
	1998–99	15	5	13	33	(61)	16	1	4	21	(39)	54
	1999–00	16	8	14	38	(50)	14	7	17	38	(50)	76
	2000–01	27	10	17	54	(48)	30	13	15	58	(52)	112
6B	1996–97	17	5	- [c]	22	(19)	84	11	- [c]	95	(81)	117
	1997–98	0	0	- [c]	0	(0)	0	0	- [c]	0	(0)	0
	1998–99	20	3	- [c]	23	(17)	106	5	- [c]	111	(83)	134
	1999–00	20	1	- [c]	21	(16)	98	13	- [c]	111	(84)	132
	2000–01	7	1	- [c]	8	(8)	92	4	- [c]	96	(92)	104

Table 4 Continued

Unit	Regulatory year	Successful: Local resident [a]	Successful: Nonlocal resident	Successful: Nonresident	Successful: Total	(%) [b]	Unsuccessful: Local resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonresident	Unsuccessful: Total	(%) [c]	Total hunter
6C	1996–97	16	7	- [c]	23	(100)	0	0	- [c]	0	(0)	23
	1997–98	23	0	- [c]	23	(96)	1	0	- [c]	1	(4)	24
	1998–99	20	4	- [c]	24	(96)	1	0	- [c]	1	(4)	25
	1999–00	19	4	- [c]	23	(85)	2	2	- [c]	4	(15)	27
	2000–01	22	3	- [c]	25	(100)	0	0	- [c]	0	()	25
6D	1996–97	1	0	0	1	(8)	4	6	2	12	(92)	13
	1997–98	2	0	0	2	(17)	7	3	0	10	(83)	12
	1998–99	0	0	0	0	(0)	3	5	0	8	(100)	8
	1999–00	2	0	1	3	(20)	10	2	0	12	(80)	15
	2000–01	0	2	0	2	(12)	10	5	0	15	(88)	17
Unit 6	1996–97	59	17	19	95	(38)	115	26	14	155	(62)	250
TOTAL	1997–98	41	5	7	53	(51)	22	14	14	50	(49)	103
	1998–99	55	12	13	80	(36)	126	11	4	141	(64)	221
	1999–00	57	13	15	85	(34)	124	25	17	166	(66)	251
	2000–01	56	16	17	89	(34)	133	23	15	171	(66)	260

[a] Resident of Unit 6.

[b] Totals may include harvest by hunters of unknown residency and may include harvest from unknown units.

[c] Nonresidents ineligible to receive permits.

Table 5 Unit 6 moose harvest percent by time period, 1996–2000.

Unit	Regulatory year	Harvest periods							n
		8/20–8/31	9/1–9/15	9/16–9/30	10/1–10/15	10/16–	11/1–11/30	12/1–12/31	
6A (East)	1996–97	0	25	31	31	13	0	0	16
	1997–98	0	30	40	10	20	0	0	10
	1998–99	0	38	38	15	8	0	0	13
	1999–00	0	18	18	53	12	0	0	17
	2000–01	0	32	26	21	21	0	0	19
6A (West)	1996–97	0	76	18	3	3	0	0	33
	1997–98	0	100	0	0	0	0	0	18
	1998–99	0	100	0	0	0	0	0	20
	1999–00	0	81	5	10	5	0	0	21
	2000–01	0	31	57	11	0	0	0	35
6A TOTAL	1996–97	0	59	22	12	6	0	0	49
	1997–98	0	75	14	4	7	0	0	28
	1998–99	0	76	15	6	3	0	0	33
	1999–00	0	53	11	29	8	0	0	38
	2000–01	0	31	46	15	7	0	0	54

Table 5 Continued

Unit	Regulatory year	Harvest periods 8/20–8/31	9/1–9/15	9/16–9/30	10/1–10/15	10/16–	11/1–11/30	12/1–12/31	n
6B	1996–97	9	68	18	5	0	0	0	22
	1997–98	-	-	-	-	-	-	-	0
	1998–99	13	87	0	0	0	0	0	23
	1999–00	11	68	21	0	0	0	0	19
	2000–01	25	75	0	0	0	0	0	8
6C	1996–97	0	65	13	9	13	0	0	23
	1997–98	0	43	43	9	4	0	0	23
	1998–99	0	58	4	29	8	0	0	24
	1999–00	0	57	35	4	4	0	0	23
	2000–01	0	44	28	12	12	4	0	25
6D	1996–97	0	100	0	0	0	0	0	1
	1997–98	0	0	0	0	0	0	0	0
	1998–99	0	0	0	0	0	0	0	0
	1999–00	0	67	33	0	0	0	0	3
	2000–01	0	50	50	0	0	0	0	2
Unit 6 TOTAL	1996–97	2	63	19	9	6	0	0	95
	1997–98	0	58	30	6	6	0	0	53
	1998–99	4	74	8	11	4	0	0	80
	1999–00	2	58	20	14	5	0	0	83
	2000–01	2	39	37	12	8	1	0	89

Table 6 Unit 6 moose harvest percent by transport method, 1996–2000.

Unit	Regulatory year	Airplane	Boat	3- or 4-wheeler	ORV	Highway Vehicle	n
6A (East)	1996–97	88	0	6	0	6	16
	1997–98	80	20	0	0	0	10
	1998–99	77	8	15	0	0	13
	1999–00	76	6	12	0	6	17
	2000–01	53	11	21	0	16	19
6A (West)	1996–97	30	70	0	0	0	33
	1997–98	39	55	0	0	0	18
	1998–99	25	75	0	0	0	20
	1999–00	29	71	0	0	0	21
	2000–01	34	63	0	0	3	35
6A TOTAL	1996–97	49	47	2	0	2	49
	1997–98	54	33	0	0	0	28
	1998–99	45	48	6	0	0	33
	1999–00	50	42	5	0	3	38
	2000–01	41	44	7	0	7	54

Table 6 Continued

Unit	Regulatory year	Airplane	Boat	3- or 4-wheeler	ORV	Highway Vehicle	n
6B	1996–97	27	73	0	0	0	22
	1997–98	0	0	0	0	0	0
	1998–99	22	56	0	0	13	23
	1999–00	18	53	0	0	41	19
	2000–01	0	70	0	0	30	10
6C	1996–97	0	43	0	0	57	23
	1997–98	0	35	0	0	65	23
	1998–99	0	37	4	4	54	24
	1999–00	0	65	9	0	26	23
	2000–01	4	39	0	0	57	23
6D	1996–97	0	0	0	0	100	1
	1997–98	0	0	0	0	100	2
	1998–99	0	0	0	0	0	0
	1999–00	0	33	0	0	67	3
	2000–01	50	0	0	0	50	2
Unit 6 TOTAL	1996–97	32	52	1	0	16	95
	1997–98	28	20	0	0	32	53
	1998–99	25	38	4	1	20	80
	1999–00	27	49	5	0	19	85
	2000–01	27	45	4	0	24	89

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 7 (3,520 mi^2)

GEOGRAPHIC DESCRIPTION: Eastern Kenai Peninsula

BACKGROUND

The Unit 7 moose population irrupted most recently during the 1960s after wildfires in adjacent Unit 15A created large areas of early seral vegetation. Wolf numbers were simultaneously reduced to low levels. A rapid population decline followed in the early 1970s after 3 severe winters in 4 years. The population has fluctuated at low levels since as predator densities stabilized and habitat succession progressed into less desirable climax stages. The Unit 7 moose population is considered stable at low densities and expected to remain at these levels unless significant habitat alteration occurs.

Since 1980, spruce bark beetles (*Dendroctonus rufipennis*) have established in many old-growth spruce stands in Unit 7. Nearly half a million acres of land on the Kenai Peninsula were infected with spruce bark beetles in 1995 (Peterson 1996) and over 2 million acres by 1999. Nearly all Kenai forest lands have been affected to date. Salvage logging (harvest of dead and infested stands of trees) is ongoing throughout the Kenai (Steve Albert ADF&G personal communication). Reduction of old-growth forests may be beneficial to the moose population by enhancing nutritional quality and availability of winter food plants. However site preparation is crucial to successful moose habitat enhancement.

In 1997 a task force was established to evaluate the biological and sociological effects of selective harvest management in south central Alaska. Members of the task force included agency representatives from the Alaska Department of Fish and Game (ADF&G) and Fish and Wildlife Protection and representatives from the local Fish and Game Advisory Committees to bring in the public perspectives. Hundertmark et al. (in press) and Fulton (in prep) reported results of this task force.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

To maintain a healthy population of moose with a minimum bull to cow ratio of 15:100.

METHODS

All harvest data is collected and reported through the statewide harvest reporting system. Information is collected from hunters on area hunted, transportation used, amount of time spent afield and, if successful, the size of the moose harvested.

Standard late fall composition surveys are completed in standard count areas. We completed aerial sex and age composition surveys in late November under favorable snow conditions. Because most of Unit 7 is mountainous, we surveyed moose by flying elevational contours. All information was entered in the Wildlife Information Data Base (WIDB) software up until 1999 when this software no longer functioned. After 1999, the survey data was maintained in a local database.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Terrain features and extensive mature spruce forest prevent application of the moose census technique described by Gasaway et al. (1986). Standard sex and age aerial surveys combined with harvest reports indicate that the moose population has remained relatively stable since the mid-1980s. The 1998–99 winter was considered severe in most of the region with deep and persistent snow. Documented winter mortality was predominantly calves of the year however we suspect that some adults were also lost. Winter severity was reflected in lower than average hunter harvest in 1999. We believe the moose population remained stable at approximately 1000 animals through 1998 but declined in 1999. No new population estimate has been attempted.

Population Composition

Only one count area, excluding Portage and Placer River drainages, was surveyed during both 1999 and 2000 fall sex and age composition surveys. In 1999 we surveyed 151 moose with ratios of 29 calves:100 cows and 45 bulls:100 cows and in 2000 we surveyed 98 moose with ratios of 8 calves:100 cows and 50 bulls:100 cows (Table 1).

MORTALITY

Harvest

<u>Season and Bag Limit</u>. Two drawing permit hunts were held in GMU 7 during this reporting period. The first hunt was held in the Placer River and Portage creek drainages (DM210). Results of this hunt are reported in the management report for 14C. The second hunt was a newly authorized hunt west of the resurrection creek bordering 15A. The season was October 20 – November 20 and the bag limit was 1 bull with spike-fork or 50-inch antlers. The remainder of the Unit 7 moose season was from 20 August–20 September for 1 bull with spike-fork or 50-inch antlers.

<u>Board of Game Action and Emergency Orders</u>. During the spring 1999 meeting, the BOG authorized a special permit hunt in the Kenai Mountains west of the Resurrection Creek trail for up to 25 permits.

Hunter Harvest. In 1999, 300 hunters reported hunting in Unit 7 during the 20 August–20 September season and harvested 40 bull moose (Tables 2 and 3). Sixteen hunters (40%) reported taking spike/fork bulls (less than 35") compared with 23 hunters (58%) who harvested large bulls (greater than 39") defined as a 50-inch antler spread or having 3 brow tines on at least 1 antler. One additional moose was reported but not classified.

In 2000, 345 hunters reported hunting in Unit 7 during the 20 August–20 September season and harvested 51 bull moose. Ten hunters (20%) reported taking spike/fork bulls compared to 34 hunters (67%) who harvested large bulls. Seven additional moose were reported but not classified.

Permit Hunts. Permit hunt results for Unit 7 (hunts DM210 and DM211) were included in the management report for Unit 14C. Permit hunt results for DM522 are included in Table 4. Two bulls were harvested in 1999 and 4 bulls in 2000. All were classified as 50-inch moose.

Hunter Residency and Success. Successful hunters averaged 5.3 days hunting in both 1999 and 2000. Hunter success in 1999 was 13%. Twelve successful hunters (30%) were unit residents, 16 (40%) were nonunit residents, and 8 (20%) were nonresidents (Table 3). Residency reported for unsuccessful hunters was as follows: unit residents 119 (46%), nonunit residents 120 (46%), and nonresidents 7 (3%).

Hunter success in 2000 was 15%. Sixteen successful hunters (31%) were unit residents, 29 (57%) were nonunit residents, and 5 (10%) were nonresidents (Table 3). Reported residency for unsuccessful hunters was as follows: unit residents 126 (43%), nonunit residents 156 (53%), and nonresidents 11 (4%).

Harvest Chronology. Beginning in 1993 the general open season for Unit 7 was 20 August–20 September (32 days). Harvest chronology indicates the highest percentage occurred during the first 5 and last 10 days of the season (Table 5). A few more moose were typically taken near the end of the season when moose were probably moving to alpine and subalpine rutting areas.

Transport Methods. In 1999, 48% of successful hunters reported highway vehicles as their means of transportation (Table 6). Airplanes were the second most common transportation means (25%) for successful hunters. Hunters using horses, boats and ORV’s accounted for 13%, 2%, and 2%, respectively, of the reported harvest.

In 2000, 41% of successful hunters reported highway vehicles as their means of transportation (Table 6). The second most common transportation means for successful hunters was by horseback (29%). Hunters using aircraft, boats, ORV’s and ATVs, accounted for 12%, 8%, 2% and 2%, respectively, of the reported harvest.

Other Mortality

In addition to reported harvest in Unit 7, 27 moose were killed; 3 by trains and 24 by motor vehicles during the 1999–2000 winter. There were no reported train kills for the 2000–2001 winter. At least 24 moose were killed in Unit 7 by motor vehicles during this same winter (Table 2). Approximately 75% of these animals were salvaged for human use. The "Give Moose a Brake" program (Del Frate and Spraker, 1991) continued its awareness activities throughout the peninsula. Crippling loss by hunters is unknown but probably less than 10% of the reported harvest.

Effects of predation by wolves and bears are unknown. The unit supports an estimated 50 wolves, a ratio of 1 wolf per 20 moose. Black bears are abundant throughout the unit, and brown bears are common in all drainages supporting salmon.

HABITAT

Assessment

Reduction of some old-growth forest in response to spruce bark beetle infestations through logging and prescribed burning by the U.S. Forest Service was a priority in Unit 7. Logging prescriptions and reforestation techniques that encourage hardwood production were recommended. If hardwood production increases in these affected areas, moose will probably benefit from the higher-quality habitat. However, if site preparation is not adequate, grass (*Calamagrostis* sp.) will compete with both spruce and hardwood seedlings and habitat quality will decline.

CONCLUSIONS AND RECOMMENDATIONS

Winter conditions in Unit 7 during 1998–99 were moderately severe, and many calves were lost throughout the region, lowering harvest rates in 1999. The following winter was mild with fair calf survival and slightly higher harvest in the fall. Human-caused moose mortality, including road or train kills and harvest, represented approximately 10% of the estimated moose population of 900–1000.

The harvest of moose under spike-fork/50 inch regulations fluctuates in response to previous winter severity. Spike-forks are almost always yearlings, and the proportion of young animals in the harvest should provide a "barometer" of the health of that particular cohort. By properly evaluating the severity of a particular winter, we can also forecast the upcoming harvest.

The bull-to-cow ratios have been higher than the recommended minimum objective of 15 bulls per 100 cows since the selective harvest program began. However the survey area may not accurately reflect the ratio across the unit. Adequate bull-to-cow ratios are desired to minimize the length of the rut and ensure that most cows conceive during their first estrous cycle (Schwartz et al. 1994). Given the low moose density and rugged terrain of Unit 7, a higher bull-to-cow ratio may be necessary and desirable to maintain a healthy population.

Under the current selective harvest system and current harvest patterns, we recommend no changes in regulations. If bull-to-cow ratios continue above objective levels, specific drainages may be designated for late season permit hunts similar to DM522. However, additional funding for more intensive survey efforts would be necessary. To avoid shifts in hunting pressure, Unit 7 and 15 general seasons should be kept consistent.

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Table 1. Unit 7 fall aerial moose composition counts and estimated population size, 1992–2000.

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	moose observed	Moose /hour	population size
1992–93	34	7	18	12	218	248	24	1000
1993–94[a]	--	--	--	--	--	--	--	--
1994–95	34	18	31	19	367	453	40	1000
1995–96[a]	--	--	--	--	--	--	--	--
1996–97	41	4	13	9	181	198	23	1000
1997–98[a]	--	--	--	--	--	--	--	--
1998–99	43	8	12	8	227	246	36	900
1999–2000	45	8	29	17	126	151	84	900
2000–2001	50	8	8	5	88	98		900

[a] No surveys completed.

Table 2. Unit 7 moose harvest[a] and accidental death, 1992–2000.

Regulatory	Reported				Estimated			Accidental death			Grand
year	M	F	Unk.	Total	Unreported	Illegal	Total	Road	Train	Total	Total
1992–93	54	0	0	54			20	31	0	31	105
1993–94	62	0	0	62			20	30	4	34	96
1994–95	56	0	0	56			20	34	18	52	108
1995–96	42	0	0	42			20	18	4	22	84
1996–97	61	0	0	61			20	27	8	35	116
1997–98	69	0	0	69			20	28	18	46	115
1998–99	46	0	0	46			20	46	7	53	119
1999–2000	40	0	0	40			20	24	3	27	87
2000–2001	51	0	0	51			20	24	0	24	95

[a]Excludes permit hunt harvest.

Table 3. Unit 7 moose hunter[a] residency and success, 1992–2000.

Regulatory year	Successful				Unsuccessful				Total Hunters
	Local[b] resident	Nonlocal resident	Nonresident	Total[c](%)	Local[b] resident	Nonlocal resident	Nonresident	Total[c](%)	
1992–93	24	26	4	54 (12)	166	205	6	379 (88)	433
1993–94	19	28	14	62 (15)	156	185	5	351 (85)	413
1994–95	22	27	4	56 (13)	141	203	13	369 (87)	425
1995–96	21	17	4	42 (13)	148	133	6	289 (87)	331
1996–97	24	29	8	61 (18)	157	130	8	295 (82)	340
1997–98	24	41	4	69 (19)	144	140	9	293 (81)	362
1998–99	23	20	3	46 (12)	147	182	14	343 (88)	389
1999–2000	12	16	8	40 (13)	119	120	7	260 (87)	300
2000–2001	16	29	5	51 (15)	126	156	11	294 (85)	345

[a] Excludes hunters in permit hunts.

[b] Local = residents of Unit 7.

[c] Total columns include hunters that did not specify residency

Table 4. Units 7 moose harvest data by drawing permit hunt, 1996–2000.

Hunt Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Males	Females	Unk.	Illegal	Total harvest
DM522	1996/97							--	--	
	1997/98							--	--	
	1998/99							--	--	
	1999/2000	25	16	90	10	2	0	--	--	2
	2000/2001	25	32	76	24	4	0	--	--	4

[a] New hunt in 1999.

Table 5. Unit 7 moose harvest[a] chronology percent by time period, 1992–2000.

Regulatory year	Harvest periods 8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unknown	*n*
1992–93[b]	--	--	26	11	26	30	7	54
1993–94[c]	15	3	11	6	32	27	5	62
1994–95[c]	25	13	18	11	7	21	5	56
1995–96[c]	26	14	7	5	10	33	5	42
1996–97[c]	20	10	15	15	11	25	3	61
1997–98[c]	23	6	12	6	19	32	3	69
1998–99[c]	28	2	11	13	28	13	4	46
1999–2000	10	10	13	23	20	20	5	40
2000–2001	22	4	24	2	27	16	6	51

[a] Excludes permit hunt harvest.
[b] General open season Sep 1–Sept. 20;
[c] General open season Aug. 20–Sep 20.

Table 6. Unit 7 moose harvest[a] percent by transport method, 1992–2000.

Regulatory year	Percent of harvest Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1992–93	16	13	13	4	0	0	51	4	55
1993–94	15	19	18	0	0	3	40	5	62
1994–95	9	20	16	4	0	0	45	7	56
1995–96	5	19	5	7	0	0	57	7	42
1996–97	7	21	7	5	0	3	56	2	61
1997–98	9	17	13	3	0	1	49	7	69
1998–99	7	20	11	4	0	4	50	4	46
1999–2000	25	13	2	0	0	2	48	10	40
2000–2001	12	29	8	2	0	2	41	6	51

[a] Excludes permit hunt harvest.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 9 (33,600 mi^2)

GEOGRAPHIC DESCRIPTION: Alaska Peninsula

BACKGROUND

Moose were scarce on the Alaska Peninsula before the mid 1900s, but they increased dramatically and spread to the southwest during the 1950s and 1960s. The scarcity of suitable habitat south of Port Moller limited expansion into Unit 9D. Even during the 1960s when the population was growing, calf:cow ratios were relatively low, and the ratio declined as the population reached its peak. Evidence of range damage from overbrowsing was evident, and nutritional stress probably caused poor calf survival. Liberal hunting regulations were in effect from 1964 to 1973, first to slow population growth and subsequently (during the early 1970s) to reduce the population so that willow stands could recover from heavy browsing. Even though a series of hunting restrictions began after 1973, the population continued to decline, especially in Unit 9E. By the early 1980s moose densities in Unit 9E were 60% below peak levels and calf:cow ratios were extremely low, despite evidence that range conditions had improved (ADF&G files). Brown bear predation on neonatal moose was the primary limiting factor of moose in Unit 9.

MANAGEMENT DIRECTION

POPULATION OBJECTIVES

Population objectives for moose in Unit 9 are to 1) maintain existing densities in areas with moderate (0.5–1.5 moose/mi^2) or high (1.5–2.5 moose/mi^2) densities; 2) increase low-density populations (where habitat conditions are not limiting) to 0.5 moose/mi^2; 3) maintain sex ratios of at least 25 bulls:100 cows in medium-to-high density populations and at least 40 bulls:100 cows in low-density areas.

METHODS

We scheduled fall sex and age composition aerial surveys throughout Units 9B, 9C, and 9E during November through early December when adequate snow cover was available. We collected harvest data from harvest tickets, monitored harvests, and checked hunters primarily within the Naknek River drainage.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Results of fall sex and age composition surveys in Units 9B, 9C, and the central portion of 9E indicated that populations in most of Unit 9 have stabilized over the past 15 years. Very low moose densities and unreliable snow conditions in Unit 9A, 9D, and the southern portion of 9E precluded efficient surveys for monitoring trends in population size or composition. Incidental observations during caribou surveys south of Port Moller showed a modest expansion of moose in that area. The U.S. Fish and Wildlife Service (FWS) did a partial survey in February 1999 and counted 101 moose, of which 20 were calves.

In March 1999, the Board of Game found that moose in Units 9B, 9C, and 9E met the criteria to be considered "important for providing high levels of human consumptive use" under the intensive management legislation.

Population Size

A 1983 census in the central portion of Unit 9E resulted in an estimate of 1148 moose (90% CI = $\pm$ 16%) in the 1314-mi^2 study area. Extrapolation of this census to the remainder of Unit 9E provided a rough estimate of approximately 2500 moose. The area of Unit 9C outside of Katmai National Park had approximately 500–600 moose. There were approximately 2000 moose in Unit 9B. Units 9A and 9D probably contained about 300 and 200 moose, respectively.

Population Composition

During this reporting period, survey efforts in Unit 9B have been minimal (Table 1). The Nakeen trend area, a small, somewhat isolated "pocket" of moose between Naknek and Levelock in southwestern 9B, was surveyed in 1997, 1998, and 1999. A survey was aborted in 2000 due to poor snow conditions and turbulence. This area receives heavy local hunting pressure, and has the lowest bull:cow ratio ($\bar{x}$ = 17 bulls:100 cows during 1997–1999) of any trend area in Unit 9. The Big Mountain trend area on the southeast side of Lake Iliamna was surveyed in 1998 and 1999. This area, despite increasing hunting pressure, continues to have the highest bull:cow ratio ($\bar{x}$ = 103:100) in Unit 9. An aircraft mishap cancelled efforts to survey trend areas in northern 9B in 1998.

The 3 trend areas in Unit 9C were surveyed 1999, but only the Branch River area was surveyed in 2000 (Table 2). Total counts and bull:cow ratios were relatively stable during this period. Calf:cow ratios in Unit 9C, like the rest of the unit, were extremely low in 1999 and 2000.

Survey efforts were expanded in Unit 9E during 1998 and 1999 (Table 3) in cooperation with the FWS and NPS, but extremely poor snow conditions in 2000 precluded any efforts. In addition to surveying most traditional trend areas in 1998, the Pacific drainages from Amber Bay to Chignik Bay were covered for the first time. The bull:cow ratios in all areas surveyed exceeded the management objective of at least 40:100, with an overall ratio of 65 bulls:100 cows. The ratio of

20 calves:100 cows in 1998 was among the highest observed in Unit 9E in the past 25 years. This ratio, however, was only 10:100 in the limited area surveyed in 1999, which included the first coverage of Pacific drainages from Wide Bay to Nakalilok Bay. In 1998 and 1999, 37% of all bulls seen (*n* = 257) had antlers with ≥50” spread. Total sample sizes and ratios from these areas indicate the population is relatively stable and harvests are not reducing the number of bulls below management objectives.

MORTALITY

Harvest

Seasons and Bag Limit. As federal subsistence management becomes more entrenched, the number of regulation changes and divergence of state and federal regulations is increasing. In Unit 9A resident and nonresident hunters could hunt from 1–15 September, and the bag limit was 1 bull. In Unit 9B nonresidents could hunt from 5–15 September with a bag limit of 1 bull with ≥50-inch antlers or ≥4 brow tines; and resident hunters could hunt from 1–15 September and, beginning in 1999, 15 December–15 January, with a bag limit of 1 bull. Effective in 1997, meat of moose taken in Unit 9B was required to remain on the bone until processed for human consumption.

The federal subsistence season in Unit 9B is from 20 August–15 September and 1 December–15 January. The nonresident season dates were the same as for Unit 9B; however, the nonresident bag limit remained at 1 bull with ≥50-inch antlers or ≥3 brow tines. The resident fall season has remained the same as 9B, but beginning in 1999 the resident winter season dates in Unit 9C have varied between the Naknek River drainage and the remainder of 9C. Within the Naknek drainage only bulls could be taken and the season was 1–31 December. In the remainder of 9C, any moose was legal from 15 December–15 January. Within the southern portion of the Naknek drainage, the federal subsistence season was open from 20 August–15 September under a registration permit. During December, federal lands were only open to local rural residents and a subsistence registration permit was required to take antlerless moose. In the remainder of 9C, the federal winter subsistence winter season was 1–31 December and any moose was legal outside the Naknek drainage. In 9E the nonresident season was 10–20 September, and the bag limit was 1 bull with an antler spread of ≥50 inches or at ≥3 brow tines on at least 1 antler.

The state season for resident hunters in Unit 9E was 10–20 September and, beginning in 1999, 1 December–20 January. The bag limit in Unit 9E was 1 bull; however, moose taken from 10–20 September must be a spike/fork or have an antler spread of ≥50 inches or have ≥3 brow tines on at least 1 antler. The federal subsistence seasons in Unit 9E were 1–20 September and 1 December–20 January with a bag limit of 1 bull. Beginning in 1999, 9D was open to residents only under a state drawing permit (hunt DM312) from 15 December–20 January; and 10 permits were issued for any bull.

Board of Game Actions and Emergency Orders. Several changes to both state and federal moose regulations were enacted for the 1999 regulatory year. The state’s winter season in Unit 9B and that portion of Unit 9C outside the Naknek drainage was moved back to 15 December–15 January, and federal season was extended to 1 December–15 January. In Unit 9E, both the state and federal winter seasons were extended to 1 December–20 January. For the first time since

Unit 9D was established, a moose hunt was authorized under a resident-only drawing permit hunt conducted from December 15–20 January, with 10 permits issued.

Hunter Harvest. During 1999, hunters reported killing 253 moose, including 238 bulls and 8 cows (Table 4). In 2000, the reported harvest was 164 moose, including 161 bulls and 2 cows. The 2000 harvest was the lowest in over 20 years. The Unit 9 harvest over the past 18 years has averaged 212 (range 164–300).

Permit Hunts. Federal subsistence registration permits are required for the early fall season (RM233) and the December cow hunt (RM232) within the Becharof National Wildlife Refuge in 9C. A quota of 5 antlerless moose was set for RM232. Since 1996, a total of 12 permits have been issued for RM233 and no moose have been taken. During 1996–2000 a total of 37 permits have been issued for RM232, and 9 cows were killed, but none since 1997.

Twenty people applied for 10 available permits in the new DM312 moose hunt in Unit 9D. Because of the logistical problems in participating in a winter hunt in Unit 9D, the Board of Game stipulated that successful applicants had to notify the department that they actually intended to hunt. In 1999 four people failed to confirm they were planning to hunt, so these permits were issued to people on an alternate list. Of the 10 people who got permits, 4 reported hunting and 1 bull was taken. In 2000, 24 people applied and three additional permits were issued to replace original winners who indicated they would not hunt. Only one person reported hunting, and no moose were taken.

Hunter Residency and Success. The number of moose hunters using Unit 9 increased during 1981–87 and peaked at 645. Since then the number leveled off at a mean of 563 for the period 1990–96. In 1997, 1998, 1999 514, 525, and 524, moose hunters reported using Unit 9, respectively (Table 5). For 2000, only 461 hunters reported using Unit 9. While there have been fluctuations in the proportion of the 3 residency categories, overall no group has shown an increase. Most subsistence hunters did not get moose harvest tickets and consequently were not represented in the local resident category. Since 1988 the success rates have been relatively stable for all 3 residency groups. Nonresidents have a higher success rate (50%, range = 43–59%) than either residents of Unit 9 (35%, range = 26–51%) or other Alaska residents (31%, range = 19–38%) because virtually all of them flew out to hunt, and many employed guides.

Harvest Chronology. Since 1988, approximately 89% of the total moose harvest was during September. Harvest levels during the winter season have remained low, but during 1996–2000 varied (range = 3–15% of total), depending on weather and travel conditions (Table 6).

Transportation Methods. Aircraft continued as the most common method of transportation in Unit 9; boats were the second most common transport mode (Table 7). No major change in transportation type has occurred in the past 5 years.

Other Mortality

Given the continued low calf production, bear predation of neonatal moose remained the apparent primary cause of natural mortality. Bear:moose ratios in Unit 9 ranged from >1:1 to 1:10, and they were much higher than anywhere else within the indigenous range of moose.

Conditions during the first half of the 1999–00 winter were the worst in 25 years, with deep snow and heavy drifting. However, by February conditions moderated and winter mortality seemed insignificant. The 2000–01 winter was extremely mild with virtually no snow accumulation.

CONCLUSIONS AND RECOMMENDATIONS

Hunting regulations have been restricted in all units, except the Branch River Drainage in 9C, to eliminate antlerless moose hunting because of low calf:cow ratios. Additionally, fall seasons have recently been shortened and moved to the first half of September in the northern 3 units to maintain bull:cow ratios at prescribed levels. Harvests have remained relatively stable for 17 years, despite major changes to moose regulations (i.e., the spite/fork-50" regulation) in other parts of Alaska. The recent average harvest of 225 moose per year appears to be within sustainable levels. Local residents in Units 9B and 9E would like to reinstitute cow hunts, but unless productivity improves, this request will be difficult to justify on biological grounds. Local residents have also voiced concern over what is perceived as increasing competition from other hunters, including a growing effort by air taxi operations during the December hunt, especially in Unit 9B. Also many local hunters preferred a later winter hunt when travel conditions are better for snowmachines. These allocation questions were addressed at the 1999 Board of Game meeting and resulted in the winter season being moved later in Unit 9B and the northern portion of Unit 9C and extended in Unit 9E.

The drawing moose hunt (DM312) in 9D has only resulted in 1 bull being taken since its inception in 1999. The hunt was under subscribed in 2001. A federal subsistence registration hunt was established in 2002. I recommend that the state hunt be changed to a general resident season with the same dates.

Brown bear predation on neonatal moose was the major limiting factor preventing the increase in moose densities in Unit 9. However, very high bear:moose ratios would require substantial reduction in bear densities to achieve a measurable improvement in moose calf survival. ADF&G has placed a priority on managing bears in Unit 9, and any drastic reduction in bear numbers would probably be opposed by a large segment of the public.

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Table 1 Unit 9 fall aerial moose composition counts, 1996–2000

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour
1996	--	--	--	--	--	--	--
1997	8	2	35	25	52	69	33
1998	48	7	19	11	189	213	19
1999	57	10	4	2	132	135	26
2000	--	--	--	--	--	--	--

Table 2 Moose composition counts in Unit 9C, 1996–2000

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour
1996	27	7	23	16	501	592	40
1997	44	7	14	9	467	512	44
1998	--	--	--	--	--	--	--
1999	37	3	9	6	516	550	38
2000	33	2	7	5	290	306	52

Table 3 Moose composition counts in Unit 9E, 1996–2000

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour
1996	50	11	28	15	281	331	36
1997	--	--	--	--	--	--	--
1998[a]	65	13	20	11	817	913	45
1999	48	6	10	6	154	164	43
2000	--	--	--	--	--	--	--

[a] Includes some surveys by U.S. Fish and Wildlife Service.

Table 4 Annual moose harvest in Unit 9, 1996–2000

	Reported			Estimated			
Year	M	F	Total[a]	Unreported	Illegal	Total	Total
1996	222	15	238	100		100	338
1997	232	5	237	100		100	332
1998	199	2	201	100		100	302
1999	238	8	253	100		100	339
2000	175	2	178	100		100	278

[a] Includes unknown sex.

Table 5 Moose hunter residency and success in Unit 9, 1996–2000

Year	Successful: Local resident	Successful: Nonlocal resident	Successful: Non resident	Successful: Total[a]	Unsuccessful: Local resident	Unsuccessful: Nonlocal resident	Unsuccessful: Non-resident	Unsuccessful: Total
1996	55	57	121	238	101	112	117	333
1997	62	42	130	232	86	95	99	282
1998	33	48	116	202	95	113	118	323
1999	53	61	131	239	111	98	124	285
2000	36	29	112	178	109	69	105	283

[a] Includes unknown residency.

Table 6 Moose harvest chronology (%) in Unit 9, 1996–2000

Year	8/20-8/31	9/1-9/4	9/5-9/9	9/10-9/15	9/16-9/20	12/1-12/15	12/16-12/31	1/1-1/20
1996	<1	8	21	48	17	5	8	--
1997	<1	7	16	42	20	8	7	--
1998	<1	6	17	47	21	6	3	--
1999	<1	3	21	45	17	5	5	4
2000	<1	6	18	51	22	0	3	0

Table 7 Successful moose hunter transport methods (%) in Unit 9, 1996–2000

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle
1996	62	0	20	5	9	1	3
1997	59	0	19	4	12	0	3
1998	66	0	24	2	5	0	1
1999	64	0	18	4	10	0	2
2000	63	0	24	6	2	1	1

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 11 (13,300 mi^2)

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

BACKGROUND

Moose abundance in Unit 11 was generally considered low from the early 1900s until the 1940s, increased during the 1950s, and reached a peak population in the early 1960s. When moose were most abundant, we observed between 85 and 120 moose per hour during fall composition counts. The moose population declined from the late 1960s until 1979, when the population was considered to have reached its lowest level. In 1979 only 12 moose per hour were observed during fall counts. Moose numbers stabilized, then started increasing in Unit 11 during the early to mid 1980s and probably peaked in 1987 when we observed 55 moose per hour. Moose numbers declined between 1990 and 1991 following severe winters, then increased slightly during the mid 1990s.

Moose harvests in Unit 11 averaged 164 (123–242) per year from 1963 until 1974. Either-sex bag limits were in effect until 1974, and cows composed up to 50% of the harvest. During this period, hunting seasons were long and split between a fall and winter season. The moose harvest and the total number of hunters peaked in the early 1970s. In response to declining moose numbers, the 1974 fall moose season was shortened, the winter season was closed, and the harvesting of cows was prohibited. Between 1975 and 1989, fall seasons remained 1–20 September. In 1990 the moose season was shortened in response to deep snow conditions and to align it with the Unit 13 season. The current state season and bag limit was established in 1993.

Most of Unit 11 was included in Wrangell–Saint Elias National Monument in December 1978. In 1980 monument status was changed to park/preserve with passage of the Alaska National Interest Lands Conservation Act.

MANAGEMENT DIRECTION

POPULATION OBJECTIVE

- Allow the population to fluctuate as dictated by available habitat and predation rates.

- Maintain a population with a posthunt minimum of 30 bulls:100 cows with 10–15 adult bulls:100 cows.

HUMAN USE OBJECTIVE

- Allow human harvest of bulls when it does not conflict with management goals for the unit or population objectives for the herd.

METHODS

An aerial survey was conducted every year during the late fall to determine sex and age composition and population trends on a count area along the western slopes of Mount Drum. We monitored harvests and hunting pressure through a harvest ticket reporting system; we also monitored the average reported antler spread in the harvest. Predation and overwinter mortalities were monitored in the field whenever possible and by reports from hunters and trappers.

Large portions of Unit 11 are classified as limited fire suppression zones where wildfire is allowed to burn. Unfavorable weather conditions for burning have occurred in recent years and wildfires impacted little or no habitat this reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

The number of moose observed during fall sex and age composition surveys in Count Area (CA) 11 (the western slopes of Mount Drum) declined during this reporting period (Table1). Historically, the number of moose counted has fluctuated between years on this count area. Moose movements and survey conditions probably account for some of the yearly variation. The average number of moose observed over three year periods were compared to smooth annual variation in survey results due to snow condition and sightability. From 1994–96, an average of 132 moose (.46 moose/mi^2) were observed. The three-year average between 1999 and 2001 was 106 moose (.37 moose/mi^2), down 20% from the 1994–96 time period. Though not definitive, this trend data suggests that the population in Unit 11 may be declining.

Population Size

An accurate population estimate is not available for all of Unit 11 because a complete census has never been conducted. Moose numbers observed during the 2001 fall composition counts in CA-11 resulted in a density estimate of 0.3 moose per mi^2. Density estimates from 0.1 to 0.4 moose/mi^2 were calculated in 1986 during late winter stratification surveys when 20% of the estimated 5200 mi^2 of moose habitat in the unit was surveyed. Based on these density estimates, an extrapolated population estimate of approximately 2500 moose was obtained. During the fall of 1993, NPS biologists conducted a Gasaway census in portions of Unit 11. The density estimate was 0.58 moose/mi^2 and the extrapolated population estimate from this survey was 3000 moose (Route, personal communication). Recent declines in the number of moose counted on CA-11 suggests moose abundance may be lower now than the 1993 National Park Service estimate.

Population Composition

The bull:cow ratio in CA-11 in 2001 was 94:100 (Table 1). The bull:cow ratio has averaged 120:100 for the 5 years between 1997 and 2001. These bull:cow ratios have been among the highest ever observed in CA-11. This adult bull:cow ratio greatly exceeds the current management goal of maintaining no less than 15 adult bulls:100 cows.

The calf:cow ratio in CA-11 was 9:100 in 2001, down 62 percent from the 2000 ratio of 24:100 (Table 1). Fall calf:cow ratios in CA-11 fluctuate considerably annually, with a 3-year average of 18 calves/100 cows. This low level of recruitment is insufficient to allow moose numbers to increase.

Distribution and Movement

Data from past fall composition and winter stratification surveys, field observations, and reports from the public indicate that the highest moose numbers in the unit are along the slopes of Mt. Sanford, Mt. Drum, and Mt. Wrangell. Portions of Unit 11 south of the Chitina River have the lowest density of moose in the unit.

Fall rutting and postrutting concentrations normally occur in upland habitats to elevations as high as 4000 ft. Migrations to lower elevations are initiated by snowfall but usually do not occur until late November–early December. By late winter, moose numbers in riparian habitats along the Copper and Chitina Rivers are at their highest levels for the year. Some moose from the western slopes of Unit 11 move to lower elevations in a westerly direction across the Copper River to winter in eastern Unit 13.

MORTALITY

Harvest

Seasons and Bag Limit.

State		
Unit 11	20 Aug–20 Sep	1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least 1 side.
Federal Subsistence		
Unit 11	20 Aug–20 Sep	1 bull by registration permit.

Board of Game Actions and Emergency Orders. During the spring 1993 board meeting, the Unit 11 season was changed to 20 August to 20 September, and the bag limit was changed to 1 bull with spike-fork antlers or antlers with a minimum 50-inch width or 3 brow tines. These changes were in effect for the 1993 season. This action aligned the state moose season and bag limit in most game management units on the road system in Southcentral Alaska. In 2000 the National Park Service initiated a registration permit hunt for federal subsistence hunting in Unit 11 by residents of designated communities in the resident zones of Units 11 and 13. The season dates are 20 Aug to 20 Sept.

Human-induced Mortality. The combined state and federal harvest for moose in Unit 11 during 2000 was 45 moose (Table 2). Thirty moose were taken under state regulations and 15 under federal. Moose harvests have been increasing during this reporting period after reaching a low of 27 bulls taken in 1998. Hunting pressure increased in 2000 with 110 individuals reported hunting under the state harvest ticket and 162 rural residents obtaining federal subsistence moose permits. During the late 1980s, an average of 187 individuals reported hunting moose in Unit 11 but this effort had dropped to an average of 118 during the mid 1990s. The current increase in hunting effort in Unit 11 reflects displacement of hunters from Unit 13, where moose hunting opportunities have declined dramatically.

Illegal and unreported harvests of both bulls and cows have been documented in Unit 11 and, in some years, may be as much as 20% of the reported harvest. Poaching activity is assumed to be greatest along the Nabesna and McCarthy Roads where vehicle access allows for hunting and transporting illegally taken moose without being observed. It is also unknown how many small bull moose are taken and reported as legal under federal registration permit. With 2 different bag limits enforced for the same area, it is difficult to limit the harvest of small bulls because they are legal under the federal subsistence regulations.

Hunter Residency and Success. Table 3 gives residency breakdowns for successful and unsuccessful moose hunters in the state hunt. Local rural residents accounted for 70% (n=28) of the total moose taken in Unit 11 during 2000 while nonresidents only took 10% (n=4) with the remainder going to nonlocal Alaskan residents. One reason for higher success rates for local subsistence hunters is that NPS regulations allow only local rural residents to hunt in those portions of the unit designated as Park. Because nonlocal residents and nonresidents can hunt only on preserve lands, they are excluded from much of the unit. Also, local residents can take any size bull under current subsistence regulations on federal lands, while nonlocals and nonresidents must take a spike-fork or 50-inch bull under state regulations.

The hunter success rate in 2000 was 27% for the state hunt, down from the 5-year average of 31%. The decline in 2000 success rate for the state hunt could be attributed to some hunters reporting under the federal permit. Success rates for federal hunters are unknown. Successful hunters spent an average of 5.8 days to kill a moose in 2000, while unsuccessful hunters averaged 7.7 days in the field. The time spent hunting and the time needed to take a moose declined during this reporting period. From 1995 through 1999, successful hunters averaged 7.1 days hunting and unsuccessful hunters 10 days.

Harvest Chronology. Chronology data indicate more moose are taken during the later portion of the season in Unit 11 (Table 4). Bull moose are more vulnerable in the latter part of the season because their movements increase at the onset of rut in mid September, which is also during leaf fall.

Transportation Methods. Unit 11 moose hunters use aircraft, 3-or 4-wheelers and highway vehicles for access to hunting areas (Table 5). NPS regulations limit transportation methods in Unit 11. Aircraft cannot be used in portions of the unit designated as park, and all vehicle use for sport hunting is restricted to existing trails except by permit. Only subsistence hunters do not need a permit and are not limited to existing trails. These rules limit hunting opportunity in the more remote portions of the unit.

Natural Mortality

Predator-prey studies have not been conducted in Unit 11. Wolves and brown bears are abundant, but predation rates are unknown. Field observations of wolf kills during winter, coupled with reports by hunters and trappers of suspected wolf predation, indicate that wolves are important predators of moose in the unit. Brown bear predation was less apparent because it does not occur during winter when it would be easier to detect. The low calf:cow ratios observed during fall counts indicate early calf mortality similar to that observed in areas with high brown bear predation on neonatal moose calves. Because this unit has a very low-density moose population, predation could limit recruitment and maintain moose at current low densities. Predation can suppress moose populations at very low densities for long periods, especially when alternative prey such as caribou and sheep are available, as they are in Unit 11, and help to keep wolf numbers high (Gasaway et al. 1983).

HABITAT

Assessment

Fires occurred throughout much of Unit 11 before the mid 1940s when the Bureau of Land Management (BLM) instituted fire suppression activities. The beneficial effects of those fires were reached in the 1960s and moose numbers were high over much of the unit. Only one fire, the Wilson Camp Fire, has burned enough acreage in the past 30 years to produce a substantial amount of moose browse. That fire occurred in 1981 and covered 13,000 acres. Recent fire starts have either received initial fire suppression activities, or if not put out, have not had favorable burning conditions or fuel supplies. Currently, vast areas within the unit support stands of mature spruce, many of which have been killed by spruce bark beetles and have limited value as moose habitat. Habitat types that moose currently use are climax upland and riparian willow communities.

Enhancement

Habitat manipulation to benefit moose is not currently an option because most of the unit is included in Wrangell–Saint Elias National Park and Preserve. Although NPS regulations prohibit habitat manipulation, Unit 11 is included in the Copper River Fire Management Plan with most remote areas under the limited suppression category.

CONCLUSIONS AND RECOMMENDATIONS

Moose numbers may have declined slightly during this reporting period. Although this conclusion is based on a decline in the number of moose counted in only one count area, a much more drastic decline has been well documented in adjacent Unit 13. Both units are similar in that they have relatively high numbers of both brown bears and wolves. Calf predation has been documented as an important factor in the moose decline in Unit 13. Calf ratios in Unit 11 are as low or lower than those observed in Unit 13 and are probably too low to allow growth of this moose population. The outlook for the Unit 11 moose population is probably one of slight increases or decreases, depending on predation from year to year, but overall moose numbers are expected to remain very low for an extended period of time.

Moose hunting patterns changed considerably in Unit 11 during this reporting period. Prior to this reporting period, hunting pressure and harvest were declining. This trend reversed itself in 1999 with both hunting pressure and the harvest increasing. Although the reasons for this change are not known, I surmise that more hunters were displaced from Unit 13 because of the dramatic decline in both moose numbers and the harvest. Also, prior to 2000 all moose hunting was monitored under the state harvest ticket system, including the federal subsistence harvest. In 2000, the National Park Service initiated a registration permit hunt for the federal subsistence hunt and hunting pressure and harvests reached levels not seen in over 10 years. Whether this effort will continue is unknown because moose numbers are lower than in the late 1980s when similar hunting effort existed. The large increase in federal hunters undoubtedly increased the harvest on smaller bulls protected under the state SF/50 regulation. Once these available bulls are harvested, the overall take may decline because calf production/survival is low and bull recruitment can not support high harvest for very long.

I recommend a research program be established to investigate factors limiting growth of the moose population. Unit 11 has the potential to support more moose. The population objective of maintaining moose at existing densities (i.e., 0.1 and 0.7 moose/mi^2) needs to be reconsidered and perhaps increased. We also need to explore options available to managers to enhance the moose population consistent with NPS regulations. I also recommend reviewing the control and enforcement of the moose harvest in Unit 11. Dual management creates numerous enforcement and reporting problems such as taking illegal moose on state or private land and reporting it as a federal subsistence moose.

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Table 1 Unit 11 Moose composition counts in Count Area 11, 1996–2001

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour	Density moose/mi^2
1996	92	11	21	10	121	134	30	0.5
1997	128	4	9	4	107	111	29	0.4
1998	111	9	15	7	97	104	24	0.4
1999	109	11	21	9	111	122	28	0.4
2000	157	3	24	9	95	104	23	0.4
2001	94	4	9	4	89	93	19	0.3

Table 2 Unit 11 Moose harvest[a] and accidental death, 1996–2000

	Reported			Estimated			
Year	M	F	Total[b]	Unreported	Illegal	Total	Total
1996	38	0	38	5	5	10	48
1997	34	0	34	5	5	10	44
1998	27	0	28	5	5	10	38
1999	38	0	40	5	5	10	50
2000	45	0	45	5	5	10	55

a Includes state harvest tickets and federal registration permit hunts.
b Includes unknown sex.

Table 3 Unit 11 Moose hunter residency and success for general state harvest ticket hunt only, 1996–2000

	Successful				Unsuccessful			
Year	Local resident	Nonlocal resident	Non Resident	Total[a]	Local resident	Nonlocal resident	Non-resident	Total[a]
1996	18	15	5	38	53	6	2	62
1997	28	3	3	34	48	26	4	79
1998	18	8	2	28	65	13	1	80
1999	25	9	6	40	37	41	4	83
2000	13	8	4	30	35	40	4	80

[a] Includes unspecified residency.

Table 4 Unit 11 Moose harvest (%) chronology by seasonal weeks for general state harvest ticket hunt only, 1996–2000

Year	Season Dates	Week of Season 1st	2nd	3rd	4th	5th
1996	20 Aug–20 Sep	5	8	11	54	22
1997	20 Aug–20 Sep	3	3	9	23	62
1998	20 Aug–20 Sep	0	4	22	41	33
1999	20 Aug–20 Sep	14	11	8	30	38
2000	20 Aug–20 Sep	7	3	10	27	53

Table 5 Unit 11 Successful moose hunter transport methods (%) for general state harvest ticket hunt only, 1996–2000

Year	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown
1996	21	10	3	26	3	8	26	3
1997	21	6	0	26	0	12	21	15
1998	29	0	0	32	0	7	25	7
1999	33	0	3	33	0	8	23	3
2000	47	0	0	27	0	7	17	3

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

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

GEOGRAPHIC DESCRIPTION: Upper Tanana and White River drainages

BACKGROUND

Following federal wolf control, the Unit 12 moose population irrupted during the 1950s through the mid-1960s. Moose numbers declined rapidly during the early 1970s, similar to populations in adjacent road accessible areas. Several severe winters, high wolf and grizzly bear predation, and high localized cow moose harvests all contributed to the population decline. Cow moose hunts were stopped after 1974, and the Nabesna Road moose season was closed entirely from 1974 through 1981. Between 1986 and 1991, the Little Tok River drainage was closed to moose hunting because of low yearling recruitment and a declining bull:cow ratio. Between the mid1970s and early 1980s, the Unit 12 moose density was estimated between 0.2 and 0.4 moose/mi^2 (ADF&G, unpublished data).

In response to the declining moose populations, wolf control programs were conducted in adjacent Units 20D (1980), 20E (1981–1983), and northern Unit 12 (1981–1983). Beginning in regulatory year (RY) 1982, which begins 1 July and ends 30 June (e.g., RY82 = 1 Jul 1982–30 Jun 1983), attempts were made to reduce the grizzly bear population by liberalizing harvest regulations. Moose habitat enhancement programs were conducted during the late 1980s and again in 1997. Between 1982 and 1989 the moose population in Unit 12 increased, probably due to a combination of these management programs and favorable climatic conditions that prevailed during this period. However, the population remained at low density (0.4–0.6 moose/mi^2).

Unit 12 has been an important moose hunting area for local residents, hunters from Southcentral Alaska, and guided nonresidents. It is also an important wildlife viewing area for tourists driving the Alaska Highway. The Upper Tanana Valley is the first area in Alaska visited by thousands of highway travelers who are here to view Alaska’s wildlife. During the 1960s when the Unit 12 moose population was high, hunting seasons and bag limits were liberal and hunter participation and success were high. Moose were commonly viewed while traveling the area's highways. During that period, needs of consumptive and nonconsumptive users were met. Since the unit's moose population declined to a low level, the hunting season and bag limit have become restrictive and harvest has declined by over 40%. Moose watching has also declined and few tourists observe moose while traveling through Unit 12.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population in concert with other components of the ecosystem.
- Continue sustained opportunities for subsistence use of moose.
- Maximize sustained opportunities to participate in hunting moose.
- Maximize opportunities for the nonconsumptive use of moose.

MANAGEMENT OBJECTIVE

- Maintain a minimum posthunting sex ratio of 40 bulls:100 cows east of the Nabesna River and a minimum ratio of 20 bulls:100 cows in the remainder of the unit.

INTENSIVE MANAGEMENT OBJECTIVES

- Population: 4000–6000 moose
- Harvest: 250–450 moose annually

METHODS

POPULATION ESTIMATION AND COMPOSITION SURVEYS

We estimated the moose population size in 1120 mi^2 in northwestern Unit 12 during November 1994 and October 1997. Methods followed standard Gasaway survey techniques (Gasaway et al. 1986), except the areas were stratified using historic count data collected during aerial contour counts or population estimation surveys. The area in northwestern Unit 12 was divided into 34 high density and 42 low/medium moose density strata sample units in 1994. Based on 1994 and 1996 survey results we restratified the area into 37 high and 39 low/medium strata sample units in 1997. We flew 24 random sample units (16 high; 8 low/medium) covering approximately 32% of the study area during 1994 and 27 random units (19 high; 9 low/medium) covering 37% of the area during 1997. Standard search intensity was about 4.25 min/mi^2 in 1994 and 3.45 min/mi^2 in 1997. Portions of 12 sample units (1994; 8 highs, 4 lows) and 14 units (1997; 9 highs, 5 lows) were resampled at a search intensity of 12 min/mi^2 to determine a sightability correction factor.

During 2000 and 2001, in cooperation with Tetlin National Wildlife Refuge staff, we estimated moose population size and composition using a spatial correlation technique (Ver Hoef 2001) in all of Unit 12 excluding portions of the Nabesna, Chisana, and White River drainages within Wrangell–St. Elias National Park and Preserve. All moose habitat in this area was divided into high (≥2 moose/sample area) or low (<2 moose/sample area) strata.

During each year, between 60–65% of the sampled areas were high strata. All moose observed were classified as either large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), small bulls (spike, cerviform, or palmate-antlered [no brow separation] yearling bulls), cows, calves, or unidentified moose.

The National Park Service (NPS) conducted a "no-strat" population estimation survey (Dale et al. 1994) in a 352-mi^2 area in the vicinity of Chisana in southeast Unit 12 during October 1998 (NPS, Wrangell–St Elias National Park and Preserve, unpublished data).

We conducted aerial composition surveys in October and November 1993–1999 in 4–9 traditional trend count areas. All moose observed were classified as either large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), small bulls (spike, cerviform, or palmate-antlered [no brow separation] yearling bulls), cows without calves, cows with 1 calf, cows with 2 calves, lone calves, or unidentified moose. These data were used to estimate population and composition trends by comparing moose observed per hour and composition ratios between years.

HARVEST

Harvest was estimated using harvest report cards with the benefit of reminder letters to hunters who did not initially report. Information obtained from the reports was used to determine total harvest, hunter residency and success rates, harvest chronology, and transportation used. Harvest data were summarized by regulatory year. Estimates of potlatch take are obtained by interviewing residents and public safety officers of villages where potlatches have taken place.

HABITAT ENHANCEMENT

We made significant progress on developing a cooperative wildlife habitat logging plan with the Department of Natural Resources/Division of Forestry designed to increase the amount of deciduous browse and cover for wildlife and to provide nursery structure for planted spruce seedlings. The Robertson River Prescribed Burn Plan was completed and should be implemented during summer 2002.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Based on data collected during annual October/November aerial composition surveys and 7 area-specific population estimation surveys (1989, 1990, 1994, 1997, 1998, 2000, and 2001), the moose population in Unit 12 increased slowly from 1982–1989 and remained relatively stable from 1989–1993. Increased calf survival allowed the Unit 12 population to grow slightly during 1994–1997. The population remained stable during 1998–2001. During the growth phase in 1994–1997, the most apparent increase occurred in the northwest portion of the unit within the area affected by the 1990 Tok wildfire (155 mi^2). Population estimates indicate this area supported 0.19 moose/mi^2 in 1989 but increased to 0.6 moose/mi^2 by 1994 and about 1.0 moose/mi^2 in 1997.

The 1999 estimated population range was 3500–4000 moose using results from past year's population estimates and composition surveys conducted in 1999. The 2001 Unit 12 population estimate was 3450–4300 moose (±16%, 90% CI). The estimated density was 0.6–0.7 moose/mi^2 of suitable moose habitat (6000 mi^2).

Localized moose harvest caused declines in moose numbers near the villages and communities in Unit 12. Poaching and taking moose for funeral and ceremonial potlatches have had the greatest effect because cow moose were harvested most. The current Fish and Wildlife Protection officer conducted intensive public awareness campaigns explaining the limiting effects of poaching on local moose numbers. His efforts resulted in a noticeable reduction in the number of poaching cases. We tried to work with the local villages to improve potlatch moose harvest reporting and to develop a strategy that would meet cultural needs but limit the harvest to more sustainable levels. We have been largely unsuccessful. The villages were very willing to report when they were going to hunt for a potlatch, which reduced confusion during periods when hunting season was not open. However, reporting following the potlatch remained poor and total take and cow harvest has not declined.

On 11 and 12 June 2001, elders from Northway (Alaska) and Beaver Creek (Yukon, Canada) villages met to discuss fish and wildlife issues as part of a traditional workshop. Potlatch moose harvest and its effects on moose population trend were discussed. The elders decided the best course of action was to conduct meetings in each village and discuss the cultural values and needs of potlatches, historic harvest practices, and current moose population trend. These meetings were scheduled for July 2002.

The Alaska Board of Game identified the moose population within Unit 12 as important for high levels of human consumptive use under the Intensive Management Law (AS 16.05.255[e]–[g]). This designation means the board must consider intensive management if regulatory action to significantly reduce harvest becomes necessary because the population is depleted or has reduced productivity. The board set the Unit 12 population objectives at 4000–6000 moose and harvest objectives at 250–350 moose. The Unit 12 moose population is at the lower end of the population objective, but calf survival is not high enough to allow the harvest objective to be met. Based on modeling the trends of the Unit 12 moose population and hunter participation and harvest, harvest needs to be maintained at 130 bulls and distributed throughout the unit to protect the bull population, especially in the more accessible areas of the unit. Significantly increasing the moose population and the sustainable harvest will require intensive management to reduce the effects of wolf and bear predation.

To better evaluate the potential outcome of different intensive management programs on the Unit 12 moose population, I modeled current population status and trend data for moose and their predators using the McNay and DeLong (1998) Predprey model. Past research found that predation by both wolves and bears was the primary factor maintaining the area moose populations at low densities (0.2–1.0 moose/mi^2, Gasaway et al. 1992; US Fish and Wildlife Service, unpublished data). The effects of wolves and bears vary among areas within Unit 12. In the Northway and Tetlin Flats, both calf mortality and predation rate studies indicated that wolves were the primary predator on calves and adult moose throughout the year. In contrast, along the Nutzotin Mountains, calf recruitment to 5 months was substantially lower and was more indicative of grizzly bear predation. Modeling exercises using actual moose composition and predator kill rate data indicated the Unit 12 moose population continued to be primarily limited by wolves although grizzly bears were an important predator in portions of the unit. Model results also indicated the Unit 12 moose population will remain at low densities for an extended period of time with little opportunity for increased harvest if predation levels remain the same.

Assuming grizzly bear predation rates remain relatively constant during the next 5 years, the model predicted the Unit 12 moose population would increase substantially if unit wolf numbers were reduced. A wolf population reduction of 80% was found to have caused moose and caribou populations to increase ($\lambda \geq 1.15$) in other areas of Alaska and Yukon (Boertje et al. 1996). If the unit's wolf population is controlled at this level, the modeled moose population increases at 8–14% annually. However, wolf control is not an option on federal lands, which constitute a majority of Unit 12. If wolf control is conducted only on state and private lands, the modeled moose population increases at about 6–9%. Because wolves are the primary predator in most of Unit 12, regulating wolf numbers by public trapping can also benefit moose. If trappers remove 40% of the fall population each year, wolf numbers would decline allowing the moose population to increase 4–5% annually.

Because the moose population in the northwest portion of the unit increased as a result of the 1990 Tok wildfire and as a result of intense public hunting and trapping of predators, other local moose population increases could possibly occur in Unit 12 without government wolf control. These moose population increases would be moderate and would be eventually limited by predation. However these population increases would be enough to satisfy the minimum intensive management objectives. Because of landownership patterns in Unit 12, this will be the management direction taken during the next 5 years.

Population Composition

We conducted moose composition surveys in Unit 12 during fall 1988–2001 (Table 1). Composition data since 1994 are not directly comparable with previous years because sampling techniques changed. Prior to 1994, trend count areas within the Tok, Little Tok, Tetlin, Nabesna, and Chisana Rivers were surveyed annually. During 1994, 1997, 2000, and 2001, we conducted population estimation surveys over a much larger area which included the traditional count areas. During 1995, 1996, 1998, and 1999, a portion of the trend count areas were surveyed to protect against missing a catastrophic decline in the area's moose population during years population estimation surveys were not conducted. Benefits of conducting population estimation surveys included confidence limits around composition estimates and, because more area and habitats were sampled, it was less likely that weather or moose distribution anomalies would affect the count. We found calf:cow ratios were lower within the high strata compared to low strata, indicating that most calf:cow pairs select for habitats not normally surveyed during trend counts. Most of the trend count areas were located within high-density areas to optimize the number of moose surveyed.

During 2000 and 2001, Tetlin National Wildlife Refuge staff cooperated with us to design moose surveying areas to obtain population and composition estimates for most of Unit 12. This cooperation will continue at least 2 more years.

During 2000 and 2001, bull:cow ratios ranged from 40:100 in western and northern portions of Unit 12 to 64–84:100 in the eastern and southern portions. Most harvest occurred in the western and northern portions of the unit and in some areas caused the bull:cow ratio to decline. Within the Tok River drainages and along the north side of the Alaska Range, the bull:cow ratio declined to 22–26:100 from the low 30s:100 during the mid-to-late 1990s but has remained relatively stable since 1999. The Unit 12 bull:cow ratio remains above the population objective.

Annually, 45–50% of the total Unit 12 moose harvest occurred in the Tok River drainage and along the Front Range. Yearling bull recruitment ranged from 7–11:100 and was not adequate to compensate for harvest. The bull:cow ratio stabilized during RY99–RY01 because hunting success rate declined probably because bull density became so low.

In 1999 calf survival to 5 months was low (17–23:100 cows) in Unit 12 and adjacent areas in Units 20D and 20E. Calf survival was also low in western and northern Unit 12 (18:100) and in southern Unit 20E (14–21:100) during 2000. In central and eastern Unit 12 the 2000 calf:cow ratio was 34:100. Unit 12 calf:cow ratios were 27–33:100 in 2001. The number of calves surviving to 5 months compared to the number of yearling bulls (9–14:100) during the report period suggests that wolves continue to be a primary predator in Unit 12.

Distribution and Movements

Moose live throughout Unit 12 below an elevation of about 4500 feet. There is about 6000 mi^2 (15,540km^2) of suitable habitat. There are both migratory and sedentary populations. Moose that rut in the Tok River area appear to move the greatest distances. Many cows migrate as far south as the Gakona River for calving, return to the Tok River for the rut, and then move north to the area burned by the 1990 Tok wildfire or to the Tanana River to winter, a straight line distance of 90–100 miles (144–160 km). In route to the Tok wildfire area during winters 1999–2001, 10–30 moose were consistently observed using an area along the Tok River that was mechanically crushed in 1998.

Moose distribution in Unit 12 changed over the past 10 years. During RY99–RY00, very few resident moose existed on the Northway Flats, in the vicinity of Tanacross, or north of Tok along the Tanana River. Year-round poaching and harvest for funeral or ceremonial potlatches contributed to the decline of resident moose in these lowland areas near human settlements. Also, some of these moose may now be spending more time in the 1990 Tok River burned area. Moose use of the Tok River valley and the Tetlin Hills increased substantially since 1989. Densities increased from 0.19 moose/mi^2 (1989) to about 1 moose/mi^2 (1997–2001). Use of this area by moose occurred throughout the year. Increased use of this area was a result of improved habitat from the 1990 Tok River fire and moderate harvests of predators.

MORTALITY

Harvest

Season and Bag Limit. Seasons and bag limits in Unit 12 were as follows:

RY99–RY00

Units and Bag Limits	Resident Open Season	Nonresident Open Season
1 bull with spike-fork antlers.	15 Aug–28 Aug	No open season
Unit 12, that portion drained by the Little Tok River upstream from and including the first eastern tributary from the headwaters of Tuck Creek.		
RESIDENT AND NONRESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–15 Sep	5 Sep–15 Sep
Unit 12, that portion lying east of the Nabesna River and south of the winter trail running southeast from Pickeral Lake to the Canadian border.		
RESIDENT AND NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–30 Sep	1 Sep–30 Sep
Remainder of Unit 12.		
RESIDENT HUNTERS: 1 bull.	1 Sep–15 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–15 Sep

RY01

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 12, that portion drained by the Little Tok River upstream from and including the first eastern tributary from the headwaters of Tuck Creek.		
RESIDENT AND NONRESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 1 side.	24 Aug–28 Aug 8 Sep–17 Sep	8 Sep–17 Sep
Unit 12, that portion lying east of the Nabesna River and south of the winter trail running southeast from Pickeral Lake to the Canadian border.		
RESIDENT AND NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.	1 Sep–30 Sep	1 Sep–30 Sep
Remainder of Unit 12.		
RESIDENT HUNTERS: 1 bull.	24 Aug–28 Aug 8 Sep–17 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		8 Sep–15 Sep

Alaska Board of Game Actions and Emergency Orders. During the spring 2000 meeting, the Alaska Board of Game split the moose season into 2 periods: 24–28 August and 8–17 September except east of the Nabesna River and south of the winter trail running southeast from Pickerel Lake to the Canadian border where the season remained 1–30 September. After creating the 5-day August season for any bull, the 14-day spike/fork-only August season was eliminated. Also in spring 2000, the board established population objectives for Unit 12 at 4000–6000 moose and harvest objectives at 250–450 moose.

Hunter Harvest. Reported harvest in Unit 12 was 137 bulls and 2 unknown sex in RY99, 112 bulls in RY00, and 99 bulls and 1 unknown sex in RY01 (Table 2). The 5-year average reported moose harvest was 121. The number of hunters and harvest increased in 1995.

Average annual harvest during 1990–1994 was 92 compared to 121 (32% increase) during 1995–2001.

During RY99–RY01 the highest number of hunters (186–207) and the greatest harvest (40–49) occurred in the Tok River valley. The other most intensively hunted area was between the Robertson River and Northway along the Alaska Highway or Tanana River. That area was hunted by 95–111 hunters and 9–19 bull moose were taken. Local residents have historically hunted these areas. During RY99–RY01, local residents comprised 42–55% of the hunters and took 39–45% of the harvest in the Tok River and 67–81% of the hunters took 67–89% of the harvest along the Tanana River and Alaska Highway. Hunter composition changed in the Tok River area as more nonlocal Alaskan residents hunted the Tok River drainage. The number of local residents and nonresidents using this area remained consistent during RY96–RY01. Since enacting antler size restrictions in RY93, harvest within the Little Tok River drainage declined to an average of 5 per year during RY94–RY01 compared to 10 and 20 bulls per year during RY91 and RY92.

Reported harvest represented about 2.5–3.5% of the prehunt Unit 12 population and had little impact on population dynamics. During RY99–RY01 the annual out-of-season take for funeral or ceremonial potlatches was 25–50 moose of either sex. Most of the potlatch harvest was comprised of cow moose. During the early 1990s this harvest was probably as high as 60 moose annually because poaching was more of a problem and additive to the potlatch take. Most out-of-season harvest occurred near communities and along the road system. Thus, the annual Unit 12 harvest was probably closer to 4–5.5% of the population. Under this harvest rate and these harvest distribution patterns, the moose population around Unit 12 villages and communities continued at low levels.

During RY99–RY01, antler size was reported for 125, 112, and 95 harvested bulls, and the average size was 45.0, 46.4, and 47.4 inches. The 5-year average (RY97–RY01) was 46.1 inches compared to the 45.5 inches during RY92–RY96. Of the 112 bull moose harvested in Unit 12 during RY00, 19 bulls (17%) were judged to be yearlings (antlers <30 inches), 47 (42%) were 2–4 years old (antler spread 30.0–49.9 inches), and 46 (41%) were mature bulls (antler spread ≥50 inches). Antler spreads were estimated for 145 bulls observed during population estimation surveys during October and November 2000 after the hunting season. Of these, 23% were yearlings, 51% were 2–4 year olds, and 26% were mature bulls. The apparent selection for mature bulls in the harvest can be explained in that 65% of the mature bulls were taken because of regulation requirements either by nonresidents or by residents hunting in antler restriction areas.

In most years, yearling bulls were underrepresented in the harvest. Based on conversations with many local hunters it is apparent that yearling bull moose movements and behavior patterns allow this age class to avoid hunters. Hunters were not passing up yearling bulls in favor of larger bulls.

Hunter Residency and Success. During RY99–RY01, local residents accounted for an average of 56%, nonlocal residents averaged 36% and nonresidents 8% of the moose hunters in Unit 12. Compared to RY94–RY98, these percentages changed due to an increase (23%) in the number of nonlocal Alaska residents that hunted Unit 12. The number of local and nonresident hunters remained relatively constant since RY94. Local hunters harvested 44 to 49% of the reported harvested bulls during RY99–RY01, nonlocals took 27 to 37%, and nonresidents 19 to 22% (Table 3). Local harvest ranged between 42–50% and nonlocal harvest between 27–38%, since RY94. The higher than expected success for nonresidents in Unit 12 was because most (≥77%) were guided.

During RY99–RY01, 520–557 hunters reported hunting moose in Unit 12 (Table 3). The 5-year average was 520 compared to the average of 466 between RY92–RY96, a 12% increase. Increased participation by nonlocal Alaska residents mostly from Southcentral Alaska accounts for a majority of the increase in hunters. This trend also occurred in adjacent Unit 20E. During RY99–RY00, the average success rate was 22% compared to 23% during RY94–RY98.

Harvest Chronology. During RY91–RY00, an average of 33 bulls were harvested during 1–6 September (Table 4) representing 30% of the fall harvest (range = 27–35%). In an attempt to maintain or reduce the fall harvest in Unit 12, during RY01 the hunting season in most of the subunit was split into 2 periods: 24–28 August and 8–17 September. Our intent was to decrease total harvest. During RY93–RY00, 18–36 ($\bar{x}$ = 27) bulls were harvested during 1–5 September. In RY01, 9 bulls were harvest during 24–28 August. During the first year under this regulation, harvest was reduced 50–69% during the first 5 days of the season. This reduction in harvest was not regained during the 10-day September season. The RY01 harvest was 19% lower than the average harvest during RY96–RY00.

The number of hunters who used the 1–30 September season in southern Unit 12 and the total harvest for this season remained similar to past years. Most of these hunters were guided nonresidents or Chisana residents.

Transport Methods. During RY99–RY01, the transportation type used by most hunters, on average, was highway vehicles (35%), followed by 4-wheelers (23%), boats (16%), other ORVs (9%), airplanes (7%), and horses (4%). Method of transport was unknown for 6% of the hunters. Compared to RY94–RY98, more hunters used 4-wheelers (34% increase) and fewer highway vehicles as transportation. Use of all other transportation types remained relatively constant. Hunters using highway vehicles had the lowest average success rate (14%), but traditionally, until RY00, took the greatest number of moose annually (Table 5).

During RY00 and RY01, hunters using 4-wheelers took the greatest number of moose. Hunters using horses had the highest success rate (54%). Horses were primarily used by guides to transport nonresident hunters into the most remote sections of the unit. Hunters using airplanes had a success rate of 45% during the past 8 years. Success rates for hunters using 4-wheelers (23%), ORVs (26%), or boats (25%) were similar and were near the unit's average success rate.

Other Mortality

Predation by wolves and grizzly bears has been the greatest source of mortality for moose in Unit 12 and has maintained the population at a low density (0.4–0.7 moose/mi^2) since the mid-1970s. In contrast with most other areas that contain sympatric moose, wolf, and grizzly bear populations, wolves, rather than bears, were the primary predator on moose calves on the Northway–Tetlin Flats, based on research conducted during the late 1980s (ADF&G unpublished data; US Fish and Wildlife Service, unpublished data). Wolf predation also appeared to be the greatest source of adult mortality. However, in some mountainous areas of Unit 12, fall composition data indicate that predation on moose neonates was high, suggesting grizzly bear predation.

In much of Unit 12 the grizzly bear population is stable at a food-limited density that is typical for Interior Alaska bear populations (16–20 bears/1000 km^2). The grizzly bear population probably declined in portions of the unit since the mid-1980s due to increased harvest by hunters.

Wolf populations increased in Unit 12 at least since 1989 when tens of thousands of Nelchina caribou started to spend the winter in or migrate through Unit 12. Between 1989 and 1992, the fall Unit 12 wolf population increased 30–40%, and during 1992–1993 there were 230–243 wolves in a minimum of 28 packs.

During RY92 and RY93, the wolf population declined in Unit 12 due to increased harvest by trappers (Gardner 2000*a*). The estimated decline within the unit was about 25%, but most of the decline occurred within the western portion of the unit where over 40% of the total harvest occurred and the estimated wolf population decline was 30–40%. Wolf harvest declined substantially (13–24% harvest rate) in RY94 through RY00 due to low pelt prices. The wolf population subsequently increased about 30% during those years and in RY00 was estimated to be 230–245 wolves.

Considering the population status and trends of wolves and grizzly bears in Unit 12, I expect the moose population to remain at low density (0.2–1.0 moose/mi^2) for an extended period. However, it appears that concentrated public wolf trapping and bear harvest can cause local populations of moose to increase, especially in areas that received habitat enhancement. The likely mechanism is improved calf and yearling survival. Adult mortality probably changes little. Modeling data and survey data support this hypothesis.

HABITAT

Assessment

Only about 6000 mi^2 in Unit 12 are moose habitat. However, excessive wildfire suppression for nearly 30 years allowed vast areas of potentially good moose habitat to become choked with spruce forests that lack high-quality deciduous moose browse. We conducted browse surveys periodically the past 15 years and found that in most years use of preferred browse species is low in relation to availability. During deep snow winters, moose concentrated in areas along the Tok and Tanana Rivers and the browsing rate was much higher. In all years, disturbed sites with early successional species were used far more heavily than adjacent undisturbed areas. During RY99–RY01 habitat was not limiting the moose population in Unit 12 but medium to large scale creation of early seral species could cause the moose population to increase, as evidenced by the 1969 Ladue burn in eastern Unit 20E (Gardner

2000*b*), the 1990 Tok burn, and the Teslin burn in the Yukon (Boertje et al. 1995). Boertje et al. (1995) hypothesized that seral stages reduce predation efficiency in a variety of ways.

Enhancement

During the 1980s, over 1800 acres of old age, decadent willows were intentionally disturbed to stimulate crown sprouting of new leaders. Using data collected during our browse surveys, we estimated that these habitat enhancement projects produced over 2 million pounds of additional browse each year for wintering moose. In eastern Unit 12 the US Fish and Wildlife Service completed several prescribed fires to benefit moose on the Tetlin National Wildlife Refuge.

In 1997 we mechanically crushed 275 acres of decadent willow and aspen within the Tok River valley to stimulate crown growth. We conducted informal surveys in this area during summers 1999 and 2001 and found extensive stands of feltleaf willow (*Salix alaxensis*) and red-stem willow (*Salix planifolia),* preferred moose browse species. In summer 2001 most of the shrubs were between 3–10 feet; <1% were above 10 feet and unavailable for moose. We documented continual use of this area during the winter by 10–30 moose and observed increased use as calving habitat.

Since 1998 we have been working in cooperation with the Division of Forestry to determine suitable logging sites within a proposed 1000-acre timber sale area in the Tok River valley. Potential cut areas are selected based on numbers of marketable trees, historic winter moose use, and the potential to regenerate quality moose browse species. In addition we are assisting in designing and implementing scarification techniques that will promote willow and aspen regeneration following logging on these sites. Cut areas will be 80–200 acres in size. Logging should begin during winter 2002–2003.

From June to September 1990, a wildfire burned approximately 97,000 acres of primarily decadent black spruce muskeg in the Tetlin Hills and adjacent Tok River lowlands. Quality moose browse species recolonized much of this area and, in response, the area's moose population increased rapidly (0.19 moose/mi^2 in 1989 to 1.0 moose/mi^2 by 1997). Excellent moose winter browse supplies are expected to exist for the next 15–20 years.

Local residents observed the increase in moose in the area burned by the 1990 Tok wildfire. As a result, more residents, including Natives, are more receptive to using fire or other habitat enhancement techniques to benefit moose, as evidenced by planned prescribe burns in the Robertson River in 2002 and near Tanacross village in 2003.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

If moose numbers are to increase along the road system in Unit 12, the number of cow moose taken for ceremonial and funerary potlatches must decline. The department tried to address this problem with local villages during village council meetings and Traditional Knowledge workshops but no corrective steps were taken. The local Upper Tanana/Fortymile Advisory Committee requested the Board of Game address the issue, and the Division of Wildlife Protection submitted a proposal to correct one element of the potlatch harvest issue but the board tabled the issued until 2003. Potlatches are culturally important and should be maintained but restrictions on harvest, especially in areas like Unit 12 where the moose densities are very low, should be implemented. During summer 2002 we will work with Northway village residents to design potlatch moose management that better protects the moose population and still meets the village's needs. Results of this meeting will be presented in the next management report.

CONCLUSIONS AND RECOMMENDATIONS

During RY99–RY01 moose were far less numerous in Unit 12 than in the 1960s. The population declined rapidly during the 1970s, increased during the late 1980s, stabilized or slightly declined from 1989–1993, increased slightly from 1994–1996, and remained stable from 1997–2001. Moose numbers, especially in the vicinity of the road system, were very low which primarily affected subsistence hunters and nonconsumptive users. Every year hundreds of Alaska Highway travelers commented on the lack of wildlife in the Upper Tanana Valley. Habitat was not limiting, but predation and out of season funeral and ceremonial take in certain areas maintained the moose population at low density. Between 1991 and 1997 the moose population increased within the area affected by the Tok wildfire. Residents of Tetlin and Tok and a growing number of nonlocal residents increased their hunting of the area and consequently legal and out-of-season harvest stabilized moose population growth.

In more accessible areas of Unit 12 the bull:cow ratio declined to 20–25:100 due to moderate harvest rates and low yearling bull recruitment. In the Little Tok River, an antler restriction regulation was adopted in an attempt to protect the bull:cow ratio, but still allow maximum hunter opportunity. Harvest may need to be restricted in a similar manner in the Tok River drainage and along the north face of the Alaska Range because of high harvest rates.

During RY96–RY01, the number of hunters increased by 12% and harvest increased by 32% compared to RY91–RY95. However, in RY01 when the Unit 12 moose season was split into a 5-day August season for any bull and a 10-day mid-September season for any bull, harvest declined by 19% compared to the average annual harvest during RY96–RY00.

The Alaska Board of Game established population objectives for Unit 12 at 4000–6000 moose and harvest objectives at 250–450 moose. The 2001 population was at or just below the population objective but was not productive enough to maintain the desired harvest. Modeling indicated intensive management objectives could be met in portions of the unit if intensive habitat management was coupled with elevated public wolf and bear harvest.

Other than the intensive management harvest objective, the Unit 12 moose goals and objectives were met during RY99–RY01. Population trends were monitored. Additional habitat enhancement programs were planned and should be implemented during the next 2 years. Hunting seasons and bag limits were established that allowed maximum hunting opportunity and met subsistence needs. We are continuing to work with local villages to reduce potlatch take, especially of cow moose. Moose watching opportunities were shared with visitors and local residents, and several presentations were given to local schools and tourist groups annually.

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Table 1 Unit 12 aerial moose composition counts, fall 1988–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/hr
1988	64	18	33	189	17	943	1133	40
1989[a]	50	13	30	223	17	1094	1317	44
1990	47	12	25	185	15	1071	1256	40
1991	49	12	24	200	14	1264	1472	44
1992	45	10	26	165	15	906	1071	32
1993[b]	26	7	36	187	22	662	850	57
1994[c]	38	16	39	87	21	327	414	
1994[d]	97	13	25	47	11	374	421	44
1995[d]	82	12	26	65	12	461	526	51
1996	39	9	32	236	19	1022	1258	57
1997[c]	36	11	41	138	23	458	596	
1997[d]	87	22	31	73	14	439	512	39
1998[e]	65	14	34	48	17	229	277	
1998[f]	38	7	29	26	17	124	150	54
1999[b]	22	8	17	102	12	721	823	65
2000[g,i]	40	9	18		12		630	
2000[h,i]	84	10	34		15		268	
2001[g,i]	40	11	27		16		672	
2001[h,i]	64	18	33		17		466	

[a] Tok and Dry Tok were not surveyed. These survey areas normally yield a sample of 400+ moose.
[b] Cheslina and the northern face of the Nutzotin Mountains were not surveyed. These survey areas normally have about 100 bulls:100 cows.
[c] Based on population estimation results from northwestern Unit 12.
[d] Cheslina, Kalukna, Nabesna, and Chisana count areas were sampled using contour survey techniques.
[e] Based on population estimation results from the Chisana area, southwest Unit 12 using the "No-strat" technique.
[f] Only the north face of the Alaska Range sampled using the contour survey technique.
[g] Survey area includes state and private lands in western and northern Unit 12.
[h] Survey area includes federal and private lands in eastern and southern Unit 12.
[i] Ratios determined using weighted contributions from high and low sample areas. Actual counts of cows, calves and bulls were not used in estimates.

Table 2 Unit 12 moose harvest and accidental death, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest by hunters										Accidental death		Total
	Reported						Estimated						
	M	(%)	F	(%)	Unk	Total	Unreported	Illegal	Total		Road	Total	
1990–1991	94	(96)	0	(0)	4	98	15–20	30–40	45–60		4–5	4–5	147–163
1991–1992	109	(99)	0	(0)	1	110	15–20	30–40	45–60		4–5	4–5	159–175
1992–1993	71	(100)	0	(0)	0	71	15–20	30–40	45–60		4–5	4–5	120–136
1993–1994	91	(100)	0	(0)	0	91	15–20	30–45	45–65		5–7	5–7	141–163
1994–1995	87	(100)	0	(0)	1	88	15–20	30–45	45–65		7	7	140–160
1995–1996	117	(100)	0	(0)	1	118	20–25	5–10	25–35		3–5	3–5	146–158
1996–1997	124	(100)	0	(0)	0	124	20–25	3–10	23–35		3–5	3–5	150–164
1997–1998	102	(100)	0	(0)	0	102	20–25	3–10	23–35		3–5	3–5	128–142
1998–1999	148	(99)	1	(1)	0	149	20–25	3–10	23–35		3–5	3–5	175–189
1999–2000	137	(99)	0	(0)	2	139	20–50	3–10	23–60		3–5	3–5	165–204
2000–2001	112	(100)	0	(0)	0	112	20–50	3–10	23–60		3–5	3–5	138–177
2001–2002	99	(98)	0	(0)	2	101	20–50	3–10	23–60		3–5	3–5	127–166

Table 3 Unit 12 moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful				Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total (%)	
1990–1991	45	26	17	98 (23)	186	131	15	332 (77)	430
1991–1992	48	49	13	110 (27)	160	132	9	305 (73)	415
1992–1993	23	35	12	71 (15)	222	164	13	408 (85)	479
1993–1994	38	33	18	91 (24)	186	90	12	289 (76)	380
1994–1995	43	28	17	88 (19)	240	118	15	374 (81)	462
1995–1996	55	34	26	118 (24)	249	113	16	378 (76)	496
1996–1997	62	41	20	124 (24)	251	119	14	384 (76)	512
1997–1998	43	29	30	102 (21)	245	125	14	384 (78)	492
1998–1999	68	46	35	149 (29)	232	110	19	361 (71)	510
1999–2000	69	41	29	139 (25)	240	155	23	418 (75)	557
2000–2001	49	41	21	112 (21)	241	144	23	409 (79)	521
2001–2002	49	27	22	101 (19)	242	155	20	419 (81)	520

[a] Residents of Units 12 and Units 20E and eastern 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.
[b] Total may include hunters who did not specify whether or not they were residents.

Table 4 Unit 12 moose harvest chronology by month/day, regulatory years 1990–1991 through 2001–2002

Regulatory	Harvest chronology by month/day						
year	8/15–8/28	9/1–9/6	9/7–9/13	9/14–9/20	9/21–9/27	9/28–10/5	Total[a]
1990–1991		18	41	28	4	3	98
1991–1992		34	45	22	4	1	110
1992–1993		25	31	6	4	4	71
1993–1994		29	40	16	4	0	91
1994–1995		25	26	25	3	4	88
1995–1996	2	33	52	17	5	6	118[b]
1996–1997	1	39	44	27	7	1	124[b]
1997–1998	1	30	38	19	10	1	102
1998–1999	2	41	65	30	5	1	149
1999–2000	11	37	54	23	3	2	139
2000–2001	4	32	48	16	6	2	112
2001–2002	9	0	41	34	6	4	101

[a] Difference between total and summation of harvests by week represents moose taken on unknown dates.
[b] One moose was taken during a federal hunt in November 1995.

Table 5 Unit 12 moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method								n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
1990–1991	17	15	21	11	0	6	23	5	98
1991–1992	10	14	10	25	0	14	25	2	110
1992–1993	18	23	10	11	0	10	28	0	71
1993–1994	8	19	15	22	0	16	18	2	91
1994–1995	10	20	19	18	0	7	23	2	88
1995–1996	10	13	28	17	0	6	22	4	118
1996–1997	13	9	22	19	0	7	28	2	124
1997–1998	15	21	16	20	0	3	24	1	102
1998–1999	16	12	17	20	0	11	22	1	149
1999–2000	12	9	16	22	0	12	27	2	139
2000–2001	14	10	19	24	0	12	20	2	112
2001–2002	15	10	20	31	0	9	16	0	101

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 13 (23,376 mi^2)

GEOGRAPHIC DESCRIPTION: Nelchina and Upper Susitna Rivers

BACKGROUND

Moose densities in Unit 13 were low during the early 1900s, but started to increase by the 1940s. Moose were abundant throughout the 1950s, and the population peaked in the mid 1960s. For the next 10 years, moose numbers declined and reached a population low by 1975. Factors contributing to the decline were severe winters, increased predation, and large human harvests of both bulls and cows. The number of moose counted during fall surveys started to increase in 1978 and climbed at an average annual rate of 5% until 1987, when the population peaked again. Moose numbers started to decline again during the early 1990s because of a series of severe winters and increased predation.

Historically, Unit 13 has been an important area for moose hunting in Alaska. Annual harvests were large, averaging over 1200 bulls and 200 cows during the late 1960s and early 1970s. Hunting seasons were long, with both fall and winter hunts. As moose numbers began to decline, we reduced harvests by eliminating both the cow season and winter season in 1972 and reducing fall bull seasons to 20 days in 1975. Harvests in the late 1970s averaged 775 bulls per year, but bull:cow ratios in the population were low. In 1980 the bag limit was changed from any bull to bulls with an antler spread of at least 36 inches or 3 brow tines on at least 1 antler. Under this management regime, the 1980 bull harvest dropped to 557, down 34% from the 1979 harvest of 848. From 1981 through 1988 the harvest increased, peaking in 1988 with a harvest of 1259 moose. Starting in 1990, however, seasons were reduced in length in response to population declines attributed to severe winters. Moose seasons were again liberalized in 1993 with harvests again increasing and remaining high until the late 1990s.

MANAGEMENT DIRECTION

POPULATION OBJECTIVE

Increase the unit moose population to between 20,000–25,000 moose with a minimum of 25–30 calves:100 cows in the fall.

HUMAN USE OBJECTIVE

Increase the yearly moose harvest of bulls and cows to a combined total between 1200 and 2000 animals.

METHODS

We conducted aerial surveys during fall to learn sex and age composition and population trends in large count areas distributed throughout the unit. Censuses have been conducted periodically in different portions of the unit to obtain population estimates. Surveys were flown during calving season to determine percent twins at birth, and in late winter to determine over winter survival. Computer modeling of the moose population was completed to predict trends. We monitored harvests by requiring permit and harvest ticket reports from all hunters and monitored habitat conditions periodically by examining browse utilization transects in different parts of the unit. Attempts at habitat improvement include updating the Copper River Fire Management Plan. In this plan large portions of the unit are included in a limited fire suppression category in which wildfires are allowed to burn. Work was completed on a controlled burn plan and plant composition data in the proposed burn area were collected. In addition, staff evaluated and responded to land-use proposals that could affect moose habitat.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Long-term population trends for moose are monitored by observing changes in the number of moose counted per hour of survey time during fall sex and age trend counts on established trend count areas. This population index is thought to be a reliable indicator of long-term trends in moose numbers because it is not influenced as much by moose movements and survey conditions as the total number of moose counted. Moose per hour data for the current reporting period include 38 moose per hour in 2000 and 35 in 2001 (Table 1). The rate of moose counted per hour in Unit 13 declined 24% from 1988 to 1994 going from 72 to 55. This decline was attributed to a series of severe winters in the early 1990s. Since 1994, the decline in number of moose counted per hour has accelerated, with 36% fewer moose counted between 1994 and 2001. Since the population high in 1988, the moose per hour count has declined 51%.

Moose censuses were conducted in the moose study area in 13A west during 1994 and 1998 through 2001. Moose density in 1994 was 2.16 moose and 1.5 cows/mi^2 (Testa personal communication). In 1998 and 1999 the results were almost identical, with average densities of 1.4 moose and 1.1 cows/mi^2. These data indicate a 31% decline in total moose and a 27% decline in cows between 1994 and 1999. The population in 13A west continued to decline in 2000 and 2001. There were .89 moose and .70 cows per square mile in the census area in 2001. The cow population has declined by 54% since 1994 in this area. Survey conditions were good in all years and the results are thought to represent an actual decline in moose and not census variation.

We used the predator prey model developed by Mark McNay (ADF&G, PredPrey v. 1.0) to model moose, wolf and bear populations in the 13A study area west of Lake Louise. Modeling focused on this area because we have the most complete demographic data for moose, wolves and bears in this study area. We modeled forward from 1994 to the present and 10 years into the future. The model results closely fit observed historic trends for both moose and wolf numbers in 13A. Moose abundance declined at approximately 5% annually through 1999. Future trends predicted by the model include a continued steep decline in the moose population and an eventual decline in wolf densities once moose numbers drop to a very low level.

Population Size

A unitwide population estimate for moose is not available. Density estimates from fall trend count areas range from a low of 0.6 moose/mi^2 in 13D to a high of 1.2 moose/mi^2 in 13C (Table 2). An average of 1.0 moose per mi^2 was observed within the trend count areas during 2001, down 9% from the 1.1 moose/mi^2 estimate in 1999. Current density estimates are down 50% unitwide from the 1987 and 1988 highs of 2.0 moose/mi^2. The average density found on count areas cannot be extrapolated unitwide to a population estimate, because count areas are located in fall concentration areas, and densities are not representative of the whole unit.

Population Composition

Population composition data collected during fall sex and age composition counts from 1996 through 2001 are presented in Table 1. The bull:cow ratio in Unit 13 increased slightly from 18 bulls:100 cows between 1996 and 1998 to 21 bull:100 cows in 1999, and has been stable since then. Of all the trend count areas, the bull:cow ratios are lowest in 13A and E (Table 2). An analysis of the bull:cow ratio by age class indicates that there were only 3–6 yearling bulls:100 cows observed during this reporting period (Table 1). Recruitment of yearling bulls is down about 66% from the 12 yearling bulls:100 cows observed in 1988. Fall composition data in recent years indicates less than 10% of the Unit 13 posthunt bull population left to breed were mature bulls. This is especially important because in portions of Unit 13 where bull:cow ratios are the lowest, the few remaining bulls are also the youngest.

Fall calf:cow ratios in 2000 and 2001 were 12 calves:100 cows and 15 calves:100 cows respectively, two of the lowest calf:cow ratios ever observed in GMU 13 (Table 1). Between 1978 and 1988 calf production and survival were high, varying from 22 to 31 calves:100 cows each fall. The 26 calves:100 cows observed in 1996 was the only time during this reporting period that the calf:cow ratio approached ratios observed in the mid 1980s, when moose numbers were increasing in Unit 13.

The number of cows counted per hour of survey time during fall sex and age counts is also monitored. Trends in adult cow abundance are more sensitive to population changes because they are not currently hunted and are more resistant to climatic factors. Between 1986 and 1988 the fall sex and age composition data showed an average cow per hour figure of 47. The 1990–97 average estimate of cows per hour was 39, down by 17%. The cow per hour rate continued to decline in 2000 and 2001 to 29 and 26 cows per hour respectively, about a 42% overall decrease since the population high in 1988. In addition to a decline in cow numbers, the average age of the remaining cows is getting older because of lower calf recruitment during most of the 1990s. As the population ages, cows become more susceptible to severe winters and predation, thus mortality increases.

Productivity

In 13A West, radiocollared moose subjected to ultrasound pregnancy exams during November of 1994, 1995, and 1997 exhibited an average pregnancy rate of 88%, which was maintained until spring in all but 1 year (Testa 1997). These pregnancy rates approach those observed during the 1980s when calf recruitment to fall was higher. Fall inutero twinning rate was 27% for radiocollared cows in 13A tested by ultrasound. Twinning rate at birth, based on calf observations, has averaged 16% since 1994. Twinning for collared cows in 13A during the last few years increased to about 18%. Twinning rates are obtained in other units by aerial surveys in early June, just past the peak of parturition. Twinning rates show large annual fluctuations that probably reflect small sample size more than reproductive change. More extensive surveys were flown during spring 2001 and 2002 in 13 B, C and E. The twinning rate was 15% in 2001 and 31% in 2002. For interior Alaska moose populations, twinning rates of 20% indicate average productivity.

Distribution and Movements

Data from fall composition surveys, censuses, and stratification flights indicate in recent years moose densities were highest in Units 13A, 13B, and 13C (Table 2). Moose were most abundant along the southern slopes of the Alaska Range in 13B and 13C and the eastern Talkeetna Mountains in 13A. Unit 13D and the Lake Louise Flats have the lowest observed density. Fall rutting and postrutting concentrations are in subalpine habitats. The distribution of wintering moose depends on snow depth. Moose move down to wintering areas at lower elevations as snow depth increases. Known winter concentration areas include the upper Susitna River, the eastern foothills of the Talkeetna Mountains, the Tulsona Creek burn, and the Copper River floodplain in Unit 13C.

Mortality

Harvest

<u>Season and Bag Limit.</u> Season dates were 20 August–20 September for the general state moose hunt between 1993–98 and then became 1 September–20 September since 1999. Until 2001 the bag limit was 1 bull with a spike/fork antler on 1 side or 3 brow tines on 1 side, or a spread of 50 inches or more. In 2001 the tine regulation changed from a minimum of 3 to a minimum of 4 brow tines. A Tier II subsistence permit hunt was established in 1995 with 150 Tier II permits issued. Permits are limited to 1 per household. The Tier II hunting season during this report period was 15–31 August. A federal subsistence hunt was established in 1990 for residents of Units 13, 12 and 20 with only 1 permit issued per household, a bag limit of any bull and season dates of 1 August–20 September.

<u>Board of Game Actions and Emergency Orders</u>. In 1993 the Board of Game standardized moose seasons and bag limits along the road system in Southcentral Alaska. Because of intensive management legislation in 1996 required for moose and caribou, the board changed the moose management objectives for Unit 13. The moose population objective was established as 20,000 to 25,000 moose. Composition objectives adopted include a calf:cow

ratio of 30 calves:100 cows and a yearling bull ratio of 10:100 during fall composition counts. The human-use objective established for the Unit 13 moose hunt was to provide a human harvest of 1200 to 2000 moose per year. This range was adopted due to board findings that human consumption of moose is the preferred use of moose in Unit 13. The amount necessary to meet the subsistence need was established at 600 moose each year. In 1999 the Board reduced the moose season by 10 days in Unit 13 with season dates of 1–20 September. In 1997 the board increased the Tier II season by 4 days, with season dates of 1–19 August, then in 1999 changed the season dates to 15–31 August. The 2000–01 moose season was reduced by emergency order in May 2000 for units 13A, B, and E, with season dates of 1–15 September, while 13C and D remained unchanged. During the spring 2001 meeting, the Board changed the bag limit from a minimum of 3 brow tines to 4 for the 2001 season and eliminated nonresident moose hunting in GMU 13 starting in 2002. The season remained 1–20 September.

<u>Hunter Harvest</u>. In 2000–01, reported harvest for Unit 13 was 562 moose from the combined state and federal seasons (Table 3). The highest harvest during this reporting period was 1027 moose taken in 1996. Since then the harvest has declined 45%. Since 1995, when hunting pressure peaked at 6215 in GMU 13, hunting effort has declined 33%. During 2000, 4137 hunters reported hunting in Unit 13.

<u>General Hunt</u>. Harvest ticket returns from 2000 showed 477 bulls taken by 3510 hunters during the general state hunt (Table 4). Unit harvest for all hunters reporting harvest locations in this hunt during 2000 includes: 13A – 106; 13B – 112; 13C – 100; 13D – 62; 13E – 85. Harvests in all units except 13D declined dramatically.

<u>Permit Hunts.</u> The current federal subsistence hunt replaced a previous state registration subsistence hunt in 1990. The Bureau of Land Management (BLM) assumed management of subsistence moose hunting on federal land in 1990, following the McDowell decision. They issue registration permits to applicants who are rural residents of Unit 13 (RM 313), as well as residents of those communities in adjacent units (RM 314) that convinced the Federal Board that they needed to hunt in Unit 13. Only 2 small tracks of federal land in 13B and 13D are open to this hunt. Harvests under this permit hunt are presented in Table 5. This is a very popular hunt for Unit 13 residents, shown by the high number of households getting permits. Harvests are low and have been relatively stable the last 5 years with no trend evident. Because the amount of federal land open for this hunt is extremely limited, the any-bull bag limit has resulted in a low bull:cow ratio on federal lands surveyed; but because harvests are so concentrated, this hunt does not influence bull:cow ratios on state lands.

A state subsistence moose hunt (TM300) with 150 permits issued for any bull was initiated in 1995, with permits allocated under the Tier II permitting system. The harvest in 2000 was 40 bulls (Table 5). Since inception, the harvest is up 54% and the hunter success rate increased from 22% to 32%. This hunt is becoming more important to permit holders as moose numbers decline. This subsistence harvest has gone from 3% in 1995 to 7% of the total unit harvest, but is still so low it has little influence on age composition of bulls remaining after the hunting season. Antler composition data from this harvest show a smaller average size of harvested bulls than those taken under the general hunt.

Illegal Harvests. Unreported and illegal harvest estimates are presented in Table 3. The estimate for the illegal take is high, (and I believe could exceed 10% of the reported harvest) because of the spike-fork/50-inch regulation. A number of yearlings taken and reported as forks may actually be illegal because of the difficulty distinguishing small paddles and palms from forks. Also, I believe numerous sub-50-inch bulls are harvested because few hunters can reliably tell a 50-inch bull from a 45-inch bull in the field. This assumption is based on 7 years of field experience monitoring this hunt as well as F&W Protection case reports. Many of the illegal bulls taken are initially misidentified as legal by the hunter, and then, once an illegal bull is taken, I believe most are subsequently reported as legal. This increased illegal harvest is important because it often comes from heavily hunted areas where very few legal bulls remain. Fall sex composition data support the assumption that the illegal take is high because current bull:cow ratios in some areas, such as 13A, are lower than expected given the number of bulls that should be protected under a spike-fork/50-inch regulation.

Hunter Residency and Success. Local residents of Unit 13 accounted for between 8% to 10% of the moose harvested under the general season, according to harvest ticket returns (Table 4). Nonresident moose hunters averaged 10% of the unit-wide moose harvest during this reporting period. Alaskans residing outside Unit 13 accounted for the remaining 80% of the harvest. Last year, under the Tier II permit hunt, unit residents harvested 85% of the moose.

The success rate for moose hunters in the Unit 13 general hunt was 14% in 2000, down from the 16% to 17% observed between 1996 and 1999 (Table 4). Hunter success for the 10-year period before 1993 averaged 24%. The hunter success rate in 2000 for the Tier II subsistence permit hunt was 32% and 9% for the federal subsistence hunt (Table 5). Successful moose hunters in the general hunt reported spending an average of 7.3 days hunting in 2000, down slightly from the 7.8 days average for the rest of the reporting period. In 1989 harvest ticket returns show that 3,556 hunters reported an average of 5.9 days hunting for a total of 21,240 days hunting moose in Unit 13. Hunting effort peaked in 1995 when 5483 hunters spent an average of 10.2 days hunting, for a total of 55,938 days afield. Hunting effort declined in 2001 to approximately 26,230 man-days.

Harvest Chronology. Chronology data for the general hunt are presented in Table 6. The last 2 weeks of the season have accounted for more than half the harvest in every year since 1994. This harvest pattern is predictable because moose are more vulnerable later in September. Leaf fall starts occurring at this time and onset of the rut initiates calling and increased bull movements.

Transport Methods. During the last 5 years, 4-wheelers have been the most important method of transportation (Table 7). It is obvious that Unit 13 is an important 4-wheeler and off-road vehicle area for moose hunters. In the last 2 years, hunters using either 4-wheelers or ORVs are the largest group of hunters and have averaged approximately 60% of the total moose harvest. As a group, aircraft and ORV users other than 4-wheelers have the highest rate of success, while those using a 4-wheeler have a lower success rate.

Other Mortality

Brown bears are abundant in Unit 13 and are important predators of neonatal moose calves, taking up to 50% of the calves born within the first 6 weeks of life (Ballard et al. 1981).

Although brown bears kill adult moose, the rate is much lower than calves. Because bears kill so many calves, a reduction in bear predation can result in increased calf survival that is carried over as spring recruitment (Ballard et al. 1987). Wolf numbers in Unit 13 started increasing in 1990. The fall 1998 and 1999 estimates exceed 500 wolves (11.7 wolves/1000km^2), the highest in over 25 years. In the 13A west study area, the fall 1999 moose/wolf ratio was 32:1. This ratio is so low that wolf predation alone could result in a decline in the moose population, especially because in Unit 13 wolves continue to take moose even when caribou are present (Ballard et al. 1987). Wolf numbers declined slightly in 2000, with a preliminary fall estimate of approximately 400 wolves.

The winter severity index between 1996 and 1999 shows a period with mild to average snow depths. The unitwide winter severity index is based on snow depths from 17 snow courses throughout the unit. Moose numbers continued to decline during this period despite the favorable weather conditions. The winter of 2000 was severe and is the second worst winter recorded. Spring 2000 surveys suggest increased mortality resulted from deep snow conditions, especially in 13E, which had record snow depths. The winter of 2001 was considered an average winter. Observations of winter mortality in Unit 13 over the years have led to the conclusion that moose mortality due to deep snow conditions has not been density dependent. Instead, there appears to be a threshold effect triggering increased calf mortality once snowfall reaches about 30 inches in depth. As the snow pack increases, yearlings, then adult bulls, and finally adult cows die, regardless of moose densities. In addition to killing moose, deep snows often make it easier for wolves to take moose, which increases predation mortality.

HABITAT

Assessment

Unit 13 has numerous areas where habitat improvement could produce more favorable browse conditions for moose. Because of the size and remoteness of much of the unit, wildfire is considered the only feasible tool for extensive habitat improvement. Wildfires occurred throughout much of Unit 13 before 1950, when fire suppression activities were initiated. Since then, negligible acreage has burned. Current fire suppression policies are presented in the Copper River Fire Management Plan, which sets aside large portions of the unit as let-burn areas where wildfires will not be suppressed. However, this plan has often been ignored and some wildfires have been suppressed, even if they occurred in an area designated as limited suppression. The current level of fire suppression has resulted in fewer fires and reduced seral habitat available as moose browse. The effect has been to lower the moose carrying capacity over extensive portions of Unit 13. Because of the lack of fire-created seral plant communities, climax upland and riparian willow communities are the most important habitat types for moose in the unit.

Evaluation of browse in important moose areas from 1983 to 1986 indicates browse species were able to withstand the level of use occurring at that time. Research continues on evaluating available browse and use by moose in 13A as part of an ongoing moose research project. Preliminary indications are that current browse utilization rates are sustainable (Collins 1997).

The use of prescribed fires to replace wildfires as a method of improving moose habitat has not been successful in Unit 13. The climate in Unit 13 typically limits the use of prescribed fire to only the driest years, when the danger of an escaped fire increases. Also, scattered cabins and private land ownership in the Basin increase the liability associated with the use of prescribed fire. In spite of problems associated with controlled burns, work with BLM and DNR is ongoing and a prescribed fire is scheduled for the summer of 2002 should the fire prescription be met. The area selected for the burn is the prior controlled burn site around Kelly Lake on the south slopes of the Alphabet Hills in Unit 13B. This area was actually lit in 1984, but the fire did not carry because it was too late in the season and ground moisture was too high.

Habitat improvement by mechanical methods such as crushing is an alternative to burning. To be effective, mechanical treatment must be done on riparian habitats where moose concentrate during critical winter months. However, mechanical treatment is expensive, and the cost limits mechanical treatment to small but important concentration areas near the road system where access for heavy equipment is available. One such small site was crushed in 1993, and initial regeneration of willows was good. Additional sites for mechanical treatment have been identified along the Copper River in Unit 13C where moose winter during deep snow years. Work continues toward gaining permission from landowners to crush this area.

Low densities of moose and an annual twinning rate of up to 30% indicated habitat is adequate for population growth if the predation pressure could be decreased.

CONCLUSIONS AND RECOMMENDATIONS

Changes in moose-per-hour rates during fall moose counts indicate that unitwide moose abundance declined between 1994 and 2001. Census data from 1994, and 1998–2001 indicate a 50% decline has occurred in Unit 13A. Declines occurred in all sex and age classes.

The calf:cow ratios during fall sex and age composition counts over the last few years are the lowest ever observed in Unit 13. The low ratios are attributed to poor survival and are 25 to 30% below levels observed between 1978 and 1988. Initial calf production has changed little over 20 years, based on pregnancy and birth rates. Pregnancy rates during fall and early spring, coupled with birth rates for pregnancy-checked radiocollared cows, approach those observed in Unit 13 moose during periods of moose population growth. Twinning rates fluctuate between units and years, probably due mostly to small sample size, and are average for an interior moose population on mature range.

The decline in the number of cows observed during both fall trend counts and censuses continued during the relatively mild winters that occurred during this reporting period. Modeling of the moose population leads to the conclusion that cow abundance will continue to decline over the next few years. The rate of decline could accelerate due to an aging cow population. The decline in calf recruitment has led to a population with an older age structure. The risk of a major decline in cows during a severe winter increases every year because older moose are more susceptible to severe winters and the associated increased predation.

Increased human harvests under the spike-fork/50-inch 3 brow tine regulation, predation, and a decline in recruitment reduced the bull:cow ratios from levels observed in the late 1980s. In some portions of the unit, the bull:cow ratio was as low as ever observed historically. Harvests under the spike-fork/50-inch 3 brow tine regulation greatly skewed the age structure of the Unit 13 bull population so that almost 80% of the bulls left to breed were estimated to be only 3 years of age or younger. Fall pregnancy rates in 13A indicate this low bull:cow ratio has not, as of yet, reduced productivity. However, long-term effects of breeding accomplished by very young bulls are unknown. It certainly has disrupted the normal rut pattern of Alaskan moose in which large, mature bulls exhibit rutting behavior that ensures an effective and efficient breeding season. Any harvest strategy that maintains most of the breeding bull population in the young cohorts should not be considered a suitable long-term management option.

Changing the bag limit to SF/50 and 4 brow tines, along with reducing the length of the season has resulted in a slight increase in the bull:cow ratio. It is too early to tell how this will impact the age structure of the bull population. Hopefully some older bulls will be left in the population to allow for a more structured and efficient rut.

Additional protection for the bull population is needed during periods of low calf survival. Although the bull:cow ratio increased, it is only because bulls declined at a slower rate than cows. More bull recruitment is needed. To accomplish this, I recommend that the bag limit be changed to eliminate the forked yearling as a legal bull. Maintaining a spike-yearling in the bag limit will allow some harvest of young bulls. This harvest would be even more focused on the slower growing spike yearlings, thus cropping poorer individuals from the gene pool in an attempt to address some concerns about the genetic effects of the selective harvest strategy. Also, enforcement problems would be greatly reduced because many of the illegal bulls taken are yearlings with paddles and palms that were mistaken for forked antlers.

Hunters have concentrated in Unit 13 because it has more open habitat than other units, which are predominantly forested. ORV access is easier in non-forested areas and there are extensive ORV trail systems in Unit 13. But even more important is the effect of the spike-fork/50-inch regulation on concentrating hunters in the open habitats of Unit 13. When you combine increased visibility of moose with the opportunity to use a 4-wheeler, hunting effort increases. Because moose can be more visible in open habitats, a hunter has more opportunity to observe the antlers and determine if the bull is legal. The impact of the 50-inch regulation has been to discourage hunting in timbered areas because it is more difficult to get an unobstructed view of the antler to determine if a bull is legal. It is now necessary to redirect hunting pressure to units that have higher bull:cow ratios. Because hunting is more difficult in these areas, it will be necessary to adopt regulations that force hunters out of Unit 13 and into other areas. Requiring a drawing permit to hunt in Unit 13 would certainly accomplish this. Requiring a unit-specific harvest may accomplish this as well. Under the unit-specific system, a hunter would choose which roadside unit he wants to hunt moose in that year. Once that choice was made, that would be the only unit the hunter could hunt in that year.

I also recommend adopting other management actions that would improve survival rates of moose calves that can then be recruited into the population. This action would reverse the downward population trend observed in the unit 13 moose population. Modeling efforts suggest that manipulation of both brown bear and wolf populations would have a significant positive effect on moose abundance. A 3% annual decrease in the brown bear population and a reduction of the wolf population to a density of 3–5 wolves/1000km^2 during the spring should result in a positive 2–5% annual growth rate of the moose population.

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Table 1 Unit 13 fall aerial moose composition counts and estimated population size, 1996–2001

Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves %	Adults	Total moose observed	Moose /hour	Density moose mi^2 (range)
1996/97	18	6	25	17	4972	6015	50	1.2 (0.2–3.0)
1997/98	18	6	19	14	5359	6209	56	1.4 (0.2–3.3)
1998/99	18	4	14	11	4904	5496	46	1.2 (0.5–2.1)
1999/00	21	4	14	11	4234	4738	46	1.1 (0.2–1.8)
2000/01	20	3	12	9	4000	4382	38	1.0 (0.8–4.4)
2001/02	21	3	15	11	3949	4446	35	1.0 (0.6–4.5)

Table 2 Unit 13 fall aerial moose composition counts, 2001

Unit	Bulls: 100 Cows	Yearling Bulls:100 Cows	Calves: 100 Cows	Calves %	Total Moose Observed	Moose /hour	Density moose mi^2 (range)
13A	18	3	15	11	845	36	0.9
13B	22	3	16	11	1833	40	0.9
13C	22	4	12	9	276	32	1.2
13D	78	6	14	7	196	25	0.6
13E	17	4	16	12	1092	29	0.9

Table 3 Unit 13 moose harvest[a] and accidental death, 1996–2000

Regulatory	Reported				Estimated			Accidental			Grand
year	M	F	U	Total[b]	Unreported	Illegal	Total	Road	Train[c]	Total	Total
1996/97	1018	1	0	1027	25	25	50	50	15	65	1142
1997/98	930	1	10	937	25	25	50	50	15	65	1052
1998/99	913	5	50	939	25	25	50	50	14	64	1053
1999/00	813	1	9	823	25	25	50	50	15	65	938
2000/01	550	3	9	562	25	25	50	50	76	126	738

[a] Includes permit hunt harvest, harvest tickets and federal subsistence hunts.
[b] Includes unknown sex.
[c] 13E – the Alaska Railroad.

Table 4 Unit 13 moose hunter residency and success for general harvest ticket hunt only, 1996–2001

	Successful				Unsuccessful				
Regulatory Year	Local[a] Resident	Nonlocal Resident	Non-resident	Total[b]	Local[a] Resident	Nonlocal Resident	Non-resident	Total[b]	Total Hunters
1996/97	85	765	84	951	402	4099	122	4676	5627
1997/98	66	709	88	869	395	4095	109	4641	5510
1998/99	66	697	91	860	410	3523	124	4083	4943
1999/00	70	566	86	722	378	3192	151	3721	4443
2000/01	38	392	47	477	353	2533	116	3033	3510

[a] Residents of Unit 13
[b] Includes unspecified residency

Table 5 Unit 13 moose harvest data by hunt, 1996–2000

Hunt Nr	Regulatory year	Permits issued	Percent Did not Hunt	Percent Unsuccessful Hunters	Percent Successful Hunters	Bulls	Cows	Unknown	Harvest
Tier II	1996/97	150	13	75	25	32	1	0	33
TM300	1997/98	150	19	77	23	25	0	0	25
	1998/99	150	17	71	29	37	0	1	38
	1999/00	150	17	70	30	35	0	--	35
	2000/01	150	10	68	32	40	0	--	40
BLM Subsistence									
RM313	1996/97	500	26	88	12	43	0	0	43
RM314	1997/98	488	26	86	14	43	0	0	43
	1998/99	557	29	89	11	41	0	0	41
	1999/00	691	29	86	14	67	0	0	67
	2000/01	740	32	91	9	43	0	2	45

Table 6 Unit 13 moose harvest chronology percent by week for general harvest ticket hunt, 1996–2000

Year	Season dates	Week of Season 1st	2nd	3rd	4th	5th	*n*
1996	20 Aug.–20 Sept.	10	9	21	35	25	910
1997	20 Aug.–20 Sept.	15	11	17	31	26	837
1998	20 Aug.–20 Sept.	13	11	21	30	24	834
1999	1 Sept.–20 Sept.	7	33	33	28		696
2000	1 Sept.–20 Sept.	16	38	46			435

Table 7 Unit 13 moose harvest percent by transport method for general harvest ticket hunt, 1996–2001

Regulatory Year	Percent of Harvest Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway Vehicle	Airboat	Unknown	*n*
1996/97	12	3	7	36	0	23	17	0	1	951
1997/98	10	3	9	41	0	19	15	1	2	869
1998/99	10	4	7	40	0	20	17	1	1	860
1999/00	12	3	10	47	0	23	16	0	2	628
2000/01	11	4	6	42	0	19	16	0	1	471

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 14A (2561 mi^2)

GEOGRAPHIC DESCRIPTION: Matanuska Valley

BACKGROUND

Moose were scarce in the Matanuska Valley as "colonists" arrived and settled during the 1930s but probably grew to numbers approaching 7000 during the 1960s (Griese 1996). Moose numbers fluctuated with deep snow winters but stabilized between 5000 and 6000 animals in the 1990s.

In the 40 years following statehood (1960–2000), hunters reported a harvest of more than 23,629 moose in Unit 14A. Annual harvest levels in the first 12 years (1960–71) ranged from 200–1300 (Griese 2000). The harvest was predominantly bulls, averaging 350 annually, but the harvest of antlerless moose was as high as 1131 in 1962–63 (Griese 2000). Antlerless moose seasons were discontinued from 1972–77 and the mean annual harvest of bulls declined to 251 (range:167–346). Antlerless seasons began again in 1978 and from 1978–98 the annual cow harvest ranged from 0 (1990) to 284 (1996). Annual harvest during the "any bull" period of 1979–1992 averaged 367 (range:201–530) (Griese 2000). From 1993–2000, the period with antler restrictive bag limits, the average harvest dropped slightly to 342 (range:233–554).

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as "spike-fork-50-inch" (SF50) (Schwartz et al 1992).

The human population in the Matanuska/Susitna Valley continues to be one of the fastest growing areas in the state. Land clearing activities associated with settlements and road construction promotes the growth of preferred moose browse and a concomitant growth in moose/human conflicts. During the 1990s, motorists killed an average of 180 moose annually in the Matanuska/Susitna Valley.

Habitat enhancement efforts during the 1990s were aided by wildfires. In 1993 a successful cooperative effort between state agencies resulted in a 900-acre controlled burn to enhance wintering moose habitat near Willow (Collins 1996). In June 1996, a 37,000-acre fire occurred in the Big Lake area (Griese and Masteller 1998). Even though the habitat enhancement from the Big Lake burn will greatly aid moose in the future, it politically restricted future prescribed burns. The Ruffed Grouse Society and the Department of Fish & Game have begun a habitat enhancement project in the Matanuska Valley Moose Range. Every year, 100–150 acres of aspen forest will be cut to produce early successional growth that will have a positive impact on moose and other wildlife species.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- To produce high yields of moose for humans and to provide maximum opportunity to participate in hunting for moose

- To provide opportunities for nonconsumptive uses.

POPULATION OBJECTIVES

To maintain a posthunt population of 6000–6500 moose with a sex ratio of 20–25 bulls:100 cows.

HUMAN-USE OBJECTIVE

To achieve an annual hunter harvest of 360–750 moose.

METHODS

We conducted Becker surveys on December 1–4, 2000 and October 23–27, 2001 (Becker and Reed 1990). We generated a population estimate and age/sex statistics using MOOSEPOP (Becker and Reed 1990). During both surveys we attempted to categorize antler size of bulls and identify brow-tine counts on bulls with 30-inch or greater antlers.

We aerially sampled a portion of the primary wintering habitat in the subunit during early March 2000 and 2001 to quantify the percent of short yearlings in the population as an assessment of recruitment.

We determined hunter effort and harvest composition from the general season and permit hunt reports. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Department of Public Safety provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property. Age categories (calf, yearling, adult) and sex of moose from road and railroad mortalities were provided by charities receiving the meat. We required the charities to surrender moose incisors for aging.

From a fixed-wing aircraft, we radiotracked and located moose radio collared in March 1996 and February 1997 (Griese and Masteller 1998). Moose were located 10 times between July 1997 and February 2000, delineating distribution during mid-winter, calving, midsummer, hunting, rutting and post-rutting seasons. Wildlife Forever, a hunter sponsored organization, provided

$4000 to begin this project, and Safari Club International provided an additional $2500. Results of the project are presented in the Appendix.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population increased about 15% between the fall survey in 2000 (5552 ±571: 80% C.I.) and the fall survey in 2001 (6679 ±453: 80% C.I.) (Table 1).

Population Composition

We observed 18 and 19 bulls:100 cows in the fall of 2000 and 2001, respectively (Table 1). Both were below objective levels (20–25 bulls:100 cows). Calves displayed high overwinter survival during the report period (Table 2).

Distribution and Movements

See Appendix.

MORTALITY

Harvest

Season and Bag Limit. In 2000, the resident and nonresident season included an archery-only season from 10–17 August, a general season from 20 August–25 September, and a general 'spike-fork-only' season from 5–15 December. During the archery-only and early fall general season, the bag limit was 1 bull with SF-50 antlers restrictions.

In 2001, the general season was extended to 30 September. The department issued 50 permits for antlerless moose for the 20 August–25 September period

Board of Game Actions and Emergency Orders. During the spring 2001 Board of Game meeting the winter 'spike-fork-only' hunt was eliminated and the department informed the Board our intent to issue 50 antlerless moose drawing permits because the population exceeded the upper end of the pervious population objective of 5500. The Board increased the population objective (from 5000–5500 to 6000–6500) and extended the harvest objective (from 600–700 to 360–750). This action came at the request of local advisory committees. The department also adjusted the potential allotment of antlerless permits from 600 down to 400.

Hunter Harvest. The bull moose harvest in 2000 and 2001 was comparable to 1998 and 1999 but down from 1996 and 1997 (Table 3). While antler sizes of moose harvested during the general season suggest similar composition to previous years, there is a lack of cooperation by hunters. Hunters failed to provide antler measurements on over 35% of the harvest reports. It is unclear if this statistic reflects a substantial increase in the harvest of sublegal bulls.

Permit Hunts. The department issued 50 antlerless moose drawing permits for the northern Matanuska River area in 2001 resulting a harvest of 30 cows (Table 4). Any-bull permits were discontinued in 2000.

Hunter Residency and Success. Hunter success increased slightly in 2001 to 13% (Table 5). Residency composition of hunters changed little from previous years.

Harvest Chronology. The harvest chronology was similar to past years (Table 6). Hunters took advantage of the 5-day season extension in 2001, taking 68 moose in this period (Table 6).

Transport Methods. Transport methods were similar to past years (Table 7). With the removal of the late 'spike-fork' season, snowmachines were not used in the 2001 season (Table 7).

Accidental and Illegal Mortality

Accidental human-caused moose mortality during the 5-year period 1997–2001 averaged 172 moose killed by highway vehicles and 17 by train (Table 3). The highway collisions went up in 2001–02 because of the increase in the moose population rather than deep snow conditions.

HABITAT

Enhancement

During the winter of 2001–02, the Ruffed Grouse Society and the Department of Fish & Game conducted the first year of a multi-year project enhancing habitat in the Matanuska Valley Moose Range. One hundred acres of an 80-year-old aspen stand were cut.

CONCLUSIONS AND RECOMMENDATIONS

The new harvest objective (360–750) was met in 2001 (Table 3). The 400 antlerless permits issued for the 2002 season will likely keep the harvest within the objective levels. An antlerless harvest is needed to bring the bull:cow ratio and the population size to objective levels. Many moose died of apparent malnourishment due to late snowfalls in April of 2002 showing what is to be expected if moose exceed the carrying capacity for the unit.

We believe effective intensive management in this subunit requires investigation into the distribution and movement of moose. Specifically, studies investigating the winter movement of moose into the Pt. MacKenzie agricultural project and the 1996 Big Lake burn area will reveal the proportion of the moose that are migratory and where the migratory individuals spend the non-winter months. The Pt. MacKenzie winter population exceeds 10 moose/mi^2, one of the highest densities in the state. These areas are critical to moose in the unit and may be used by moose summering within the boundaries of Units 16A, 16B, and 14B where moose populations have declined 30–40% in the past few years.

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Table 1 Unit 14A fall aerial moose composition surveys and censuses, 1991–2001

Regulatory Year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves(%)	Adults Observed	Moose Observed	Moose /mi^2	Estimated Population Size
1991–92 [a]	14	5	39	26	1110	1472	3.7	5885±706 [b]
1992–93 [c]	9	6	40	27	697	934	n/a	5200–6200
1993–94 [d]	16	11	37	24	942	1232	3.6	5672±798 [b]
1994–95 [c]	21	8	35	22	1098	1398	n/a	5500–6500
1995–96 [e]	--	--	--	--	--	--	--	5000–5500
1996–97 [f]	23	6	42	25	1696	2290	n/a	5500–6500
1997–98 [g]	14	5	30	21	611	774	n/a	5000–6000
1998–99 [h]	17	7	33	22	1191	1509	3.0	4729±530 [b]
1999–00 [h]	19	10	37	24	1021	1317	3.4	5348±721 [b]
2000–01 [h]	18	7	37	19	1300	1693	3.5	5552±571 [b]
2001–02 [h]	19	8	34	22	1781	2301	4.2	6679±453 [b]

[a] Gasaway et al (1986) survey
[b] 80% confidence interval
[c] Sampling of 1991 surveyed units (Griese and Masteller,1996)
[d] Becker survey
[e] No surveys
[f] Combined results of Matanuska River drainage east of Moose Creek and composition surveys in CAs 1–7 &Pt. MacKenzie
[g] Incomplete Becker survey due to antler drop
[h] Modified Becker survey (non-random sampling but duplication of 1991 sampling units)

Table 2 Unit 14A late winter aerial moose composition surveys, 1990–2001

Regulatory year	Date	Count areas	Total moose	Calves[a]	Percent calves
1990–91	03/04–11	5,6&8	1348	167	12
1991–92	02/25	7	121	26	21
	04/10	3–6 & 8	546	76	14
1992–93	03/24	4–8	693	131	19
1993–94	03/05–09	4–8	981	175	18
1994–95	04/03–04	4–8 & Pt. McKenzie	518	75	14
1995–96	03/28	6 & Pt. McKenzie	471	85	18
1996–97	04/08–09	5,6,8 & Pt. MacKenzie	226	53	23
1997–98	no count				
1998–99	03/12–15	4–8 & Pt. MacKenzie	1178	201	17
1999–00	03/08–10	1,2,4–8 & Pt. MacKenzie	1291	222	17
2000–01	03/26–04/02	1–8 & Pt. MacKenzie	633	120	19
2001–02	03/28–29	1,3,5–8 & Pt. MacKenzie	899	148	16

[a] Calves = short yearlings

Table 3 Unit 14A moose harvest[a] and accidental death, 1990–2001

Regulatory	Reported			Estimated			Accidental deaths[e]			Grand
year	M	F	Total[b]	Unreported[c]	Illegal[d]	Total	Road	Train	Total	total
1990–91	258	0	259	13	35	55	140	22	162	476
1991–92	490	39	534	25	25	50	166	15	181	765
1992–93	530	157	694	27	30	57	132	7	139	890
1993–94	233	204	438	12	40	52	166	18	193	683
1994–95	281	242	532	14	60	74	260	40	300	906
1995–96	335	128	471	22	50	72	85	11	96	639
1996–97	554	284	846	35	50	85	185	17	202	1133
1997–98	488	249	741	33	55	83	168	16	184	1008
1998–99	376	212	596	25	55	80	129	14	143	819
1999–00	319	0	328	23	60	83	181	34	215	626
2000–01	314	1	320	22	60	82	131	7	138	540
2001–02	349	30	379	27	60	87	250	14	264	730

[a] Includes permit hunt harvest
[b] Includes moose of unknown sex
[c] Derived by taking 5–7% of the reported kill from harvest tickets
[d] Includes moose taken in defense of life or property
[e] Road and train kills are minimum numbers

Table 4 Moose harvest data by permit hunts in Unit 14A, 1990–2001

Hunt	Regulatory year	Applicants	Permits issued	Percent[a] did not hunt	Percent[a] unsuccessful hunters	Percent[a] successful hunters	Bulls	Cows	Total
DM411 (Any bull–early fall)									
	1995–96	1521	70	16	54	29	20	0	20
	1996–97	1978	100	10	53	37	37	0	37
	1997–98	1414	50	6	70	24	12	0	12
	1998–99	1463	50	16	52	28	14	0	14
	1999–00 [b]	--	0	--	--	--	--	--	--
DM412 (Any bull – late fall)									
	1995–96	1078	20	5	35	60	12	0	12
	1996–97	1235	30	4	11	86	24	0	24
	1997–98	1162	20	20	25	55	11	0	11
	1998–99	1200	20	10	45	45	9	0	9
	1999–00 [b]	--	0	--	--	--	--	--	--
DM418 (Antlerless - late fall)									
	1993–94	3760	70	13	40	47	3	30	33
	1994–95	5464	100	10	13	77	5	71	76
	1995–96	4781	70	14	31	54	2	36	38
	1996–97	3866	70	14	0	86	2	58	60
	1997–98	3252	70	4	20	76	0	53	53
	1998–99	3740	70	11	49	40	2	26	28
	1999–00 [b]	---	0	---	---	---	---	---	---

Table 4 Continued

Hunt	Regulatory year	Applicants	Permits issued	Percent[a] did not hunt	Percent[a] unsuccessful hunters	Percent[a] successful hunters	Bulls	Cows	Total
DM419 & 420 (Antlerless–early fall)									
	1990–91	0	0	---	---	---	---	---	---
	1991–92	7057	100	13	48	39	0	39	39
	1992–93	11,000	400	12	49	39	3	154	157
	1993–94	10,390	400	10	44	46	4	174	179
	1994–95	11,185	400	10	46	44	4	169	174
	1995–96	10,075	200	7	48	46	1	90	91
	1996–97	10,447	500	8	44	48	3	225	231
	1997–98	8675	450	8	48	44	1	195	197
	1998–99	9230	400	8	46	46	1	182	183
	1999–00 [b]	---	0	---	---	---	---	---	---
DM409 (Antlerless-N. Matanuska River Area)									
	2001–02	4803	50	8	32	60	0	30	30

[a] Percent of permits issue

[b] Discontinued hunt

Table 5 Unit 14A moose hunter residency and success [a], 1990–2001

	Successful					Unsuccessful					
Regulatory year	Local[b] resident	Nonlocal resident	Nonres.	Unk.	Total (%)	Local[b] resident	Nonlocal resident	Nonres.	Unk.	Total (%)	Total hunters
1990–91	242	3	8	6	259 (14)	1466	22	14	26	1528 (86)	1787
1991–92	469	11	9	6	495 (17)	2286	39	12	23	2360 (83)	2855
1992–93	500	12	12	15	539 (16)	2629	50	24	102	2805 (84)	3344
1993–94	215	4	1	6	226 (9)	2291	59	11	68	2429 (91)	2655
1994–95	274	6	1	1	282 (11)	2208	46	4	18	2286 (89)	2568
1995–96	294	11	2	3	310 (9)	2997	84	22	17	3120 (91)	3430
1996–97	471	11	11	1	494 (12)	3324	79	40	21	3464 (88)	3958
1997–98	435	21	5	7	468 (12)	3161	68	43	18	3299 (88)	3758
1998–99	332	16	11	3	362 (11)	2837	85	30	27	2979 (89)	3341
1999–00	311	9	5	0	325 (11)	2429	64	21	29	2543 (89)	2871
2000–01	297	13	7	3	320 (11)	2427	47	38	16	2528 (89)	2848
2001–02	323	13	11	2	349 (13)	2256	45	30	11	2342 (87)	2691

[a] Does not include drawing permit hunters
[b] Unit 14 residents

Table 6 Unit 14A moose harvest chronology[a] 1990–2001

Regulatory	August			September					November	December			
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15	Unknown	Total
1990–91[b]	--	--	--	211	36	--	--	--	--	--	--	12	259
1991–92[c]	--	--	--	260	109	110	--	--	--	--	--	20	499
1992–93[c]	--	--	--	260	120	144	--	--	--	--	--	15	539
1993–94[d]	--	76	17	24	37	68	--	--	--	--	--	6	227
1994–95[d]	--	63	31	50	44	87	--	--	--	--	--	16	279
1995–96[e]	3	69	20	47	31	45	--	--	41	8	36	20	310
1996–97[e]	8	88	20	43	50	66	--	--	133	30	39	17	494
1997–98[e]	3	85	22	35	41	61	--	--	110	41	51	19	468
1998–99[e]	2	71	25	43	39	57	--	--	46	21	45	13	362
1999–00[f]	6	57	14	32	25	43	52	--	--	35	50	14	328
2000–01[f]	4	68	20	38	30	43	24	--	--	27	55	11	320
2001–02[g]	8	61	28	35	42	46	46	68	--	--	--	15	349

[a] Does not include drawing permit hunts
[b] Open season = Sep 1–10
[c] Open season = Sep 1–20
[d] Open season = Aug 20–Sep 20 (SF/50 –"spike-fork/50-inch")
[e] Open season = Aug 10–17 (Archery only), Aug 20–Sep 20 (Gen.SF/50), Nov 20–Dec 15 (SF)
[f] Open season = Aug 10–17 (Archery only), Aug 20–Sep 25 (Gen.SF/50), Dec 5–Dec 15 (SF)
[g] Open season = Aug 10–17 (Archery-only), Aug 20–Sep 30 (Gen.SF/50)

Table 7 Unit 14A percent transport methods of successful moose hunters[a], 1990–2001

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Sample size
1990–91	7	7	12	22	0	10	35	7	259
1991–92	4	4	12	24	0	12	38	6	499
1992–93	4	5	13	22	0	7	42	5	539
1993–94	4	5	12	23	0	7	43	6	228
1994–95	4	3	13	26	0	7	40	7	292
1995–96	2	3	10	29	1	2	41	7	310
1996–97	2	3	7	21	16	7	40	4	494
1997–98	3	3	6	29	18	4	34	3	468
1998–99	4	4	8	35	6	5	33	5	362
1999–00	3	2	13	29	7	6	37	3	328
2000–01	3	2	10	34	8	4	36	3	320
2001–02	5	1	11	37	0	7	35	3	349

[a] Does not include drawing permit hunts

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 14B (2152 mi^2)

GEOGRAPHIC DESCRIPTION: Western Talkeetna Mountains

BACKGROUND

The first comprehensive moose survey in Unit 14B conducted in the fall 1987 estimated moose numbers at 2814 ± 248 (80% CI) (Masteller 1995). The population declined about 35% following the deep snow winter of 1989–90 (Masteller 1995). By the fall of 1994 the population grew to 2336 ± 527 (80% CI) but the severe winter of 1994–95 probably caused high mortality levels (Masteller 1998). The last survey conducted in the fall 1999 estimated the population at 1687 ± 244 (80% CI).

The moose harvest has decreased dramatically since the 1970s and 1980s. Hunter harvest averaged 96 and 259 moose during the 1970s and 1980s, respectively. Liberal cow seasons allowed peak harvests to reach 372 moose in 1971, 534 in 1984, and 347 moose in 1987 (Griese 1993). There have been no cow seasons since 1987. Since antler restrictions were enacted beginning fall 1993, harvests have averaged 62 moose per year.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Produce high yields of moose for humans
- Provide maximum opportunity to hunt moose

MANAGEMENT OBJECTIVE

- Attain a population of 2500–2800 moose, with a sex ratio ≥ 20 bulls:100 cows during the rut
- Achieve an annual harvest of 100–200 moose

METHODS

We generated a population estimate in the fall of 1999 using the Gasaway et al. (1986) stratified random census technique. Surveys were not conducted in 2000 or 2001.

The harvest was monitored with harvest reports and permits from Unit 14B hunters. Successful permit holders were required to provide antlers for measurement and lower front teeth for age determination. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Department of Public Safety provided numbers of moose killed illegally by highway vehicles or in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population size

The fall 1999 survey conditions were excellent. The resulting moose population estimate in Unit 14B was 1687 ± 244 (80%CI) (Table 1). However, the winter of 1999–00 had deep snow conditions that contributed to the highest number of road/railroad kills (100) since 1990 (Table 2). The moose population had decreased about 28% since the Becker survey of 1994 and was comparable to levels found in 1990 and 1992, prior to the impacts of the 1999–00 winter. Unit 14B will be surveyed during the fall of 2002.

Population Composition

In our November 1998 survey, we observed 38 bulls and 11 calves:100 cows with 8% of the sampled population being calves (Table 1). The fall 1999 survey estimated 40 bulls and 21 calves:100 cows with 13% of the sampled population as calves (Table 1). The yearling bull:cow ratio was 10:100 in 1998 and 12:100 in 1999.

MORTALITY

Harvest

<u>Season and Bag Limit</u>. The fall 2000 general open season was 10–17 August (for archery-only hunters), 20 August–25 September and 5–15 December for all resident and nonresident hunters. During the 2 early seasons, the bag limit was 1 bull with a spike or fork antler on at least 1 side or with an antler spread at least 50 inches or 3 or more brow tines on at least 1 side (SF50). The late season bag limit was 1 bull with spike or fork antlers only. Sixty drawing permits (DM416) to take any bull were issued for the 1–15 November period.

<u>Board of Game Actions and Emergency Orders</u>. In response to declining moose numbers in Unit 16 and 14B, the Board closed the 2001 general open season in Unit 16B; eliminated the winter hunt (5–15 December) in Units 16A, 14A, and 14B; and eliminated the any-bull permits in 16A (DM556) and 14B (DM416). To help fill some of the lost hunting opportunities through these actions, the general open season was extended 5 days to close on 30 September in Units 16A, 14A, and 14B.

At the spring 2001 meeting, the Board also changed the harvest objective for moose in Unit 14B in light of a long-term decline in moose numbers. The old objective of 200–300 has not been meet in over a decade. A more realistic objective of 100–200 moose was set.

<u>Hunter Harvest</u>. Reported harvest has decreased since 92 bulls were taken during 1996–97 (Table 2). Hunters harvested 55 bulls in 2000–01 and 67 bulls in 2001–02. The number of moose

taken under the any-bull permits dropped to 7 animals in 2000–01 which was the last year the permits were issued (Table 3).

Hunter Residency and Success. Local residents of Unit 14 consistently make up the vast majority of the hunter composition (Table 4). The number of hunters has been relatively consistent in the past decade ranging between 314–555 hunters (Table 4). Hunting success rates during the past decade range between 9–16%.

Harvest Chronology. The extended season (25–30 September) accounted for an additional 23 animals taken in 2001–02 (Table 5). No animals were killed during the archery only season (10–17 August) in the past 3 years.

Transport Methods. The elimination of the winter hunt in 2001–02 consequently eliminated the use of snowmachines as a transportation method (Table 6). Four-wheelers and highway vehicles have accounted for a majority of the transportation type used by successful hunters in the past 10 seasons (Table 6).

Other Mortality

Moose killed by auto/train collisions numbered 21 and 41 in 2000–01 and 2001–02, respectively (Table 3). These numbers are at or below the 10 year average of 41 auto/train collisions with moose in Unit 14B (Table 3).

CONCLUSIONS AND RECOMMENDATIONS

Even before the severe winter of 1999–00, the moose population was far below the objective level of 2500–2800. It is not likely that the 2002 survey will find the population near the objective level. The average annual harvest by hunters for the last 3 years was 63, far below the new objective of 100–200. Hunter harvest under the SF/50 regulation is unlikely to reach 100 moose unless antler restrictions are relaxed, access opportunities substantially increase, or the moose population increases.

The SF/50 regulation was adopted for Unit 14B because it shared common boundaries with Units 13A and 14A. Concern for enforcement of the antler restriction along the boundary and the concern for false reporting were principal reasons for its inclusion in the program. Annual movements often carry moose across borders of Units 13E, 16A, 14A, and 14B (Modafferi 1999). Therefore, management decisions for Unit 14B should be made in conjunction with neighboring units.

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Table 1 Unit 14B fall aerial moose composition surveys, 1992–2001

Regulatory year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Adults observed	Moose observed	Observable moose/mi^2	Population estimate (±80% CI)
1992–93 [a]	27.2	4.4	21.7	14.5	580	659	1.5	1582 ± 178
1993–94 [b]	--	--	--	--	--	--	--	--
1994–95 [c]	31.1	8.2	17.3	12.0	862	969	2.2	2336 ± 527
1995–96 [b]	--	--	--	--	--	--	--	--
1996–97 [b]	--	--	--	--	--	--	--	--
1997–98 [b]	--	--	--	--	--	--	--	--
1998–99 [d]	37.5	9.5	11.1	7.5	407	440	--	--
1999–00 [e]	40.2	12.3	21.3	13.2	616	699	1.6	1687 ± 244
2000–01 [b]	--	--	--	--	--	--	--	--
2001–02 [b]	--	--	--	--	--	--	--	--

[a] Data from "Becker Surveys" conducted in November. SCF estimated at 1.40, 1.35 and 1.25 for low, medium, and high density strata, respectively.

[b] No surveys conducted.

[c] Data from "Becker Surveys" conducted in late October/early November. SCF estimated at 1.00, 1.41 and 1.00 for low, medium and high density strata, respectively.

[d] High-grade sex and age composition survey conducted 20 November, 1998.

[e] Data from "Gasaway Surveys" conducted in late October/early November. SCF estimated at 1.20, 1.33, 1.15, and 1.03 for low, medium, high, and s-high density strata, respectively.

Table 2 Unit 14B annual moose harvest (general open season plus permit hunts) and accidental death tally, 1992–2001

Regulatory	Reported			Estimated			Accidental[d]			
year	M	F	Total[a]	Unreported[b]	Illegal[c]	Total	Road	Train	Total	Total
1992–93	34	0	34	2	5	7	10	24	34	75
1993–94	30	0	31	3	15	18	15	13	24	73
1994–95	36	0	36	4	15	19	34	56	90	145
1995–96	55	0	55	5	20	25	6	21	27	107
1996–97	92	0	92	9	20	29	10	7	17	138
1997–98	72	2	74	7	20	27	13	14	27	128
1998–99	80	0	80	8	20	28	15	18	33	141
1999–00*	67	0	67	7	20	27	20	80	100	194
2000–01	55	0	55	6	20	26	14	7	21	102
2001–02	67	0	67	7	20	27	31	10	41	135

[a] Total includes moose of unknown sex.
[b] Derived by taking 5% of the total reported kill prior to SF50 (1993) and 10% after 1993.
[c] Includes moose taken in defense of life or property.
[d] Road and train are minimum numbers.
* Information updated since last management report.

Table 3 Unit 14B moose harvest permit hunts, 1992–2001

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Total
DM415									
	1995–96	896	100	20	73	6	6	0	6
	1996–97	913	100	16	67	12	12	0	12
	1997–98	949	100	14	73	13	12	1	13
	1998–99	1100	100	20	71	9	7	0	7
	1999–00 [a]	--	--	--	--	--	--	--	--
DM416									
	1995–96	642	30	23	53	23	7	0	7
	1996–97	790	30	10	27	63	19	0	19
	1997–98	783	30	10	47	40	12	0	12
	1998–99	899	30	17	43	40	12	0	12
	1999–00	3778	60	12	60	27	16	0	16
	2000–01	3347	60	25	63	12	7	0	7
	2001–02 [b]	--	--	--	--	--	--	--	--

[a] Early season any-bull permits were discontinued as a request by the SF50 Task Force.
[b] Any-bull permits were discontinued.

Table 4 Unit 14B moose hunter residency and success for the general open season, 1992–2001

	Successful					Unsuccessful					
Regulatory year	Local[a] resident	Nonlocal resident	Nonres.	Unk.	Total (%)	Local[a] resident	Nonlocal resident	Nonres.	Unk.	Total	Total hunters
1992–93	31	0	3	0	34 (11)	259	10	5	6	280	314
1993–94	27	1	2	1	31 (10)	279	3	2	11	295	326
1994–95	35	0	1	0	36 (11)	290	8	3	4	305	341
1995–96	36	1	2	3	42 (9)	411	13	5	12	441	483
1996–97	56	2	3	0	61 (12)	471	12	9	4	496	555
1997–98	43	1	5	0	49 (10)	393	18	9	2	422	471
1998–99	55	2	4	0	61 (13)	393	13	12	4	422	483
1999–00*	44	1	4	2	51 (9)	461	7	13	14	495	549
2000–01	40	3	4	1	48 (10)	421	19	14	3	457	505
2001–02	61	2	3	1	67 (16)	329	11	11	3	354	421

[a] Unit 14 residents.

* Information updated since last management report.

Table 5 Unit 14B moose harvest chronology for the general open season, 1992–2001

Regulatory	August			September					November	December			
year	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15	Unknown	Total
1992–93 [a]	--	--	--	24	5	--	--	--	--	--	--	5	34
1993–94 [b]	--	5	2	5	6	12	--	--	--	--	--	1	31
1994–95 [b]	--	8	1	1	5	19	--	--	--	--	--	2	36
1995–96 [c]	2	3	0	4	9	13	--	--	2	2	7	0	42
1996–97 [c]	0	15	2	3	8	12	--	--	9	1	8	3	61
1997–98 [c]	1	7	1	6	11	9	--	--	3	3	6	2	49
1998–99 [c]	2	6	5	6	6	16	--	--	4	4	7	5	61
1999–00* [d]	0	7	2	3	5	14	9	--	--	3	7	1	51
2000–01 [d]	0	4	0	5	2	15	9	--	--	2	10	1	48
2001–02 [e]	0	10	0	4	6	7	15	23	--	--	--	2	67

[a] Open season = Sep 1–10.
[b] Open season = Aug 20–Sep 20 (SF/50 –“spike-fork/ 50-inch”).
[c] Open season = Aug 10–17 (Archery-only), Aug 20–Sep 20 (Gen.SF/50), Nov 20–Dec 15 (SF-only).
[d] Open season = Aug 10–17 (Archery-only), Aug 20–Sep 25 (Gen.SF/50), Dec 5–15 (SF-only).
[e] Open season = Aug 10–17 (Archery-only), Aug 20–Sep 30 (Gen.SF/50).
* Information updated since last management report.

Table 6 Unit 14B transport methods used by successful moose hunters during the general open season, 1992–2001

Regulatory year	Percent of successful moose hunters: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	No. moose harvested
1992–93	26	0	0	41	0	15	15	3	34
1993–94	23	0	6	32	0	10	23	6	31
1994–95	8	6	6	36	0	14	25	6	36
1995–96	12	0	7	36	5	12	26	2	42
1996–97	12	0	5	32	20	6	22	5	61
1997–98	16	2	10	27	12	12	18	2	49
1998–99	8	2	5	36	15	10	20	5	61
1999–00*	18	2	0	29	16	10	24	2	51
2000–01	8	0	4	27	17	19	23	2	48
2001–02	15	2	4	42	0	15	22	0	67

* Information updated since last management report.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 14C (1,912 mi^2) and Portage and Placer river drainages in Unit 7

GEOGRAPHIC DESCRIPTION: Anchorage Area

BACKGROUND

Moose were uncommon in the Anchorage area before the 1940s. They increased in the late 1940s as brushy regrowth replaced mature forests that were cut or burned during the development of Anchorage and the Fort Richardson Military Reservation. Numbers increased considerably during the early 1950s, and by the late 1950s and early 1960s moose were abundant. The moose population has remained high during the past 4 decades.

Prime browse occurs in open-canopied, second-growth willow, birch, and aspen stands on burned-over military lands and on several hundred acres of military lands that have been rehabilitated during the last 2 decades. Parks, greenbelts, and residential areas in the Anchorage Bowl also contain browse. Quality riparian habitat abounds along area streams and rivers. Extensive stands of subalpine willow are on south-facing slopes in most drainages in the area. However, during the last 2 decades, overabundant moose have reduced the distribution and density of browse species.

Annual harvests have fluctuated dramatically in recent decades. A record harvest of nearly 500 moose (50% females) occurred in 1965, while hunters harvested only 18 moose in 1978. Diverse harvests were often due to changes in seasons and bag limits as much as changes in the moose population. Annual harvests increased steadily during the late 1980s and early 1990s but began to decline in 1992. The 5-year mean harvest during this reporting period was 91 moose (22% cows).

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

- Maintain a population of 2000 moose

- Maintain a posthunting sex ratio of no less than 25 bulls:100 cows.

METHODS

We conducted aerial surveys annually (except in 2000) in most hunt areas to estimate sex and age composition during fall and early winter (Table 1). Fall surveys were not flown in 2000 because there was inadequate snow cover until late December or early January, after most bulls had shed antlers. Hunters were required to report their success on either harvest or permit reports, depending on whether they participated in the general season or a special permit hunt. The reports require information on days hunted, hired services, harvest date and location, sex of the animal taken, method of transportation, and antler configuration.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Moose populations were reasonably stable during the 1980s. Population stability was partially due to a series of mild winters beginning in 1979–80.

Moose are adversely affected by snow depths from 70–90 cm (28–36 inches), which impede movement, and depths greater than 90 cm, which restrict movement to the extent that adequate food may be unattainable (Coady 1974). Mean snow depths in Anchorage area lowlands are not normally challenging to wintering moose. Since 1988, however, the Anchorage area has had a series of severe winters. Continued severe winters will exacerbate overbrowsing, which may result in substantial losses of moose in subsequent years.

Deep snows during the winter of 1994–95 caused a substantial decline in the unit's moose population; vehicle collisions and starvation caused most of the known moose mortality. The number of moose killed in collisions with vehicles and trains continued to increase (Table 2). Fall 1996 surveys found the moose population 25–30% below the fall 1994 estimate. With milder winters and a reduction in harvest, the unit's moose population recovered by fall 1998 to near or above the management objective of 2000. Another severe winter in 1998–99 reduced the population to an estimated 1650 by fall 1999. No surveys were conducted in 2000; however, the population has probably rebounded slightly.

Population Size

We estimate a fall 2000 population of 1700–1800 moose in Unit 14C, including the Placer and Portage River drainages (Table 1). About 250 moose inhabit the Anchorage Management Area (excluding the Hillside count area).

Population Composition

The bull:cow ratio ranged from 36:100 to 44:100. It has increased in the Peters Creek and Eklutna/Thunderbird drainages (Table 1). The bull:cow ratio has declined in the Twentymile, Portage, and Placer drainages and in Hunter Creek. The bull:cow ratio was intentionally reduced in the Twentymile, Portage, and Placer drainages to enhance winter survival of cows and calves. There is no clear trend in bull:cow ratios on Fort Richardson and the Hillside area. The percentage of calves in the population ranged from 16–18%. The unit had 9–13 yearling bulls per 100 cows.

Distribution and Movements

Moose are yearlong residents, ranging from sea level to an elevation of 3500 feet. During winters with substantial snow accumulation, most moose are at elevations below 1500 feet. Movements of several miles or more by both sexes occur during the breeding season in late September through October and again before green-up in late March and early April.

MORTALITY

Harvest

Season and Bag Limit. The open seasons for resident and nonresident hunters in the Fort Richardson Management Area were 7 September–15 November and 15 December–15 January in 1999–00, and 5 September–15 November and 15 December–15 January in 2000–01. The bag limit was 1 moose by drawing permit. Hunting in this area was limited to archery only, except in the fall season when muzzleloading rifles were permitted north of Eagle River. We issued 85–96 archery permits and 25 muzzleloader permits for bulls and antlerless moose.

We issued an additional 15 drawing permits for both sexes for Elmendorf Air Force Base in 1999 and 2000. The bag limit was 1 moose, and the season was 7–30 September in 1999 and 5–30 September in 2000. There was no open season in the Anchorage Management Area. The open season for resident and nonresident hunters in the Peters Creek Management Area was 7–30 September in 1999 and 5–30 September in 2000. The bag limit was 1 moose by drawing permit and archery only; 15 permits were issued in 1999 and 2000. The open season for resident and nonresident hunters in the Eklutna Lake Management Area was 7–30 September in 1999 and 5–30 September in 2000. The bag limit was 1 bull by archery only. The hunt was administered by registration permit with a quota of 4 bulls.

The open season for resident hunters in the remainder of Unit 14C was 7–25 September in 1999 and 5–25 September in 2000. The bag limit was 1 bull moose with spike-fork/50-inch antlers; however, hunters could take antlerless moose by drawing permit only (50 and 40 permits were issued in 1999 and 2000, respectively). The open season for the Twentymile River area was 20 August–30 September in 1999 and 2000. The bag limit was 1 bull by drawing permit with 35 permits issued in 1999 and 10 permits in 2000.

Board of Game Actions and Emergency Orders. In 1995 and 1996 the Board of Game considered several proposals for a moose hunt in the Anchorage Management Area but delayed a final decision until the March 1997 meeting in Anchorage. In March 1997 the board considered several proposals for hunting with shotguns and muzzleloaders in Chugach State Park and bow hunts in several municipal parks. None were approved. However, the Board of Game finally authorized a moose hunt for antlerless moose and spike-fork bulls in the upper Campbell, Rabbit and Potter Creek drainages (DM666) in March 1999. No permits have been issued because the Division of Parks and Outdoor Recreation continued to prohibit discharge of firearms in these drainages. Beginning in 1998, only Alaska residents could obtain an antlerless moose permit in the remainder of Unit 14C. In March 1999 the Board of Game extended the season for the Eklutna Management Area to October 20 to allow bowhunting during the rut, and extended the general season moose hunt from September 20 to September 25. All antlerless moose hunts were reauthorized annually, except DM666 beginning in 2001.

An emergency order closed the moose hunting season in the Eklutna Management Area (RM445) effective October 3, 2000, when the quota of 4 moose was achieved. An emergency order closed the moose hunting season in the Eklutna Management Area (RM445) effective September 21, 2001, when the quota of 2 moose was achieved. The 2001 quota had been reduced from 4 to 2 moose because 5 moose were harvested and 1 mortally wounded during the 2000 season. An emergency order opened the moose hunting season on Elmendorf Air Force Base (DM428, DM429) from December 15, 2001, to January 15, 2002. The Board of Game authorized this action because Elmendorf Air Force Base was closed to public access from September 11, 2001, through the remainder of the fall hunting season, due to national security issues. The Board also authorized reissuing drawing permits to Fort Richardson hunters (DM422–DM425) who could not gain access to the military reservation after September 11, 2001. Permits for the 2001 hunting season were reissued to the same hunters in 2002, unless they had harvested a moose on Fort Richardson or were unable to participate.

The Board revised 5 AAC 92.230 (Feeding of game). Effective July 1, 2002, it is illegal to negligently leave human food, pet food, or garbage in a manner that attracts moose. The previous wording was “intentionally” rather than “negligently.” Initially the fine was $50, but it was increased to $100 in September 2002.

<u>Hunter Harvest</u>. During the 1999–00 and 2000–01 seasons, 73 and 87 moose were harvested, respectively, with a 2-year mean of 62 bulls and 18 cows (Table 2). Approximately 31% of the bulls were taken during the general season. The remaining moose were taken in permit hunts.

<u>Permit Hunts</u>. During the 1999–00 season, we issued 546 permits to hunt moose in Unit 14C. Of these, 51 hunters (14%) were successful. In 2000–01, 420 permits were issued, and 70 hunters (26%) were successful (Table 4). Drawing permit hunts were very popular. In 1999, there were 9220 hunters who applied for 235 drawing permits (2059 applicants for the 35 permits for the Placer/Twentymile hunts and 1615 applicants for the 20 antlerless permits in Hunter/Knik drainages). In 2000, there were 8647 applicants for 200 drawing permits (1677 for the 10 permits for the Placer/Twentymile hunts). Additionally 311 hunters in 1999, and 220 hunters in 2000 received registration permits for the Eklutna Valley archery hunt. The number of permittees increased in 1999 due to a hunting extension of 1 month, which allowed bowhunters to call moose during the peak of the rut. Despite its popularity, the success rate for this hunt, 1–5% in the late 1990s (Table 4), remains low. The high number of unsuccessful bowhunters in this hunt was partly responsible for the low success rate (14%) for all permit hunts, compared with other years (23–26%; Table 4).

<u>Hunter Residency and Success</u>. Residents of Unit 14 accounted for 88% of the moose harvested in Unit 14C in 1999 with nonresidents taking 6%. In 2000, residents accounted for 92% and nonresidents took 2% of the total harvest (Table 3). As predicted, the regulation that reserved local drawing permits for Alaskan hunters beginning in 1998 did not affect success rates.

<u>Harvest Chronology</u>. It is difficult to compare annual harvests for the first week in September (Table 5) because season opening dates are variable (i.e., the day after Labor Day). In 1990, after the general season was shortened by 10 days (from 30 September to 20 September), harvests shifted primarily to the second week in September, rather than being compressed into the third week, as might be expected (Table 5). The second week in September is essentially the

opening week of moose hunting for much of the unit when the day after Labor Day is later than usual (e.g., 8 September in 1998). On the other hand, when the general season was extended from September 20 to September 25 (e.g., 1999 and 2000), about one-fourth to one-third of hunters harvested a bull in the last few days of the season. A permit archery hunt was held on military land from mid-December through mid-January, after many moose summering in the Fort Richardson-Elmendorf-Ship Creek area became accessible in lowland areas of Fort Richardson.

Transport Methods. Approximately two-thirds of all successful moose hunters reached their kill sites by highway vehicle (Table 6). The high proportion of walk-in hunters is due to proximity of many moose to roads and trails and the prohibition of motorized off-road vehicles and airplanes in most of Chugach State Park.

Other Mortality

Moose killed by vehicles and trains accounted for 54–63% of known, human-caused mortality during the reporting period. Vehicles killed at least 239 moose and trains killed 22 in 1994–95, a record high because of near-record snow depths that forced many moose into town. During this report period, a mean of at least 163 moose were killed in vehicle and train collisions annually (Table 2). These are conservative figures because not all collisions are reported and some moose, never found, die from injuries.

Natural mortality was low in the Anchorage area from the mid-1950s to the late 1980s because of moderate annual snowpack and relatively low numbers of predators. More moose have starved in recent winters due to 1) greater than average snowpack that cover potential browse and require greater expenditure of energy and 2) overbrowsing in previous winters. In recent years, 2 packs of wolves have occupied the Knik and Twentymile River drainages.

HABITAT

Assessment

Large tracts of subalpine and riparian habitat are protected throughout the 500,000-acre Chugach State Park and Chugach National Forest land between Girdwood and Portage. Several thousand acres of lowland habitat are on military lands between lower Ship Creek and Eagle River. Extensive urbanization has reduced winter range on portions of the military reservation and on private lands throughout the unit. Roads and trails associated with development, however, provide movement corridors, which reduce energy expenditures for moose during years of heavy snowfall.

Enhancement

Extensive habitat enhancement on military, state, and municipal lands is not economically feasible because burning, the most cost-effective method, is difficult to do safely in a densely populated area. Habitat enhancement is not a desirable alternative in Chugach State Park. Chugach National Forest staff enhanced moose habitat in a limited area near Portage, primarily to enhance viewing opportunity. Winter habitat will inevitably decrease over time in the Anchorage area, as will the number of moose that depend on winter habitat.

CONCLUSIONS AND RECOMMENDATIONS

One population objective was met. The bull:cow ratio exceeded 25:100. However, the fall 2000 population was estimated at 1700–1800 moose, below the management objective of 2000 moose. Following 1–2 mild winters, the population should rebound to meet the management objective.

Existing management programs were developed in cooperation with staffs from Fort Richardson, Elmendorf Air Force Base, and Chugach State Park. Through restrictions on harvest methods and compromises on open and closed areas, management regimes have been developed and are acceptable to all parties.

Current regulations adequately address management concerns by providing for substantial hunting opportunities and harvests from a productive moose population in an area where several land management agencies have limited access modes.

Nuisance moose in residential areas remain a significant problem. The Alaska Department of Transportation and Public Facilities estimated rural moose-vehicle collisions cost an average of $15,150 for vehicle repairs; emergency, medical, and legal services, and lost wages (ADOTPF 1995). Moose-vehicle collisions may cost Anchorage residents $2.4 million/year, based on the number of moose-vehicle collisions reported during this 5-year report period. Moose also cause considerable damage to ornamental plants, vegetable gardens, and fruit trees in winter and spring. Some residents continue to feed local moose, despite the regulation prohibiting feeding, and when a handout is not immediately forthcoming, these moose can be unusually aggressive toward people. Area staff spends considerable time listening and responding to complaints about property damage, public safety, and injured moose. On the other hand, residents tolerate much damage, and most residents and visitors consider moose a desirable species. Public education regarding moose behavior and biology may improve public tolerance and reduce conflicts (Whittaker et al. 2001).

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Table 1 Unit 14C fall aerial moose composition counts and estimated population size, 1996–2001

Area	Regulatory year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Total moose observed	Moose /hour	Estimated population size[a]
Twentymile River	1996–97	37	11	40	23	168	56	250
Portage River	1997–98	30	9	47	27	173	57	
Placer River	1998–99	24	4	30	19	181	48	240
	1999–00	18	4	23	16	116	35	135
	2000–01[b]	--	--	--	--	--	--	
Hillside	1996–97	30	11	40	23	90	47	125
	1997–98	44	5	38	21	212	77	
	1998–99	29	13	36	22	213	70	280
	1999–00	35	7	35	21	145	51	170
	2000–01[b]	--	--	--	--	--	--	
Anchorage Bowl	1996–97	--	--	--	--	--	--	200[c]
(except Hillside)	1997–98	--	--	--	--	--	--	
	1998–99	--	--	--	--	--	--	300[c]
	1999–00	--	--	--	--	--	--	250[c]
	2000–01[b]	--	--	--	--	--	--	
Fort Richardson	1996–97	57	10	31	16	294	24	340
Elmendorf AFB	1997–98	59	12	33	17	356	36	
Off-base Ship Cr.	1998–99	42	13	32	18	386	32	503
	1999–00	57	24	31	16	408	31	474
	2000–01[b]	--	--	--	--	--	--	

Table 1 Continued

Area	Regulatory year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Total moose observed	Moose /hour	Estimated population size[a]
Eagle River	1996–97	--	--	--	--	--	--	120
	1997–98	--	--	--	--	--	--	
	1998–99	36	6	22	14	101	--	130
	1999–00	--	--	--	--	--	--	110
	2000–01[b]	--	--	--	--	--	--	
Peters Creek	1996–97	44	11	39	21	33	19	50
	1997–98	52	4	11	7	45	25	
	1998–99	73	16	16	9	69	24	90
	1999–00	95	11	26	12	42	19	50
	2000–01[b]	--	--	--	--	--	--	
Eklutna River Thunderbird Cr.	1996–97	--	--	--	--	--	--	110
	1997–98	--	--	--	--	--	--	
	1998–99	18	0	24	17	48	13	60
	1999–00	28	6	22	15	48	12	55
	2000–01[b]	--	--	--	--	--	--	
Bird Creek Indian River[d]	1996–97	--	--	--	--	--	--	100
	1997–98	--	--	--	--	--	--	
	1998–99	--	--	--	--	--	--	150
	1999–00	--	--	--	--	--	--	120
	2000–01[b]	--	--	--	--	--	--	

Table 1 Continued

Area	Regulatory Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves (%)	Total moose observed	Moose /hour	Estimated population size[a]
Hunter Creek	1996–97	27	6	15	13	112	45	150
Knik River	1997–98	33	12	16	10	165	47	
	1998–99	36	0	27	16	104	52	140
	1999–00	23	4	12	9	123	37	145
	2000–01[b]	--	--	--	--	--	--	
Lake George	1996–97	--	--	--	--	--	--	
	1997–98	43	6	14	9	132	--	170
	1998–99	--	--	--	--	--	--	165
	1999–00	--	--	--	--	--	--	140
	2000–01[b]	--	--	--	--	--	--	
Unit 14C	1996–97	42	10	31	18	697	32	1450
Total	1997–98	44	9	30	17	1083	45	
	1998–99	36	9	30	18	1102	35	2100
	1999–00	41	13	26	16	882	31	1650
	2000–01[b]	--	--	--	--	--	--	

[a] Estimate based on most recent count, using sightability index of 0.77 (based on Fort Richardson estimate calculated with MOOSPOP). Estimates in unsurveyed drainages are extrapolated based on trends in adjacent count areas.
[b] Fall surveys not conducted due to lack of snow.
[c] No aerial surveys; estimate is best guess.
[d] Last surveyed in 1988.

Table 2 Unit 14C moose harvest and accidental death, 1996–2001

Regulatory year	Hunter harvest: Reported M (%)	F (%)	Total[a]	Estimated Unreported	Illegal	Total	Accidental death[b] Road	Train	Total	Total
1996–97	88 (85)	16 (15)	104	10	10	20	136	11	147	271
1997–98	72 (76)	23 (24)	95	10	10	20	137	10	147	262
1998–99	72 (74)	25 (26)	97	10	10	20	152	6	158	275
1999–00	61 (84)	12 (16)	73	10	10	20	150	11	161	254
2000–01	63 (72)	24 (28)	87	10	10	20	160	5	165	272

[a] Includes those with unreported sex.
[b] Reported deaths only.

Table 3 Unit 14C moose hunter residency and success, 1996–2001

	Successful				Unsuccessful				
Regulatory year	Local resident[a]	Nonlocal resident	Nonresident	Total (%)[b]	Local resident[a]	Nonlocal resident	Nonresident	Total (%)[b]	Total hunters
1996–97	86	14	2	104 (21)	352	22	4	381 (79)	485
1997–98	87	5	3	95 (21)	345	20	4	369 (79)	464
1998–99	94	1	2	97 (19)	418	7	3	428 (81)	525
1999–00	64	5	4	73 (14)	437	19	4	461 (86)	534
2000–01	80	5	2	87 (20)	320	17	6	347 (80)	434

[a] Residents of Unit 14 (majority from Unit 14C).
[b] Includes hunters with unspecified residency.

Table 4 Unit 14C moose harvest data by permit hunt, 1996–2001

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest[a]
DM210, 211	1996–97	50	10	47	53	88	12	24
Twentymile	1997–98	45	9	54	46	79	21	19
Portage	1998–99	50	16	57	43	100	0	18
Placer	1999–00	35	54	100	0	0	0	0
	2000–01	10	40	83	17	100	0	1
DM424,425,427	1996–97	85	7	65	35	89	11	28
Fort Richardson	1997–98	96	10	50	50	72	28	43
(archery only)	1998–99	95	14	61	39	75	25	32
	1999–00	95	14	65	35	72	28	29
	2000–01	95	16	50	50	73	27	40
DM422,423	1996–97	25	0	68	32	88	12	8
Fort Richardson	1997–98	25	24	100	0	0	0	0
(muzzleloader)	1998–99	25	20	72	28	67	33	6
	1999–00	25	8	61	39	89	11	9
	2000–01	25	16	67	33	57	43	7
RM445[b]	1996–97	182	29	97	3	100	0	4
Eklutna	1997–98	190	33	99	1	100	0	1
(archery only)	1998–99	161	35	97	3	100	0	3
	1999–00	311	22[c]	98	2	100	0	3
	2000–01	220	51[d]	95	5	100	0	5

Table 4 Continued

Hunt no. /Area	Regulatory Year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest[a]
DM441	1996–97	5	0	40	60	0	100	3
Hunter	1997–98	5	0	100	0	0	0	0
Knik	1998–99	20	15	59	41	17	83	7
	1999–00	20	5	95	5	0	100	1
	2000–01	10	0	70	30	0	100	3
DM428, 429	1996–97	15	7	14	86	67	33	12
Elmendorf AFB	1997–98	15	0	33	67	50	50	10
(archery only)	1998–99	15	7	43	57	50	50	8
	1999–00	15	7	50	50	86	14	7
	2000–01	15	7	50	50	57	43	7
DM442	1996–97	10	20	88	12	0	100	1
Ship	1997–98	10	30	86	14	0	100	1
	1998–99	10	50	80	20	0	100	1
	1999–00	20	30	93	7	0	100	1
	2000–01	20	20	81	19	0	100	3
DM443	1996–97	10	30	86	14	0	100	1
Peters and	1997–98	10	30	100	0	0	0	0
Little Peters	1998–99	10	10	78	22	0	100	2
	1999–00	10	20	100	0	0	0	0
	2000–01	10	30	86	14	0	100	1

Table 4 Continued

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest[a]
DM448, 449	1996–97	15	33	90	10	100	0	1
Birchwood[c]	1997–98	15	20	92	8	0	100	1
(archery only)	1998–99	15	7	79	21	33	67	3
	1999–00	15	20	92	8	100	0	1
	2000–01	15	27	73	27	100	0	3
Totals for all	1996–97	397	19	75	25	81	19	82
permit hunts	1997–98	411	22	77	23	69	31	75
	1998–99	401	23	74	26	69	31	80
	1999–00	546	31	86	14	77	23	51
	2000–01	420	35	74	26	66	37	70

[a] Includes moose with unspecified sex.
[b] Registration hunt.
[c] Includes 58 permittees who did not report.
[d] Includes 108 permittees who did not report.

Table 5 Unit 14C moose harvest[a] chronology, 1996–2001

Regulatory year	Percent of harvest					n
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	
1996–97[b]	24	48	29	--	--	21
1997–98[c]	30	40	30	--	--	20
1998–99[d]	--	56	44	--	--	16
1999–00[e]	5	32	27	36	--	22
2000–01[f]	20	33	20	27	--	15

[a] Excludes permit hunt harvests.
[b] Season 9/3–9/20
[c] Season 9/2–9/20
[d] Season 9/8–9/20
[e] Season 9/7–9/25
[f] Season 9/5–9/25

Table 6 Unit 14C moose harvest percent by transport method, 1996–2001

Regulatory year	Percent of harvest								n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle	Unknown	
1996–97	8	4	24	1	0	0	63	1	104
1997–98	7	3	11	1	1	2	71	3	88
1998–99	2	5	10	2	0	6	71	3	87
1999–00	4	4	1	1	0	1	86	3	73
2000–01	2	1	6	0	0	2	84	5	87

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 PO BOX 25526
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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 15A (1314 mi^2)

GEOGRAPHIC DESCRIPTION: Northern Kenai Peninsula

BACKGROUND

Historical records and reports from residents indicate moose were abundant throughout the century in Unit 15A. The most recent population peak occurred in 1971. The near absence of wolves from 1913 to 1968, and increased moose survival following a 500-mi^2 forest fire in 1947 were 2 events that increased moose numbers throughout the 1950s and 1960s. Although seasons were long and either-sex harvest was allowed, the moose population increased beyond its carrying capacity and extensive overbrowsing occurred by the late 1960s. A wildfire in 1969 burned approximately 135 mi^2 (11 percent of 15A), initially reducing moose habitat in 15A, then harsh winters from 1971– 1974 reduced the moose population over the entire Kenai Peninsula. Estimates for Units 15A and 15B indicate the combined population estimate declined from 7900 in 1971 to 3375 by 1975. Unit 15A represents 75% of these estimates, a decline from 5900 to 2500 moose. By 1982, following more favorable winters, the moose population estimate for 15A increased to 3000.

In 1987 and 1990 estimation methods described by Gasaway (1986) were used in the unit for the first time. They indicated a stable population trend in the range of 3014–3850 moose. In February 2001, we completed a moose census using methods developed by VerHoef. Using VerHoef's modified Gasaway census technique we estimated the moose population in Subunit 15A at 2097 (95% confidence intervals 1704–2431). The winters of 1998–99 and 1999–00 were classified as severe for 15A with snow accumulation up to 40 inches. We believe the moose population was reduced by these severe winters between 30 to 39 percent, resulting in a current population estimate of 2100.

No large wildfires have occurred since the fires in 1947 and 1969 on the Kenai Peninsula. Consequently, less browse associated with successional forest stages was available to moose and a gradual decline in moose population size is anticipated during normal winters. Small wildfires and intentional habitat improvement efforts have temporarily reversed this general trend in local areas.

Increased human presence and impact of the Alaska National Interest Lands Conservation Act on the Kenai Peninsula have increased the necessity for cooperative interagency management of renewable resources. To this end, the department works closely with a variety of agencies and landholders, while still clearly retaining management authority for wildlife on nonfederal lands and nonsubsistence wildlife species on federal lands. The Kenai National Wildlife Refuge is the largest landholder in Unit 15A and actively participates in a variety of cooperative moose management programs. These include support of the ADF&G Moose Research Center near Sterling, cooperative management of Skilak Loop as a wildlife viewing area, and recent attempts to provide increased access for hunters in wheelchairs. Close coordination and cooperation should continue.

A selective harvest strategy with a spike/fork-50 inch bag limit was initiated on the Kenai Peninsula in 1987. The proportion of males in the population has subsequently increased, and hunters seem generally satisfied with the selective harvest strategy. We completed a 5-year evaluation of selective harvest on the Kenai in 1992, and a 10-year evaluation in 1999.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Maintain a healthy population of moose with a posthunting bull-to-cow ratio of at least 15:100 in Unit 15A, excepting the Skilak Loop Wildlife Management Area (SLWMA).

Primary moose management objectives in Skilak Loop Wildlife Management Area (SLWMA) are listed:

- View moose in a natural setting throughout the year.
- Provide opportunities to view all components of the moose community, including their behavior and habitat.
- Provide opportunities to harvest moose when a reduction in numbers is desirable to achieve other objectives.
- Achieve and maintain the resident population at 130 animals or a density of 1.8 to 2.0 moose per mi^2. Resident moose in excess of 130 will be available for harvest.
- Increase the bull-to-cow ratio to at least 40 bulls:100 cows.

In addition to the resident population, moose from surrounding areas commonly winter in SLWMA. Winter populations reach 300 animals. Habitat will be managed to provide for 130 resident and up to 170 additional wintering moose.

METHODS

We conducted aerial surveys in November and December of each year in selected trend count areas to ascertain sex and age composition. In 1999 and 2000 weather conditions were not suitable to conduct fall sex and age composition surveys.

A population estimate for Unit 15A was developed from data collected in February 2001. Jay Ver Hoef (ADFG Fairbanks Biometrician) developed the techniques used for S-Plus Spatial Statistics.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The February 2001 estimate for moose wintering in the unit was 2097 $\pm$ 15.9% (1704–2431) at the 95% CI. The February 1990 estimate for moose wintering in the unit was 3432 $\pm$ 12.18% (3014–3850) at the 90% CI. These data indicated a decline of approximately 39 percent of the mean; however, it is believed that most of this decline occurred during the severe winters of 1998–99 and 1999–00.

Population Composition

Poor weather and lack of complete snow cover prevented us from completing a fall sex and age composition survey in 1999 and 2000. In 1998, we observed 1528 moose in fall composition surveys, compared to 1467 in 1996 (Table 1). Calves composed 17% of the 1998 sample and occurred in the proportion of 27:100 cows. Calf composition data declined compared to data from 1992 to 1996; however, calf survival was high the previous year. Subsequently, there were a substantial number of nonproductive yearling cows in 1998. Bulls were observed at a ratio of 31:100 cows, 5 bulls:100 cows more than in 1996. Yearling bulls increased from 8:100 cows in 1996 to 11:100 cows in 1998, after the mild winter of 1997–98. The winter of 1998–99 was extremely harsh: 161 moose, primarily calves, died from starvation, part of a large number of animals that succumbed to the winter.

MORTALITY

Harvest

Season and Bag Limit. The general open season in Unit 15A was from August 20 to September 20. In spring of 1995 the Board of Game approved an archery season for Unit 15A with a season from August 10 to 17. Archery hunters were restricted to the same bag limit used during the general season. The bag limit was 1 bull with spike/fork or 50-inch antlers or at least 3 brow tines on at least 1 antler. Forty permits were issued in a drawing permit hunt in Skilak Loop Wildlife Management Area for antlerless moose in 1999–00 and 20 permits for spike/fork bulls. The antlerless season was from September 15–30 and the spike/fork bull season from September 21–30. The bag limit for the antlerless season prohibited harvesting of calves and females with calves. These permit hunts were not held during the fall 2000 season.

Board of Game Actions and Emergency Orders. There was no Board of Game action taken during this reporting period.

Hunter Harvest. In 1999, 1195 hunters harvested 92 moose (88 bulls and 4 of unreported sex) during the nonpermit seasons (Tables 2 and 5). The 1999 harvest declined by 66% compared to the 1998 harvest of 271 moose. This reduction in harvest reflects severe winter losses sustained by the 15A moose population from deep snows during the winter of 1998–99.

In 2000, 1162 hunters harvested 131 moose (130 bulls and 1 of unspecified sex) during the nonpermit seasons. The 2000 harvest increased by 30% compared to 1999.

Results of an August 10–17 archery season were included in the total harvest figures for Unit 15A. However, information requested on harvest ticket reports did not include the time spent hunting by unsuccessful hunters; therefore, it was not possible to determine how many hunters went afield during the archery season. Data collected at field checkstations were used to estimate hunter participation. An estimated 200 to 250 archery hunters participated during the 10–17 August 1999 and 2000 archery-only hunts in 15A. They reported a harvest of 16 bulls (17%) in 1999 and 11 bulls (8%) in 2000. Archers, hunting under the spike/fork-50-inch antler restriction, harvested primarily bulls in the spike/fork category.

Of the 92 moose harvested in 1999, 71 (77%) were reported with antler-spread data. Because the current bag limit was designed to focus harvest on a portion of the yearlings and on mature bulls, we assumed that bulls <35-inch antler spread met the yearling (spike/fork) requirement and $\geq$ 35-inch spreads were mature bulls (having 3 brow tines or an antler spread >50 in.). Forty-eight percent (*N* = 34) of the harvest were spike/fork bulls and 52 percent (*N* = 37) were mature bulls. Eighteen percent (*N* = 13) of the reported harvest were bulls with an antler spread $\geq$ 50-inches. In 2000, the harvest comprised 62 (50%) yearlings and 61 (50%) mature bulls. Twenty-eight percent (N=35 of 123) of the bulls were $\geq$ 50 inches.

Federal subsistence hunters, whose season began on 18 August, harvested no moose during the August 18 and 19 season in the past four years.

Permit Hunts. The antlerless permit hunt in SLWMA was held in 1999 but was not allowed in 2000. There were 1570 applicants for 40 permits to hunt antlerless moose, and 35 of the permit winners hunted, harvesting 8 moose (Table 3). There were 740 applicants for 20 permits for spike/fork bulls in SLWMA in 1999; the season was not open in 2000. Twelve permit holders hunted in 1999 but none were successful (Table 4). All moose harvested in the antlerless hunt were females.

Hunter Residency and Success. The 1999 hunter success was 8%, compared to 19% in 1998. In 1999, 79 successful hunters (86%) were unit residents, 9 (10%) were non-unit residents, and 4 (4%) were nonresidents (*N* = 92). Residency reported for unsuccessful hunters was as follows: unit residents 954, non-unit state residents 131 and nonresidents 18. (Table 5). Successful hunters averaged 6.7 days, compared to 9.0 days for all hunters.

The 2000 hunter success was 11%, compared to 8% in 1999. In 2000, 106 (81%) successful hunters were unit residents, 20 (15%) were non-unit residents, and 5 (4%) were nonresidents (*N* = 131). Residency reported for unsuccessful hunters was as follows: unit residents 835, non-unit state residents 177 and nonresidents 19. (Table 5). Successful hunters averaged 6.2 days, compared to 7.6 days for all hunters.

Transport Methods. Fifty-four percent of the 1999 successful hunters reported highway vehicles as their primary means of transportation. Boats were the second most common (17%) means of transportation and 4-wheelers third (12%). Hunters using aircraft, ORVs, and horses accounted for 9% of the reported harvest combined.

The 2000 transportation data compared closely with 1999, when 66% of successful hunters reported using highway vehicles (Table 6). In 2000, aircraft were used by 4%, compared to 12% for 4-wheelers. ORVs and horses only made up 5% of the total means of transport use.

Harvest Chronology. Sixteen percent of the 1999 and 11% of the 2000 harvest occurred during the August 10–17 archery season (Table 7). Seventeen percent of the 1999 and 24% of the 2000 harvest occurred during the first 5 days of the general hunt season. The highest percentage of harvest in 1999 (18%) and 2000 (28%) occurred during the last 5 days of the general season.

Other Mortality

Crippling loss by hunters and loss to predation was unknown. In 1999, 81 moose were reported killed in 15A by vehicle/wildlife accidents, compared to 59 in 2000 (Table 2). About 50% of moose killed by vehicles each year are calves. Between 1992 and 1998, an average of 131 moose were killed in wildlife/vehicle accidents in Unit 15A compared to a mean of 70 over the past two years. The significant reduction in number of moose killed resulted from the overall reduction in the moose population during these severe winters. A public awareness program, begun in 1990 to reduce the number of vehicle/wildlife collisions (Del Frate and Spraker 1991), has failed to demonstrate a significant reduction in accidents.

HABITAT

Assessment

The 1969 burn (85,000 acres) is still providing browse for most of the moose wintering in Unit 15A. However, this area and small areas of improved habitat north of Skilak Lake compose only 10–15% of moose habitat in the unit. The remaining moose habitat is unproductive due to forest succession and browse heights not optimal for moose.

Enhancement

In May 1991, approximately 8320 acres burned in the southeastern portion of 15A near Pothole Lake. This burn is expected to increase available moose habitat; however, this may only benefit animals in the immediate area of the burn due to its small size. Substantial statewide publicity regarding beneficial effects of wildfire for forest succession wildlife stemmed from the Pothole Lake fire.

A 10,369-acre area in the Mystery Creek Road vicinity was to be burned by U.S. Fish and Wildlife Service in the fall of 1991. Unfavorable weather conditions and other factors prevented this prescribed burn project until July 1999 when a small portion of the area was burned. Approximately 40% of this area was scheduled to be left untreated as scattered islands for wildlife cover and as a seed source for revegetation.

CONCLUSIONS AND RECOMMENDATIONS

Kris Hundertmark (ADFG) completed a 10-year review of the selective harvest strategy in 1999. The bull-to cow-ratio increased from a 5-year (1982–86) average of 13:100 to 22:100 in 1991, but declined to 16:100 in 1992 following the severe winter of 1991–92. In 1994–95 the ratio rebounded to 24:100 and remained relatively stable at 26:100 in the 1996 and 1997 fall composition surveys. In 1998 the ratio increased to 31:100.

Composition surveys were not completed during this two-year reporting period. Low recruitment following the severe winters of 1998–99 and 1999–00 reduced the number of bulls available for harvest and hunter effort due to the perceived low probability of success. Over the past 5 years, hunter effort has averaged 1306 hunters per season, ranging from 1162 to 1424. The interest in archery hunting has also remained high with the archers taking 16% and 11% of the harvest in the past 2 years, respectively.

With the increase in the number of bulls, the opportunity for viewing and photography has increased. Public perception of improved population health and the need for public support for continuation of the program has also widened.

During the past 10 years, 5 severe winters, 1991–92, 1994–95, 1996–97, 1998–99, and 1999–00 have affected moose numbers in Unit 15A. The number of available bulls following these winters declined, as did the harvest. In 1999–00, the harvest declined 66% compared to the previous year. In 2000–01, following a second severe winter and low survival, the harvest rebounded by only 30%. In 1999, hunter success decreased because very few yearling moose were available to hunters. The number of moose killed by automobiles also declined. The reduction was caused by a reduced moose population size.

Unlike other game management units in Alaska, no emergency reduction in the 1999–00 or 2000–01 moose seasons or bag limit was necessary due to effects of the previous winters. In addition to a reduction in harvest after a severe winter, the number of hunters has also decreased. The conservative nature of the spike-fork/50-inch bag limit on the Kenai Peninsula allowed the department to continue to offer the same recreational opportunity as in previous years. No changes in management objectives or bag limits are recommended at this time.

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Table 1 Unit 15A aerial moose composition counts and estimated population size, 1992–00

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	Total moose observed	Moose /hour	Estimated population size
1992–93	16	5	36	23	1019	1331	--	
1993–94[a]								
1994–95	24	9	32	20	955	1199	--	
1995–96[a]								
1996–97	26	8	39	24	1120	1467	--	
1997–98[a]								
1998–99	31	11	27	17	1269	1528	--	3000–3800
1999–00[a]		No Surveys						
2000–01[a]		No Surveys						1700–2450

[a] No data available.

Table 2 Unit 15A moose harvest[a] and accidental death, 1992–00

Regulatory year	Hunter Harvest: Reported M (%)	F (%)	Unk.	Total	Estimated: Unreported	Illegal	Total	Accidental death: Road	Train	Total	Grand total
1992–93	141	2	0	143			40	99	0	99	282
1993–94	229	2	1	232			40	119	0	119	391
1994–95	233	2	3	238			40	168	0	346[b]	584
1995–96	115	0	2	117			40	90	0	90	247
1996–97	257	0	3	260			40	160	0	160	460
1997–98	187	0	4	191			40	143	0	143	374
1998–99	264	0	7	271			40	138	0	138	449
1999–00	88	0	4	92			40	81	0	81	213
2000–01	130	0	1	131			40	59	0	59	230

[a] Excludes permit hunt harvest. [b] 178 moose died due to starvation during winter.

Table 3 Unit 15A harvest data by permit hunt DM524, Skilak Loop Antlerless Moose, 1990–00

Hunt No. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Total harvest
DM524	1990–91	20	15	50	35	0	7	0	7
Skilak	1991–92	20	0	45	55	0	11	0	11
Loop	1992–93	20	0	70	30	0	6	0	6
Antlerless	1993–94	30	7	62	38	0	10	0	10
	1994–95	30	13	50	50	0	13	0	13
	1995–96	40	20	78	22	0	7	0	7
	1996–97	No	Season						
	1997–98	No	Season						
	1998–99	40	10	69	31	0	11	0	11
	1999–00	40	13	77	23	0	8	0	8
	2000–01	No	Season						

Table 4 Unit 15A harvest data by permit hunt DM526, Skilak Loop Spike/Fork Moose, 1995–00

Hunt Nr /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Total harvest
Skilak	1995–96[a]	20	35	92	8	1	0	0	1
Loop	1996–97	No	Season						
Spike/	1997–98	20	35	92	8	1	0	0	1
Fork	1998–99	No	Season						
	1999–00	20	40	100	0	0	0	0	0
	2000–01	No	Season						

[a] First year of Spike/Fork season in Skilak Loop.

Table 5 Unit 15A moose hunter[a] residency and success, 1992–00

Regulatory year	Successful: Local[b] resident	Nonlocal resident	Nonresident	Total (%)	Unsuccessful: Local[b] resident	Nonlocal resident	Nonresident	Total(%)	Total hunters
1992–93	121	14	2	143 (12)	874	171	15	1064	1207
1993–94	193	27	8	232 (16)	968	193	13	1195	1427
1994–95	197	30	5	238 (17)	943	204	15	1187	1425
1995–96	99	13	4	117 (10)	871	133	11	1018	1135
1996–97	208	41	9	260 (19)	1005	136	19	1164	1424
1997–98	163	24	2	191(14)	974	144	18	1140	1331
1998–99	239	26	3	271(19)	988	138	17	1147	1418
1999–00	79	9	4	92(08)	954	131	18	1103	1195
2000–01	106	20	5	131(11)	835	177	19	1031	1162

[a] Excludes hunters in permit hunts.
[b] Local = residents of Unit 15.

Table 6 Unit 15A moose harvest[a] percent by transport method, 1992–00

Regulatory year	Percent of harvest: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1992–93	13	3	12	5	0	4	59	4	143
1993–94	10	2	12	4	0	7	59	6	232
1994–95	6	1	15	6	0	4	63	4	238
1995–96	9	3	17	8	0	2	57	4	117
1996–97	6	3	11	8	0	2	66	4	260
1997–98	3	2	14	7	0	4	69	2	191
1998–99	3	1	7	9	0	3	72	6	271
1999–00	8	1	17	12	0	5	54	2	92
2000–01	4	2	11	12	0	3	66	2	131

[a] Excludes permit hunt harvest.

Table 7 Unit 15A moose harvest[a] chronology percent by harvest periods, 1992–00

Regulatory year	Harvest periods 8/10–8/19	8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unk	*n*
1992–93	--	--	8[b]	33[c]	18	13	25	4	143
1993–94[d]	--	35	7	10	8	13	23	5	232
1994–95[d]	--	34	11	8	6	15	21	6	238
1995–96	11[e]	20	10	10	9	15	21	5	117
1996–97	12[e]	26	10	6	7	18	18	4	260
1997–98	20[e]	24	5	6	7	16	17	5	191
1998–99	17[e]	23	8	8	8	15	13	8	271
1999–00	16	17	5	12	12	16	18	4	92
2000–01	11	24	7	8	8	13	28	2	131

[a] Excludes permit hunt harvest.
[b] Archery season - 8/25–29, 92; 8/10–17, 95 and 96, S/F-50".
[c] General open season Sep 1–Sep 20; S/F-50".
[d] General open season Aug 20–Sep 20, S/F-50"; archery season (Aug 25–29) was closed in 1993 and 1994.
[e] Archery season August 10–17, S/F-50", general open season Aug 20–Sep 20.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 15B (1121 mi^2)

GEOGRAPHIC DESCRIPTION: Kenai Peninsula

BACKGROUND

Historical records and reports from Kenai Peninsula residents indicate moose in Unit 15B have been relatively abundant throughout the century with the most recent peak in 1971. The near absence of wolves from 1913 to 1968 is believed to be one of the primary reasons for the growth of this population. A wildfire that burned approximately 500 mi^2 in Unit 15A in 1947 also benefited moose with improved winter range. A series of harsh winters from 1971 to 1974 subsequently reduced the moose population in Unit 15B, and the winters of 1998–99 and 1999–00 were severe. Population estimates show a decline in 1971 from 1975 moose to 843 moose by 1975. A census in February 1990 indicated a slight increase since 1975, placing the moose population at that time at 1042. A census conducted in February 2001 indicated between 777 and 1139 moose were in Subunit 15B. Predation effects are unchanged, and the current population is believed to be stable at about 1000 moose. Habitat conditions are declining with plant succession.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Central Kenai Peninsula

- Maintain a population of moose with a bull-to-cow ratio of 15:100
- Allow for maximum opportunity to participate in hunting in 15B West

In 15B East

- Maintain a population of moose with a bull-to-cow ratio of 40:100
- Provide for the opportunity to harvest a large antlered bull under aesthetically pleasing conditions

METHODS

We conduct aerial surveys in November and December of each year in selected trend count areas to determine the sex and age composition of the moose population in Subunit 15B.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

A February 2001 census of the 650.4 mi^2 of suitable moose habitat in Unit 15B revealed a population estimate of 958 moose, with a 95% confidence interval ranging from 777 to 1139 or ± 19%. The estimated mean density was 1.5 moose/mi^2. Because the census was conducted during February, after most bulls had shed their antlers, composition by sex was not determined. However, we completed age composition of the population, and calves comprised 20.6% of the population compared to 9.5% found in the February 1990 census following a severe winter.

This estimate indicates a slight decrease in population size, compared to 1042 animals estimated in 1990. Over the past 10 years, winters have been normal or mild with the exceptions of 1994–95, 1998–99 and 1999–00 when record snow depths were reported.

Population Composition

We collected insufficient data during this reporting period to determine sex and age composition for the entire unit. Aerial surveys were completed in the 4 count areas in 15B West in 1996, and we observed 224 moose (Table 1). Composition for this 15B West count was 39 calves and 33 bulls per 100 cows, and calves comprised 23% of moose observed (Table 1).

MORTALITY

Harvest

Season and Bag Limit.

	Resident Open Season	Nonresident Open Season
Unit 15B that portion bounded by a line running from the mouth of Shantatalik Cr. on Tustumena Lake, northward to the west fork of Funny R. to the Kenai Nat'l Wildlife Refuge; then east along the refuge boundary to its junction with the Kenai R. and Skilak Lake; then south along the western side of Skilak R., Skilak Glacier and Harding Icefield; then west	Sept 1–Sep 20 Sept 26–Oct 15	Sept 1–Sep 20 Sept 26–Oct 15

along the Unit 15B boundary
to the mouth of Shantatalik Cr.
One bull with 50-inch antlers by
drawing permit only; up to 100
permits will be issued.

Remainder of Unit 15B
One bull with spike-fork or 50-inch antlers

or antlers with 3 brow tines on at least one side,
by bow and arrow only or one bull with spike-fork — Aug. 10–Aug. 17
or 50-inch antlers or 3 brow tines or more on at
least one side — Aug. 20– Sept. 20

Board of Game Actions and Emergency Orders. Board of Game approved a proposal in spring 1999 to establish an archery-only season in 15B West.

Hunter Harvest. In Unit 15B West, 279 hunters went afield, harvesting 44 bull moose in 1999. In 2000, 273 hunters harvested 47 bull moose (Table 2 and 4). The mean harvest of 46 moose during this 2-year period represents a 12% decrease when compared to the mean harvest of 52 from 1992 to 1998.

Of the 44 moose reported by hunters in 1999, 33 (75%) of the harvest reports included antler spread data. Because the current bag limit is designed to focus harvest on yearling and mature bulls, we assumed an antler spread <35 inches met the yearling (spike-fork) requirement and antlers $\geq$ 35 inches wide were from mature bulls. The harvest comprised 23 (70%) spike-fork and 10 (30%) mature bulls. Successful hunters averaged 5.2 days afield compared to 8.5 for all hunters.

Forty-six (98%) of the 47 moose harvested in 2000 were reported with an antler spread. Thirty-two (70%) of these were yearlings and 14 (30%) were mature bulls. Nine (20%) of these bulls had an antler spread 50 inches or larger. Successful hunters averaged 7.4 days afield compared to 8.7 for all hunters.

Permit Hunts. Unit 15B East is managed as an area where hunters are able to view and harvest large antlered bulls. Hunters are allowed to harvest bulls with an antler spread of 50 inches or larger or bulls with antlers having 3 brow tines on at least 1 antler. It was also mandatory for successful hunters to present the antlers of their harvested bull for an official measurement by department staff. Hunters were selected by a random drawing with 100 permits issued for two separate seasons. A total of 1588 and 2017 applications were received during 1999 and 2000, respectively. Permittees reported harvesting 17 bull moose in 1999 and 17 in 2000 (Table 3). In 1999, 66 (66%) of the 100 permit holders hunted, yielding a success rate for hunters of 26%. In 2000, 62 (62%) of the permit holders hunted, resulting in a success rate for hunters of 27 percent. The mean antler spread from bulls harvested during 1999 was 52.8 inches with a range of 42.3 to

61.1 inches (n = 14). Seventy-nine percent (11 of 14) of these bulls had an antler spread of 50 inches or larger and 14% (2 of 14) were 60 inches or larger. The average antler of a bull harvested in 2000 was 54.1 inches with a range of 40.5 to 71.1. Seventy-six percent (13 of 17) of the bulls taken had an antler spread of 50 inches or larger and 18% (3 of 17) had a spread 60 inches or more. In 1999 and 2000, successful hunters averaged hunting 5.0 days and observed an average of 2 sublegal and 2 legal bulls per hunt. The highest number of bulls observed reported by one hunter was 27.

Hunter Residency and Success. Forty-three (98%) of the 44 successful Unit 15B West hunters in 1999 were unit residents, 1 (2%) was a non-unit resident and no nonresidents reported hunting (Table 4). Unsuccessful hunters comprised 204 (87%) unit residents, 31 (13%) non-unit residents, and no nonresidents. Hunter success was 16 % (n = 44).

In 2000, 43 (91%) of 47 successful hunters were unit residents and 4 (9%) were non-unit residents. 226 hunters reported as unsuccessful, with similar residency percentages as unsuccessful hunters in 1999. No nonresidents hunted in 15B West during 2000. Hunter success was 17% for 2000, (n = 47).

Transport Methods. In Unit 15B West, 66 and 74% of successful hunters reported highway vehicles as their primary means of transportation in 1999 and 2000, respectively (Table 5). The second most common transportation means was horses, at 11% in 1999, and 4-wheelers and ORVs at 7% in 2000. No successful hunters used aircraft in 1999 and only 2% in 2000. In Unit 15B East, over 90% of successful hunters used horses as their primary transport method to access their hunting area in each year.

Harvest Chronology. Twenty-five percent of the successful hunters harvested a moose during the archery season from Aug. 10–17 in 1999. In 2000, 17% of the harvest was taken during the same period. Thirty percent of the 1999 and 15% of the 2000 harvest occurred during the first 5 days of the general season (Table 6). In 1999, the next highest harvests (16%) occurred between September 11 to 15 and September 16 to 20. In 2000, the highest harvest (26%) occurred during the last 5 days of the season.

Other Mortality

The extent of weather-related mortality and predation by wolves and bears is unknown in Unit 15B. However, due to the moderately high density of black and brown bears and wolves, predation alone is believed to be controlling moose numbers at this time. Mortality from starvation was high in 1999–00 but minimal during 2000–01.

Forty-seven moose were reported killed in 15B West by vehicles from July 1, 1999 to June 30, 2000. In the same period for 2000–01, 30 moose were killed in vehicle/wildlife accidents. Moose killed by vehicles comprised 50% calves, 40% cows, and 10% bulls.

HABITAT

Assessment and Enhancement

The last large-acreage habitat enhancement occurred when a wildfire burned most of the unit in about 1890. No significant habitat enhancement, with the exception of the 1947 wildfire that burned 30,600 (8%) of the 398,000 acres below timberline, has occurred in this unit since 1890. The U.S. Fish and Wildlife Service enhanced approximately 3700 acres of predominantly winter habitat using a variety of mechanical tree removal techniques in 1968. Since 1968, 5 wildfires and 1 controlled burn have occurred, resulting in 11,500 acres burned, or 3% of the acres below timberline. Several small areas (less than 50 acres) have also been designated as wood cutting areas for noncommercial use. Judging from the relative density of moose in the wood cutting areas, I believe these small logged areas provide additional moose browse. However, by and large the quality of moose habitat in Unit 15B is relatively poor and declining due to natural plant succession.

CONCLUSIONS AND RECOMMENDATIONS

The reported harvest in Unit 15B West of 44 moose in 1999 and 47 in 2000 indicates a decreased harvest when compared with a mean of 52 moose harvested annually from 1992 to 1998. The mean annual harvest since the initiation of the selective harvest program in 1987 to 2000 was 49, ranging from 35 to 67. A mean of 72 bulls was harvested annually during the 5-year period (1982–86) before the selective harvest program began. A comparison of these mean harvests indicates a mean reduction of 32% in harvest during the first 14 years of the program. A similar comparison of hunting effort shows a decline from a mean of 389 hunters (range = 258–487) for the 5 years before selective harvest to a 14-year mean of 300 (range = 272–350) once the program began. A population modeling effort using estimated recruitment and mortality parameters predicted the harvest would approach the 72 moose mean harvest reported before the selective harvest program by 1991. The current level with no upward trend suggests this harvest objective will not be met. One possible explanation was moderate to severe winters resulting in high calf mortality during 1987–88, 1989–90, 1991–92, 1994–95, 1998–99 and 1999–00. The model prediction was based on normal winter mortality. Although winter mortality was not determined for these years, it was significant, reducing the number of bulls available for harvest. The decline in hunting effort also reduced harvest.

The permit hunt in 15B East continues to provide excellent hunting opportunities and is popular among resident hunters. The harvest of 17 bulls during 1999 and 17 in 2000 indicates a decline in harvest when compared with the mean harvest from the previous 5 years of 23 moose. This decline was the result of 2 factors: the loss of mature bulls during the severe winters and the increased price charged by outfitters to transport hunters into the area. Because only older bulls can be harvested in this area, the loss of bulls in these older age classes takes several years to replace. The only practical means of access into this area is by horse, but the cost of contracting with a local outfitter has increased beyond what most hunters are willing to pay. Although the number of hunters reported going afield has not declined, the number of hunters hunting in areas accessible by horse has declined. These remote areas have higher moose densities and provide a greater opportunity to harvest a moose.

Harvest levels are well within acceptable guidelines to maintain a minimum bull-to-cow ratio of 40 to 100. Since the objective for this area is to provide an opportunity to take a large bull and hunt under aesthetically pleasing conditions, I recommend no change in season. I would further recommend that the bag limit be maintained to preserve this area as a control area to evaluate changes in the male segment of the moose subpopulations in adjacent areas where both small and large bulls are harvested.

Summer and winter moose range on the Kenai National Wildlife Refuge in Unit 15B continues to deteriorate due to wilderness lands management policies that favor advanced forest succession. The department and U.S. Fish and Wildlife Service should cooperate on selected habitat enhancement projects (mechanical manipulation and prescribed burns) to improve moose habitat in the Slikok and Coal Lake areas.

Moose surveys have not been a high priority in 15B due to low harvest and the higher demand for moose in Subunits 15A and 15C. Since a complete survey has not been conducted since 1996, I recommend a survey be scheduled for fall 2002.

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Spraker, T.H. 2002. Unit 15B moose management report. Pages 204-215 *in* C. Healy, editor. Moose management report of survey and inventory activities 1 July 1999–30 June 2001. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Table 1. Unit 15B aerial moose composition counts and estimated population size, 1992–00

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	Moose observed	Moose/ hour	Estimated population size
1992–93[a]	50	--	20	12	126	143	--	1042
1993–94[b]								
1994–95[a]	57	15	29	15	414	489	--	
1995–96[c]								
1996–97	33	17	39	23	173	224	--	1052
1997–98[b]								
1998–99[b]								
1999–00[b]								
2000–01[b]								

[a] Survey data from 15B East permit area only.

[b] No surveys completed this year.

[c] Late winter Gasaway Census completed (90% CI 733–1370). No composition data available.

Table 2. Unit 15B moose harvest[a] and accidental death, 1992–00

Regulatory year	Hunter Harvest: Reported M (%)	F (%)	Unk.	Total	Estimated: Unreported	Illegal	Total	Accidental death: Road	Other	Total	Total
1992–93	47	0	1	48			20	42	--	42	110
1993–94	45	0	1	46			20	77	--	77	143
1994–95	56	0	0	56			20	59	--	59	135
1995–96	35	0	0	35			20	70	--	70	125
1996–97	55	0	1	56			20	80	--	80	156
1997–98	67	0	0	67			20	68	--	68	135
1998–99	57	0	0	57			20	74	--	74	131
1999–00	42	0	2	44			20	47	--	47	111
2000–01	47	0	0	47			20	30	--	30	97

[a] Excludes permit hunt harvest.

Table 3. Unit 15B East moose harvest data by permit hunt, 1990–00

Hunt Nr/ Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk.	Total harvest
Totals for	1990–91	100	29	56	44	31(100)	0	0	31
all permit	1991–92	100	34	42	58	38(100)	0	0	38
hunts	1992–93	100	24	66	34	26(100)	0	0	26
DM530–DM539	1993–94	100	31	65	35	24(100)	0	0	24
	1994–95	100	34	68	32	21(100)	0	0	21
	1995–96	100	35	65	35	23(100)	0	0	23
	1996–97	100	31	61	39	27(100)	0	0	27
	1997–98	100	32	62	38	26(100)	0	0	26
	1998–99	100	37	70	30	19(100)	0	0	19
	1999–00	100	34	74	26	17(100)	0	0	17
	2000–01	100	38	73	27	17(100)	0	0	17

Table 4. Unit 15B West moose hunter[a] residency and success, 1992–00

Regulatory year	Successful: Local[b] resident	Nonlocal resident	Nonresident	Total	(%)	Unsuccessful: Local[b] resident	Nonlocal resident	Nonresident	Total	Total hunters
1992–93	40	6	1	48	(15)	247	24	1	272	320
1993–94	39	6	1	46	(13)	269	32	1	304	350
1994–95	46	4	1	56	(17)	222	31	2	267	323
1995–96	34	0	1	35	(12)	215	26	8	249	284
1996–97	46	8	1	56	(17)	248	17	2	268	324
1997–98	59	7	1	67	(20)	253	14	3	270	337
1998–99	55	2	0	57	(17)	239	31	2	272	329
1999–00	43	1	0	44	(16)	204	31	0	235	279
2000–01	43	4	0	47	(17)	203	23	0	226	273

[a] Excludes hunters in permit hunts.
[b] Local = residents of Unit 15.

Table 5. Unit 15B West moose harvest[a] percent by transport method, 1992–00

Regulatory year	Percent of harvest: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1992–93	4	6	2	8	0	2	67	10	48
1993–94	0	7	9	2	0	0	65	17	46
1994–95	2	11	4	2	0	0	66	16	56
1995–96	0	20	0	11	0	0	60	9	35
1996–97	0	13	5	4	0	2	66	11	56
1997–98	1	10	3	3	0	0	69	13	67
1998–99	0	5	5	9	0	5	65	11	57
1999–00	0	11	5	7	0	7	66	5	44
2000–01	2	6	9	4	0	0	74	4	47

[a] Excludes permit hunt harvest.

Table 6. Unit 15B moose harvest[a] chronology percent by harvest period, 1992–00

Regulatory Year	Harvest periods 8/10–17	8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unknown	*n*
1992–93[b]		--	--	48	13	19	17	4	48
1993–94[c]		37	17	4	9	9	15	9	46
1994–95[c]		30	5	5	9	4	39	7	56
1995–96[c]		20	9	9	6	17	40	0	35
1996–97[c]		33	2	11	15	13	19	7	56
1997–98[c]		52	4	9	3	16	12	3	67
1998–99[c]		42	9	4	11	12	16	7	57
1999–00[e]	25	30	7	0	2	16	16	5	44
2000–01[e]	17	15	4	0	13	19	26	6	47

a Excludes permit hunt harvest.
b General open season Sep 1–20, S/F-50”.
c General open season Aug 20–Sep 20, S/F-50”.
e Archery season August 10–17, S/F-50”, established in fall 1999.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 15C (2441 mi^2)

GEOGRAPHIC DESCRIPTION: Southern Kenai Peninsula

BACKGROUND

Moose are considered the region's most economically important wildlife species because of their popularity as a big game animal and their visible presence in developed areas. A rapid population decline occurred in the early 1970s after 3 severe winters in 4 years. The population increased during the 1980s in spite of high predator densities. In some areas the moose population has approached or exceeded carrying capacity.

Declining availability and quality of winter habitat are serious factors limiting moose on the lower Kenai Peninsula especially near Homer. During heavy snow accumulations, moose in Unit 15C are restricted to low elevation riparian habitats and south-facing benchlands. Some of the region's most important winter ranges include the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, the lower reaches of Fox River and Sheep Creek, and the Homer Bench. Community development in these areas is a threat to moose habitat.

Spruce bark beetles (*Dendroctonus rufipennis*) have established in many old-growth spruce stands in Unit 15. Nearly half a million acres of land on the Kenai Peninsula were infected with spruce bark beetles in 1995 (Peterson 1996) with over 2 million acres infested to date. Nearly all Kenai forest lands have been affected to date. Salvage logging (harvest of dead and infested stands of trees) is ongoing throughout the Kenai (Steve Albert ADF&G pers. commun.). Reduction of old-growth forests may be beneficial to the moose population by enhancing nutritional quality and availability of winter food plants. However, site preparation is crucial to successful moose habitat enhancement.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

- Maintain a population of 3000 moose.
- Maintain a minimum posthunting sex ratio of 15 bulls:100 cows.

METHODS

All harvest data is collected and reported through the statewide harvest reporting system. Information is collected from hunters on area hunted, transportation used, amount of time spent afield and, if successful, size of the moose harvested.

We documented winter moose mortalities by reports from the public and coincident with ADF&G field activities. Whenever practical, we inspected carcasses to determine their location, sex, age class, and approximate time and cause of death. Leg bones were collected to examine bone marrow for fat content.

Standard late fall composition surveys are completed in trend count areas. We completed aerial sex and age composition surveys in late November under favorable snow conditions. All information was entered in the Wildlife Information Database (WIDB) software until 1999 when this software no longer functioned. After 1999, the survey data was maintained in a local database.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Results from aerial surveys and harvest reports indicate the moose population has remained relatively stable since the mid 1980s. Both the 1997–98 and the 1998–99 winters were considered severe in most of the region with deep and persistent snow. Documented winter mortality was predominantly calves of the year; however, we suspect that some adults were also lost. Winter severity was reflected by the lower-than-average hunter harvest in subsequent years. We believe the moose population declined slightly during this reporting period and may be at the lower end of the estimated 2500–3000 animals.

Population Size

A complete Gasaway-style (1986) census was conducted during late winter of 1992 under optimal snow conditions. The lowland portion of Unit 15C (1190 mi^2) was censused, and a population estimate of 2079 moose was calculated from survey results. Confidence intervals around the estimated population ranged from $\pm$ 19.81% for 80% CI (1677–2491) to $\pm$ 31.48% for 95% CI (1425–2734). Low sightability of moose caused the high CI. The true population for the census area was probably near the upper confidence limits. We estimated an additional 200–300 moose in the mountainous portion of Unit 15C outside the census area.

Population Composition

A standard composition survey was completed in one trend area in Unit 15C during 1999 and one late winter survey in 2000. We classified 578 moose in 1999 with ratios of 18 calves:100 cows and 27 bulls:100 cows. Calf percentage was 12%, reflecting poor neonatal survival in this unit where predation is normally high (Table 1). In the 2000 winter survey we counted 329 moose with 22% calves indicating much better calf survival.

MORTALITY

Harvest

Season and Bag Limit. In 1993 the moose season was extended from the 1 September–20 September season to 20 August–20 September. The bag limit is 1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on at least 1 side. The 5-year average harvest for 15C was 272 moose (Table 2).

Board of Game Action and Emergency Orders. The Board of Game has considered proposals to change or eliminate the Lower Kenai Controlled Use Area during most of its region II meetings. In 1994 the board allowed a 2-day "window" during the last 10 days of the general season for hunters to use motorized vehicles. Subsequent proposals to further change or eliminate the CUA have failed.

A limited entry antlerless moose season was first proposed in 1993. The local advisory committee failed to support this hunt; therefore, the board did not consider the proposal without committee support. A modified version of this proposal was again proposed to the board in 1995 with the support of the local advisory committees. The board passed this proposal, however, hunters were restricted to taking cows without calves and had to be accompanied by department personnel. With input from the Advisory committees, the board has reauthorized the antlerless hunts each year with moderate changes. Currently the drawing season runs concurrently with the general season and the number of permits increased to 50 for 2002.

Hunter Harvest. In 1999, 1163 hunters harvested 171 moose during the general season (Table 4). One hundred four (61%) hunters reported taking spike/fork bulls (<35 inches) compared to 63 (37%) hunters who harvested bulls with an antler spread of at least 50 inches or having 3 brow tines on at least 1 antler. Four (2%) indicated either unknown size or illegal classification.

In 2000, 1146 hunters harvested 208 moose during the general season (Table 4). One hundred nineteen hunters (57%) reported taking spike-fork bulls compared to 78 hunters (38%) who harvested bulls with antler spreads of at least 50 inches or with 3 brow tines on at least 1 antler. Twelve reports (6%) indicated either unknown size or illegal classification.

Permit Hunts. There was a Tier II subsistence season 1–30 September in a portion of Unit 15C southwest of a line from Point Pogibshi to the point of land between Rocky and Windy Bay. The bag limit was 1 bull. Since 1992 an average of 1 moose has been taken annually, however no moose were taken in either 1999 or 2000 (Table 3).

Beginning in 1995, the Board of Game authorized limited drawing permit hunts for antlerless moose near Homer. In 1999 thirty-five permits were issued and hunters harvested 7 moose (27% success) (Table 3). No permits were issued in 2000 since survey results indicated the moose population was near objectives and winter severity index was high. The remainder of the Unit 15C moose season was 20 August–20 September for 1 bull with spike-fork or 50-inch antlers.

Hunter Residency and Success. Hunter success in 1999 was 15%, which was the lowest success rate reported in the last 9 years. One hundred forty five (85%) successful hunters were Unit 15 residents, 14 (8%) were nonunit residents, and 10 (6%) were nonresidents (Table 4). Residency reported for unsuccessful hunters was 875 unit residents (88%), 109 nonunit residents (11%), and 8 nonresidents (1%).

Hunter success in 2000 was 18%. One hundred seventy eight (86%) successful hunters were unit residents, 25 (12%) were nonunit residents, and 5 (2%) were nonresidents (Table 4). Residency reported for unsuccessful hunters was 836 (89%) unit residents, 107 (11%) nonunit residents, and 24 (3%) nonresidents.

Harvest Chronology. Reported chronology of harvest reveals the highest percentage of moose harvested occurred during the first 6 days of the season in all years. When the season began 20 August, this trend did not change (Table 5).

Transport Methods. In 1999 off-highway vehicles (OHVs consisting of ORVs and 3 and 4-wheelers) and highway vehicles were reported as the primary means (46% and 40% respectively) of transportation used by successful hunters (Table 6). Horses (8%), boats (2%) or aircraft (1%), were the least common transport modes.

In 2000, 52% of successful hunters reported highway vehicles as their means of transportation (Table 6). The number of hunters using OHVs increased in both years and exceeded 50% for the first time. Hunters routinely use the extensive network of trails and logging roads for hunting. The second most common transportation mode for successful hunters was highway vehicles (26%). Hunters using horses (13%), boats (4%), or aircraft (<1%) were least common.

Other Mortality

In addition to reported harvest, at least 59 moose were killed in Unit 15C by motor vehicles during 1999. At least 58 moose were killed in 2000 by motor vehicles (Table 2). Approximately 75% of these animals were salvaged for human use. The "Give Moose A Brake" program (Del Frate and Spraker 1991) continued its awareness activities throughout the peninsula. Crippling loss by hunters is unknown but is believed to be less than 10% of the reported harvest.

The moose population that winters on the Homer Bench continues to be at or above carrying capacity. Additional winter mortality is expected under normal or poor winter conditions.

HABITAT

Assessment

Reduction of some old-growth forest in response to spruce bark beetle infestations through logging has been underway in Unit 15C for over 10 years. We recommended logging prescriptions and reforestation techniques that encourage hardwood production. If hardwood production increases in these affected areas, moose will probably benefit from higher-quality early seral stage habitat. However, if site preparation is not adequate, grass (*Calamagrostis* spp.) will compete with hardwood and spruce seedlings, creating less desirable moose habitat.

Enhancement

As part of licensing requirements, the Alaska Energy Authority (AEA) produced a mitigation plan to maintain or improve habitat within the Bradley Lake hydroelectric area. Moose were significantly affected through project construction and operation. Mitigation focused on compensation for habitat lost from the rising lake. A total of 593 acres of land in the Fritz Creek drainage near Homer was purchased and a $150,000 trust fund was established to provide money for moose management. Trustees were selected (1 each) from ADF&G, AEA, and the Homer Fish and Game Advisory Committee. Trustees continue to struggle to maximize the trust to benefit moose on the lower peninsula. Future land acquisitions of quality moose habitat are being considered.

CONCLUSIONS AND RECOMMENDATIONS

Both the 1997–98 and 1998–99 winters were considered severe with high documented mortality. We suspect that the moose population may have declined during this period. The 1999–2000 winter was variable with deep snow in the northern portions of the subunit that further affected moose survival. The lower than average harvest for both the reporting years reflected this trend. The 2000–2001 winter was milder than average and the population has begun to recover. Human-caused moose mortality, including road kills and harvest, represented 10–12% of the estimated moose population of 2500.

We identified 2 solutions to address the problems of declining habitat quality and starvation of moose in the Homer area. Habitat enhancement and population reduction within the affected areas would achieve these results. We believe both should occur simultaneously. Approximately $210,000 remains in a moose-mitigation trust that has been set aside for use in the Homer area. We recommend a portion of this money be allocated to habitat enhancement as soon as possible.

We also began population reduction efforts. In 1995 the Board of Game authorized a moose hunt with support from the local Advisory Committee. The goal of this program was to reduce the wintering moose population in the Homer area to allow browse to regenerate. We recommend that the program continue and the wintering population maintained at approximately 360 animals.

The harvest of moose and hunter success under spike-fork/50-inch regulations fluctuated in response to previous winter severity. Spike-forks are almost always yearlings, and the proportion of young animals in the harvest provides a "barometer" of the health of that particular cohort. By properly evaluating severity of a particular winter, we can also forecast the upcoming harvest.

Impact of predation by wolves and bears is unknown. The unit supports an estimated 50–70 wolves in 5 to 8 packs, a ratio of at least 1 wolf:35 moose and no more than 1 wolf:50 moose. Bears exert additional pressure on Unit 15 moose. Black bear are abundant throughout the unit, and brown bear are common and may be increasing in all drainages supporting salmon. Predation should prevent the moose population from increasing, except in years with mild winters.

The bull-to-cow ratio has been higher than the recommended minimum objective of 15 bulls per 100 cows since the selective harvest program began. However the survey areas may not accurately reflect the ratio across the unit. Bull-to-cow ratios during fall composition surveys varied, depending on the units surveyed and if animals were still in post rut aggregations.

Adequate bull-to-cow ratios are desired to minimize the length of the rut and ensure that most cows conceive during their first estrous cycle (Schwartz et al. 1994

Hunter numbers peaked during the mid-to-late 1990s then declined during this reporting period. Some hunters have complained of overcrowded hunting conditions, however the high use of OHVs distributed hunters across the unit. Trail damage reports are becoming more prevalent and some action may be necessary in the future to reduce habitat degradation. To avoid shifts in hunting pressure, Unit 15C season length or bag limit should not be altered until similar changes are recommended for the remainder of Units 15 and 7.

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Table 1. Unit 15C fall aerial moose composition counts and estimated population size, 1992–2000.

Regulatory year	Bulls: 100 Cows	Yearling bulls: 100 Cows	Calves: 100 Cows	Calves (%)	Adults	Total Moose observed	Moose /hour	Estimated Population size
1992–93	28	10	33	21	663	834	62	2500
1993–94[a]								
1994–95	19	7	41	26	1,283	1,727	91	2500
1995–96[a]								
1996–97	29	11	37	22	285	343	73	2500
1997–98	31	13	46	26	649	877	60	2500
1998–99[b]	61	6	31	16	87	104	37	2300
1999–2000	27	7	18	12	506	578	103	2500
2000–2001[c]				22	256	329	40	2500

[a] No surveys conducted.
[b] Partial survey.
[c] Late winter survey.

Table 2. Unit 15C moose harvest[a] and accidental death, 1992–2000.

	Hunter Harvest										
Regulatory	Reported				Estimated			Accidental death			
year	M	F	Unk.	Total	Unreported	Illegal	Total	Road	Train	Total	Total
1992–93	185	0	0	185			30	45	--	45	260
1993–94	270	0	0	270			30	75	--	75	375
1994–95	307	0	0	307			30	53	--	53	390
1995–96	192	0	0	192			30	63	--	63	285
1996–97	347	0	0	347			30	44	--	44	421
1997–98	351	0	0	351			30	84	--	84	465
1998–99	283	0	0	283			30	76	--	76	389
1999–2000	171	0	0	171			30	59	--	59	260
2000–2001	208	0	0	208			30	58	--	58	296

[a]Excludes permit hunt harvest.

Table 3. Unit 15C moose harvest data by permit hunt, 1992–2000.

Hunt Nr. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
TM549	1992–93	8	12	50	38	3	0	0	3
Point	1993–94	5	0	80	20	1	0	0	1
Pogibshi	1994–95	5	20	75	25	1	0	0	1
	1995–96	4	0	75	25	1	0	0	1
	1996–97	4	25	66	33	1	0	0	1
	1997–98	4	25	100	0	0	0	0	0
	1998–99	4	0	50	50	2	0	0	2
	1999–2000	4	25	100	0	0	0	0	0
	2000–2001	4	0	100	0	0	0	0	0
DM541–DM548[b]	1995–96	30	10	41	59	0	16	0	16
DM549	1996–97	20	15	47	53	0	9	0	9
	1997–98	20	20	69	31	0	5	0	5
	1998–99	20	30	79	21	0	3	0	3
	1999–2000	35	20	73	27	0	7	0	7
	2000–2001	0							0
DM550	1996–97	20	15	24	76	0	13	0	13
	1997–98	20	10	11	89	0	16	0	16
	1998–99	30	20	66	33	0	8	0	8

[a] Tier II moose hunt for 1 bull.
[b] DM541-DM548 was renamed to DM549–DM550 for 1996 through 1998 and again renamed to DM549 for 1999.

Table 4. Unit 15C moose hunter[a] residency and success, 1992–2000.

	Successful				Unsuccessful				
Regulatory year	Local[b] resident	Nonlocal resident	Nonresident	Total[c] (%)	Local[b] resident	Nonlocal resident	Nonresident	Total[c](%)	Total hunters
1992–93	163	13	7	185 (16)	850	127	7	988 (84)	1171
1993–94	230	28	6	270 (21)	854	159	8	1044 (79)	1314
1994–95	252	31	9	307 (22)	910	143	21	1120 (78)	1427
1995–96	171	17	4	192 (20)	696	77	4	781 (80)	973
1996–97	303	33	11	347 (24)	993	100	12	1112 (76)	1459
1997–98	316	26	9	351 (25)	914	106	16	1041 (75)	1392
1998–99	256	24	2	283 (22)	903	110	15	1032 (78)	1315
1999–2000	145	14	10	171 (15)	875	109	8	995 (85)	1163
2000–2001	178	25	5	208 (18)	836	107	24	943 (82)	1146

[a] Excludes hunters in permit hunts.
[b] Local = residents of Unit 15.
[c] Total columns include hunters that did not specify residency.

Table 5. Unit 15C moose harvest[a] chronology percent by harvest periods, 1992–2000.

Regulatory year	Harvest periods 8/20–25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unknown	*n*
1992–93[b]	--	--	43	18	14	21	4	185
1993–94[c]	29	12	14	17	9	14	4	270
1994–95[c]	34	11	16	10	11	13	4	307
1995–96[c]	26	10	10	13	14	21	6	192
1996–97[c]	33	12	11	14	9	14	4	347
1997–98[c]	32	12	8	12	13	17	7	351
1998–99[c]	31	11	12	13	12	17	5	283
1999–2000[c]	28	11	11	18	12	16	5	171
2000–2001[c]	28	13	18	12	10	16	4	208

[a] Excludes permit hunt harvest.
[b] General open season Sep 1–Sep 20.
[c] General open season Aug 20–Sep 20.

Table 6. Unit 15C moose harvest[a] percent by transport method, 1992–2000.

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
	Percent of harvest								
1992–93	4	17	3	24	0	14	31	7	185
1993–94	3	12	3	35	0	12	30	5	270
1994–95	2	9	5	35	0	7	38	5	307
1995–96	4	7	5	33	0	7	40	4	192
1996–97	3	7	4	37	0	8	39	2	347
1997–98[b]	1	7	3	36	0	6	42	5	351
1998–99	1	6	2	35	0	6	44	5	283
1999–2000	1	8	2	39	0	7	40	4	171
2000–2001	<1	13	4	45	0	7	26	4	208

[a] Excludes permit hunt harvest.
[b] One hunter reported using an airboat to harvest a moose.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 16A (1850 mi^2)

GEOGRAPHIC DESCRIPTION: West side Susitna River (Kahiltna River to Chulitna River)

BACKGROUND

The moose population in Unit 16A has been known to fluctuate greatly due to severe winters. Griese (1996) described significant winter die-offs of moose occurring at least once each decade beginning with the 1950s. The winter of 1989–90 caused 30–40% mortality from malnutrition, highway accidents, and predation facilitated by deep snows. Recovery from the resulting low density was slowed by subsequent deep-snow winters of 1990–91, 1992–93 and 1994–95 and by increasing predator populations.

Unit 16A shares land within Denali National Park and Denali State Park, and has relatively few access points from the road system. After 16A was separated from Unit 16B in 1973, historical annual hunter harvest fluctuated as a result of variable moose densities, bag limits, and improved hunter access (Griese 1996). Harvest numbers ranged between 308 (1984) and 37 (1990). The annual harvest has averaged 166 bulls in the past 5 seasons (1996-2001).

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as "spike-fork-50-inch" (SF50) (Schwartz et al 1992).

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Produce moderate, sustainable levels of moose for humans, while allowing sustainable harvest levels of predators to meet desirable predator:prey ratios

- Enhance wildlife viewing opportunities within state and national parks

MANAGEMENT OBJECTIVES

- Maintain a posthunt population of 3500–4000 moose, with a sex ratio of 20–25 bulls:100 cows during the rut

- Achieve an annual harvest of 190–360 moose

METHODS

On November 17–25, 2000 we conducted a stratified-random-sample survey in Unit 16A (Becker and Reed 1990). We generated a population estimate and age/sex statistics using MOOSEPOP (Becker and Reed 1990). We attempted to categorize antler size of bulls and identify brow-tine counts on bulls with 30-inch or greater antlers. The previous survey in this unit was conducted in the fall of 1997.

We monitored the harvest of moose from harvest and permit reports. Bulls taken by permittees were required to provide antlers for measurement and lower front teeth for age determination. We measured antler width, number of points per brow palm, and number of points per main palm on each side. The Department of Public Safety provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population decreased about 33% between the fall surveys in 1997 (3636 ± 614: 80% CI) and 2000 (2420 ± 528: 80% CI) (Table 1).

Population Composition

The composition assessed in 2000 included 28 bulls and 22 calves:100 cows which is down from 33 bulls and 35 calves:100 cows found in 1997 (Table 1).

MORTALITY

Harvest

<u>Season and Bag Limit</u>. The general open season in 1999 and 2000 was 20 August–25 September and 5–15 December for all resident and nonresident hunters. During the early season the bag limit was 1 bull under SF50 antler restrictions. The late season bag limit was 1 bull with spike or fork antlers only. We issued 100 any-bull permits for 1–15 November (DM556).

<u>Board of Game Actions and Emergency Orders</u>. During the spring 2001 Board of Game meeting the winter spike-fork-only hunt was eliminated and the any-bull permits were discontinued. To make up for these lost hunting opportunities yet decrease the harvest potential found with the discontinued hunts, the Board agreed to extend the general season 5 days to end on September 30th and add an August 10-17 archery-only season.

Hunter Harvest. The average annual harvest between 1999–2001 was 154, which was below the previous 3-year average of 189 and below the harvest objective minimum (190-360) (Table 2). The decrease in harvest is likely due to lower moose densities but also influenced by the removal of the any-bull permits (Table 3) and spike-fork-only winter hunt in 2001.

Hunter Residency and Success. The number of moose hunters in Unit 16A averaged 892 during 1999–2001 (Table 4). The majority of hunters are not residents of Unit 16 (Table 4). Combined hunter success was 16% during 1999–2001, down from 18% in the previous 3-year period (Table 4).

Harvest Chronology. Hunters took advantage of the additional 21–25 September period and during that period killed more moose than any other 5-day period in 2001 (Table 5). No moose were taken in the August 10-17 archery season in 2001. The pattern of harvest chronology was generally similar to past years.

Transport Methods. Transport methods were similar to past years (Table 6). With the removal of the late spike-fork season and November drawing hunts, snowmachines were not used in the 2001 season (Table 6).

HABITAT

Enhancement

An 18,000-acre area east of the lower end of Kroto Creek (Deshka River) has been prepared for a controlled burn since 1994 (W. Collins pers. comm.). The prescribed burn continues to be delayed because of concern for public criticism in the wake of the 1995 Miller's Reach/Big Lake wildfire. In addition, ideal conditions for such a burn have not coincided with fire crew presence.

CONCLUSIONS AND RECOMMENDATIONS

The approximate 33% decline in the moose population between the 1997 and 2000 surveys is likely due to the severe winter conditions in 1999-00 and an increase in wolf numbers (Masteller 2000). The harvest increased slightly in 2001 due to an extension of the general season (Table 4). Hunter effort will likely continue to increase in Unit 16A and surrounding units due to the closure of the general season in Unit 16B. It is unlikely that the moose population will reach the objective levels until the predator population decreases and we have milder winters with moderate snow-depths.

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Table 1 Unit 16A fall aerial moose composition counts and estimated subpopulation sizes, 1990–2001

Regulatory year	Bull: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calves	Adults observed	Total moose observed	Moose /mi^2	Population estimate
1990–91 [a]	27	7	31	29	1105	1366	1.8	3123±289 [b]
1991–92 [c]	--	--	--	--	--	--	--	--
1992–93 [d]	36	11	32	19	779	963	1.7	2900 ± 564 [b]
1993–94 [d]	24	10	24	16	698	828	1.9	3284 ± 903 [b]
1994–95 [e]	36	11	33	19	804	981	--	3000–3,600
1995–96 [c]	--	--	--	--	--	--	--	--
1996–97 [c]	--	--	--	--	--	--	--	--
1997–98 [d]	33	12	35	21	974	1234	2.1	3636 ± 614 [b]
1998–99 [c]	--	--	--	--	--	--	--	--
1999–00 [c]	--	--	--	--	--	--	--	--
2000–01 [d]	28	6	22	15	661	787	1.4	2420 ± 528
2001–02 [c]	--	--	--	--	--	--	--	--

[a] Gasaway et. al. (1986) survey methodology
[b] 80% C.I.
[c] No surveys conducted
[d] Becker and Reed (1990) survey methodology
[e] Sex and age composition surveys

Table 2 Unit 16A annual moose harvest and accidental death, 1990–2001

Regulatory	Reported			Estimated			Accidental[d]			Grand
year	M	F	Total[a]	Unreported[b]	Illegal[c]	Total	Road	Other	Total	Total
1990–91	37	0	37	2	10	12	6	0	6	55
1991–92	135	0	138	7	15	22	15	0	15	175
1992–93	136	0	138	7	15	22	9	0	9	169
1993–94	96	0	98	10	20	30	9	0	9	137
1994–95	115	0	115	10	20	30	4	0	4	149
1995–96	134	0	134	8	25	33	15	0	15	182
1996–97	197	1	199	14	25	39	4	0	4	242
1997–98	198	0	198	14	25	39	14	0	14	251
1998–99	169	1	169	12	25	37	10	0	10	216
1999–00	168	0	171	12	25	37	16	0	16	224
2000–01	141	0	141	10	25	35	20	0	20	196
2001–02	150	0	150	11	25	36	15	0	15	201

[a] Includes moose of unknown sex

[b] Derived by taking 5–10% of the reported kill

[c] Includes moose taken in defense of life or property

[d] Roadkill is minimum number

Table 3 Unit 16A moose harvest data by permit hunt, 1990–2001

Hunt No.	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
							Bulls	Cows	Total
DM554 and DM556 (1–15 Nov.)	1993–94	1310	100	20	64	36	28	0	28
	1994–95	1715	100	12	51	49	49	0	49
	1995–96 [a]	1349	100	17	53	30	30	0	30
	1996–97 [a]	1188	100	17	39	44	44	0	44
	1997–98 [a]	1192	99	11	48	41	40	0	40
	1998–99 [a]	1489	100	17	58	24	24	0	24
	1999–00 [a]	3068	100	11	59	30	29	0	29
	2000–01 [a]	3513	100	15	64	21	21	0	21
	2001–02 [b]	--	0	--	--	--	--	--	--
DM552 (20 Aug.–20 Sept)	1995–96	711	100	22	53	25	25	0	25
	1996–97	774	100	15	65	20	19	0	19
	1997–98	652	99	10	72	18	16	0	17
	1998–99	965	100	13	63	25	24	0	24
	1999–00 [b]	--	0	--	--	--	--	--	--
	2000–01 [b]	--	0	--	--	--	--	--	--
	2001–02 [b]	--	0	--	--	--	--	--	--

[a] DM556 only
[b] Discontinued hunt

Table 4 Unit 16A moose hunter residency and success, 1990–2001

Regulatory year	Successful: Local resident [a]	Nonlocal resident	Non-resident	Unk	Total	(%)	Unsuccessful: Local resident [a]	Nonlocal resident	Non-resident	Unk	Total	Total hunters
1990–91	4	35	1	1	37	(7)	23	448	9	16	473	510
1991–92	9	123	4	2	138	(16)	28	673	12	8	721	859
1992–93	7	126	4	1	138	(16)	34	630	24	21	709	847
1993–94	5	62	1	2	70	(11)	37	529	6	13	548	618
1994–95	6	57	2	1	66	(12)	32	488	8	4	500	566
1995–96	7	65	6	1	79	(12)	62	516	16	6	600	679
1996–97	14	116	4	3	136	(19)	53	513	12	8	586	725
1997–98	16	113	11	1	141	(18)	54	598	25	3	626	767
1998–99	5	112	2	2	121	(16)	56	572	19	7	654	775
1999–00	14	115	9	4	142	(17)	41	643	18	10	715	857
2000–01	2	109	6	3	120	(12)	55	772	22	5	854	974
2001–02	12	128	10	0	150	(18)	39	632	19	5	695	845

[a] Unit 16 residents

Table 5 Unit 16A moose harvest chronology[a] by months of season, 1990–2001

	August		September					November	December			
Year	20–26	27–31	1–7	8–14	15–20	21–25	26-30	20–30	1–7	8–15	Unknown	Total
1990–91 [b]	--	--	21	11	--	--	--	--	--	--	5	37
1991–92 [c]	--	--	72	53	7	--	--	--	--	--	6	138
1992–93 [c]	--	--	75	51	6	--	--	--	--	--	5	138
1993–94 [d]	13	4	8	19	24	--	--	--	--	--	2	70
1994–95 [d]	6	4	11	13	29	--	--	--	--	--	1	64
1995–96 [e]	8	1	11	12	35	--	--	5	1	4	2	79
1996–97 [e]	5	5	19	25	41	--	--	18	6	10	7	136
1997–98 [e]	20	7	11	29	36	--	--	17	4	8	9	141
1998–99 [e]	9	5	13	22	41	--	--	11	4	13	3	121
1999–00 [f]	7	8	15	21	38	32	--	--	2	15	3	142
2000–01 [f]	6	3	5	16	36	29	--	--	7	11	7	120
2001–02 [g]	8	3	7	8	34	36	52	--	--	--	2	150

[a] Does not include harvest from drawing permit hunts
[b] Open season = Sep 1–10
[c] Open season = Sep 1–15
[d] Open season = Aug 20–Sep 20 (SF-50)
[e] Open season = Aug 20–Sep 20 (SF-50), Nov 20–Dec 15 (SF-only)
[f] Open season = Aug 20–Sep 25 (SF-50), Dec 1–15 (SF-only)
[g] Open season = Aug 10–17 (Archery-only), Aug 20–Sep 30 (SF-50)

Table 6 Transport method used by successful moose hunters[a] in Unit 16A, 1990–2001

Regulatory year	Percent of successful moose hunters								Nr. moose harvested
	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1990–91	22	3	24	14	0	24	14	0	37
1991–92	15	0	25	30	0	11	17	1	138
1992–93	16	0	21	28	0	14	18	3	138
1993–94	13	0	23	34	0	11	19	0	70
1994–95	21	0	17	33	0	8	20	1	64
1995–96	7	0	16	24	7	12	32	1	79
1996–97	9	0	19	30	17	6	15	4	136
1997–98	9	0	16	34	16	6	15	4	141
1998–99	10	1	21	21	16	7	22	2	121
1999–00	8	1	26	39	6	3	16	2	142
2000–01	10	0	20	40	6	13	12	0	120
2001–02	10	0	27	37	0	8	17	1	150

[a] Does not include harvest from drawing permit hunts

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 16B (10,405 mi^2)

GEOGRAPHIC DESCRIPTION: West Side of Cook Inlet and Kalgin Island

BACKGROUND

Moose numbers almost certainly exceeded 10,000 in Unit 16B during the early 1980s (Griese 1996). Harkness (1993) speculated the population before the severe winter of 1989–90 was probably 8500–9500 moose. Following a 15–20% decline after the winter of 1989–90, moose numbers in the unit continued to decline in response to continued deep snow winters and growing predator influence (Griese 2000). Faro (1989) implied that predation on neonatal moose calves by bears influenced recruitment and caused the current declining trend. McDonough (unpublished data) estimated 150–200 wolves in the unit during the winter of 2001–02, up dramatically from the 120–140 wolves estimated in the fall 1998 (Masteller 2000).

Since 1972, when Unit 16B was separated from 16A, hunter harvest of moose has declined from a high of 842 in 1973 to only 99 moose during a short 1990 season. Harvest in the 1990s averaged 249 moose per year. From 1962–74, hunting seasons in Unit 16B were liberal (August 20–September 30 and November 1–30 seasons for either-sex moose). Through 1989, except 1975, an antlerless moose hunt was held during September. Increasing numbers of hunters and lower moose recruitment caused late season hunts to be converted to permit hunts beginning in 1983. Tier II permits were issued starting in 1990 to assure local residents an opportunity to meet subsistence needs.

Starting in 1993, the bull harvest during the general season was restricted to moose with antlers having a spike or fork on at least 1 side or a minimum of 3 brow tines on at least 1 side or a minimum total width of 50 inches. This selective harvest strategy is referred to as “spike-fork-50-inch” (SF50) (Schwartz et al 1992).

The Kalgin Island moose population resulted from a translocation of calves during 1957–59. Numbers grew to a peak density of 7 moose/mi^2 during 1981 (Taylor 1983) but was reduced to 1 moose/mi^2 by 1985. High moose densities severely degraded habitat and caused the adoption of restrictive population objectives that maintained moose densities at less than 1 moose/mi^2 while vegetation recovered (Faro 1990). There has been an any-moose registration hunt since 1999.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Produce high yields of moose for humans and provide maximum opportunity to hunt moose

POPULATION OBJECTIVES

Unit 16B (*excluding Kalgin Island*)

- Maintain a moose population of 6500–7500 moose and 20–25 bulls:100 cows

Kalgin Island

- Maintain a posthunt population of 20–40 moose and at least 15 bulls:100 cows

HUMAN USE OBJECTIVES

- Achieve a harvest of 310–600 moose

METHODS

Because of the Unit's size, we divide 16B into 3 zones (north, middle, and south) for survey purposes. In November 1999, we conducted a Gasaway et al. (1986) survey in 16B-middle (north of the Beluga River/Lake and south of Skwentna River). We conducted Becker surveys (Becker and Reed 1990) in 16B-middle in November 2001, and in 16B-North (North of Skwentna River) in November 2000 and 2001. Composition counts were conducted in large survey units in 16B-south (south of Beluga River) in December 2000, and October 2001.

We generated a population estimate and age/sex statistics using MOOSEPOP (Becker and Reed 1990). We attempted to categorize antler size of bulls and tally brow-tines on bulls with 30-inch or greater antlers.

Surveys were conducted on Kalgin Island in January and December 2000, and October 2001.

We collected harvest and hunter effort data from registration (Kalgin), harvest and Tier II permit reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population size

We estimated the 16B-middle population at 3314 ± 489 (80% C.I.) in fall 1999 and 1836 ± 267 (80% C.I.) in fall 2001 (Table 1). We estimated the 16B-north population at 909 ± 184 (80% C.I.) in fall 2000 and 1187 ± 182 (80% C.I.) in fall 2001 (Table 1). The Unit 16B fall population in 2001 is likely between 3700–4000 moose. The latest survey on Kalgin Island conducted after the hunt in 2001 showed 125–150 moose.

Population Composition

The 16B-middle composition assessed in 1999 included 28 bulls and 9 calves:100 cows, and 32 bulls and 10 calves:100 cows in 2001 (Table 1). The 16B-north composition assessed in 2000 included 39 bulls and 7 calves:100 cows, and 40 bulls and 14 calves:100 cows in 2001 (Table 1). The 16B-south composition assessed in 1999 included 38 bulls and 8 calves:100 cows, and 31 bulls and 13 calves:100 cows in 2001 (Table 1). Overall, the composition in the entire unit in 2001 was 33 bulls and 12 calves:100 cows. Kalgin Island in 2001 had 60 bulls and 80 calves:100 cows.

MORTALITY

Harvest

Season and Bag Limit.

During 1999–00 and 2000–01, in the area south and west of Beluga River, Beluga Lake, and Triumvirate Glacier, the season was 20 August–30 September for residents only with a bag limit of 1 bull with SF50 antlers. In the remaining northern 2/3 of the unit, the same season and bag limit were open to both residents and nonresidents. In addition, 260 permits were issued for a Tier II hunt during 15 November–28 February for any bull. These Tier II hunt areas are divided into 3 units (TM565, TM567, TM569).

The general season was closed in 2001. Four hundred Tier II permits were issued for 20 August–30 September (SF-50) and the 15 November–28 February (any bull) periods.

The registration hunt for any moose on Kalgin Island was 20 August–30 September in 1999 and shortened to 20 September in 2000 and 2001.

Board of Game Actions and Emergency Orders. At the March 2001 meeting, the Board eliminated the general season in 16B because of the continuing decline in moose numbers unitwide. Responding to local advisory committee's recommendations, the Board increased the population objective to 6500–7500 from 5500–6500. The Board also shortened the hunt on Kalgin Island by 10 days.

Hunter Harvest. The harvest decreased dramatically in 2001 due to the closure of the general season (Table 2). The Tier II harvest increased in proportion to the greater allotment of permits issued in 2001 (Table 3). The harvest on Kalgin Island has decreased each year since the 1999 registration season started (Table 3).

Hunter Residency and Success. General season hunter success decreased slightly in 1999 and 2000 (Table 4).

Harvest Chronology. Harvest chronology in the general harvest has not changed significantly in the past 6 seasons (Table 5).

Transport Methods. The lack of road accessibility to the unit is reflected by the dominance of aircraft and boat transportation used by successful hunters. Transport methods in the general harvest have not changed significantly in the past 10 seasons (Table 6).

Other Mortality

The severe winter of 1999–00 negatively impacted the moose population. In midwinter we observed moose floundering in snow depths exceeding 5 feet (Griese 2000). As the winter progressed, rain fell giving the surface an ice crust that facilitated easy wolf travel and complicating moose movement. Recent survey results reflect a major population decline. The effects of predation by wolves and bears continue to be apparent on mainland 16B as assessed from low calf recruitment in the fall. A wolf survey conducted in January/February 2002, estimated the minimum number of wolves in Unit 16B at 150–200, up dramatically from the 120–140 wolves estimated in the fall 1998 (Masteller 2000).

CONCLUSIONS AND RECOMMENDATIONS

The moose population Unit 16B fell outside of objective levels by the fall of 1999–00 (Griese 2000) and continues to decline. Our estimate of 3700–4000 moose is below the minimum objective of 6500 and well below what the habitat could support. Current season and bag limit structure is adequate to allow bull:cow ratios to remain above minimum objective levels. If the moose density continues to decline, we should be cautious to maintain bull:cow ratios at or above 25 bulls:100 cows (Griese 2000).

Future efforts should be directed at gaining accurate and precise estimates of predator populations. Also, starting a long-term monitoring program of the unit’s moose browse will provide needed empirical data to further clarify whether predators or habitat is more limiting in this declining moose population. We should continue to campaign for prescribed burns including a potential controlled site near Sucker Creek on the north side of Mount Susitna which has been identified for over 7 years (Griese 2000).

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Table 1 Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, 1990–2001

Reg. year	Area	Date	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calves	Adults	Total moose observed	Moose observed: mi^2	Population estimate
1990–91	Northern[a]	11/21–27	32	9	23	15	650	745	1.4	2650±412 [b]
	Middle[a]	12/08–21	34	5	25	16	673	789	1.4	3824±314 [b]
1991–92 [c]			--	--	--	--	--	--	--	--
1992–93	Southern[d]	12/15	36	5	12	12	109	124	--	--
1993–94	Northern [e]	11/15–20	50	10	16	10	374	416	1.1	2006±432 [b]
	Middle [e]	11/28–12/3	21	9	25	17	391	463	1.4	3653±1965 [b]
1994–95	Northern [f]	11/13–18	42	10	12	7	405	431	1.0	--
	Middle [f]	11/18–25	26	4	24	16	314	374	--	--
	Southern[g]	11/29–12/2	25	5	25	17	220	261	1.0	810–1210
	Kalgin Is.[h]	11/18	35	15	65	33	27	40	1.7	55–75
1995–96	Northern [d]	2/27–28	--	--	--	7	298	321	--	--
	Middle [d]	2/27–28	--	--	--	12	855	969	--	--
	Southern [d]	2/29–3/3	--	--	--	6	505	537	0.8	1081±145 [b]
	Kalgin Is.[f]	2/09	--	--	--	28	26	36	1.5	60–90
1996–97	Northern[a]	11/1–2	38	7	23	14	422	484	1.2	1912±325
	Southern[d]	11/8–9	32	7	14	10	305	338	--	--
	Kalgin Is.[f]	11/8	67	27	60	26	25	35	1.5	80–110
1997–98	Southern[d]	11/25, 12/3	37	8	13	9	544	591	--	--
	Kalgin Is.[f]	2/27	--	--	--	23	17	22	0.9	100–130

Table 1 Continued

Reg. year	Area	Date	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Percent calves	Adults	Total moose observed	Moose observed /mi^2	Population estimate
1998–99	Southern [d]	11/22	35	7	8	6	337	357	--	--
	Kalgin Is.[h]	12/7	27	9	36	29	82	116	5.0	130–150
1999–00	Middle [a]	11/22–27	28	2	9	7	587	631	1.3	3314±489 [b]
	Southern [d]	11/15–22	38	4	8	6	432	458	--	--
	Kalgin Is.[h]	01/5	--	--	--	24	38	50	2.2	60–80
2000–01	Northern [e]	11/20–22	39	5	7	5	253	268	0.6	909±184
	Southern [d]	12/16	--	--	--	--	85	98	--	--
	Kalgin Is.[h]	12/12	--	--	--	30	35	50	2.2	80–100
2001–02	Northern [e]	11/5–7	40	7	14	9	393	438	0.8	1187±182
	Middle [e]	11/8–11	32	4	10	7	494	537	0.7	1836±267
	Southern [d]	10/30–11/4	31	3	13	9	539	594	--	700–850
	Kalgin Is.[h]	10/22	--	--	--	33	64	96	4.2	110–140

[a] Gasaway et. al. (1986) random stratified survey
[b] 80% confidence intervals
[c] No count
[d] Trend area composition survey (2–4 min./mi^2)
[e] Becker survey (Becker and Reed 1990)
[f] Sex and age composition survey (4–6 min./mi^2)
[g] J. VerHoef's regression sampling method for 1/3 of area (612 ± 151 (80% CI)) plus 350–550 estimated for remainder of area
[h] Sex and age composition survey (6–8 min./mi^2)

Table 2 Unit 16B annual moose harvest and accidental death, 1990–2001

Regulatory	Reported				Estimated			Accidental			Grand
year	M	F	Unk	Total	Unreported	Illegal[a]	Total	Road	Other	Total	Total
1990–91	93	5	1	99	10	25	35	2	0	2	136
1991–92	262	0	0	262	15	25	40	1	0	1	303
1992–93	234	1	3	238	15	25	40	0	0	0	278
1993–94	155	21	0	176	10	35	45	0	0	0	221
1994–95	230	0	0	230	15	35	50	2	3	5	285
1995–96	187	11	2	200	10	25	35	0	0	0	235
1996–97	293	9	3	305	20	25	45	1	0	1	351
1997–98	314	13	1	328	20	25	45	1	0	1	374
1998–99	288	7	1	296	20	30	50	0	0	0	346
1999–00	297	50	4	351	20	25	45	0	0	0	396
2000–01	264	42	0	306	20	25	45	0	0	0	351
2001–02	130	21	0	151	20	25	45	0	0	0	196

[a] Includes moose taken in defense of life or property

Table 3 Unit 16B moose harvest data by permit hunt, 1993–2001

Hunt Nr. [a]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
						Bulls	Cows	Total
TM565	1993–94	30	13	10	73	7	15	22
	1994–95	138	32	23	40	55	0	55
	1995–96	140	40	46	10	14	0	14
	1996–97	141	26	38	35	49	0	49
	1997–98	139	30	32	37	50	1	51
	1998–99	140	21	39	37	52	0	52
	1999–00	140	22	31	41	57	0	57
	2000–01	140	16	54	31	43	0	43
	2001–02	140	29	41	30	42	0	42
TM567	1993–94	15	33	0	67	4	6	10
	1994–95	59	19	14	66	39	0	39
	1995–96	60	30	58	7	4	0	4
	1996–97	60	18	30	49	30	0	30
	1997–98	59	12	38	48	29	0	29
	1998–99	60	17	37	42	25	0	25
	1999–00	60	13	18	58	35	0	34
	2000–01	60	25	37	38	23	0	23
	2001–02	160	31	41	28	44	0	44
TM569	1993–94	60	45	35	20	12	0	12
	1994–95	58	43	29	17	10	0	10
	1995–96	60	32	47	18	8	1	11
	1996–97	60	45	25	28	16	0	17
	1997–98	59	53	24	17	9	1	10
	1998–99	60	30	42	25	15	0	15
	1999–00	60	35	37	20	12	0	12
	2000–01	60	50	42	8	5	0	5
	2001–02	100	42	27	31	31	0	31

Table 3 Continued

Hunt Nr.	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest		
						Bulls	Cows	Total
RM572	1999-00	437	37	42	18	30	50	80
	2000–01	355	32	50	18	22	42	64
	2001–02	142	30	48	22	10	21	31

[a]TM = Tier II permit, RM = registration permit.

Table 4 Unit 16B moose hunter[a] residency and success 1990–2001

Regulatory year	Successful: Local[a] resident	Nonlocal resident	Nonresident	Total	(%)	Unsuccessful: Local resident	Nonlocal resident	Nonresident	Total	(%)[b]	Total hunters
1990–91	3	64	2	69	(16)	24	325	1	350	(840	419
1991–92	13	153	35	201	(26)	24	514	41	579	(74)	780
1992–93	14	136	38	193	(25)	26	480	53	570	(75)	763
1993–94	15	78	36	132	(23)	28	358	40	437	(77)	570
1994–95	5	82	38	126	(23)	23	352	35	413	(77)	539
1995–96	4	116	38	161	(25)	28	406	44	485	(75)	646
1996–97	11	145	39	199	(30)	24	410	31	465	(70)	664
1997–98	12	165	48	229	(32)	21	419	36	479	(68)	708
1998–99	7	152	37	196	(25)	25	497	53	575	(75)	771
1999–00	7	117	40	168	(22)	26	508	62	596	(78)	764
2000–01	10	129	30	171	(22)	20	535	60	619	(78)	790
2001–02[c]	--	--	--	--	--	--	--	--	--	--	--

[a] Does not include individuals participating in permit hunts

[b] Unit 16 residents

[c] No general open season

Table 5 Unit 16B moose harvest chronology[a] by months of season, 1990–2001

	August		September					January		
Year	20–25	26–31	1–6	7–12	13–18	19–24	25–30	10–23	Unknown	Total
1990–91	--	--	40	17	--	--	--	--	12	69
1991–92[c]	--	--	56	33	80	27	--	--	8	204
1992–93[c]	--	--	45	52	58	28	--	--	9	192
1993–94	10	6	9	24	46	20	--	9	7	131
1994–95[e]	16	11	11	36	36	12	--	--	4	126
1995–96[f]	13	7	14	20	31	32	40	--	3	160
1996–97[f]	8	17	16	20	40	42	51	--	5	199
1997–98[f]	11	12	20	16	52	53	56	--	9	229
1998–99[f]	12	10	14	20	31	44	59	--	7	197
1999–00	5	1	8	17	34	45	51	--	8	169
2000–01	6	5	10	17	37	55	40	--	4	174
2001–02	--	--	--	--	--	--	--	--	--	--

[a] Does not include harvest from permit hunts
[b] Open season = Sep 1–10
[c] Open season = Sep 1–20
[d] Open season = Aug 20–Sep 20 (SF/50), Jan 10–23 (SF/50 – Res. only)
[e] Open season = Aug 20–Sep 20 (SF/50)
[f] Open season = Aug 20–Sep 30 (SF/50); Kalgin Island = Aug 20–Sep 20 (Any bull)
[g] Open season = Aug 20–Sep 30 (SF/50)
[h] No general open season

Table 6 Transport method used by successful moose hunters[a] in Unit 16B, 1990–2001

Regulatory year	Percent of successful moose hunters: Airplane	Horse	Boat	3-or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unk	Nr moose harvested
1990–91	65	0	19	1	3	3	4	4	69
1991–92	68	1	22	4	0	1	2	2	204
1992–93	64	3	19	4	0	3	2	5	192
1993–94	56	11	21	1	6	1	0	4	131
1994–95	60	11	17	3	1	1	1	6	126
1995–96	67	9	19	3	0	1	0	1	160
1996–97	61	9	18	6	1	3	1	3	199
1997–98	62	6	19	4	0	2	3	3	229
1998–99	55	7	25	8	0	2	1	2	197
1999–00	60	5	19	9	0	2	2	2	169
2000–01	65	3	21	7	0	1	2	2	174
2001–02 [b]	--	--	--	--	--	--	--	--	--

[a] Does not include harvest from permit hunts
[b] No general open season

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 17 (18,800 MI^2)

GEOGRAPHIC DESCRIPTION: Northern Bristol Bay

BACKGROUND

Moose are relatively new inhabitants in the Bristol Bay area, possibly immigrating into the area from middle Kuskokwim River drainages during the last century. Until recently, populations were low and moose primarily inhabited the Nushagak/Mulchatna River system. Local residents harvested moose opportunistically; however, caribou, reindeer, bears, and beaver were historically the main sources of game meat. The department began collecting data on the Unit 17 moose population in 1971. At that time, Faro (1973) reported that moose were not abundant in the unit and that animals close to the villages were subject to heavy hunting pressure.

Hunting seasons have varied over the years, but the bag limit has always been restricted to bulls. In the past, a general disregard for seasons and bag limits by unit residents was suspected to be the principal factor contributing to low densities of moose in the unit (Taylor 1990).

In the last two decades moose populations throughout Unit 17 have increased substantially in number and range. Reasons for this increase include moderate snowfalls in several successive winters and decreased human harvest of female moose. The reduction in the female harvest was caused in part by a positive response by unit residents to department education efforts and an abundance of an alternative big game resource as the Mulchatna caribou herd grew and extended their range (Van Daele 1995).

Moose are now common along the Nushagak/Mulchatna Rivers and all of their major tributaries. They are also throughout the Wood/Tikchik Lakes area. Moose have successfully extended their range westward into the Togiak and Kulukak River drainages of Unit 17A, where a viable population has become established in the last 7 years.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

Unit 17A

Establish a minimum population of 100 moose and a target population of 600–1000 moose

Unit 17B

Achieve and maintain a density of 1 moose/mi^2 on habitat considered good moose range

Unit 17C

Maintain a minimum density of 0.5 moose/mi^2

METHODS

Moose populations in Unit 17A were monitored in cooperation with personnel from the Togiak National Wildlife Refuge (TNWR). Movements along the border of Units 17A and 17C were monitored during a radiotelemetry study from 1989 to 1994. In March 1998, 36 moose were radiocollared in Unit 17A to study movements and population parameters (Aderman, et. al.1999). Late winter aerial surveys of the Unit 17A were conducted during this reporting period.

Aerial surveys of trend count areas in Units 17B and 17C have been used in the past to sample sex and age composition and to collect data on population trends in representative portions of the unit. Optimal survey periods were from 1 November–15 December when moose were established on their winter ranges and bulls still had their antlers. In most years, however, suitable weather, snow cover, and survey aircraft were not available during the optimal period. Late fall composition surveys in the upper Nushagak and Mulchatna River drainages were initiated in 1992–93 to investigate population trends, but have not been conducted since 1998.

Moose population estimation surveys have been attempted six times in portions of Units 17B and 17C. A portion of Unit 17C was surveyed in 1983. In 1987 a portion of the upper Mulchatna River area in Unit 17B was surveyed, and in 1995 western 17C along with most of 17A were surveyed. In March 1999, a population estimation survey for entire Unit 17C was completed using a spatial statistics stratification model. In March 2001, a population estimation survey for the western portion of Unit 17B (upper Nushagak River drainage) was completed using a spatial statistics stratification model

We collected harvest data by means of harvest ticket reports and registration permit reports. Nonreporting hunters were contacted by telephone and were sent reminder letters. We monitored harvest and cooperated with enforcement efforts of Fish and Wildlife Protection during the hunting season.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Aderman et. al. (1995) estimated there were approximately 100 moose in Unit 17A and the portion of Unit 17C surveyed in 1995. In March 2000 and 2001, department staff and TNWR staff surveyed in Unit 17A, east of and including the Matogak River drainage and north of the Nushagak Peninsula, counting 422 moose in 2000 and 471 in 2001. The present population size in Unit 17A likely exceeds 500 moose (Aderman et. al. 2000). We have seen a continued increase in the number of moose in the unit since the early surveys.

The moose population in Unit 17B was estimated to be 2500–3000 moose in 1987 (Taylor 1990). That estimate was based on extrapolations from a survey in the upper Mulchatna River area. Assuming that 50% of the unit is good moose habitat, we established the management goal for the unit at 4900 moose. Survey data for this unit were inconsistent and difficult to interpret. Taylor (1988) noted that trend count data were of limited use in estimating moose density in Unit 17 and periodic population estimation surveys were the only objective method of assessing trends. Lacking such information, we conducted late winter surveys of major drainages to investigate population trends between 1992 and 1997 (Tables 1–2). From the available data, it appeared the moose population size in the unit was stable to increasing. In March 2001, I conducted a moose population estimation survey in the western portion of Unit 17B including the upper Nushagak River drainage and drainages of Lake Kulik and Lake Beverley. Ninety-five (95) of 441 sample units were surveyed, yielding an extrapolated estimate of 1202 (± 141 at 90% CI) moose, including 61 (± 9 at 90% CI) calves (5.1% of moose). Extrapolating this estimate to the entire subunit indicates the Unit 17B moose population is at less than half the population management objective.

The moose population in Unit 17C was estimated to be 1400–1700 moose in 1987 (Taylor 1990). That estimate was based on extrapolations from the moose survey conducted in 1983. The management objective for the unit is about 1750 moose. In March 1999, I conducted a moose population estimation survey for Unit 17C north of the Igushik River. One hundred and three (103) of 774 sample units were surveyed, yielding an extrapolated estimate of 2955 (± 488 at 90% CI) moose, including 435 (± 76 at 90% CI) calves (14.7% of moose). This estimate indicates the Unit 17C moose population is at the population management objective.

Population Composition

Bull:cow ratios in all areas of Unit 17 have historically been high, but no composition data were collected during this reporting period. Calf production and survival have fluctuated between areas and years. In 1997–98, late winter survey data indicated minimum calf percentages of 19.4% in the Mulchatna drainages and 24.9% in the upper Nushagak drainages. The 1999 survey indicated a minimum calf percentage of 14.7% in Unit 17C and the 2001 survey indicated a minimum calf percentage of 5.1% in western Unit 17B.

Distribution and Movements

Much of Unit 17 is wet or alpine tundra, and moose are located predominantly along the riparian areas. We know little about specific movement patterns, except that they are influenced primarily by the rutting season in late September and by snow conditions in early winter.

Data from a joint ADF&G–TNWR radiotelemetry study indicated that most moose radiocollared in western Unit 17C stayed in that area, but there was some movement into Unit 17A. One radiocollared moose and her calf moved from Weary River to Kulukak River (Jemison 1994). During the February 1995 population estimation survey, 29 moose moved into 17A from the upper Sunshine Valley in 17C (Aderman et al. 1995). Aderman et al. (2000) found that in Unit 17A, some radiocollared moose remained in the same range during winter and summer, while other radiocollared moose used different ranges during those seasons.

MORTALITY

Harvest

Season and Bag Limit. Unit 17A was open to resident/subsistence hunters only by registration permit August 20 to September 15 (RM573). Registration permit holders could take 1 bull, regardless of antler size.

Unit 17B was divided into 2 sections: the Mulchatna River drainage upstream and including the Chilchitna River and the remainder of the unit. The upstream section was open for resident hunters from September 1–15 and nonresident hunters from September 5–15. The remainder of Unit 17B was open to resident hunters during September 1–15, September 5-15 for nonresidents, and for resident hunters with a registration permit from August 20 to September 15 (RM583) and during December 1–31 (RM585). The nonresident bag limit was 1 bull with 50" or greater antler spread or with 4 or more brow tines on at least 1 side. The bag limit for residents was 1 bull with spike/fork or 50” antlers (3+ brow tines). Registration permit holders could take 1 bull, regardless of antler size.

Unit 17C was also divided into 2 sections: the Iowithla River drainage, Sunshine Valley, and all portions of the unit west of the Wood River and south of Aleknagik Lake and the remainder of the unit. Open season for resident hunters was from September 1–15 throughout the unit. An additional resident-only registration permit hunting season was open in the remainder of the unit from August 20 to September 15 (RM583) and during December 1–31 (RM585). Nonresidents were prohibited from hunting in Unit 17C. The bag limits in 17C were the same as in 17B.

Registration hunt RM 573 permits were valid only in Unit 17A, and were available to any Alaska resident who applied in person at Togiak (August 5–September 15). Registration hunt RM583 and RM585 permits were valid for both 17B and 17C. Permits were available to any Alaska resident who applied in person at Dillingham (RM583: July 15–August 31, RM585: October 25–December 31).

Board of Game Actions and Emergency Orders. In March 2001 the Board of Game passed a regulation requiring all nonresident moose hunters in Unit 17B attend a department-approved hunter orientation course (to include trophy recognition and meat care) or must be accompanied by a registered guide or resident family member within the second degree of kindred.

During the March 1999 Board of Game meeting, the board identified moose in Units 17B and 17C as populations important for providing high levels of harvest for human consumption. During the March 2001 Board of Game meeting, the board established a population objective of 4,900 to 6,000 and harvest objective of 200 to 400 moose in Unit 17B for intensive management purposes. The board established a population objective of 2,800 to 3,500 and harvest objective of 165 to 350 moose in Unit 17C for intensive management purposes.

Hunter Harvest. Because of an almost four-fold increase in hunters afield since 1983 (1983/84–293; 2000/01–1112), reported moose harvests in Unit 17 have more than tripled during the past 18 years (1983/84–127; 1999/00–425). The total harvest in the past 5 years in Unit 17B has ranged from 168 to 226, with an annual average harvest of 188 moose. In Unit 17C the 5-year mean annual harvest was 148, with a range of 113 to 192 moose (Table 3).

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the last 7 seasons, over 56% of the reported harvest has consisted of moose with antler spreads of 50" or greater. The largest antlers reported for each of these seasons have exceeded 70" (Table 4).

General Hunt. The general moose hunt in Unit 17B and 17C is of shorter duration and with more restrictive bag limits than the registration hunts. Greater numbers of nonlocal Alaska residents and nonresidents hunt moose during this hunt than local (Unit 17) Alaska residents (Table 5). Unit 17A has not had an open general moose hunting season since 1980–81; however, 10–25 moose of both sexes were probably killed annually (Table 6). The reported harvest in the past 5 years for the general moose season in Unit 17B has ranged from 122 to 171, with a mean annual harvest of 145 moose (Table 7). In Unit 17C, the 5-year mean annual harvest for the general hunt has been 22 moose, with a range of 18 to 27 (Table 8).

Permit Hunts. Longer seasons and more liberal bag limits have enticed many resident hunters to participate in the registration hunts (RM573, RM583, and RM585). By 1999, 749 hunters received permits, and 612 hunters reported hunting, killing 279 moose (Table 9).

During the third legal hunting season in Unit 17A (1999), 41 hunters reported killing 10 moose; the following season, 2000, 49 hunters reported killing 10 moose (Table 10). In 1999, in Units 17B and 17C, 749 hunters received registration hunt permits, 571 reported hunting and 269 moose were killed. In 2000, in Units 17B and 17C, 685 hunters receiving registration hunt permits, 526 reported hunting and 179 moose were killed (Tables 11 and 12).

Hunter Residency and Success. The mean number of moose hunters participating in the general moose hunting season in Unit 17 during the past 5 years was 497, an increase from the previous reporting period (Woolington 2000). Participation by resident hunters in the general hunt has declined because of increased interest in the registration hunt. Nonresident participation continued to increase, despite more restrictive regulations from earlier years. Unitwide success during the general hunt ranged from 29% to 40% during the past 5 years, with a mean annual success rate of 34%. In regulatory years 1996-97 though 2000-01, nonresidents accounted for 66% of reporting hunters, residents of Unit 17 8%, and other residents of Alaska made up 25% of the total number of hunters in the general hunt (Table 5).

The mean number of moose hunters participating in registration moose hunts in Unit 17 during the past 5 years was 533, a 27% increase from the previous reporting period (Woolington 2000). Success during the registration hunts in Unit 17 ranged from 33% to 46% during the past 5 years, with a mean annual hunter success rate of 40%. Residents of Unit 17 composed 78%, and other residents of Alaska made up 22% of hunters in the registration hunts from regulatory years 1996-97 through 2000-01 (Table 9).

Harvest Chronology. Because of changes in seasons and weather, chronology data did not indicate consistent patterns (Table 13 and 14). Unit residents were the main participants in the August and December seasons. These seasons were originally established to provide local residents an opportunity to harvest moose that were not rutting. The regulatory intent was to discourage the illegal killing of female moose and harvests during closed seasons.

Transport Methods. Aircraft were the primary means of access for moose hunters in the general hunt in Unit 17 (5-yr mean = 67%, Table 15). Most participants in the registration hunt used boats for access (5-yr mean = 74%, Table 16). In 1990–91, off-road vehicles, including 3- and 4-wheelers, became prohibited modes of transportation for big game hunters in Unit 17B.

Other Mortality

Predation by wolves and bears occurred regularly throughout this reporting period. Reports from local resident and nonlocal hunters suggest wolf numbers appeared to be increasing unit wide, and brown bears are common. Snow depths throughout the unit were moderate during the winters of this reporting period, and there were no reports of excessive winter mortality. Moose were apparently able to find abundant forage on winter ranges in riparian areas.

There was one report of a moose being killed by a motor vehicle on the Aleknagik Lake Road near Dillingham during this reporting period. The meat was salvaged for human consumption.

Illegal harvest continued to be a problem in Unit 17A. Unit residents actively pursued moose with snowmachines during the winter and spring. Both male and female moose were taken. However, illegal harvests in Units 17B and 17C have decreased dramatically in the past 10 years. There has also been a significant decline in the number of female moose taken. It is now common to see moose near Nushagak River villages throughout the winters.

HABITAT

Assessment

Aderman (1999) established 7 intensive mapping areas in Unit 17A, based on computer-aided analysis of Landsat photos. He visited 104 sites for ground-truthing in July 1998. Information collected included dominant vegetation species, slope, aspect, and drainage. Aderman (1999) estimated a minimum of 560 mi^2 of optimal moose winter habitat and another 520 mi^2 of secondary moose winter habitat in Unit 17A.

No formal habitat-monitoring programs were conducted in the remainder of Unit 17. Moose winter ranges along the Nushagak and Mulchatna Rivers, and along the lower reaches of the major tributaries to those rivers, are probably in good condition. Although there is evidence of heavy browsing, willow stands on gravel bars are abundant and include a good mix of brush heights. Winter range conditions in the middle and upper reaches of the tributaries have not been assessed but are probably not as productive.

Enhancement

No habitat enhancement activities have been documented in Unit 17. Because of the relative inaccessibility of most of the unit and the occurrence of natural habitat change, man-caused habitat enhancement activity is not practical or necessary.

Lightning-caused wildfires are not uncommon in the unit, particularly in Unit 17B. During this reporting period, there were no large wildfires.

In most years the most important natural force responsible for enhancing moose habitat was the scouring of gravel bars and low-lying riparian areas by ice and water during spring thaw. This was especially true for the Nushagak and Mulchatna Rivers and the lower reaches of the major tributaries to those rivers.

NONREGULATORY MANAGEMENT PROBLEMS

Dramatic increases in the number of caribou in the Mulchatna herd through the mid 1990s impacted the moose population in this unit, though there was little direct competition between these ungulates. Short-term impacts of large caribou populations include decreased illegal moose harvest by local residents and increased hunting pressure by other residents and nonresidents interested in combination hunts for moose and caribou. The most significant long-term impact on moose may be the response of predator populations to abundant prey resources. Wolf numbers increased in the unit during this reporting period. There were few instances of wolves following the caribou herd, so when the herd moved out of a pack's territory, moose became the primary source of meat for wolves. The same prey shift can be expected when the caribou herd crashes.

CONCLUSIONS AND RECOMMENDATIONS

Predation by wolves, bears, and humans continued to increase in recent years. Good browse conditions and a continuing series of average winters resulted in stable-to-increasing moose populations in Units 17A and 17C during this reporting period. The moose population has exceeded the minimum goal in Unit 17A and is approaching the management objective. The first reliable population estimate for a substantial portion of Unit 17B was achieved during this reporting period. Moose numbers in Unit 17B, however, are probably in decline as evidenced by the poor calf recruitment. A reliable population estimation survey for Unit 17C in 1999 indicated the population in 17C has reached or exceeded the management objective. Although objective habitat evaluations were lacking for most of the unit, it appeared that browse quality and quantity were sufficient to support the population on most of the winter ranges.

Fall trend counts were notoriously unreliable in providing consistent data on moose populations in Unit 17. Suitable survey conditions, including complete snow coverage, light winds, and moose movements onto winter range, rarely occur before antler drop. Periodic population estimation surveys of portions of the unit during late winter provide the best moose population information. Unfortunately it does not provide reliable information on sex or age composition.

Moose hunting activity and harvest have increased in Unit 17 during the past decade. The increased number of caribou in the area has contributed to more nonlocal hunters along the Nushagak/Mulchatna River drainages. Hunting methods and harvest chronology have remained consistent in recent years, so the increased harvest is indicative of increased effort.

The moose population in Unit 17A has increased dramatically in recent years. Unit residents anxious to take advantage of this increase were given that opportunity during the 1997–98 season. We worked with local residents and with staff from TNWR, and developed a draft moose management guideline that establishes an objective of 600–1000 moose in the unit. We also entered into a cooperative moose research project with TNWR in March 1998 to 1) document population trends, 2) evaluate the moose habitat in the unit and estimate carrying capacity, and

3) develop appropriate management goals and regulatory proposals. It is critical that these cooperative efforts be coupled with continued efforts to curtail illegal harvest of moose in the Togiak valley.

The Board of Game had considered impacts of liberalized caribou seasons on the Unit 17 moose population and adjusted the moose season for 1993–94, and the board adjusted it again in 1997. The board and the department will need to continue managing these 2 ungulate populations and monitoring predator populations.

Recommended management actions for the next few years include the following:

1 Establish moose survey areas within Unit 17 and attempt to conduct a population estimation survey area each winter on a rotating basis;

2 Develop a final moose management plan for Unit 17A in cooperation with Togiak National Wildlife Refuge, local advisory committees, and local citizen groups;

3 Continue to manage Unit 17 moose populations conservatively as long as large numbers of hunters are attracted to the area in pursuit of Mulchatna caribou;

4 Continue to seek cost-effective and accurate methods to obtain bull:cow ratios within the unit.

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Table 1 Unit 17B, Upper Mulchatna river drainages moose trend count areas, late winter aerial moose counts, 1992/93–1998/99

Regulatory Year	Survey area				Survey Total	Moose/ hour	Relative Snow Level[b]
	Mulchatna River[a]	Mosquito River	Stuyahok River	Old Man River			
1992–93[c]	304	64	13	126	507	194.3	moderate
1993–94[d]	201	47	6	102	356	114.5	low
1994–95[fe]	354	96	9	83	542	140.1	moderate
1995–96[f]	62[f]	14	4	---	90	52.9	very low
1996–97[g]	---	--	--	---	0	---	bare ground
1997–98[h]	354	96	9	83	484	258.1	deep
1998–99[i]	---	--	--	---	---	---	low

[a] Survey area encompasses the Mulchatna River from its mouth to Red Veils, including all riparian habitat within 1 mile of the river.
[b] Subjective evaluation of snow depths within the vicinity of the survey area (actual depths are recorded in field notes)
[c] Mulchatna River drainages surveyed on 25 Jan. 1993, other drainages surveyed on 9 Feb. 1993.
[d] Mulchatna River drainages surveyed on 15 Mar. 1994, other drainages not surveyed.
[e] Mulchatna River drainages surveyed on 23 Feb. 1995, other drainages surveyed 24 Jan. 1995.
[f] All drainages surveyed on 11 March 1996. Mulchatna and Old Man surveys were aborted due to bare ground.
[g] No survey conducted due to extremely low snow levels and a preponderance of bare ground.
[h] All drainages surveyed on 23 January 1998.
[i] No surveys conducted in 1999

Table 2 Units 17B and 17C, Upper Nushagak, Nuyakuk, and Wood river drainages moose trend count areas, late winter aerial moose counts, 1992/93–1998/99

Regulatory Year	Survey area: Nushagak River[a]	Nuyakuk River[b]	King Salmon River[b]	Wood River[c]	Survey Total	Moose/hour[d]	Relative Snow Level[e]
1992–93[f]	319	12	--	19	350	203.2	moderate
1993–94[g]	---	--	--	--	0	---	low
1994–95[h]	484	4	--	42	530	281.4	moderate
1995–96[i]	401	7	26	--	434	253.8	very low
1996–97[j]	---	--	--	--	0	---	bare ground
1997–98[k]	882	--	--	--	882	363.0	deep
1998–99[l]	---	--	--	--	---	---	low

[a] Survey area encompasses the Nushagak River from its Koliganek to Big Bend, including all riparian habitat within 1 mile of the river. Entire survey area is within unit 17B.
[b] Survey area within unit 17B.
[c] Survey area within unit 17C.
[d] Moose per hour analysis only includes the Nushagak River portion of the survey.
[e] Subjective evaluation of snow depths within the vicinity of the survey area (actual depths are recorded in field notes)
[f] All areas surveyed on 3 February 1993.
[g] No survey conducted.
[h] All areas surveyed on 24 January 1995.
[i] All areas surveyed on 6 March 1996.
[j] No survey conducted due to extremely low snow levels and a preponderance of bare ground.
[k] All drainages surveyed on 5 February 1998.
[l] No surveys conducted in 1999

Table 3 Reported moose harvest data for all hunts in Unit 17, 1964/65–2000/01

Regulatory year	Reported Harvest	Hunters afield	Success rate	Unit[a]			
				17A	17B	17C	Unk
1964–65	32	---	---	---	---	---	---
1965–66	42	---	---	---	---	---	---
1966–67	26	90	29%	---	---	---	---
1967–68	38	77	49%	---	---	---	---
1968–69	46	66	70%	---	---	---	---
1969–70	15	31	48%	---	---	---	---
1970–71	25	35	71%	---	---	---	---
1971–72	37	63	59%	---	---	---	---
1972–73	38	74	51%	---	---	---	---
1973–74	42	93	45%	---	---	---	---
1974–75	69	119	58%	---	---	---	---
1975–76	115	207	56%	---	---	---	---
1976–77	49	168	29%	---	---	---	---
1977–78	54	113	48%	---	---	---	---
1978–79	65	160	41%	---	---	---	---
1979–80	33	68	49%	---	---	---	---
1980–81	89	212	42%	---	---	---	---
1981–82	76	209	36%	---	---	---	---
1982–83	49	149	33%	---	---	---	---
1983–84	127	293	43%	0	72	48	0
1984–85	158	344	46%	0	86	70	0
1985–86	148	401	37%	0	94	52	0
1986–87	202	486	42%	0	122	73	0
1987–88	207	499	42%	0	152	42	0
1988–89	187	457	41%	0	157	28	0
1989–90	175	438	40%	0	122	48	0
1990–91	225	489	46%	0	178	44	0
1991–92	268	590	45%	0	172	85	0
1992–93	263	705	47%	0	160	90	13
1993–94	249	705	35%	1	150	78	20
1994–95	296	800	37%	0	167	94	69
1995–96	336	881	38%	0	192	109	35
1996–97	373	913	41%	0	207	113	53
1997–98	347	956[b]	36%	15	168	126	38
1998–99	389	1048[b]	37%	10	168	171	40
1999-00	425	1116[b]	38%	10	170	192	53
2000-01	373	1112[b]	34%	10	226	136	1

[a] Harvest data not broken down by unit before 1983–84.
[b] Included hunters who registered for both fall and winter registration hunts.

Table 4 Unit 17 moose antler sizes (percent) in the reported harvest, 1992/93–2000/01

Regulatory Year	Antler size <30"	30–50"	>50"	Largest antlers
1992–93	6	36	57	80”
1993–94	3	30	68	73”
1994–95	9	29	62	73”
1995–96	7	35	57	78”
1996–97	9	26	65	75”
1997–98	6	36	57	73"
1998–99	9	35	56	74”
1999-00	7	37	56	71”
2000-01	8	27	65	80”

Table 5 Unit 17 moose hunter[a] residency and success, 1992/93–2000/01

Regulatory Year	Successful: Local Resident	Successful: Nonlocal resident	Successful: Nonresident	Successful: Total (%)	Unsuccessful: Local resident	Unsuccessful: Nonlocal resident	Unsuccessful: Nonresident	Unsuccessful: Total(%)	Total hunters
1992–93	61	79	64	212 (41)[b]	65	114	124[b]	310 (59)[b]	522
1993–94	21	28	93	144 (33)[c]	27	117	142[c]	292 (67)[c]	436
1994–95	22	41	91	161 (33)[d]	24	117	180[d]	329 (67)[d]	490
1995–96	23	30	115	171 (35)[e]	28	103	177[e]	314 (65)[e]	485
1996–97	16	35	144	196 (40)[f]	33	82	174[f]	291 (60)[f]	487
1997–98	13	33	100	150 (35)[g]	29	79	161	277 (65)[g]	427
1998–99	15	34	120	169 (32)	27	111	220	359 (68)[h]	528
1999-00	16	26	99	146 (29)[i]	20	91	235	358 (71)[i]	504
2000-01	4	41	139	184 (34)	18	98	236	353 (66)[j]	537

[a] Excludes hunters in permit hunts.
[b] Includes 8 successful and 7 unsuccessful hunters of unknown residency.
[c] Includes 2 successful and 6 unsuccessful hunters of unknown residency.
[d] Includes 7 successful and 8 unsuccessful hunters of unknown residency.
[e] Includes 3 successful and 6 unsuccessful hunters of unknown residency.
[f] Includes 1 successful and 2 unsuccessful hunters of unknown residency.
[g] Includes 4 successful and 8 unsuccessful hunters of unknown residency.
[h] Includes 1 unsuccessful hunter of unknown residency.
[i] Includes 5 successful and 12 unsuccessful hunters of unknown residency.
[j] Includes 1 unsuccessful hunter of unknown residency.

Table 6 Unit 17A moose harvest[a] and accidental death, 1992/93–2000/01

Regulatory year	Hunter Harvest: Reported M (%)	F (%)	Unk.	Total	Estimated: Unreported	Illegal	Total	Accidental death	Grand total
1992–93	0	0	0	0	0	10	10	0	15
1993–94	1 (100)	0	0	1	0	20	20	0	21
1994–95	0	0	0	0	0	25	25	0	25
1995–96	0	0	0	0	0	15	15	0	15
1996–97	0	0	0	0	0	10	10	0	10
1997–98	0	0	0	0	0	10	10	0	10
1998–99	0	0	0	0	0	10	10	0	10
1999-00	0	0	0	0	0	10	10	0	10
2000-01	0	0	0	0	0	10	10	0	10

[a] Excludes permit hunt harvest.

Table 7 Unit 17B reported moose harvest[a] and accidental death, 1992/93–2000/01

Regulatory Year	Hunter Harvest: Reported M (%)	F (%)	Unk.	Total	Estimated[b]: Unreported	Illegal	Total	Accidental death	Grand total
1992–93	152 (100)	0	0	152	0	0	0	0	152
1993–94	125 (100)	0	1	126	0	0	0	0	126
1994–95	132 (100)	0	0	132	0	0	0	0	132
1995–96	148 (100)	0	0	148	0	0	0	0	148
1996–97	171 (100)	0	0	171	0	0	0	0	171
1997–98	127 (100)	0	0	127	0	0	0	0	127
1998–99	139 (100)	0	0	139	0	0	0	0	139
1999-00	122 (100)	0	0	122	0	0	0	0	122
2000-01	165 (100)	0	0	165	0	0	0	0	165

[a] Excludes permit hunt harvest.
[b] No estimates of unreported/illegal harvests have been made for this unit.

Table 8 Unit 17C reported moose harvest[a] and accidental death, 1992/93–2000/01

Regulatory Year	Hunter Harvest: Reported M (%)	F (%)	Unk.	Total	Estimated[b] Unreported	Illegal	Total	Accidental death	Grand total
1992–93	56 (100)	0	0	56[c]	0	0	0	0	56
1993–94	18 (100)	0	0	18	0	0	0	0	18
1994–95	28 (100)	0	0	28[d]	0	0	0	1[e]	29
1995–96	32 (100)	0	0	22[f]	0	0	0	0	22
1996–97	23 (100)	0	0	23[g]	0	0	0	2[h]	25
1997–98	21 (100)	0	0	21[i]	0	0	0	0	21
1998–99	27 (100)	0	0	27[j]	0	0	0	1	28
1999-00	23 (100)	0	0	23[k]	0	0	0	0	23
2000-01	18 (100)	0	0	18[l]	0	0	0	1	19

[a] Excludes permit hunt harvest.
[b] No estimates of unreported/illegal harvests have been made for this unit.
[c] Does not include 3 bulls from an unspecified portion of Unit 17.
[d] Does not include 1 bulls from an unspecified portion of Unit 17.
[e] Includes 1 bull killed in defense of life or property.
[f] Does not include 3 bulls from an unspecified portion of Unit 17.
[g] Does not include 11 bulls from an unspecified portion of Unit 17.
[h] Does not include 1 cow and 1 bull killed in motor vehicle accidents near Dillingham.
[i] Does not include 2 bulls from an unspecified portion of Unit 17.
[j] Does not include 3 bulls from an unspecified portion of Unit 17.
[k] Does not include 1 bull from an unspecified portion of Unit 17.
[l] Does not include 1 bull from an unspecified portion of Unit 17.

Table 9 Unit 17 moose hunter residency and success[a] by permit hunt, 1992/93–2000/01

Regulatory Year	Successful Local Resident	Successful Nonlocal resident	Successful Nonresident	Successful Total (%)	Unsuccessful Local resident	Unsuccessful Nonlocal resident	Unsuccessful Nonresident	Unsuccessful Total(%)	Total hunters
1992–93	43	7	0	50 (27)	122	11	0	133 (73)	183
1993–94	84	21	0	105 (39)	130	33	0	164 (61)	269[c]
1994–95	106	29	0	135 (44)	128	45	0	175 (56)	310[d]
1995–96	117	48	0	165 (42)	131	100	0	231 (58)	396
1996–97	117	60	0	177 (42)	157	92	0	249 (58)	426
1997–98	164	33	0	197 (37)	272	60	0	332 (63)	529
1998–99	183	37	0	220 (42)	251	54	0	305 (58)	525
1999-00	221	58	0	279 (46)	262	71	0	333 (54)	612
2000-01	144	45	0	189 (33)	304	82	0	386 (67)	575

[a] Includes only permittees who reported hunting.
[b] Unit 17 residents.
[c] Includes 0 successful and 1 unsuccessful hunters of unknown residency.
[d] Includes 0 successful and 2 unsuccessful hunters of unknown residency.

Table 10 Unit 17A reported moose harvest data by permit hunt, 1997/98–2000/01

Hunt No /Area	Regulatory Year	Permits issued[a]	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk.	Total harvest
573	1997–98	44	11	62	38	15 (100)	0	0	15
	1998–99	48	10	77	23	10 (100)	0	0	10
	1999-00	57	28	76	24	10 (100)	0	0	10
	2000-01	56	13	80	20	10 (100)	0	0	10

[a] Registration permits were valid for only Unit 17A.
[b] Includes only those permittees reporting that they hunted.

Table 11 Unit 17B reported moose harvest data by permit hunt, 1992/93–2000/01

Hunt No /Area	Regulatory Year	Permits issued[a]	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk.	Total harvest
983	1992–93	277	30	63	27	8(100)	0	0	8
583	1993–94	433	19	61	39	23 (100)	0	1	24
	1994–95	438	18	56	44	35 (100)	0	0	35
	1995–96	521	21	56	44	44 (100)	0	0	44
	1996–97	546	20	63	37	36 (100)	0	0	36
583/585	1997–98[c]	629	25	63	37	41 (100)	0	0	41
	1998–99[c]	634	25	69	31	29 (100)	0	0	29
	1999-00	749	24	53	47	48 (100)	0	0	48
	2000-01	685	23	61	39	61 (100)	0	0	61

[a] Registration permits were valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17B.
[b] Of those permittees that reported hunting in Unit 17B.
[c] Includes permits issued and harvest for both fall (Aug.20-Sept15) and winter (Dec. 1-31) permit hunts.

Table 12 Unit 17C reported moose harvest data by permit hunt, 1992/93–2000/01

Hunt No /Area	Regulatory Year	Permits issued[a]	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk.	Total harvest
983	1992–93	277[b]	30	63	27	31[d] (100)	0	3	34
583	1993–94	433	19	61	39	59[e] (100)	1	0	60
	1994–95	438	18	56	44	65[f] (100)	0	1	66
	1995–96	521	21	59	41	87[g] (100)	0	0	87
	1996–97	546	20	54	46	89[h] (99)	0	1	90
583/585	1997–98[c]	629	25	60	40	105[i] (100)	0	0	105
	1998–99[c]	634	25	48	52	144[j] (100)	0	0	144
	1999-00	749	24	49	51	169[k] (100)	0	0	169
	2000-01	685	23	68	32	118[l] (100)	0	0	118

[a] Registration permits were valid for both Units 17B and 17C. Permit data are for both areas combined, harvest data are specific to Unit 17C.
[b] Of those permittees who reported hunting in Unit 17C.
[c] Includes permits issued and harvest for both fall (Aug.20-Sept15) and winter (Dec. 1-31) permit hunts.
[d] Not included are 8 bulls from an unspecified portion of Unit 17.
[e] Not included are 20 bulls from an unspecified portion of Unit 17 and 1 bull from Unit 17A.
[f] Not included are 34 bulls from an unspecified portion of Unit 17.
[g] Not included are 33 bulls from an unspecified portion of Unit 17 and 1unknown sex.
[h] Not included are 51 bulls from an unspecified portion of Unit 17.
[i] Not included are 36 bulls from an unspecified portion of Unit 17.
[j] Not included are 37 bulls from an unspecified portion of Unit 17.
[k] Not included are 52 bulls from an unspecified portion of Unit 17.
[l] Not included are 51 bulls from an unspecified portion of Unit 17.

Table 13 Unit 17 reported moose harvest[a] chronology percent by month, 1992/93–2000/01

Regulatory Year	Harvest periods Aug 10-20	Aug 21-31	Sep 1-10	Sep 11-20	Sep 21-30	Dec 1-10	Dec 11-20	Dec 21-31	Unk.	n^b
1992–93[c]	0	3	44	41	0	2	2	4	3	212
1993–94[d]	1	2	54	35	0	0	1	1	6	144
1994–95[d]	1	3	47	37	3	1	2	3	5	161
1995–96[d]	1	2	55	32	0	0	1	1	9	171
1996–97[d]	1	2	63	27	0	1	0	2	6	196
1997–98[d]	0	1	55	36	0	1	1	1	5	150
1998–99[d]	0	2	60	35	0	0	0	0	2	169
1999-00	0	3	51	42	0	2	0	1	1	146
2000-01	0	0	55	10	0	0	0	0	4	184

[a] Excludes permit hunt harvest.
[b] Reported harvest
[c] General season dates: Unit 17B (upstream) - Sep 1–20
Unit 17B (remainder) - Residents: Sep 1–20, Dec 1–31
Nonresidents: Sep 5–15
Unit 17C (Iowithla, etc.) - Residents: Sep 1–15
Unit 17C (remainder) - Residents: Sep 1–15, Dec 1–31
[d] General season dates Unit 17B - Sep 1–15
Unit 17C - Residents: Sep 1–15

Table 14 Unit 17 reported moose harvest chronology for permit hunts, percent by month, 1992/93–2000/01

Regulatory Year	Harvest periods: Aug 10–20	Aug 21–31	Sep 1–10	Sep 11–20	Sep 21–30	Dec 1–10	Dec 11–20	Dec 21–31	Unk.	*n*[a]
1992–93[b]	20	72	2	0	0	0	0	0	6	50
1993–94[c]	9	40	19	10	2	3	6	5	8	105
1994–95[c]	7	30	29	10	1	2	7	8	6	135
1995–96[c]	15	33	26	14	1	2	1	4	6	165
1996–97[c]	7	33	23	20	1	2	5	3	5	177
1997–98[d]	6	35	16	21	0	2	4	11	5	197
1998–99[d]	10	44	22	14	0	1	1	6	2	220
1999-00	13	44	16	13	0	1	4	4	6	279
2000-01	17	32	24	19	0	2	1	1	5	189

[a] Reported harvest

[b] Registration permits valid for Aug 20–31.

[c] Registration permits valid for any bull, Aug 20–Sep 15 and Dec 1–31.

d Registration permits valid for any bull; Unit 17A Aug. 20-Sep 15, Unit 17B and 17C Aug 20–Sep15 and Dec. 1–31.

Table 15 Unit 17 reported moose harvest[a] percent by transport method, 1992/93–2000/01

Regulatory year	Percent of harvest: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Total moose
1992–93	64	0	29	0	2	0	1	3	212
1993–94	71	0	26	0	9	0	0	1	144
1994–95	71	0	22	0	2	0	1	3	161
1995–96	64	0	33	1	1	0	1	1	171
1996–97	68	0	29	0	2	0	1	1	196
1997–98	65	0	30	1	3	0	1	0	150
1998–99	67	0	32	0	1	1	0	1	169
1999-00	61	0	36	0	3	0	0	0	146
2000-01	75	0	23	0	0	0	0	2	184

[a] Excludes permit hunt harvest.

Table 16 Unit 17 reported moose harvest by permit hunt, percent by transport method, 1992/93–2000/2001

Regulatory Year	Percent of harvest: Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	Total moose
1992–93	9	0	83	1	0	1	1	5	50
1993–94	15	0	73	0	6	0	4	3	105
1994–95	18	0	59	0	12	0	3	8	135
1995–96	25	0	68	0	4	0	1	2	165
1996–97	26	0	63	0	6	0	2	3	177
1997–98	8	1	73	0	16	0	1	2	197
1998–99	5	0	81	3	6	0	0	5	220
1999-00	11	0	74	1	9	0	2	2	279
2000-01	13	0	78	1	3	0	1	4	189

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 18 (42,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

Moose were thought to have begun immigrating to the Yukon-Kuskokwim Delta during the mid-to-late 1940s. Local elders from the Yukon River have confirmed this timing. The Yukon population occupies most of the available riparian habitat and the population is growing. The Kuskokwim population is small and is still in the process of colonizing the available riparian habitat. Most of the Yukon-Kuskokwim Delta is lowland treeless tundra, which is not suitable as winter habitat for moose. During the winter, moose are generally confined to riparian zones (forest and willow habitats) along the major rivers.

Moose densities are moderate and growing in the Yukon River drainage, but very low throughout the entire lower Kuskokwim River drainage. Although moose are now more common than in the past, overall densities are low in Unit 18 relative to habitat availability.

Heavy hunting pressure from communities along the Kuskokwim River has effectively limited moose population growth along that riparian corridor. While moose population growth along the Yukon River had been slowed for similar reasons, compliance with hunting regulations has improved and moose populations there have responded. Extensive habitat is available for moose colonization and range expansion along most of the lower Kuskokwim River and larger tributaries. Moose densities in adjacent Units 17, 19 and 21E remain higher than moose densities in Unit 18.

The boundaries of Unit 18 and those of the Yukon Delta National Wildlife Refuge nearly coincide. The southern tip of Unit 18 is within the Togiak National Wildlife Refuge. ADF&G shares common interests with the Refuge and we regularly cooperate during surveys, field projects, and public meetings.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Allow the Unit 18 moose populations to increase to the levels the habitat can support.
- Maintain healthy age and sex structures for moose populations within the Yukon and Kuskokwim River drainages.
- Determine population size, trend, and composition of Unit 18 moose populations.
- Achieve a continual harvest of bulls without hindering population growth.
- Improve harvest reporting and compliance with hunting regulations.
- Minimize conflicts among user groups interested in moose within and adjacent to Unit 18.

MANAGEMENT OBJECTIVES

- Allow the lower Yukon River moose population to increase above its estimated size of 2,500–3,000 moose. Allow the lower Kuskokwim River moose population to increase above its estimated size of 150–250 moose to at least 2,000 moose.
- Maintain the current age and sex structure for both populations, with a minimum of 30 bulls: 100 cows.
- Conduct seasonal sex and age composition surveys as weather allows.
- Conduct winter censuses and recruitment surveys in the established survey areas on a rotating basis.
- Conduct fall and/or winter trend counts to determine population trends.
- Conduct hunts for bulls consistent with population goals.
- Improve knowledge of and compliance with harvest reporting requirements and hunting regulations through education and incentives.
- Address user conflicts through education and hunter contacts.

METHODS

We monitor moose harvests and hunting activity in Unit 18 using hunter check stations and harvest tickets/reports. In 1999 and 2000 from late August through September we operated a hunter check station at Paimiut Slough along the Yukon River near the border of Units 18 and 21E. In 2000, we contacted Unit 18 hunters within the Kuskokwim River drainage by boat. Whenever possible, we collect incisors for aging and take antler measurements. Hunter participation is voluntary.

We've conducted an incentive program to encourage hunters to turn in their harvest reports annually since 1998. Local license vendors donated prizes and the department purchased prizes that were randomly distributed to hunters selected from a list of those who returned harvest reports. Prizes had values up to $200. We held the drawing in August just prior to the upcoming hunting season.

Prior to 1999, censuses were conducted using methods developed by Gasaway et al. (1986). Beginning in 1999, we've conducted moose censuses using census methods developed by Ver Hoef (1998, personal communication). The survey boundaries using Gasaway methods and Ver Hoef methods are shown in figures 1 and 2. Each area is scheduled to be censused on a rotational basis and will be modified to accommodate the newer methods in turn. The census areas are delineated within Unit 18 as follows:

- Paimiut Area: The Yukon River from Pilot Station upriver to old Paimiut Village, previously censused in late February and early March 1992 and again in winter 1998.

- Lower Kuskokwim Area: The Kuskokwim River corridor between Kalskag and Kwethluk, previously censused in March 1993, and again surveyed in winter 2000.

- Lowest Yukon Area: The Yukon River downstream from Mountain Village, where moose populations on 1700 square miles of forested habitat were estimated with intensive surveys in March 1994.

- Andreafsky Area: The Yukon River from Pilot Station downstream to Mountain Village, previously censused in March 1995 and again in winter 1999.

- NYAC Area: The uplands of the eastern tributaries of the lower Kuskokwim River. This census area was delineated for a Gasaway style survey but has not yet been surveyed. Delineation for a Ver Hoef style survey is pending.

We continued discussions of a cooperative strategy to improve the moose population along the Lower Kuskokwim River with the Lower Kuskokwim Fish and Game Advisory Committee, the Association of Village Council Presidents, interested individuals, and the Fish and Wildlife Service.

We provided public information and education through public service announcements made available to the media, regular newspaper articles, and informal hunter contacts. We distributed coffee cups (emblazoned with an educational logo portraying the potential production of one cow moose) to hunters, advisory committee members, village leaders, Board of Game members, and others influential with hunters. This "moose circle coffee cup" has become a valuable focus for our educational efforts.

We provided enforcement information to the Fish and Wildlife Protection Troopers (FWP) in Bethel and Aniak. The Bethel FWP position, which was vacant during the previous reporting period, was filled and a supervisory position was transferred to Bethel. Consequently, our cooperation with FWP increased during this reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We conducted a moose population census in the Lower Kuskokwim survey area in March 2000 (Figure 2). We surveyed 36 of 36 high-density strata and 24 of 105 low-density strata from March 8 through March 12. The midpoint of the population estimated was 84 ±29.7% at the 95% confidence interval.

The Lower Kuskokwim survey area was previously censused in 1993. Observers found 216 ±44.6% moose (95% confidence interval). The available census methods are not robust at extremely low densities. It is more appropriate to interpret these data as revealing persistent, extremely low moose numbers rather than a declining trend.

The Lower Kuskokwim survey area is 907 mi^2 in size with a density of 0.09 moose/mi^2. The moose habitat in this area is comparable to that in the Paimiut count area where the moose density in 1998 was 1.27 moose/mi^2. Clearly, the moose habitat in the Lower Kuskokwim survey area is underutilized.

Censuses were planned for the three count areas along the Yukon River in March 2001. However, only the stratification portion of these surveys was completed because survey conditions deteriorated as warm weather spoiled the snow cover.

During January 2000 and March 2001, we conducted moose trend counts to assess and compare moose densities within the Kuskokwim River drainage to those along the Yukon River within the Paimiut Area. We flew 4 passenger aircraft and flew at 80 mph, 700 feet above ground level and counted moose in the best moose habitat near the rivers. The observers included a pilot, a biologist, and 1 or 2 observers from Kuskokwim River villages per flight. An additional goal of these trend counts was to educate the village observers by giving them a perspective of the potential for larger moose populations within the Kuskokwim River drainage.

Within the Kuskokwim River drainage, we found an average of 9.9 moose/hour in January 2000 and 5.6 moose/hour in March 2001. Within the Yukon drainage, we found an average of 229 moose/hour in January 2000 and 266 moose/hour in March 2001.

In June 2001, we conducted a composition survey within the Lowest Yukon Area that lasted 4.6 hours and revealed 11.9 moose per hour. The most recent census in this area occurred in 1994 when 65 moose were seen during 38.7 hours, or 1.7 moose per hour. While these surveys are not directly comparable, the great difference in the number of moose observed per hour suggests that the moose population in the Lowest Yukon Area has grown considerably since the last census.

Population Composition

We counted 70 moose, 11 of which were calves (19 calves:100 adults) during the 1998 Lower Kuskokwim Area census. No sex composition information is available because the survey was conducted during the winter.

We conducted composition counts during calving within the Paimiut Area on May 30, 2001. We saw 146 moose during 3.6 hours of flying, including 26 bulls, 45 cows, 12 unknown adults, 37 yearlings, and 22 calves including 2 sets of twins.

We conducted composition counts during calving within the Lowest Yukon Area on June 7, 2001. We saw 55 moose during 4.6 hours of flying, including 12 bulls, 5 cows >2 years, 11 2-year-old cows, 19 yearlings, and 8 calves from 4 sets of twins.

Distribution and Movements

Moose are distributed throughout the Yukon River riparian corridor. The highest concentrations occur during the winter. Within this riparian corridor, the densities are greatest toward the east and decline toward the west. Moose are usually found at low density near the villages. Some moose are also found along the tributaries and distributaries of the Yukon and in the highlands north of the Yukon River.

Moose can be found throughout the year along the riparian corridor of the Kuskokwim River within the unit from Lower Kalskag to Bethel. They exist at extremely low densities given the available habitat. Moose are seen in the downriver third of this corridor only sporadically.

The area drained by the tributaries of the Kuskokwim River and those rivers draining into Kuskokwim Bay support small numbers of moose as colonizing animals from adjacent areas arrive. However, these moose have not survived to establish localized populations.

We have some radiotelemetry data, which show that moose are entering Unit 18 from adjacent Unit 17. Two cow moose radiocollared in the Togiak drainage by Togiak National Wildlife Refuge staff were found dead in Unit 18 in winter 1999. One was found in the upper Kwethluk drainage and the other, along with her calf, was found in the upper Goodnews drainage. Both radiocollared cows were killed illegally. Two other moose radiocollared in Unit 17A, including a cow with twins, were found in Unit 18 during this reporting period (Aderman and Woolington, 2001).

During the summer, moose are found in low numbers throughout the Unit. Moose have been reported along the Manokinak River, near Chevak, and even swimming in the ocean beyond the mouth of the Yukon River. While these reports are unusual, they make the point that moose move about broadly throughout the Yukon-Kuskokwim Delta.

MORTALITY

Harvest

<u>Season and Bag Limit</u>. Historic seasons and bag limits can be found in the 2000 Moose Management Report. Seasons and bag limits for this reporting period can be found in Table 1. Federal seasons in Unit 18 were the same as State of Alaska seasons with two exceptions. The federal season within the Kuskokwim River drainage was from 25 Aug–25 Sep. Also, there is no federal season in Unit 18 south of and including the Kanektok River drainages.

The winter season was open from 27 Dec–5 Jan during 1999–2000 and from 1 Feb–10 Feb during 2000–2001. The bag limit throughout Unit 18 is one bull.

1999–2000 Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, that portion north and west of a line from Cape Romanzof to Kusilvak Mountain, and then to Mountain Village, and west of (but not including) the Andreafsky drainage		
1 bull	5 Sep – 25 Sep	5 Sep – 25 Sep
Remainder of Unit 18		
1 bull per regulatory year; during the period 1 Dec–28 Feb, a 10-day season may be announced by emergency order	1 Sep–30 Sep 27 Dec–5 Jan	1 Sep – 30 Sep

2000–2001 Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, that portion north and west of a line from Cape Romanzof to Kusilvak Mountain, and then to Mountain Village, and excluding all Yukon River drainages upriver from Mountain Village		
1 bull	1 Sep – 25 Sep	1 Sep – 25 Sep
Remainder of Unit 18		
1 bull per regulatory year; during the period 1 Dec–28 Feb, a 10-day season may be announced by emergency order	1 Sep–30 Sep 1 Feb–10 Feb	1 Sep – 30 Sep

Board of Game Actions and Emergency Orders. A 10-day winter season during the period from 1 Dec–28 Feb may be announced by emergency order when weather and travel conditions are safe. The season dates are selected after polling the affected villages. This season was opened from 27 Dec–5 Jan in 1996–1997, 1997–1998, 1998–1999, and 1999–2000. Most villages prefer to have this season just after Christmas to allow time for travel conditions to improve and to avoid interference with the holiday. They also prefer to hunt prior to Slavic since feasting is an important part of the Russian Orthodox celebration. This explains the rather static nature of these emergency order openings.

During 2000–2001 the winter season was opened along the Yukon River upriver from Mt. Village from 1 Feb–10 Feb. It was not opened earlier due to unsafe travel conditions.

This season was not opened within, and south and east of the Kuskokwim River drainage. This was the first year the winter season remained closed in this portion of Unit 18 and follows a request to leave it closed for at least 5 years. The decision to leave this area closed was made after considerable discussion with the Lower Kuskokwim Advisory Committee, the US Fish and Wildlife Service, and other interested parties. This is part of an overall strategy to improve moose numbers within the Unit 18 portion of the Kuskokwim River drainage.

The Board of Game clarified the description of the moose hunt area below Mountain Village during their fall 1999 meeting. The new definition of this hunt area is that portion of Unit 18 north and west of a line from Cape Romanzof to Kusilvak Mountain, to Mountain Village, and excluding all Yukon River drainages upriver from Mountain Village.

The Board of Game also clarified the area description of the Kalskag Controlled Use Area during the fall 1999 meeting. The board's action clearly identified Tucker's Slough as part of this area.

The fall season in the hunt area downriver from Mountain Village was opened on 1 September rather than 5 September to provide additional opportunity to harvest moose in response to poor salmon returns. The board increased this season with the understanding that future population growth could be jeopardized. However, an economic disaster had been declared and the board felt the risk to future population growth was outweighed by the need for moose meat.

Human-Induced Harvest. Hunting (both legal and illegal) remains the most significant source of moose mortality in Unit 18. During the 1999–2000 open season, 436 hunters reported a harvest of 143 moose**.** For the 2000–2001 season, 421 hunters reported a harvest of 175 moose. Nearly all of this reported harvest comes from the fall seasons (Table 2). Harvest reporting for moose taken during the winter season has typically been very poor.

Local demand for moose in Unit 18 is high. The annual combined reported and unreported harvest is estimated at 10–15% of the population on the Yukon River. Harvest probably exceeds annual recruitment on the Kuskokwim River and moose only survive there due to continual immigration from adjacent areas. Estimated unreported harvest probably equals or exceeds the reported harvest in the Kuskokwim drainage. We estimate the unitwide unreported harvest is approximately 100–200 moose annually.

It is clear that the reported harvest of moose in Unit 18 does not reflect the actual harvest, but only shows the harvest by people who operate within the regulatory system. The percentage of local residents hunting during established seasons with valid hunting licenses and harvest tickets is increasing, particularly during the fall. On the Yukon River, we believe that harvest reporting has improved largely because of the presence of the Paimiut hunter check station, the acceptance of harvest tickets/reports, and the willingness of most hunters to harvest only bulls. Although reporting has improved along the Yukon River, in Unit 18 there are hunters who do not report. Because of the unreported harvest, moose harvest data from Unit 18 must be regarded as incomplete and should be viewed as minimum estimates.

During the 1999–2000 season, approximately 80% (112 moose) of the reported harvest occurred in the Yukon River drainage with the remainder in the Kuskokwim River drainage. During the 2000–2001 season, 82% of the harvest (144 moose) was reported taken in the Yukon River drainage with the remainder in the Kuskokwim River drainage or elsewhere within the Unit (Table 3).

A 5-year moratorium on moose hunting in the hunt area downriver from Mountain Village ended when a season was reopened in 1994–1995. Since then, 129 bull moose have been reported harvested. This includes 16 bulls harvested in 1999–2000 and 34 bulls harvested in 2000–2001. This is particularly interesting since as recently as 1988, no moose were observed during an intensive survey of this area.

During September 1999 and 2000, we operated the Paimiut moose hunter check station for the fourteenth and fifteenth consecutive years, respectively, at the junction of Twelve-Mile Slough and Paimiut Slough on the Yukon River. The check station is located near the border of Units 18 and 21E. In the summer of 1998 the Fish and Wildlife Service and the department built a cabin on the check station site. This cabin has greatly improved the comfort and safety of workers at Paimiut. It also provided an opportunity to honor the previous area biologist who died in 1996 while doing moose composition counts on the Yukon River. This cabin was dedicated to the memory of Randy Kaycon.

We estimate between 30–100 moose were harvested each year from an area extending from the upper Innoko River and Iditarod River in Unit 21E to Russian Mission in Unit 18. Many of these moose were brought through or processed near the Paimiut check station. The moose examined at the check station each season were primarily young bulls in good condition and were harvested in Unit 21E.

In 1999, we examined 37 moose at the Paimiut hunter check station. We collected incisors from 31 of these moose. The average age of the harvest as determined by sectioning these teeth was 2.5 years. Average antler width of 35 of these moose was 36.5 inches. In 2000, we examined 27 moose and collected 22 incisors. The average age of the harvest was 3.5 years and the average antler width was 35.9 inches. Tooth sectioning data indicated that the moose examined at the Paimiut check station typically are young animals (Table 4). These data suggest that hunters are not selective but rather harvest the first legal animal available to them.

Determining the exact number of hunters using the area is difficult since some boats make multiple trips, some pass during the evening, and some hunters chose to stop only on their way out of the hunt area. We estimate that 75–100 boats carrying 175–225 hunters passed the check station with the large majority electing to stop at least once during their hunt.

We operated a floating check station within the Unit 18 portion of the Kuskokwim River drainage during the 2000–2001 hunting season and contacted 49 people. We provide information regarding the importance and benefits of not killing cow moose and distributed coffee mugs emblazoned with the moose reproduction circle logo. We did not encounter any successful Unit 18 moose hunters within the Kuskokwim drainage.

There is a growing use of Alaska State Statute 5 AAC 92.019 in Unit 18. This statute allows moose to be taken outside established seasons for customary and traditional Alaska Native funerary or mortuary religious ceremonies. Typically, Unit 18 hunters contact the department prior to hunting under this statute and we provide them with a letter outlining the statute, informing them which animals are legal, and describing how to accomplish harvest reporting. We also provide the hunters with a copy of the statute. We then contact Fish and Wildlife Protection and inform them of the arrangement.

This statute requires the department to publicize a list of big game populations and areas, if any, for which the taking of a big game animal would be inconsistent with sustained yield principles. A big game animal from a population on this list would not be available for harvest under this statute. The list for Unit 18 includes all cow moose and all moose within and south and east of the Kuskokwim River drainage.

During 1999–2000, 4 hunters contacted the department regarding mortuary moose and 1 bull was reported harvested. During 2000–2001, 4 hunters contacted the department and no moose were reported harvested. The statute does not require hunters to notify the department if they are unsuccessful. However, all but one of the unsuccessful hunters reported.

<u>Permit Hunts</u>. There were no permit hunts for moose in Unit 18 during the reporting period.

<u>Hunter Residency and Success</u>. As reported in past years, Alaska residents accounted for most of the hunting activity in Unit 18 with the vast majority being Unit 18 residents. Of 436 hunters who reported hunting in Unit 18 during the 1999–2000 season, 10 were nonresidents. Of 421 hunters who reported hunting in Unit 18 during the 2000–2001 season, 13 were nonresidents. The low moose densities and high cost generally make Unit 18 an unattractive destination for nonresident moose hunters.

Hunter success rates based on harvest reports were 33% for the 1999–2000 season and 32% for the 2000–2001 season. Successful hunters spent an average of 6.4 days hunting moose in Unit 18 in 1999–2000 and 7.1 days in 2000–2001. Unsuccessful hunters spent an average of 8.4 days hunting moose in Unit 18 in 1999–2000 and 8.1 days in 2000–2001.

Many Unit 18 residents are aware that hunting opportunities are better in adjacent Units 19 and 21E. Hunters from Unit 18 regularly use boats during the fall season to access hunting areas upriver in adjoining units. On the Kuskokwim River, many of the residents hunting moose between Kalskag and McGrath (in Unit 19) are from Unit 18. Similarly, on the Yukon River, a large number of hunters use boats to travel from Unit 18 into Unit 21E. All of the hunters at the

Paimiut hunter check station who reported hunting in Unit 21E were residents of Unit 18. As a consequence, harvest allocation has been controversial among residents of Unit 18 and residents of Units 19 and 21E.

Harvest Chronology. The majority of reported moose harvest occurs during September when the general season is open. Only small numbers of moose have been harvested in the winter season (Table 2).

Transport Methods. During the reporting period, boats were by far the most frequently used mode of transportation by moose hunters in Unit 18. Other minor reported modes of transportation were snowmachines and aircraft. There has been virtually no change in the method of access reported by moose hunters in Unit 18 since moose harvest reporting began.

Other Mortality

Black and grizzly bears occur along the major river corridors and large tributaries in Unit 18. During calving surveys in spring 2001 within the Paimiut Area, we saw several black bears among calving moose and local residents have complained of heavy predation on calves by black bears. However, little direct information is available regarding this type of predation in Unit 18. Certainly, some predation occurs, but the effect bears have on moose numbers, particularly through predation on calves, is unknown.

Reports indicate that wolf numbers have increased considerably during this and the previous 2 reporting periods. This is expected since caribou have become more available, trapping pressure has declined, and moose numbers have increased. We estimate 100–150 wolves in 15–20 packs reside in Unit 18. Throughout most of Unit 18 the distribution of wolves reflects the distribution of moose, especially in the Yukon River drainage. In the lower Kuskokwim River drainage, caribou are the main prey item for wolves and the distribution of wolves is not as closely linked to moose.

HABITAT

Assessment

We estimate a minimum of 8,000 mi^2 of moose habitat exists in Unit 18. Approximately 4,500 mi^2 of this habitat occurs along the riparian zone of the Yukon River and the remaining 3,500 mi^2 is found along the Kuskokwim River and its tributaries. The islands and adjacent sloughs along the Yukon River corridor from Paimiut to Mountain Village represent the most productive moose habitat in Unit 18. No overbrowsing is evident in this area. The willows downriver from Mountain Village in the Yukon Delta are overgrown and senescent, except for willow bars and those islands in the Yukon flooded each spring. The Yukon Delta has many distributaries fringed by willows and cottonwoods but has fewer moose than could be supported by the available forage.

The riparian corridor along the Kuskokwim River in Unit 18 downstream of Kalskag is excellent moose habitat. Between Lower Kalskag and Akiachak, the forest and brush along the Kuskokwim provides some escape cover for moose. Downstream of Akiachak toward the mouth of the Kuskokwim, the riparian corridor narrows and escape cover is lacking. Along the

Kanektok, Goodnews, and Arolik Rivers, moose are rarely found in the riparian corridor because cover and browse are very sparse.

Tributaries of the Kuskokwim bordered by spruce and cottonwood, interspersed with willow and alder, extend onto the tundra along the Gweek and Johnson Rivers to the west, and along the Tuluksak, Fog, Kisaralik, Kasigluk, Akulikutak, Eek, and Kwethluk Rivers, and smaller unnamed rivers to the east. In each of these drainages, the habitat could support more moose. Lack of escape cover from illegal hunters is the limiting factor affecting moose numbers in these low-density areas.

Enhancement

There were no habitat enhancement activities in Unit 18 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

The most important management need is to improve moose numbers within the Kuskokwim River drainage. We have initiated discussions with the Lower Kuskokwim Advisory Committee, the US Fish and Wildlife Service, village and tribal leaders, and other interested parties to develop a strategy to increase moose numbers that is acceptable to local residents and managers alike.

An issue that had greater importance during previous reporting periods is the allocation of hunting effort and harvest by local residents of Units 18, 19 and 21E. This is a "downriver resident" versus "upriver resident" issue along the Yukon and Kuskokwim Rivers. This issue has not been resolved but has lessened along the Yukon River as more moose have become available within Unit 18 and as understanding of upriver land ownership has grown. We hope to address this issue along the Kuskokwim through the Kuskokwim River moose strategy described above.

CONCLUSIONS AND RECOMMENDATIONS

Within living memory, moose have colonized the Yukon-Kuskokwim Delta in moderate densities along the Yukon River from Paimiut to the mouths of the Yukon, but remain at low to very low densities throughout the remainder of the unit. Although much of Unit 18 is lowland tundra unsuitable as moose winter habitat, moose could be present in higher numbers because areas of riparian habitat remain unoccupied. Although calf production and yearling recruitment are high, hunting pressure from the relatively dense human population in the unit has slowed moose population growth.

The illegal harvest, particularly of cows, remains the most serious moose management problem in Unit 18. Although compliance is improving, a poorly developed cash economy, declining commercial fishing opportunities, and high density of people and villages along the major rivers complicate moose management considerably. Over 20,000 rural residents live in 42 communities throughout Unit 18 and we need continued effort to curb illegal harvest of moose.

Differing state and federal seasons and bag limits for moose had previously hampered our ability to effectively manage moose and enforce hunting regulations. Recently however, there has been very good cooperation among federal and state wildlife managers to work toward common solutions for moose management. In general, throughout Unit 18, state and federal seasons now coincide.

Recent actions by user groups to shoulder some responsibility for the growth of local moose populations are welcome signs of increasing participation with existing management systems. Continued efforts to work with local user groups are vital for effective management. However, individuals continue to submit or support proposals liberalizing moose seasons and harvest opportunities in Unit 18, regardless of the biological status of the moose population.

The growth of the Mulchatna caribou herd and recent movements of the Western Arctic caribou herd into Unit 18 may eventually reduce hunting pressure on the local moose population. However, we anticipate the demand for moose will continue to exceed the supply.

We recommend that monitoring and taking inventory of the moose population remain a priority in Unit 18, especially the continuation of the population censuses along the Yukon and Kuskokwim rivers. We should continue to conduct composition counts and trend counts. The census results, in conjunction with composition surveys, will provide the department with baseline demographic information and recruitment rates to properly manage the moose population.

The poor harvest reporting rates in Unit 18 are being addressed through an incentive that uses harvest reports as entry forms for a prize drawing. This raffle was initiated during the 1998–1999 hunting season and it has been well received by area hunters. Table 5 shows a trend of increasing use of harvest tickets/reports that began prior to the initiation of this program and has continued. The credit this program deserves for this continued increase is unknown, however, there are educational components associated with this program that provide additional value. We recommend that this program be continued.

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Wildlife Biologist III

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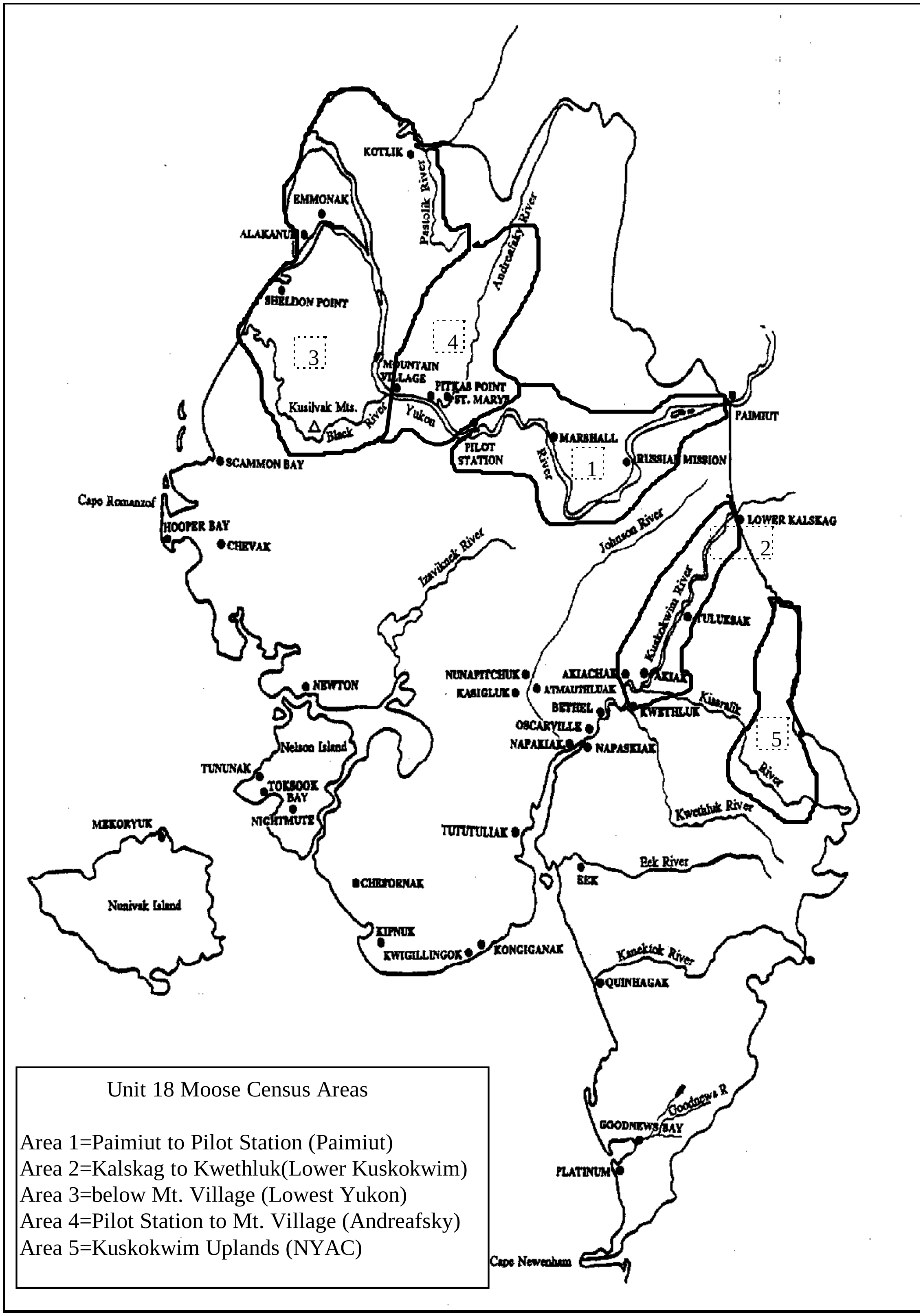

Figure 1 Unit 18, showing major drainages, communities, and Gasaway census areas

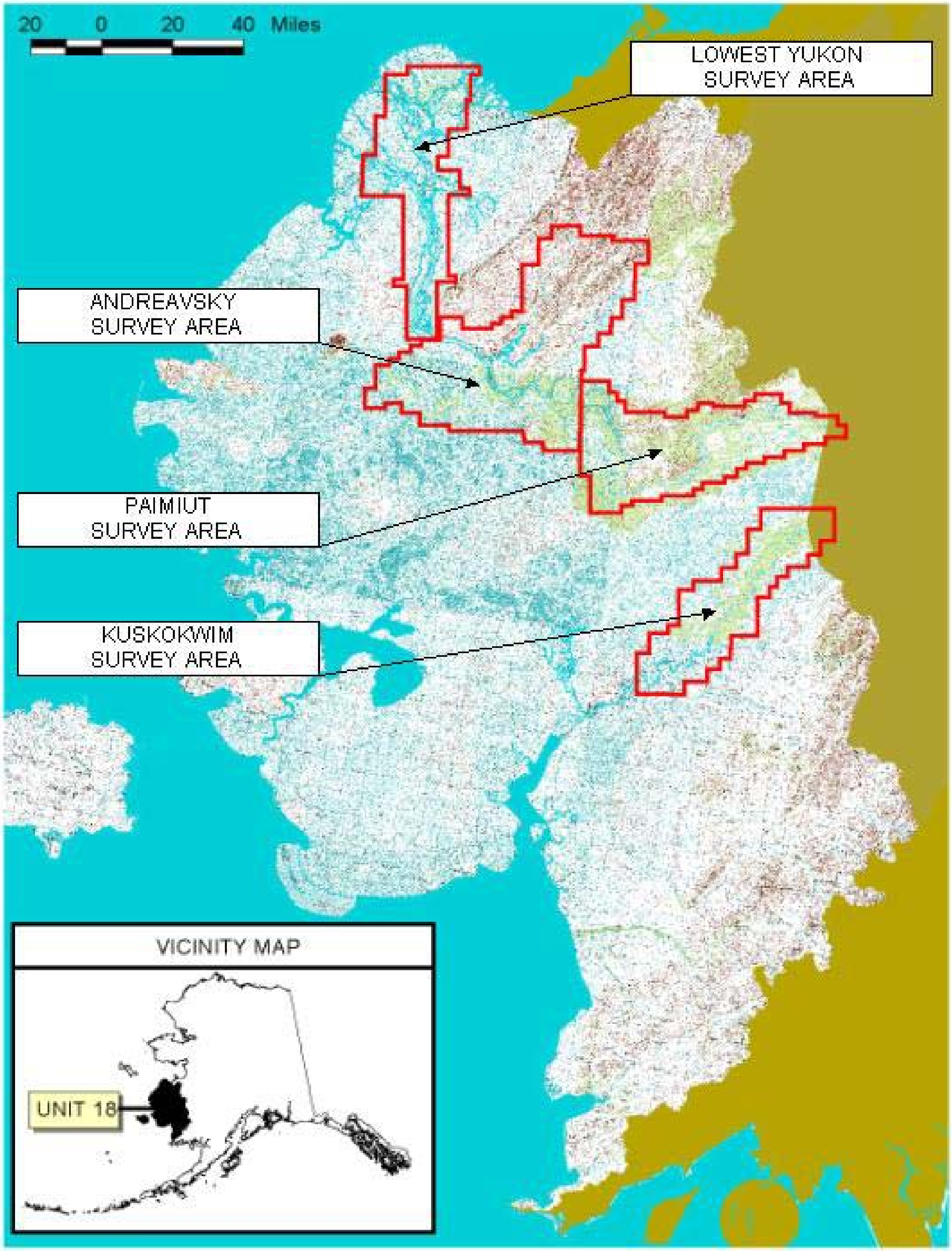

Figure 2 Unit 18 showing geostatistical population census areas (Ver Hoef style survey areas)

Table 1 Summary of moose hunting regulations and harvest in Unit 18, 1999–2001

Regulatory year	Season dates	Bag limit and area affected
1999–2000	5 Sep–25 Sep	1 bull; Yukon River Delta[a]
	1 Sep–30 Sep	1 bull; remainder of Unit 18
	27 Dec–5 Jan[b]	1 bull; excluding Yukon River Delta[a]
2000–2001	1 Sep–25 Sep[c]	1 bull; Yukon River Delta[d]
	1 Sep–30 Sep	1 bull; remainder of Unit 18
	1 Feb–10 Feb[a]	1 bull; excluding Yukon River Delta[d] and the Kuskokwim River drainage[e]

[a]That area north & west of a line from Cape Romanzof to Mountain Village, & west of & excluding the Andreafsky River drainage.

[b] A 10-day winter season is announced by emergency order between 1 Dec–28 Feb.

[c]This season was changed by emergency regulation to address an economic emergency caused by poor salmon returns.

[d]That portion of Unit 18 north & west of a line from Cape Romanzof to Kusilvak Mountain, to Mountain Village, and excluding all Yukon River drainages upriver from Mountain Village.

[e] The Kuskokwim River drainage includes the Kuskokwim River drainage proper and that poriton of Unit 18 south and east of the Kuskokwim River drainage.

Table 2 Fall and winter moose harvests for Unit 18, 1978–1999

Regulatory	Fall harvest		Winter harvest		Unknown harvest		Total
Year	(N)	(%)	(N)	(%)	(N)	(%)	Harvest (N)
1978–1979	42	88	6	12	0	0	48
1979–1980	11	92	1	8	0	0	12
1980–1981	45	94	3	6	0	0	48
1981–1982	72	90	8	10	0	0	80
1982–1983	54	93	4	7	0	0	58
1983–1984	61	97	2	3	0	0	63
1984–1985	63	87	7	10	2	3	72
1985–1986	43	83	8	15	1	2	52
1986–1987	54	90	6	10	0	0	60
1987–1988	40	83	8	17	0	0	48
1988–1989	67	98	0	2	0	0	68
1989–1990	31	94	1	3	1	3	33
1990–1991	55	90	6	10	0	0	61
1991–1992	63	94	4	6	0	0	67
1992–1993	64	83	13	17	0	0	77
1993–1994	93	97	3	3	0	0	96
1994–1995	76	87	11	13	0	0	87
1995–1996	71	96	3	4	0	0	74
1996–1997	97	100	0	0	0	0	97
1997–1998	95	100	0	0	0	0	95
1998–1999	124	99	1	1	0	0	125
1999–2000	136	95	7	5	0	0	143
2000–2001	166	95	5	3	4	2	175

Table 3 Moose harvest in the Yukon River, Kuskokwim River and Johnson River drainages, Unit 18, 1981–2001

	Moose harvest (%)		
Regulatory year	Yukon River	Kuskokwim River	Johnson River
1981–1982	57	32	11
1982–1983	58	36	6
1983–1984	63	33	4
1984–1985	62	32	6
1985–1986	67	17	16
1986–1987	66	34	0
1987–1988	52	42	6
1988–1989	81	19	0
1989–1990	55	39	6
1990–1991	80	15	5
1991–1992	75	24	1
1992–1993	64	33	3
1993–1994	77	24	2
1994–1995	86	14	0
1995–1996	85	15	0
1996–1997	72	28	0
1997–1998	75	24	1
1998–1999	78	12	6
1999–2000	80	18	2
2000–2001	82	14	3
Average	71	25	4

Table 4 Summary of moose ages from teeth collected at the Paimiut moose hunter check station 1986–2000

	Year harvested															
	00	99	98	97	96	95	94	93	92	91	90	89	88	87	86	
DOB																TOTAL
00	0															0
99	4	0														4
98	4	8	0													12
97	6	12	13	0												31
96	4	7	7	21												39
95	0	2	8	9		1										20
94	2	1	1	7		14	0									25
93	1	0	4	2		11	14	0								32
92	0	0	1	0		8	13	21	1							44
91	0	0	0	2		1	9	6	12	1						31
90	0	0	0	1		7	4	15	16	17	0					60
89	0	1	2			0	3	5	8	12	17	1				49
88	1					5	3	3	3	14	13	7	0			48
87						1	3	3	4	5	10	21	22	1		70
86							4	2	2	2	4	6	12	12	0	44
85							0	1	0	0	4	3	4	5	0	17
84							1	0	1	2	1	2	2	3	6	18
83							0	0	0	0	0	0	0	0	8	8
82							1	1	1	1	4	3	1	1	2	15
81							0			0	1	0	1	5	3	10
80							1			2	1	1	0	1	2	8
79										1	1		0	0	0	2
78													0	2	1	3
77													0	0	1	1
76													1	0		1
75														1		1
Total	22	31	36	42		48	56	57	48	57	56	44	43	31	23	597

Table 5 Number of hunters and reported harvest since the 1993–1994 regulatory year. A harvest reporting incentive program was initiated in 1998–1999.

Regulatory year	Number of hunters	Reported Harvest
1993–1994	249	96
1994–1995	247	87
1995–1996	301	74
1996–1997	350	97
1997–1998	363	95
1998–1999	383	125
1999–2000	436	143
2000–2001	421	175

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 19 (36,486 mi^2); 21A and 21E (23,270 mi^2)

GEOGRAPHIC DESCRIPTION: All of the drainages into the Kuskokwim River upstream from Lower Kalskag; Yukon River drainage from Paimiut upstream to, but not including, the Blackburn Creek drainage; the entire Innoko River drainage; and the Nowitna River drainage upstream from the confluence of the Little Mud and Nowitna Rivers.

BACKGROUND

Moose are a relatively recent faunal addition to western Interior Alaska. According to oral history, their initial discovery was apparently sometime after the turn of the twentieth century. As recent as the 1970s, populations were probably at record highs. Currently, moose are found throughout this area, with the exception of the rugged peaks of the Alaska Range. The major factors influencing moose abundance in the area include predation, weather, and hunting. Hunting pressure is thought to be moderate except in a few easily accessible areas. Failure to report harvests, particularly by local residents, is a chronic problem.

Unit 19, as well as Units 21A and 21E, can be conveniently divided into 2 regions that have distinct differences in moose habitat, user access, and hunting practices. Units 19A, 19D, and 21E are generally lower elevation areas accessible by boat. Hunters generally have been local residents living and hunting for food in Unit 19, Unit 21, or adjacent Unit 18. Units 19B, 19C, and 21A are generally higher elevation areas where access is largely restricted to aircraft. Few people live in these areas, and those traveling there to hunt have been mainly seeking large bulls for their trophy quality, although acquisition of meat has been an important consideration as well.

Aerial composition surveys have been the primary means of assessing population status and trend in this large area. There is a history of surveys dating back several decades. Unfortunately, these data are of limited value because of inconsistencies in survey areas and methods. The data is also subject to annual variations in weather conditions affecting moose movements and the timing and quality of surveys.

Historical moose survey information is limited. A combination of changes in moose survey techniques and the logistical challenges of moose surveys in remote areas has resulted in a discontinuous and often incomparable moose count database. Since the general standardization of survey techniques in the 1980s, we have attempted to establish trend count areas and survey areas to balance the information needs of management with fiscal limitations.

MANAGEMENT DIRECTION

Subunit boundaries within the area were designed to provide for 2 major uses of moose. The lowland areas along the Kuskokwim River (Units 19A and 19D) and along the Yukon and lower Innoko Rivers (Unit 21E) have been managed in an attempt to provide a sustained, relatively high harvest of moose. The higher elevation portions (Units 19B, 19C, and 21A) have been managed largely for trophy quality animals. Because topography directly affects access, management of the area should continue to be based on these premises.

MANAGEMENT OBJECTIVES

- Annually assess population status, trend, and bull:cow ratios in portions of the area where harvest levels make significant impacts on moose populations.

- Maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C, and 21A.

- Assess accuracy of harvest reporting in selected portions of the area.

- Encourage landowners to reduce fire suppression efforts on wildfires that do not threaten human life, property, or valuable resources, so that fire can fulfill its natural role in maintaining young, highly productive, and diverse habitats.

METHODS

We conducted population composition and trend surveys in selected portions of the area using standard aerial survey techniques (Gasaway et al. 1986). These surveys were flown in 50–100 mi^2 sampling areas using fixed-wing aircraft. Sampling areas had fixed boundaries and were flown in the fall after sufficient snowfall has occurred, but prior to antler shedding by bulls. Surveys were usually flown at a search intensity of 3–5 minutes/mi^2, depending on the habitat type and the associated visibility.

We estimated population size in a portion of Unit 21E in February 2000 using the Geostatistical Population Estimator (GSPE) (Ver Hoef 2001). We also estimated populations in a portion of Unit 19D East in November 2000 and again in October 2001. The survey area included the portion of Unit 19D in the Kuskokwim River drainage upstream from the Selatna River, not including the Takotna River drainage upstream from its confluence with the Nixon Fork.

Calf twinning surveys were conducted during May and June in Unit 19D along the Kuskokwim River, in Unit 19A along the Holitna River, and in Unit 21E. They were conducted much like the fall surveys described above, except they were flown beginning in mid-May when moose calving starts and continued through early June when leaf out limits sightability. These surveys were completed in fixed geographical areas, however search effort was greatest in meadows and low shrub areas with high sightability.

Harvest was monitored by requiring hunters to acquire moose harvest tickets and to report residency, effort, location of hunt, transportation method, commercial services used, success, sex of kill, and antler width. In a portion of Unit 19D, a registration hunt was established for the fall 2001 season. The purpose was to get better hunter data and to collect teeth from harvested moose to assess the age structure of the harvest.

Population and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000).

MANAGEMENT PLANNING

During RY99 the Unit 19D East moose population situation gained political attention and the Governor appointed a group referred to as the Unit 19D East Adaptive Management Team to develop recommendations for the department to address the moose population declines. This team was made up of 2 members representing local users, 2 members representing conservation interests, and the Director of Wildlife Conservation and the McGrath area biologist representing the department. This team met several times from June 2000 to February 2001 and presented a report including recommendations for regulatory changes and information gaps to the Commissioner of Fish and Game. Since February 2001 the group met once to review results of the research project's first year.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

We conducted trend area counts in every subunit except Unit 19B during RY99–RY00. We completed spring population estimates in Unit 21E in February 2000, in Unit 19D in November 2000, and Unit 19D in October 2001.

Unit 19A. The Unit 19A moose population was stable to declining, based on trend data from the Holitna/Hoholitna trend count area and a density estimate in a portion of the Aniak River drainage. Trend area information indicates observable moose numbers increased from the late 1980s until RY94, when peak numbers of total moose and moose per hour were observed (Table 1a). Trend counts during RY96 and RY97 indicated a steady decrease in total numbers of moose observed. Trend surveys were not conducted during RY98, RY99 and RY00, because of poor survey conditions and manpower challenges. The November 2001 trend count indicated very low numbers including very low bull:cow ratio (6:100), low calf:cow ratios (8:100), and the lowest number of total moose ever recorded. Explanations for some of the decline could have been the shallow snow and relatively temperate late fall weather causing atypical distribution. The February 2001 density estimate was 0.70 moose/mi^2 (±21%, 90% CI) indicating a low to moderate late winter moose density for western Interior Alaska. These data indicated poor calf survival to fall, and poor overwinter adult survival. Based on local hunter and trapper information, predation by wolves and increasing incidents of grizzly bears in the area could be the primary factors.

Unit 19B. No trend count data or population estimates are available from Unit 19B. Moose trend count areas have been sporadically established, but were abandoned because early winter snowfall conditions varied greatly, influencing moose distribution and causing extreme variations in the data. However, the moose population in Unit 19B appeared to be stable to declining, based on harvest data and information from local hunters and guides.

Unit 19C. The moose population in Unit 19C was stable based on trend counts (Table 1b). Trend data through the fall of 1996 showed a population increase. Composition ratios were very similar during RY97 and RY99, however the total number of observed moose declined. No survey was completed during RY00, due to poor conditions. The RY01 fall survey indicated a continued slow decline in the bull:cow ratio and a stable calf:cow ratio. For the first time, the yearling bull:cow ratio showed a decrease, possibly indicating lower calf survival. The total number of moose observed during fall 2001 was similar to other years. However, the moose per hour information was similar to the fall 1999 trend area count. The decline in the bull:cow ratio was due to declining overall numbers and, based on hunter and trapper information, poor calf survival primarily due to predation by bears and wolves.

Unit 19D. The moose population in Unit 19D stabilized at low densities during this reporting period (RY99–RY00). The low densities are indicative of the low-density equilibrium described by Gasaway et al. (1992) for wolf–bear–moose systems in Alaska and the Yukon. The GSPE completed in November 2000 in Unit 19D East (5200 mi^2) indicated overall moose density was 0.16 moose/mi^2 (±33%, 95% CI). The October 2001 GSPE, completed in the same area as the 2001 survey, was 0.43 moose/mi^2 (±30%, 95% CI). The higher 2001 count was attributed to several possible factors including: higher survey intensity, better sightability conditions, and randomly drew more productive sample units.

Unit 19D also contains the well-established Candle–Wilson composition/trend count areas. In this portion of Unit 19D East, survey information indicated a decreasing bull:cow ratio from 18:100 during RY98 to 6:100 during RY01. Calf:cow ratios fluctuated from 22–52 calves:100 cows. Overall, observed numbers of moose have fluctuated between 56 and 95 total moose from RY96–RY01 (Table 1c).

Unit 21A. The moose population in Unit 21A was stable to declining. Trend data was not collected on a regular basis in the unit. However, anecdotal winter observations by trappers indicated a decline in the overwintering population. Also, staff from the Innoko National Wildlife Refuge estimated a density of 0.64 moose/mi^2 (±29.6%, 90% CI) in the refuge portion of Unit 21A and into Unit 21E. However the results of this estimate are not comparable to our density measures due to differences in technique.

Unit 21E. The moose population in Unit 21E is believed to have been stable during RY99–RY00. No surveys were conducted in the Holy Cross trend area during RY99–RY00 due to poor survey conditions (Table 1d). Our February 2000 GSPE in a 5070-mi^2 portion of Unit 21E indicated a density of 1.0 moose/mi^2 and provided a baseline for further population monitoring.

Population Composition

In Unit 19A, bull:cow ratios from 10 fall surveys between RY76 and RY97 in the Holitna River drainage showed some deterioration of the bull:cow ratio and the RY01 survey indicated further decline (Table 1a). Intense hunting pressure in that area, along with predation from bears and wolves probably caused some of the declining ratios. Fall calf:cow ratios fell precipitously in this area indicating low calf survival. This substantiated data was gathered during a February 2000 survey along the Hoholitna River. The survey indicated calf (9-mo-old) survival was <5% (7/152), which was very low. The total number of moose observed was also low during the survey indicating a declining population in that area. Unit 19B composition data is largely unknown. However, harvest data from the unit indicated a decline in the number of bulls and specifically in the number of large bulls. Anecdotal information collected from several guides indicated a reduction in the number of bulls available over the past few seasons.

Unit 19C is represented by the Farewell trend count area. In 11 surveys conducted in the Farewell area from RY87 to RY01, notable increases in the moose population were seen through RY96. Data indicated a general decline in the bull:cow ratio from RY97 through RY01. Yearling bull:cow ratios remained relatively steady from RY90–RY99, however during the RY01 survey, data indicated a decline in the yearling bull:cow ratio. Calf:cow ratios appear to be remaining stable (Table 1b).

In Unit 19D the moose population continued to maintain low densities. Bull:cow ratios in the Candle–Wilson count area were low and variable (6–18:100) from RY96 to RY01, but the overall trend was down. Yearling bull:cow ratios also declined from RY96 to RY01. Fluctuations could have been due to a combination of decreasing sample size and declining number of bulls (Table 1c). Calf:cow ratios likewise were highly variable (22–52:100).

Units 21A and 21E sex and age composition data were not gathered from the Holy Cross trend count area during RY99–RY00 due to poor survey conditions during the fall. A spring density survey estimated the percent calves at 16.1%, indicating good production and survival to February.

MORTALITY

Harvest

Seasons and Bag Limits.

In Unit 19A within the Lime Village Management Area, residents could take 2 moose of either sex by Tier II permit during 10 August–25 September or during 20 November–31 March. The Lime Village Management Area was closed to nonresidents.

Unit 19A outside of the Lime Village Management Area and upstream of the Kolmakof and Holokuk Rivers had a bag limit for residents of 1 bull during 1–20 September or 20–30 November, and either sex could be harvested during 1–10 February. Nonresidents could take 1 bull having antlers at least 50 inches or at least 4 brow tines on 1 or both sides during 1–20 September.

Unit 19A outside of the Lime Village Management Area and downstream of the Kolmakof and Holokuk drainages had resident open seasons of 1–20 September, 20–30 November, and 1–10 February for any bull. The February season in RY00 was closed by emergency order in all of Unit 19A. During RY01 the February season was closed by emergency order upstream of the Holokuk and Kolmakof. Nonresidents were allowed to harvest bulls with antlers 50 inches or greater or at least 4 brow tines on at least 1 side during 1–20 September.

Units 19B and 19C had resident seasons of 1–25 September for any bull. Nonresidents were allowed to harvest bulls with 50-inch plus antlers or antlers with 4 or more brow tines on at least 1 side during the same time period. In addition, a registration hunt for resident hunters was established by the Board of Game in Unit 19C for antlered bull moose during 15 January–15 February.

In Unit 19D during RY99 along the Kuskokwim River upstream from and including the Selatna River drainage, resident hunters could take 1 bull moose during 1–25 September or 1–31 December. Nonresidents were not allowed to participate in the hunt. An additional 20–31 August season was available within the area upstream of Big River, south and east of the North Fork Kuskokwim River. The December season was closed by emergency order. In the remainder of Unit 19D, residents were allowed 1 bull during 1–25 September or 1–31 December. Nonresidents had to comply with the 50-inch antler regulation and could hunt only during 1–25 September.

In Unit 19D during RY00 along the Kuskokwim River upstream from but not including the Selatna River and Black River drainage, resident hunters could take 1 bull moose during 1–20 September or 1–15 December. Nonresidents were not allowed to participate in the hunt. An additional 20–31 August season was available within the area upstream of Big River, south and east of the North Fork Kuskokwim River. The December season was closed by emergency order. In the remainder of Unit 19D, residents were allowed 1 bull during 1–20 September or 1–31 December. Nonresidents were not allowed to hunt.

In Unit 19D during RY01 along the Kuskokwim River upstream from but not including the Selatna River and Black River drainage, resident hunters could take 1 bull moose during 1–20 September or during 1–15 December by registration permit (RM650). Nonresidents were not allowed to participate in the hunt. An additional 20–31 August season was available within the area upstream of Big River, south and east of the North Fork Kuskokwim River, also by the same registration permit. The December season was closed by emergency order. In the remainder of Unit 19D, residents were allowed 1 bull during 1–20 September or 1–31 December. Along with resident hunters, nonresidents were allowed to hunt in a small area including the Cheeneetnuk and Gagaryah River drainages, excluding a corridor extending 2 miles north of the Swift River. This nonresident area was open 1–20 September for bulls with 50-inch antlers or at least 4 brow tines on 1 side.

Unit 21A resident hunters could harvest 1 bull during 5–25 September or in November. Nonresident hunters could harvest 1 bull during the 5–25 September season with a 50-inch minimum antler or antlers with 4 or more brow tines on 1 side.

Unit 21E resident hunters could hunt any bull 5–25 September, or any moose 1–10 February except moose could not be taken within one-half mile of either the Yukon or Innoko Rivers during February. Nonresidents had the same September season, but had to select a bull with at least 50-inch antlers or antlers with 4 or more brow tines on 1 side.

Alaska Board of Game Actions and Emergency Orders. Unit 19D season dates were changed during the spring 2000 Alaska Board of Game meeting for RY00. We proposed reducing the season to 15 days in September and eliminating the December season, except in the remainder of the unit downstream of the Selatna River. The goal was to slow the decline in bull:cow ratios. The board passed a 5-day season reduction during the fall season, throughout the unit, and shortened the December season upstream of the Selatna River to 1–15 December. Included with these changes was a complete elimination of the nonresident season that had existed below the Selatna River drainage.

During a special May 2001 Board of Game meeting in Fairbanks, the board made several changes to the moose season in Unit 19D East. First, they expanded the size of the area that restricted aircraft use for moose hunting to include all the Takotna River drainage and to include the Kuskokwim drainage south of the Big River to the Selatna River and Black River drainages. They created a moose registration hunt in Unit 19D East to allow the department to collect more precise information on hunter effort and harvest. The board passed a proposal to open a small area for nonresidents in the Cheeneetnuk and Gagaryah River drainages, excluding a corridor extending 2 miles north of the Swift River. The board had closed that area during the spring 2000 meeting.

During the spring 2002 Board of Game meeting in Fairbanks, several changes were made. In Unit 21A in the Nowitna River drainage, the nonresident season was shortened to 5–20 September to align with the lower Nowitna River nonresident season. In Unit 19A the board passed a proposal prohibiting hunting for moose and caribou by nonresidents within 2 miles of either side of all rivers in Unit 19A from Kalskag to the Holitna River. This was a compromise between the area guides and local subsistence hunters that had proposed closing the unit entirely to nonresident hunters.

The department supported shortening the fall season in Units 19A and 19B, but the board decided to maintain the current seasons. They passed a proposal to reduce the February season in that portion of Unit 19A upstream of the Holokuk and Kolmakof drainages from 1–10 February to 1–5 February and changed the bag limit from any moose to bulls only, but maintained the current season of 1–10 February in the portion of Unit 19A downstream from and including the Holokuk and Kolmakof drainages. The board extended the Holitna/Hoholitna River Management area to include the Aniak River drainage, requiring hunters who fly into Unit 19B and take big game to also be flown out of Unit 19B. These hunters can no longer float into Unit 19A. The board passed a proposal for the August portion of the Unit 19D moose season changing the border from the riverbank to the drainage, allowing hunters on the North Fork Kuskokwim River to hunt both banks. The board eliminated the December season in Unit 19D East and reduced it to 1–15 December in the remainder of the unit. The board passed a department-amended version of a public proposal to reduce the season in Unit 19C to 1–20 September. The original proposal was to restrict resident hunters to bulls with 50-inch antlers and increase the antler restrictions for nonresidents to 55 or 60 inches.

Hunter Harvest. Hunter harvest is reported in Tables 2a–2h. Reported annual moose harvest in Unit 19A declined during RY99–RY00. The average reported annual harvest during RY96–RY00 was 139 (Table 2b). The majority of moose reported taken during RY96–RY00 were bulls (93%), with light cow harvest in February. Because reporting rate by local hunters was low, actual harvest rates are a minimum of 33% greater.

Reported annual harvests in Units 19B and 19C were probably much closer to actual harvest than in Unit 19A. They averaged 149 and 139 moose, respectively, during RY96–RY00 (Tables 2c and 2d). This also indicated a slight decline from RY97–RY98. In Unit 19D compliance with reporting requirements was estimated to be poor. Reported kill averaged 94 (Table 2e) during RY96–RY00. This was a decline from the previous 5-year average of 102 moose.

In Unit 21A reported moose harvests were stable during RY96–RY00, with 116 animals taken on average (Table 2g). In Unit 21E reported harvests were stable during RY96–RY00. The reported harvest of 210 moose in RY97 was the highest on record, probably reflecting better compliance with reporting requirements and some increases in harvest (Table 2h).

Permit Hunts. Beginning with the RY90 season, a Tier II drawing permit hunt was established for moose hunting in the Lime Village Management Area in Unit 19A. During RY90, 10 permits were issued with a harvest quota of 25 either-sex moose. The bag limit was changed to 28 moose with a limit of 2 per permit for RY93. Reported harvests were light, for example the RY98 hunt included 7 moose killed, 1 unsuccessful hunter, and 7 permittees that did not attempt to hunt (Table 3). There was also a federal permit hunt in the same area, with a harvest quota of 40 moose.

In Unit 19C during RY97 a winter registration hunt was established. The season is 15 January–15 February and excludes the use of aircraft. Hunter participation has been low, however, interest by Nikolai residents has increased. The average reported harvest has been 2 moose, with from 1 to 6 hunters getting the permits.

In RY01 a registration hunt was put into place in Unit 19D East. This registration hunt was a result of the Unit 19D East planning team meetings. The goal was to more accurately assess hunter effort and success in Unit 19D East. Moose teeth collected from successful hunters in this hunt will be processed and aged to examine the age structure of the population. During the first season 289 permits were issued and 65 bulls were taken (Table 3).

Antler Size. The average antler size for bulls harvested in RY96–RY00 in Units 19B was 53 inches, in 19C, 51 inches, and 21A, 50 inches. These subunits had a high proportion of guided and unguided nonresident hunters who were required to take bulls with a minimum antler size. The average antler size for RY96–RY00 in the Units 19A was 43 inches, in 19D it was 46 inches and 21E, 43 inches. These subunits had a high proportion of local resident hunters who were not required to take bulls with a minimum antler size. Average antler size within individual subunits was relatively stable during RY96–RY00.

Hunter Residency and Success. Nonlocal residents accounted for the major portion of the reported harvests in Units 19A, 19C, and 21E, while the majority of hunters in Units 19B and 21A were nonresidents (Tables 4a–4h). In Unit 19D the majority of the hunters were local unit residents. This segregation by residence location was due to different means of access and access restrictions.

In Unit 19A hunter residency did not change dramatically during RY96–RY00. Hunters from throughout Unit 19 accounted for 28% of reporting hunters (RY96–RY00). Alaska residents from outside the unit accounted for 51% of reporting hunters. Nonresident hunters accounted for less than 12% (Table 4b). During RY96–RY00 Unit 19B hunters consisted of nonlocal Alaskan (35%) and nonresident (65%) hunters (Table 4c). Very few people live in the subunit. Hunters in Unit 19C were nonlocal Alaskans (57%) and nonresidents (43%). Unit 19D hunters were largely local residents (49%). Alaska residents from other areas made up an additional 36% of the reporting hunters. Nonresidents only accounted for about 15% of the hunters who reported during the previous 5-year period (Table 4e).

Unit 21A hunters consisted largely of nonlocals (21%) and nonresidents (79%) (Table 4g). Hunters reporting from Unit 21E were generally from 1 of 4 villages in the subunit (16%) or were nonlocal residents of Unit 18 (67%). The proportion of nonresidents was generally less than 10% but increased in RY96–RY00 to an average of 17% of all hunters in the subunit (Table 4h).

In Unit 19A the reported hunter success rate averaged 47% (37–54%) during RY96–RY00. In Unit 19B the reported hunter success averaged 38% (32–47%) during RY96–RY00. In Unit 19C the reported success rate averaged 54% (50–60%) during RY96–RY00. In Unit 19D the reported success averaged 51% (46–60%) from RY96–RY00. In Unit 21A the reported average success was 58% (47–65%) from RY96–RY00. In Unit 21E the average reported success was 78% (70–83%) during RY96–RY00.

Transport Methods. Transportation methods used by hunters are reported in Tables 5a–5h. As in previous years, the Units 19A, 19D, and 21E method of transport most commonly used was boat (RY00 data, 67%, 79%, and 79%, respectively) (Tables 5b, 5e and 5h). The use of aircraft for transportation was predominant during RY00 in Unit 19B with 90% and in 21A with 69% of all access (Tables 5c and 5g). In Unit 19C, transportation to the field for 98% of the hunters was usually by aircraft, however in RY98, hunters reported using aircraft 67% and ATVs and horses 31% (Table 5d). This happened because most hunters transported ATVs to the Farewell Station Airstrip and some guided hunters used horses. Differences in transportation methods in different areas were used to define the original unit boundaries to spatially separate user groups and hunting patterns. Therefore, local hunters were still largely separated from nonlocal hunters since the subunit boundaries were last adjusted in the early 1980s.

Other Mortality

Illegal harvests, defense of life or property kills, wounding loss, and funeral potlatch harvests probably account for an additional 150–200 moose deaths annually in Unit 19, and probably 100–150 additional kills in Units 21A and 21E. Of much greater importance to the dynamics of the moose population, however, is predation mortality. Based on trapper questionnaires, pilot reports and data collected during moose surveys, predation on calves, yearlings, and adults by wolves has been substantial in recent years, as has calf predation by black bears.

HABITAT

Assessment

It is unlikely the moose population is limited by the available habitat. In Alaska, optimal moose forage is generally associated with willow bands, and in seral growth stages following wildfires. In Unit 19D East, over 2300 linear miles of riparian habitat is maintained by shifting rivers in a wide band along the Kuskokwim River and its major tributaries. Additional riparian habitat exists along smaller creeks and around hundreds of boreal lakes and ponds. Limited suppression of naturally occurring wildfires has created a mosaic of vegetation successional stages. During most summers, hundreds of square miles of boreal forest burns in small isolated fires throughout the area, creating increased potential for rejuvenation of moose winter forage plants. In addition, climax stands of subalpine willow persist in bands around the treeline of the boreal forest in the hills along the north side of the Kuskokwim drainages.

A February 2000 browse survey in Unit 19D near McGrath indicated many of the riparian willows were beginning to outgrow the browsing pressure. The 1999–2000 snowfall in the same area was greater than normal, forcing more moose onto the riparian willow bars. Substantial browsing was documented in these areas.

Enhancement

We continued efforts to document browse utilization on heavily used winter ranges along the Kuskokwim River. We also continued habitat enhancement efforts. Close cooperation with Alaska Department of Natural Resources Division of Forestry (DNR Forestry) fire management personnel resulted in relatively high-acreage burns in recent years. In cooperation with DNR Forestry we finished a prescribed fire plan for portions of Unit 19C in the Farewell area. Spring flooding conditions along the Kuskokwim River produced a substantial ice-scouring event that will help rejuvenate willow stands that had begun to grow out of reach of moose. Wildfires consumed approximately 325,000 acres in Units 19D, 21A and 19A in summer 2002.

CONCLUSIONS AND RECOMMENDATIONS

Populations over the reporting area were generally stable to declining, with considerable variation both within and between years. Regulatory year 2001 data indicated potential declining populations in all subunits surveyed except Unit 19D, where the population appears to have stabilized at low densities. Unit 19D was the only area that indicated a stable population compared to the previous reporting period in observed numbers. However, the bull:cow ratios in the trend area continued to decline. Calf:cow ratios were stable.

We completed density estimates in Units 21E, 19A, and 2 (2000, 2001) in Unit 19D. This will help us further assess the status of the populations. The fall weather conditions, along with fiscal and manpower challenges, continued to plague the McGrath moose survey–inventory program. Annual data collection efforts (trend and composition counts) in as many units as possible are the best and most cost-effective way to assess yearly changes in population composition and to monitor population trends. During the next reporting period, with a new assistant area biologist position, we hope to gain ground on data collection.

We accomplished much of our objective to assess population status, trend and bull:cow ratios in portions of the unit where harvest levels make significant impacts on moose populations. However, efforts will be made during the next reporting period to improve data collection in the western portion of Units 19B, 19C and 21A to complete gathering baseline information. This is the first step in developing sound long-term management plans for moose in this area.

We met our objective to maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C and 21A during this reporting period. This objective was designed as an index to the population status of large bulls and overall hunter success.

We made some progress on our objective to assess the accuracy of harvest reporting in portions of the area. We reviewed subsistence harvest surveys and compared them to reported harvests. During the next reporting period efforts will be made to implement a system to better assess reporting rates in selected areas, primarily Units 19A, 21E. These units have historically poor reporting and have sparked increasing debate over the population levels, trends, and the impact of all sources of mortality, including hunting.

We accomplished our objective to encourage wildfires. We maintained communications with DNR Forestry and the local Native corporations to advocate a "let burn" policy when possible. We also worked to alter some fire management zones from the full suppression category to modified or limited suppression to increase options for land managers. We will continue to revise the Farewell prescribed burn plan that was attempted in 2000. The prescription will be changed and hopefully this burn will occur in the next reporting period.

The objective to maintain an annual average antler spread measurement of at least 48 inches in Units 19B, 19C, and 21A was easily measured, so we could determine that the objective was met. Other objectives were not easy to quantify, therefore, could not be readily evaluated. During the next reporting period more quantifiable objectives will be formulated.

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Table 1a Holitna/Hoholitna Count Area (Unit 19A) fall aerial moose composition counts, regulatory years 1987–1988 through 2001–2002

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Moose	Moose/ hour
1987–1988	22	4	72	50	36	84	140	85
1988–1989	31	16	56	103	30	240	343	95
1989–1990	24	13	55	160	30	361	528	163
1990–1991	26	10	52	139	29	336	475	162
1991–1992[a]								
1992–1993	31	15	63	172	32	360	542	169
1993–1994[a]								
1994–1995	14	2	42	209	27	568	778	251
1995–1996[a]								
1996–1997	22	10	50	146	29	355	502	152
1997–1998	14	11	34	85	23	286	371	169
1998–1999[a]								
1999–2000[a]								
2001–2002	6	3	8	13	7	183	196	59

[a] No survey.

Table 1b Farewell Burn Count Area (Unit 19C) fall aerial moose composition counts, regulatory years 1987–1988 through 2001–2002

Regulatory year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose	Moose/ hour
1987–1988	53	10	19	32	13	207	242	115
1988–1989	58	20	34	47	18	218	265	126
1989–1990	47	15	22	55	13	361	416	194
1990–1991	43	8	26	58	16	315	373	159
1991–1992	44	8	29	59	17	293	352	156
1992–1993	46	8	38	58	21	220	278	100
1993–1994[a]								
1994–1995	52	10	19	45	11	353	404	170
1995–1996[a]								
1996–1997	46	11	15	43	10	411	454	158
1997–1998	30	10	27	75	17	368	443	174
1998–1999[a]								
1999–2000[b]	33	11	27	42	17	206	248	86
2000–2001[a]								
2001–2002	25	3	25	76	17	377	454	81

[a] No survey.
[b] Fall 1999 – only 77.5% of the survey area flown.

Table 1c Candle/Wilson A, B, C, and D count areas (Unit 19D) fall aerial moose composition counts, regulatory years 1996–1997 through 2001–2002

Regulatory year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose
1996–1997	18	7	34	19	21	66	95
1997–1998	13	6	52	25	32	54	79
1998–1999	13	4	34	13	23	43	56
1999–2000[a]							
2000–2001	9	2	29	16	20	61	77
2001–2002	6	2	22	14	17	68	82

[a] No survey.

Table 1d Holy Cross (Unit 21E) fall aerial moose composition counts, regulatory years 1987–1988 through 2001–2002

Regulatory year	Bulls: Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose	Moose/ hour
1987–1988	19	9	43	150	26	420	570	83
1988–1989[a]								
1989–1990	31	12	45	148	25	432	584	161
1990–1991	29	7	51	211	28	536	758	253
1991–1992[a]								
1992–1993	26	5	22	67	14	412	483	163
1993–1994[a]								
1994–1995	29	9	63	216	32	444	674	234
1995–1996[a]								
1996–1997	30	11	34	158	21	604	762	186
1997–1998[a]								
1998–1999	26	11	35	77	22	276	353	103
1999–2000[a]								
2000–2001[a]								
2001–2002[a]								

[a] No survey.

Table 2a Unit 19 moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory year	Harvest by hunters							
	Reported						Estimated	
	M	(%)	F	(%)	Unk	Total	unreported[a]	Total
1986–1987	454	(98)	8	(2)	2	464	153	617
1987–1988	530	(97)	17	(3)	2	549	181	730
1988–1989	615	(98)	15	(2)	7	637	210	847
1989–1990	546	(99)	7	(1)	6	559	184	743
1990–1991	383	(95)	20	(5)	1	404	133	537
1991–1992	461	(97)	13	(3)	2	476	157	633
1992–1993	485	(95)	24	(5)	3	512	169	681
1993–1994	542	(99)	3	(1)	2	547	181	728
1994–1995	581	(99)	8	(1)	0	589	194	783
1995–1996	527	(99)	2	(1)	6	535	176	711
1996–1997	621	(99)	8	(1)	3	632	208	840
1997–1998	561	(99)	7	(1)	4	572	189	761
1998–1999	535	(97)	14	(3)	3	552	182	734
1999–2000	442	(97)	13	(3)	11	466	153	619
2000–2001	478	(100)	0	(0)	2	480	158	638

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2b Unit 19A moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters							Total
	Reported						Estimated	
	M	(%)	F	(%)	Unk	Total	unreported[a]	
1994–1995	160	(95)	8	(5)	0	168	55	223
1995–1996	137	(99)	2	(1)	2	141	47	188
1996–1997	174	(96)	8	(4)	2	184	61	245
1997–1998	136	(96)	6	(4)	0	142	47	189
1998–1999	130	(90)	14	(10)	2	146	48	194
1999–2000	103	(90)	11	(10)	4	118	39	157
2000–2001	108	(100)	0	(0)	0	108	36	144

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2c Unit 19B moose harvest, regulatory years 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters							Total
	Reported						Estimated	
	M	(%)	F	(%)	Unk	Total	unreported[a]	
1994–1995	163	(100)	0	(0)	0	163	54	217
1995–1996	136	(100)	0	(0)	0	136	45	181
1996–1997	166	(100)	0	(0)	0	166	55	221
1997–1998	158	(100)	0	(0)	1	159	52	211
1998–1999	152	(100)	0	(0)	1	153	50	203
1999–2000	108	(100)	0	(0)	4	112	37	149
2000–2001	152	(100)	0	(0)	1	153	50	203

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2d Unit 19C moose harvest, regulatory years 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters								
	Reported						Estimated		
	M	(%)	F	(%)	Unk	Total	unreported[a]	Total
1994–1995	152	(100)	0	(0)	0	152	50	202
1995–1996	127	(100)	0	(0)	0	127	42	169
1996–1997	153	(100)	0	(0)	0	153	50	203
1997–1998	140	(100)	0	(0)	0	140	46	186
1998–1999	149	(100)	0	(0)	0	149	49	198
1999–2000	130	(99)	1	(1)	0	131	43	174
2000–2001	121	(100)	0	(0)	1	122	40	162

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2e Unit 19D moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters							
	Reported						Estimated	
	M	(%)	F	(%)	Unk	Total	unreported[a]	Total
1994–1995	106	(100)	0	(0)	0	106	35	141
1995–1996	109	(100)	0	(0)	3	112	37	149
1996–1997	102	(100)	0	(0)	1	103	34	137
1997–1998	103	(99)	1	(1)	1	105	35	140
1998–1999	86	(100)	0	(0)	0	86	28	114
1999–2000	93	(100)	0	(0)	2	95	31	126
2000–2001	83	(100)	0	(0)	0	83	27	110

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2f Units 21A and 21E moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory	Harvest by hunters							
	Reported						Estimated	
year	M	(%)	F	(%)	Unk	Total	unreported[a]	Total
1986–1987	227	(95)	11	(5)	0	238	79	317
1987–1988	251	(98)	6	(2)	0	257	85	342
1988–1989	306	(98)	6	(2)	5	317	105	422
1989–1990	277	(99)	1	(1)	0	278	92	370
1990–1991	304	(99)	3	(1)	3	310	102	412
1991–1992	284	(99)	4	(1)	0	288	95	383
1992–1993	223	(99)	2	(1)	0	225	74	299
1993–1994	241	(99)	2	(1)	0	243	80	323
1994–1995	276	(97)	10	(3)	0	286	94	380
1995–1996	273	(98)	6	(2)	0	279	92	371
1996–1997	306	(95)	15	(5)	0	321	106	427
1997–1998	316	(98)	6	(2)	1	323	106	429
1998–1999	298	(97)	8	(3)	0	306	101	407
1999–2000	288	(98)	6	(2)	4	298	98	396
2000–2001	297	(99)	4	(1)	0	301	99	400

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2g Unit 21A moose harvest, 1994–1995 through 2000–2001

Regulatory	Harvest by hunters							
	Reported						Estimated	
year	M	(%)	F	(%)	Unk	Total	unreported[a]	Total
1994–1995	124	(99)	1	(1)	0	125	41	166
1995–1996	116	(100)	0	(0)	0	116	38	154
1996–1997	130	(100)	0	(0)	0	130	43	173
1997–1998	113	(100)	0	(0)	0	113	37	150
1998–1999	111	(100)	0	(0)	0	111	37	148
1999–2000	123	(100)	0	(0)	1	124	41	165
2000–2001	102	(100)	0	(0)	0	102	34	136

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 2h Unit 21E moose harvest, 1994–1995 through 2000–2001

Regulatory year	Harvest by hunters: Reported M	(%)	F	(%)	Unk	Total	Estimated unreported[a]	Total
1994–1995	152	(94)	9	(6)	0	161	53	214
1995–1996	157	(96)	6	(4)	0	163	54	217
1996–1997	176	(92)	15	(8)	0	191	63	254
1997–1998	203	(97)	6	(3)	1	210	69	279
1998–1999	187	(96)	8	(4)	0	195	64	259
1999–2000	165	(96)	6	(4)	3	174	57	231
2000–2001	195	(98)	4	(2)	0	199	66	265

[a] Unreported harvest estimated at 33% of total reported harvest.

Table 3 Permit hunt results from Lime Village Tier II (TM684) and Unit 19C (RM655) and Unit 19D (RM650), regulatory years 1992–1993 through 2000–2001

Hunt #	Regulatory year	Successful hunters	Unsuccessful hunters	Did not hunt	Total hunters
TM684	1992–1993	9	4	3	16
	1993–1994	12	2	6	20
	1994–1995	7	1	6	14
	1995–1996	5	3	7	15
	1996–1997	4	1	9	14
	1997–1998	5	2	7	14
	1998–1999	7	5	16	28
	1999–2000	2	9	17	28
RM655	1997–1998	1	0	0	1
	1998–1999	2	1	0	3
	1999–2000	0	3	1	4
	2000–2001	4	2	6	12
RM650	2000–2001	65	224	0	289

Table 4a Unit 19 moose hunter residency and success, 1986–1987 through 1999–2000

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1986–1987	89	191	119	47	446 (54)	101	183	77	15	376 (46)	822
1987–1988	121	245	162	21	549 (54)	95	280	94	6	475 (46)	1024
1988–1989	110	285	188	54	637 (54)	132	271	105	28	536 (46)	1173
1989–1990	114	134	185	36	469 (45)	95	305	162	5	567 (55)	1036
1990–1991	81	189	111	23	404 (37)	94	329	232	20	675 (63)	1079
1991–1992	87	259	123	7	476 (47)	122	266	141	5	534 (53)	1010
1992–1993	100	256	113	41	510 (48)	123	257	149	18	547 (52)	1057
1993–1994	89	271	153	30	543 (53)	57	247	166	6	476 (47)	1019
1994–1995	121	276	181	18	596 (45)	124	368	224	16	732 (55)	1328
1995–1996	91	263	170	11	535 (44)	159	325	194	8	686 (56)	1221
1996–1997	113	295	212	12	632 (52)	123	258	202	2	585 (48)	1217
1997–1998	113	223	227	9	572 (48)	99	251	253	9	612 (52)	1184
1998–1999	93	221	210	28	552 (45)	69	312	289	11	681 (55)	1233
1999–2000	94	206	149	17	466 (41)	103	292	264	9	668 (59)	1134

Table 4b Unit 19A moose hunter residency and success, 1994–1995 through 2000–2001

	Successful					Unsuccessful					
Regulatory year	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
1994–1995	56	82	23	7	168 (46)	61	107	26	2	196 (54)	364
1995–1996	28	83	23	7	141 (46)	58	89	15	1	163 (54)	304
1996–1997	42	119	20	3	184 (54)	51	86	18	0	155 (46)	339
1997–1998	44	77	19	2	142 (51)	33	67	35	3	138 (49)	280
1998–1999	56	65	19	6	146 (50)	24	89	32	1	146 (50)	292
1999–2000	45	46	21	6	118 (43)	54	76	25	4	159 (57)	277
2000–2001	18	53	32	5	108 (37)	52	70	59	3	184 (63)	292

Table 4c Unit 19B moose hunter residency and success, 1994–1995 through 2000–2001

	Successful					Unsuccessful					
Regulatory year	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
1994–1995	0	71	88	4	163 (40)	0	128	108	9	245 (60)	408
1995–1996	0	66	69	1	136 (41)	0	82	107	5	194 (59)	330
1996–1997	0	54	107	5	166 (47)	0	79	103	2	184 (53)	350
1997–1998	0	41	114	4	159 (40)	0	83	147	5	235 (60)	394
1998–1999	0	48	100	5	153 (37)	0	80	175	6	261 (63)	414
1999–2000	0	44	59	9	112 (32)	0	78	159	5	242 (68)	354
2000–2001	0	60	88	5	153 (37)	0	105	160	1	266 (63)	419

Table 4d Unit 19C moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1994–1995	0	98	53	1	152 (52)	0	85	53	1	139 (48)	291
1995–1996	0	78	49	0	127 (49)	0	88	42	0	130 (51)	257
1996–1997	0	89	62	2	153 (60)	0	61	41	0	102 (40)	255
1997–1998	1	68	69	2	140 (58)	0	64	37	0	101 (42)	241
1998–1999	1	75	72	1	149 (52)	0	82	53	1	136 (48)	285
1999–2000	0	79	50	2	131 (50)	0	81	48	0	129 (50)	260
2000–2001	0	68	54	0	122 (50)	0	69	50	2	121 (50)	243

Table 4e Unit 19D moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1994–1995	57	38	6	5	106 (45)	56	49	21	5	131 (55)	237
1995–1996	53	38	19	2	112 (43)	84	44	16	2	146 (57)	258
1996–1997	56	33	14	0	103 (49)	67	22	18	0	107 (51)	210
1997–1998	54	34	17	0	105 (54)	55	23	12	1	91 (46)	196
1998–1999	28	28	15	15	86 (49)	34	45	10	3	92 (51)	178
1999–2000	45	35	15	0	95 (46)	37	52	24	0	113 (54)	208
2000–2001	48	31	3	1	83 (60)	26	26	3	0	55 (40)	138

Table 4f Units 21A and 21E moose hunter residency and success, regulatory years 1986–1987 through 2000–2001

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1986–1987	43	135	45	15	238 (75)	10	63	7	0	80 (25)	318
1987–1988	21	164	43	29	257 (68)	9	83	20	9	121 (32)	378
1988–1989	13	177	69	58	317 (75)	2	62	28	16	108 (25)	425
1989–1990	19	178	53	28	278 (73)	9	66	18	9	102 (27)	380
1990–1991	40	203	52	15	310 (72)	13	80	25	3	121 (28)	431
1991–1992	41	200	42	4	287 (64)	22	104	34	0	160 (36)	447
1992–1993	20	152	35	19	226 (63)	8	91	26	5	130 (37)	356
1993–1994	39	141	45	14	239 (67)	9	71	36	1	117 (33)	356
1994–1995	35	184	47	17	283 (67)	8	87	43	2	140 (33)	423
1995–1996	40	191	46	2	279 (70)	10	74	31	2	117 (30)	396
1996–1997	42	206	71	2	321 (73)	8	78	31	0	117 (27)	438
1997–1998	33	212	67	11	323 (74)	7	61	41	4	113 (26)	436
1998–1999	39	194	59	14	306 (70)	3	63	62	2	130 (30)	436
1999–2000	44	152	87	15	298 (62)	16	85	82	3	186 (38)	484
2000–2001	45	162	86	8	301 (63)	10	85	78	3	176 (37)	477

Table 4g Unit 21A moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

	Successful					Unsuccessful					
Regulatory year	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
1994–1995	0	83	39	3	125 (52)	0	76	37	1	114 (48)	239
1995–1996	3	76	36	1	116 (64)	1	37	26	1	65 (36)	181
1996–1997	1	78	51	0	130 (65)	0	45	25	0	70 (35)	200
1997–1998	1	57	50	5	113 (63)	0	36	29	1	66 (37)	179
1998–1999	0	64	39	8	111 (58)	0	30	48	2	80 (42)	191
1999–2000	0	55	67	2	124 (53)	1	47	63	0	111 (47)	235
2000–2001	0	50	51	1	102 (47)	0	52	63	0	115 (53)	217

Table 4h Unit 21E moose hunter residency and success, regulatory years 1994–1995 through 2000–2001

	Successful					Unsuccessful					
Regulatory year	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident	Nonlocal resident	Nonresident	Unk	Total (%)	Total hunters
1994–1995	40	106	8	7	161 (86)	8	17	1	0	26 (14)	187
1995–1996	34	118	10	1	163 (76)	6	40	5	1	52 (24)	215
1996–1997	31	138	20	2	191 (80)	4	37	6	0	47 (20	238
1997–1998	28	159	17	6	210 (83)	2	30	12	3	47 (17)	257
1998–1999	37	132	20	6	195 (80)	3	33	14	0	50 (20)	245
1999–2000	38	103	20	13	174 (70)	13	40	19	3	75 (30)	249
2000–2001	38	119	35	7	199 (77)	6	37	15	3	61 (23)	260

Table 5a Unit 19 moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1986–1987	44	<1	44	2	3	<1	1	5	0	446
1987–1988	38	<1	44	3	7	2	<1	5	0	549
1988–1989	45	<1	43	2	5	1	<1	4	0	637
1989–1990	47	<1	41	2	2	<1	<1	5	0	469
1990–1991	53	1	35	2	4	<1	<1	4	0	404
1991–1992	49	<1	41	3	4	<1	<1	1	0	476
1992–1993	41	1	45	2	9	0	<1	2	0	510
1993–1994	57	1	33	3	2	<1	<1	3	0	543
1994–1995	47	<1	38	5	6	<1	<1	3	0	589
1995–1996	50	2	38	6	<1	<1	<1	3	0	535
1996–1997	50	2	39	5	2	<1	<1	<1	0	632
1997–1998	53	2	34	5	5	<1	<1	<1	0	572
1998–1999	50	2	35	7	5	<1	<1	<1	<1	552
1999–2000	51	1	34	8	4	<1	0	1	<1	466
2000–2001	54	1	37	6	1	0	0	<1	<1	480

Table 5b Unit 19A moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									Total
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	
1994–1995	14	0	65	<1	17	0	<1	3	0	168
1995–1996	17	0	74	<1	2	<1	0	6	0	141
1996–1997	13	0	80	<1	5	<1	0	0	0	184
1997–1998	17	0	64	2	16	0	0	<1	0	142
1998–1999	13	<1	67	1	15	0	1	1	1	146
1999–2000	21	0	59	1	14	0	0	5	<1	118
2000–2001	27	0	70	1	1	0	0	1	<1	108

Table 5c Unit 19B moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									Total
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	
1994–1995	79	0	18	0	<1	0	0	2	0	163
1995–1996	85	1	11	2	0	0	1	0	0	136
1996–1997	90	0	8	1	0	0	0	1	0	166
1997–1998	92	0	5	0	1	0	2	0	0	159
1998–1999	90	0	7	1	0	0	1	1	<1	153
1999–2000	88	0	8	3	0	0	0	1	0	112
2000–2001	87	0	12	0	0	0	0	1	0	153

Table 5d Unit 19C moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

	Harvest percent by transport method									
Regulatory year	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	74	3	5	15	0	2	0	1	0	152
1995–1996	75	4	3	15	0	<1	2	<1	0	127
1996–1997	76	7	0	16	0	<1	0	<1	0	153
1997–1998	73	8	2	15	<1	1	0	0	0	140
1998–1999	64	6	1	25	2	1	0	1	0	149
1999–2000	70	4	0	24	0	1	0	1	0	131
2000–2001	71	3	1	21	4	0	0	0	0	122

Table 5e Unit 19D moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

	Harvest percent by transport method									
Regulatory year	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	9	0	74	4	6	0	3	4	0	106
1995–1996	19	2	67	6	<1	0	2	4	0	112
1996–1997	17	0	71	3	4	1	4	0	0	103
1997–1998	19	0	74	2	1	0	2	2	0	105
1998–1999	20	0	79	0	1	0	0	0	0	86
1999–2000	20	0	78	2	0	0	0	0	0	95
2000–2001	5	0	92	2	0	0	0	1	0	83

Table 5f Units 21A and 21E moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									Total
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	
1994–1995	27	<1	61	1	6	2	0	2	0	286
1995–1996	32	<1	62	<1	3	0	<1	1	0	279
1996–1997	33	0	59	<1	6	<1	0	<1	0	321
1997–1998	29	0	66	<1	3	0	0	<1	0	323
1998–1999	34	0	61	<1	3	0	0	<1	0	306
1999–2000	34	<1	60	<1	4	<1	<1	2	0	298
2000–2001	30	0	65	<1	3	0	<1	2	0	301

Table 5g Unit 21A moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									Total
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	
1994–1995	57	<1	33	2	<1	5	0	2	0	125
1995–1996	66	0	29	2	0	0	<1	2	0	116
1996–1997	68	0	30	2	0	0	0	<1	0	130
1997–1998	70	0	28	<1	<1	0	0	<1	0	113
1998–1999	69	0	30	0	<1	0	0	0	0	112
1999–2000	70	1	24	1	0	1	1	2	0	124
2000–2001	69	0	27	1	0	0	1	2	0	102

Table 5h Unit 21E moose harvest percent by transport method, regulatory years 1994–1995 through 2000–2001 (successful hunters only)

Regulatory year	Harvest percent by transport method									
	Airplane	Dog Team /Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway Vehicle	Unk	Airboat	Total
1994–1995	4	0	83	<1	10	0	0	2	0	161
1995–1996	8	<1	86	0	4	0	0	1	0	163
1996–1997	10	0	79	<1	9	<1	0	<1	0	191
1997–1998	8	0	87	0	4	0	0	<1	0	210
1998–1999	14	0	79	<1	5	0	0	2	0	195
1999–2000	7	0	85	0	6	0	0	2	0	174
2000–2001	10	0	84	0	4	0	0	2	0	199

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 20A (6796 mi^2)

GEOGRAPHIC DESCRIPTION: Tanana Flats, Central Alaska Range

BACKGROUND

Moose are found throughout the foothills of the Alaska Range and the Tanana Flats at exceptionally high densities relative to similarly sized areas throughout North America. Unit 20A moose are a world class wildlife resource. Gasaway et al. (1983) presented a detailed history of the Unit 20A moose population through 1978, while Boertje et al. (1996) presented a history through 1995.

Preferred moose habitat is composed of riparian willow, poorly drained meadows, shallow lakes, early successional forest, and subalpine shrub communities. Approximately 5040 mi^2 of the unit comprises moose habitat.

Moose numbers increased in Unit 20A during the 1950s and reached high densities in the early 1960s, perhaps 4–5 moose/mi^2. Annual moose harvests averaged 311 moose between 1963 and 1969 (McNay 1993). During 1969–1974, harvest increased to an average of 617 moose per year. Cow moose comprised 34% of the annual harvest during 1963–1974.

Similar to numerous other ungulate populations in Alaska, the moose population declined beginning in the late 1960s and reached its lowest point in the mid-1970s. Beginning in 1975, seasons and harvests were dramatically reduced and taking of cows was prohibited. In late winter 1976 the division implemented a program to reduce wolf numbers. During 1975–1978, mean annual moose harvest was limited to 64 bulls.

During wolf reduction efforts in Unit 20A (1976–1982), the moose population increased rapidly and has increased or remained stable most years since 1982. During 1979–1982, harvests averaged 226 bulls per year (McNay 1993). During 1983–1993 the mean annual harvest increased to 358 bulls. A wolf control program to reduce predation on the declining Delta caribou herd began in October 1993, but was discontinued in December 1994. Division staff reduced wolf numbers by trapping and snaring and may have influenced moose population dynamics.

Regulations provide a variety of hunting opportunities in Unit 20A, but a large majority of the harvest occurs during the general September bulls-only season. The southwestern portion of the unit currently includes the Wood River Controlled Use Area (WRCUA; no motorized access except aircraft), the Ferry Trail Management Area (FTMA; harvest limited to bulls with spike-fork or 50-inch antlers), the Healy Lignite Management Area (HLMA; bowhunting only), the Yanert Controlled Use Area (YCUA; no motorized access except aircraft, with harvest limited to bulls with spike-fork or 50-inch antlers), and the Nenana Controlled Use Area (NCUA; restricts the use of airboats for hunting moose).

Approximately one-third of Unit 20A is military land, including 1003 mi^2 of Fort Wainwright Army property, 893 mi^2 of Fort Greely Army property, and 17 mi^2 of Clear Air Force Station property. A variety of access restrictions, both spatial and temporal, apply to portions of these military lands.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide the greatest sustained opportunity to participate in hunting moose.
- Provide an opportunity to view and photograph moose.

MANAGEMENT OBJECTIVES

- Manage for a November population of between 10,000 and 12,000 moose.
- Manage for a posthunting sex ratio of ≥30 bulls:100 cows overall and ≥20 bulls:100 cows in the Tanana Flats, Western Foothills, and Eastern Foothills areas.

METHODS

POPULATION STATUS AND TREND

1999 Population Estimation Survey

We surveyed 86 survey units (SU) (52 high moose density, 34 low moose density; 500 mi^2) of 987 SUs (5747 mi^2) during the period 6–17 November. We were unable to survey 2 planned SUs due to restricted air space over military lands or turbulence. Eight of the 86 SUs were additional units added in the FTMA to increase sampling effort in that area. In all, we surveyed 18 of 98 SUs in the FTMA. We used the Geostatistical Population Estimator method (GSPE; Ver Hoef 2001), a modification of the standard Gasaway et al. (1986) technique. We dry-lab stratified Unit 20A into low and high moose density strata based on an earlier 4 strata classification of the area. Medium-, high-, and super-high density strata from the 4 strata classifications were combined into a single "high-density" stratum. Where a SU contained both high- and low-density strata, the stratum found in greatest abundance was assigned to the unit (e.g., if a SU contained 51%

high-density and 49% low-density strata, the stratum assignment was "high-density"). Sixty percent of the SUs surveyed were high density, and 40% surveyed were low density. A simple random sample of SUs was selected from each stratum using Microsoft®Excel Windows®98 software. "Tanana Flats" and "Foothills" portions of Unit 20A, which were treated as separate geographic strata in 1996, 1997, and 1998 surveys, were combined in the 1999, 2000, and 2001 analyses.

The GSPE method does not employ a sightability correction factor (SCF), thus does not correct for moose not seen during the survey. Rather, the GSPE method employs greater search intensity, 8–10 min/mi^2 vs. 4–6 min/mi^2 (Gasaway et al. 1986), resulting in a higher level of sightability.

Search intensity averaged 4.5 min/mi^2, considerably less than the recommended 8–10 min/mi^2. However, search intensity was not corrected for areas of non-moose habitat (e.g., >4500 feet in elevation or large bodies of water) that were not searched. Therefore, actual search intensity was certainly greater, although probably still below recommended levels. Interior Alaska received over 12" of snow in late October and early November. Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were reported mostly as excellent (34%) and good (61%) with the remainder reported as fair (5%). Turbulence was not a factor during surveys, although surveys were suspended several days due to high or turbulent winds.

2000 Stratification Surveys

We stratified 468 SUs (approximately 2575 mi^2) of 987 SUs (5747 mi^2) on 17 October and 8–10 November. Unit 20A was subdivided into SUs with north–south boundaries every 2 degrees of latitude and east–west boundaries every 5 degrees of longitude. This resulted in nearly square SUs that were approximately 5.7 mi^2. They included all areas of suitable moose habitat ≤4500 feet elevation. Sample units entirely above 4500 feet elevation were excluded from the survey because land higher in elevation is not considered suitable moose habitat (Gasaway et al. 1986). However, if any portion of an SU was ≤4500 feet, the entire SU was included in the survey. Surveys were flown in a Cessna 206 traveling at approximately 90 nautical mi/h and, generally, 400–500 feet AGL. Surveys were conducted with 2 observers (aft port and starboard) and 1 recorder (fore starboard). Criteria used to define strata within SUs included number of moose observed, number of tracks observed, and overall habitat quality (low, medium, high with respect to relative amount of browse cover observed). Sample units were classified as low- or high-density stratum.

2000 Population Estimation Survey

We surveyed 114 SUs (69 high density, 45 low density; 627 mi^2) of 987 SUs (5747 mi^2) during the period 30 October–9 December using GSPE methods described above. Fourteen of the 114 SUs were additional units added in the FTMA, YCUA, and WRCUA to increase sampling effort in those areas. In all, we surveyed 13 of 82 SUs in the FTMA, 12 of 65 in the YCUA, and 26 of 160 in the WRCUA.

Search intensity averaged 6.7 min/mi^2, less than the recommended 8–10 min/mi^2. However, search intensity was not corrected for areas of non-moose habitat (e.g., >4500 feet in elevation or large bodies of water) that were not searched. Therefore, actual search intensity was certainly greater and probably reached recommended levels. The area received adequate snowfall for surveys by the third week of October and additional snow fell periodically throughout the remainder of the survey period. Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were reported mostly as good (44%) with the remainder reported as excellent (26%) or fair (29%). Turbulence was not a factor during surveys, although surveys were suspended several days due to high or turbulent winds.

2001 Stratification Surveys

We stratified 430 SUs (approximately 2365 mi^2) of 987 SUs (5747 mi^2) on 11–13 November using the methods described above.

2001 Population Estimation Surveys

We surveyed 78 (50 high-density and 28 low-density; 455 mi^2) of 987 SUs (5747 mi^2) during 31 October–18 November using the methods described above.

Search intensity averaged 6.9 min/mi^2, slightly less than the recommended 8–10 min/mi^2. However, search intensity was not corrected for areas of non-moose habitat (e.g., >4500 feet in elevation or large bodies of water) that were not searched. Therefore, actual search intensity was certainly greater and probably reached recommended levels. Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were reported primarily as good (70%) with the remainder reported as excellent (18%) or poor (12%). Snow conditions tended to deteriorate as the survey period progressed. Turbulence was not a factor, although surveys were suspended several days due to high or turbulent winds.

Twinning Surveys

Twinning rates in 2000 and 2001 were estimated from a radiocollared sample of moose in the central portion of Unit 20A. Approximately 30 fixed-wing radiotracking flights were flown each year between mid-May and mid-June to measure twinning rates. Twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows greater than 2 years old accompanied by calves.

HARVEST

We estimated annual harvest from harvest report cards. This included data from report cards from the general season and drawing hunts for antlerless moose in the central Tanana Flats and bulls in the eastern portion of the WRCUA. Reminder letters were sent to nonreporting general season hunters, and up to 2 letters were sent to permit holders who failed to report. Harvest parameters summarized included hunter residency, hunter success, harvest chronology, and transport methods. When antler size of bulls was reported, we considered bulls with antler spreads <30 inches to be yearlings. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001).

We estimated other mortality from Department of Public Safety records of collisions with motor vehicles and Alaska Railroad records of collisions with trains.

WEATHER

We evaluated weather (snowfall and temperature) using National Weather Service records and personal observations.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We estimated 11,205 (9636–12,774; 90% CI) moose in 1999, 10,557 (8657–12,457; 90% CI) in 2000, and 11,511 (9784–13,238; 90% CI) in 2001 (Table 1). Population estimates in 1996–2001, excluding the 1997 estimate, which had relatively poor precision (±27%, 90% CI), indicate that the Unit 20A moose population has likely stabilized at approximately 10,500–11,500 animals or about 2.1–2.3 moose/mi^2.

Population Composition

In 1999 we classified 965 moose and estimated 33 calves:100 cows and 23 bulls:100 cows (Table 1). In 2000 we classified 1337 moose and estimated 33 calves:100 cows and 23 bulls:100 cows. In 2001 we classified 887 moose and estimated 26 calves:100 cows and 26 bulls:100 cows. The relatively low calf:cow ratio in 2001 was likely the result of low parturition rates that year (R Boertje, ADF&G, unpublished data). Bull:cow ratios declined from 39 bulls:100 cows in 1996 to 23 bulls:100 cows in 1999 (Table 1). Bull:cow ratios were significantly (Z = 2.51, 1 df, P <0.05) lower in 1999 than 1998, and the decline resulted in bull:cow ratios falling below the Unit 20A management objective of 30 bulls:100 cows. Bull:cow ratios have remained below the management objective since 1999.

We met our objective of ≥20 bulls:cows in the Tanana Flats, Western Foothills, and Eastern Foothills portions of Unit 20A. In 2000 the estimated number of bulls:100 cows was 22, 23, and 28 in the Tanana Flats, Western Foothills, and Eastern Foothills, respectively. In 2001 bull:100 cow ratios were similar in the Tanana Flats (26:100) and Western Foothills (22:100), but higher in the Eastern Foothills (40:100).

In the southwestern portion of Unit 20A, where numerous trails provide motorized access, the bag limit has been 1 bull with spike-fork or 50-inch antlers (subsequently referred to as SF50) since RY88. This antler restriction was adopted in response to declining bull:cow ratios between RY84 (23–42 bulls:100 cows; Jennings 1986) and RY87 (13–27 bulls:100 cows; McNay 1989). Bull:cow ratios improved during the early 1990s, presumably because of the antler restriction. For example, bull:cow ratios exceeded the management objective for the Western Foothills of 20 bulls:100 cows in 1993 (31 bulls:100 cows in the Walker Dome trend area). However, since the mid 1990s, bull:cow ratios in the FTMA declined from an estimated 26:100 in 1994 to 9:100 in 2001. In addition, in the Western Tanana Flats, bull:cow ratios have been at or below 20 bulls:100 cows in both 2000 (20:100) and 2001 (17:100). Unitwide antler restrictions that will go into effect in RY02 may improve bull:cow ratios in these areas.

Twinning Rates

Twinning rates remain poor and have been extremely low 3 of the past 4 years (Table 2). This is consistent with other measures of poor productivity, such as low parturition rates, reproductive pauses, and delayed age of first reproduction, indicating that the Unit 20A moose population is nutritionally stressed (Boertje et al. 1999) because of high moose densities and, presumably, declining habitat quality.

Distribution and Movements

The moose population is distributed throughout Unit 20A, consisting of nonmigratory and migratory subpopulations (Gasaway et al. 1983). From February to April some bull and cow moose migrate from the surrounding foothills (Alaska Range and Chena and Salcha River drainages) to calving areas on the Tanana Flats in Unit 20A. They remain there for the summer and return to the foothills from August through October. Although we do not know what proportion of the moose migrate, Gasaway et al. (1983) estimated that the seasonal migrants probably increase the density of moose on the Tanana Flats 2- to 4-fold over the density of resident Unit 20A moose.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Unit 20A during RY99 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20A, the Ferry Trail Management Area and the Yanert Controlled Use Area.		
RESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on 1 side.	1 Sep–25 Sep (General hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 3 or more brow tines on 1 side.		1 Sep–25 Sep
Unit 20A within the Nenana Controlled Use Area		

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep (General hunt only)	
NONRESIDENT HUNTERS: 1 bull.		1 Sep–25 Sep
Remainder of Unit 20A. 1 moose per regulatory year only as follows:		
RESIDENT HUNTERS: 1 bull; or	1 Sep–25 Sep (General hunt only)	
1 antlerless moose by drawing permit only; up to 300 permits may be issued; or	1 Sep–25 Sep (General hunt only)	
1 bull by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.	1 Nov–30 Nov (General hunt only)	
NONRESIDENT HUNTERS: 1 bull; or		1 Sep–25 Sep
1 antlerless moose by drawing permit only; up to 300 permits may be issued; or		1 Sep–25 Sep
1 bull by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.		1 Nov–30 Nov

Seasons and bag limits in Unit 20A during RY00 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20A, the Ferry Trail Management Area and the Yanert Controlled Use Area.		
RESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on 1	1 Sep–20 Sep (General hunt only)	

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
side.		
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		1 Sep–20 Sep
Unit 20A within the Nenana Controlled Use Area.		
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep (General hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		1 Sep–20 Sep
Remainder of Unit 20A.		
1 moose per regulatory year only as follows:		
RESIDENT HUNTERS: 1 bull; or	1 Sep–20 Sep (General hunt only)	
1 antlerless moose by drawing permit only; up to 300 permits may be issued; or	1 Sep–25 Sep (General hunt only)	
1 bull by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.	1 Nov–30 Nov (General hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side; or		1 Sep–20 Sep
1 antlerless moose by drawing permit only; up to 300 permits may be issued; or		1 Sep–25 Sep
1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.		1 Nov–30 Nov

Alaska Board of Game Actions and Emergency Orders. In RY91 the bag limit for the FTMA and YCUA was 1 bull moose with spike-fork or 50-inch antlers or antlers with 3 or more brow tines on 1 side (SF50/3). During RY92–RY95 the bag limit for the FTMA and YCUA was 1 bull moose with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on 1 side (SF50/4). During RY96–RY99 the bag limit was changed back to 1 bull moose with SF50/3. Then in RY00 the Board of Game again increased the brow tine requirement to SF50/4 in these areas. At that time, the board also restricted the bag limit for nonresident hunters in all of Unit 20A to 1 bull moose with 50-inch antlers or antlers with 4 or more brow tines on 1 side. Those bag limits remained in effect through the RY01 hunting season.

The board reauthorized 3 antlerless moose hunts by drawing permit in RY99 and RY00. Two (DM760 and DM762) occurred on the northcentral Tanana Flats near Fairbanks where moose densities were high. DM760 ran from 1–13 September while DM762 ran from 14–25 September. The third antlerless hunt (DM764) occurred during 1–25 September in the eastern portion of the WRCUA.

The board made no changes during this reporting period to muzzleloader permit hunt DM766 created in RY96. This bulls-only hunt allows the department to issue up to 75 permits for hunters using muzzleloaders in a portion of the WRCUA during November. Seventy-five permits were issued in RY99, but no permits were issued during the RY00 or RY01 hunting seasons.

The board created the Nenana Controlled Use Area (NCUA) in portions of Units 20A and 20C in RY96, which prohibited the use of airboats for hunting or transporting moose hunters or their gear during 1–25 September. The NCUA was modified in RY98 to allow the use of airboats for hunting moose within the main channels of the Teklanika, Toklat, and Nenana Rivers, and at the public boat launch in Nenana.

The board modified the common boundary between the FTMA and WRCUA from the Totatlanika River to Tatlanika Creek in RY98. The boundary was changed back to the Totatlanika River in RY00. Although there was action at the spring 2002 Board of Game meeting to move the boundary back again to Tatlanika Creek, the proposal failed.

Intensive Management (IM) deliberations for Unit 20 were postponed during the spring 2000 meeting until November, at which time the board adopted IM population (10,000–12,000 moose) and harvest (500–720 moose) objectives for Unit 20A.

Alaska Board of Game Actions, March 2002 — The Alaska Board of Game took action to restrict resident bag limits for moose throughout Unit 20A beginning RY02. The resident bag limit for the FTMA, HLMA, WRCUA, and YCUA will be 1 bull moose with SF50/4. The resident bag limit in the remainder of Unit 20A will be 1 bull moose with SF50/3. The nonresident bag limit was unaffected and will remain 1 bull moose with 50-inch antlers or antlers with 4 or more brow tines on 1 side.

The board reauthorized up to 300 antlerless drawing permits (hunts DM760, DM762 and DM764) for 1–25 September in Unit 20A. The board also authorized an antlerless hunt by registration permit, 1–25 September, for the Unit 20A portion of the NCUA (i.e., the Western Tanana Flats). In addition, the board authorized up to 300 drawing permits for calf moose for the period 1–25 September. This hunt is experimental and will be revisited by the board in 2004. Finally, the board authorized that recipients of antlerless drawing registration permits and calf drawing permits be prohibited that year from hunting for antlered bull moose in Unit 20A.

Hunter Harvest. Reported harvest of bull moose in Unit 20A increased 66% between RY90–RY91 ($\bar{x}$ = 376 bulls) and RY96–1997 ($\bar{x}$ = 625 bulls), and then remained relatively stable through RY99 (Table 3). Liberalizing the general season from 20 to 25 days in RY95 likely contributed to the increased harvest. The harvest of bull moose declined to less than 550 in RY00 and RY01 after the season was reduced by 5 days (1–20 Sep) and antler restrictions were adopted unitwide for nonresident hunters.

Permit Hunts. Hunter participation and harvest was lower than expected for antlerless drawing permit hunts through RY01 (Table 4). This may partly be explained by many permittees choosing to take bull moose rather than filling their antlerless permit. To increase participation and harvest in future permit hunts, the board adopted a regulation prohibiting recipients of drawing and registration permits for antlerless and calf moose from taking an antlered bull moose in Unit 20A.

Hunter Success and Residency. Hunter success rates during the general hunting season tended to be higher in Unit 20A (Table 5) than surrounding subunits (i.e., 20B, 20C, 20F and 25C; Selinger 2000; Young 2000*a*,*b*). Success rates reached their highest level in 10 years in RY99 (42%). In RY00 and RY01, success rates were lower than those reported for the previous 5 regulatory years (RY95–RY99). This was likely a function of reduced season length; success rates were higher in years with a 25-day season (RY95–RY99) than years with a 20-day season (RY90–RY94 and RY00–RY01). Nonresidents had higher success rates than residents.

The number of hunters reporting hunting moose in Unit 20A increased during the early to mid-1990s, but has remained relatively constant since RY96. A 40% increase between RY94 (n = 1166) and RY96 (n = 1636) was likely due, at least in part, to the liberalization of the general moose season in RY95 from 20 to 25 days. However, a reduction in season length from 25 to 20 days beginning in RY00 did not result in a commensurate reduction in the number of moose hunters.

Harvest Chronology. Moose harvest in Unit 20A has traditionally been well distributed throughout the season (Table 6). In RY99 the most productive harvest periods were 11–15 and 16–20 September. However, during RY00–RY01, slightly more bull moose were reported taken early (1–5 Sep) and late (16–20 Sep) in the season than during the middle (6–15 Sep) of the season.

Transport Methods. During the last 10 regulatory years, approximately two-thirds of the successful moose hunters used airplanes or boats (including airboats; Table 7). Hunting by horseback was popular in the YCUA and the southern portion of the WRCUA. Three- and 4-wheeler use increased during the early-to-mid 1990s, but appears to have stabilized. The FTMA continued to be a popular place for hunters using 3- and 4-wheelers. In addition, hunters increasingly used boats to transport these vehicles to the Tanana Flats.

Airboat use remains controversial. Since RY97, airboats have been distinguished as a transportation category on harvest report cards. The percentage of successful moose hunters in Unit 20A that used airboats has been relatively stable during RY97–RY01 (Table 6).

Other Mortality

A study of moose mortality began in 1996, and a progress report is available (Boertje et al. 1999).

The number of moose killed in accidents with motor vehicles and trains has been substantial in some years, but was relatively low during RY99–RY00 (Table 3). This may be the result of average snowfall during winters 1999–2000 (70.0 in) and below average snowfall in 2000–2001 (56.6 in).

WEATHER

Unusual weather may have influenced moose population dynamics during RY90–RY01. Winter 1990–1991 had the highest snowfall on record in Fairbanks (147.3 in) and was closely followed by 1992–1993 (139.1 in). These record snowfalls are over twice the long-term average (68 in). In contrast, winters 1997–1998 (46.0 in), 1998–1999 (31.0 in), and 2001–2002 (25.5 inches through Jan 2002) received less than normal accumulations of snow.

Summer 1992 was probably the shortest on record. It was bracketed with snowfall in mid-May and in September (24 inches of snowfall, 3 times the previous record, and cold temperatures, 13 degrees colder than previous record). Conversely, 1993 was likely the longest summer on record, with an early spring leaf-out, warm summer temperatures, and a late fall.

HABITAT

There has been considerable discussion in recent years about the potential for Unit 20A to support many more moose. We remain concerned about the population exceeding the habitat capability and becoming vulnerable to severe weather patterns. Already, we have documented that this population has the lowest productivity of studied moose populations in North America (Boertje et al. 2000). Therefore, a higher moose density is not desirable until habitat improves. Two large wildfires (114,000 acre Survey Line Burn and 85,000 acre Fish Creek Burn) occurred on the Tanana Flats during summer 2001, but potential benefits to the moose population will likely not be realized for many years. Mortality research implemented in 1996 is evaluating many factors influencing the status of the moose population relative to habitat, predators, and sustainable harvest.

NONREGULATORY PROBLEMS/ISSUES

An electric intertie that will bisect important moose habitat in western Unit 20A is currently under construction between Healy and Fairbanks. Construction on the selected Rex–South route will probably affect moose in 2 ways. First, the intertie corridor may improve access, and changes in regulations to prevent local overharvest of bulls may be necessary. More importantly, increased fire suppression near the corridor may adversely affect habitat capability for moose over time. We forwarded these concerns to appropriate land use agencies, and the line has been routed so that minimal effects on fire suppression will occur.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates from 1996–2001 indicate the Unit 20A moose population has stabilized within the range of our population objective. However, estimates also suggest that the number of adult (≥1 year of age) cows in the population has been slowly increasing, while the number of bulls has been slowly declining. Low twinning rates, 0% yearling pregnancy rates, delayed age of first reproduction, and reproductive pauses are all indicative of a relatively unproductive moose population. Current research indicates that moose production in Unit 20A is reduced because of high moose densities and, presumably, declining habitat quality. Therefore, I recommend we continue to conduct antlerless moose hunts (i.e., DM760, DM762, and DM764) in the high moose density areas of the northcentral Tanana Flats and eastern WRCUA. Antlerless moose harvest should be evaluated as a tool to prevent an overabundance of moose that are vulnerable to the synergistic effects of adverse weather and increased predation. In addition, it is important to improve habitat quality and determine the status of the Unit 20A moose population relative to nutrient–climate limitations, and increasing predator numbers (Boertje et al. 1996).

Although we met our management objective of 20 bulls:100 cows in the Tanana Flats, Western Foothills and Eastern Foothills, we did not meet our management objective of 30 bulls:100 cows unitwide. Consequently, I recommend reducing the reported harvest of bull moose to ≤400 (≤300 adult bulls and the remainder yearlings) until bull:cow ratios recover. Low bull:cow ratios have been a chronic problem in the FTMA and YCUA, hence antler restrictions since the late 1980s. In RY01, ratios in the Western Tanana Flats dropped below 20 bulls:100 cows for the first time. Regulations adopted by the Board of Game in 2002, which were aimed at reducing the harvest of bull moose in Unit 20A (i.e., unitwide antler restrictions, antlerless and calf hunts, restrictions preventing hunters holding cow or calf permits from taking antlered bull moose in 20A), should result in improved bull:cow ratios in these areas, as well as, Unit 20A overall. I recommend we continue to closely monitor bull:cow ratios both at unitwide and lesser spatial scales (e.g., management area, controlled use area, and sub-areas) to monitor the effects of current regulatory changes on bull:cow ratios.

We met the Board of Game's IM population and harvest objectives of 10,000–12,000 moose and 500–720 moose, respectively, during this reporting period. However, with unitwide antler restrictions going into effect in RY02 and the bull harvest expected to drop to about 400 animals or less, I recommend a limited number of calves and additional cows be taken to maintain the harvest level within IM guidelines.

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Table 1 Unit 20A fall (Oct–Dec) aerial moose composition counts and estimated population size, 1990–2001

Calendar year	Bulls:100 Cows	Yearlings: 100 Cows	Calves:100 Cows	Percent calves	Adults	Moose observed	Moose/mi^2	Estimated population size (90% CI)
1990[a]	23, 24, 26	15	48	27	584	292, 180, 158	2.0	10,100
1991[b]	22, 32	15	34	21	1954	949, 1531	2.2	11,100
1992[a]	28, 31, 36	14	36	21	274	107, 105, 137	2.2	11,300
1993[b]	29, 30	19	38	23	1340	852, 883	2.4	11,900
1994[c]	35	23	46	25	1038	1391	2.6	13,300
1995[d]	--	--	--	28	--	575	--	--
1996	39	24	42	23	2578	3343	2.3[e]	11,500 (± 13%)
1997	33	28	34	21	816	1037	2.6[e]	12,935 (± 27%)
1998	31	18	31	18	1035	1268	2.2[e]	11,144 (± 19 %)
1999	23	13	33	21	760	965	2.2[f]	11,205 (± 14%)
2000	23	10	33	21	1089	1377	2.1[f]	10,557 (± 18 %)
2001	26	18	26	17	737	887	2.3[f]	11,511 (± 15%)

[a] Windy, Walker Dome, and Japan Hills trend areas, respectively.
[b] Central Tanana Flats and Western Foothills, respectively.
[c] Central Tanana Flats and Western Foothills combined.
[d] Lack of snow prevented early winter surveys.
[e] Corrected for sightability (SCF = 1.15).
[f] Geo-statistical Population Estimation method does not incorporate a SCF (see methods).

Table 2 Unit 20A Tanana Flats moose twinning rates, 1987–2001

Calendar year	Date	Cows w/Single calf	Cows w/Twins	Cows Total	% Twins[a]
1987		45	5	50	10
1988		52	8	60	13
1989	20–24 May[b]	43	8	51	16
1990	24 May	25	7	32	22
1991	20–21 May	19	5	24	21
1992[c]					
1993	28 May	28	0	28	0
1994	22 May	42	9	51	18
1995	22 May	43	3	46	7
1996	26 May	33	7	40	18
1997	21 May	26	3	29	10
1998	26–30 May	51	4	55	7
1999	25–26 May	62	2	64	3
2000[d]	14 May–9 June	26	3	29	10
2001[d]	14 May–6 June	27	1	28	4

[a] Percentage of cows with calves that had twins.
[b] Includes data from surveys when paired helicopter/fixed-wing observations were made (20–21 May) and when only fixed-wing observations were made (24 May).
[c] No calving surveys done.
[d] Based on data from radiocollared moose ≥5 years of age, which results in higher estimates than traditional twinning rate surveys in which 3- and 4-year-old moose that are less likely to produce twin calves are included.

Table 3 Estimate of Unit 20A moose harvest[a] and accidental death, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest by hunters: Reported M	F	Unk	Total	Estimated: Unreported[b]	Illegal/Other[c]	Total	Accidental death: Road[d]	Train[e]	Total	Total
1990–1991	370	0	0	370	65		65				435
1991–1992	382	0	0	382	68		68				450
1992–1993	246	0	0	246	44		44				290
1993–1994	386	0	0	386	68		68				454
1994–1995	399	0	0	399	71		71				470
1995–1996	526	0	0	526	93		93				619
1996–1997	617	61	0	678	120		120				798
1997–1998	629	68	2	699	124	11	135	2	17[e]	19	853
1998–1999	613	74	4	691	122	3	125	3	15[e]	18	834
1999–2000	663	1	16	680	120	5	125	3	11[e]	14	819
2000–2001	541	74	5	620	110	9	119	2	34[e]	36	775
2001–2002	537	72	6	615	109	4[f]	113	0[f]	2[g,h]	2	730[i]

[a] Includes general and permit hunt harvest.
[b] Based on 17.7% unreported harvest (including wounding loss) estimated by Gasaway et al. (1992).
[c] Includes illegal, DLP, dispatched, potlatch, stickdance, and other reported deaths.
[d] Documented kills; actual number killed by vehicles is certainly greater.
[e] Confirmed dead between Alaska Railroad (ARR) mileposts 327.0 and 411.7 (ARR mileposts 327.0 through 369.9 are located in Unit 20C near the Unit 20A border); "Missing" (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[f] Number of moose killed through December 2001.
[g] Confirmed dead between ARR mileposts 371.0 and 411.7; "Missing" (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[h] Number of moose killed through April 2002.
[i] Preliminary.

Table 4 Unit 20A moose harvest data by permit hunt, regulatory years 1996–1997 through 2001–2002

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk (%)	Harvest
760	1996–1997	75	19 (25)	31 (55)	25 (45)	0 (0)	25 (100)	0 (0)	25
	1997–1998	75	17 (23)	32 (55)	26 (45)	0 (0)	26 (100)	0 (0)	26
	1998–1999	75	13 (17)	32 (52)	30 (48)	0 (0)	30 (100)	0 (0)	30
	1999–2000	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	2000–2001	75	14 (19)	32 (52)	29 (48)	1 (3)	28 (97)	0 (0)	29
	2001–2002	75	22 (29)	25 (47)	28 (53)	0 (0)	28 (100)	0 (0)	28
762	1996–1997	75	24 (32)	24 (47)	27 (53)	1 (4)	26 (96)	0 (0)	27
	1997–1998	75	23 (31)	24 (46)	28 (54)	4 (14)	24 (86)	0 (0)	28
	1998–1999	75	22 (29)	23 (43)	30 (57)	3 (10)	27 (90)	0 (0)	30
	1999–2000	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	2000–2001	75	18 (24)	27 (47)	30 (53)	2 (7)	28 (93)	0 (0)	30
	2001–2002	75	22 (29)	26 (49)	27 (51)	3 (11)	24 (89)	0 (0)	27
764	1996–1997	150	107 (71)	34 (79)	9 (21)	2 (22)	7 (78)	0 (0)	9
	1997–1998	150	107 (71)	34 (79)	9 (21)	1 (11)	8 (89)	0 (0)	9
	1998–1999	150	87 (58)	54 (86)	9 (14)	0 (0)	9 (100)	0 (0)	9
	1999–2000	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	2000–2001	150	100 (67)	37 (74)	13 (26)	1 (8)	12 (92)	0 (0)	13
	2001–2002	150	97 (65)	33 (42)	20 (58)	2 (10)	18 (90)	0 (0)	20
766	1996–1997	75	43 (57)	22 (69)	10 (31)	10 (100)	0 (0)	0 (0)	10
	1997–1998	75	43 (57)	18 (56)	14 (44)	14 (100)	0 (0)	0 (0)	14
	1998–1999	75	39 (52)	25 (69)	11 (31)	11 (100)	0 (0)	0 (0)	11
	1999–2000	75	32 (43)	23 (54)	20 (46)	20 (100)	0 (0)	0 (0)	20
	2000–2001	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	2001–2002	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
Totals	1996–1997	375	193 (51)	111 (61)	71 (39)	13 (18)	58 (82)	0 (0)	71

Hunt	Regulatory year	Permits issued	Did not hunt (%)		Unsuccessful hunters (%)		Successful hunters (%)		Bulls (%)		Cows (%)		Unk (%)		Harvest
for all permit hunts	1997–1998	375	190	(51)	108	(58)	77	(42)	19	(25)	58	(75)	0	(0)	77
	1998–1999	375	161	(43)	134	(63)	80	(37)	14	(18)	66	(83)	0	(0)	80
	1999–2000	75	32	(43)	23	(53)	20	(47)	20	(100)	0	(0)	0	(0)	20
	2000–2001	300	132	(44)	96	(57)	72	(43)	4	(6)	68	(94)	0	(0)	72
	2001–2002	300	138	(46)	84	(53)	75	(47)	5	(7)	70	(93)	0	(0)	75

Table 5 Unit 20A moose hunter[a] residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1990–1991	257	43	61	9	370 (31)	651	122	52	15	840 (69)	1210
1991–1992	264	62	48	8	382 (33)	566	148	48	10	772 (67)	1154
1992–1993	150	51	32	13	246 (25)	549	113	59	15	736 (75)	982
1993–1994	281	54	39	12	386 (34)	571	108	32	24	735 (66)	1121
1994–1995	270	67	45	17	399 (34)	605	103	43	16	767 (66)	1166
1995–1996	390	68	64	4	526 (37)	709	107	37	8	861 (62)	1387
1996–1997	427	102	73	5	607 (37)	830	134	61	4	1029 (63)	1636
1997–1998	406	110	98	5	619 (39)	738	163	65	10	976 (61)	1595
1998–1999	367	131	108	2	608 (37)	816	158	64	6	1044 (63)	1652
1999–2000	378	144	132	6	660 (42)	674	166	67	7	914 (58)	1574
2000–2001	338	133	73	4	548 (34)	723	204	115	2	1044 (66)	1592
2001–2002	348	132	57	2	539 (35)	691	215	78	5	989 (65)	1528

[a] Excludes hunters in permit hunts.
[b] Residents of Unit 20.

Table 6 Unit 20A moose harvest[a] chronology percent by month/day, regulatory years 1990–1991 through 2001–2002

Regulatory	Harvest chronology percent by month/day						
year	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25	Unk/Other	*n*
1990–1991	27	12	27	29	1	3	370
1991–1992	24	19	28	25	0	3	382
1992–1993	45	24	13	16	0	2	246
1993–1994	34	19	25	17	1	4	386
1994–1995	27	20	23	25	0	5	382
1995–1996	19	17	21	22	15	4	526
1996–1997	26	15	19	22	14	4	607
1997–1998	24	15	17	22	18	4	619
1998–1999	22	15	17	24	19	3	608
1999–2000	20	15	25	22	15	2	660
2000–2001	26	18	25	27	0	3	548
2001–2002	24	21	23	29	0	3	539

[a] Excludes permit hunt harvest.

Table 7 Unit 20A moose harvest[a] percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method									n
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	
1990–1991	37	6	31	9	0	9	4		3	370
1991–1992	34	5	29	14	0	10	5		3	382
1992–1993	33	4	27	16	2	10	7		2	246
1993–1994	34	2	37	12	0	6	7		2	386
1994–1995	29	3	33	22	0	8	5		0	399
1995–1996	30	4	35	17	0	7	4		2	526
1996–1997	28	3	32	20	0	10	4		3	607
1997–1998	32	4	22	23	0	5	6	5	3	619
1998–1999	37	3	19	22	0	7	4	7	1	608
1999–2000	37	5	18	20	0	11	4	5	1	660
2000–2001	37	5	19	19	0	10	3	5	2	548
2001–2002	34	5	19	20	0	10	3	7	1	539

[a] Excludes permit hunt harvest.

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 20B (9114 mi^2)

GEOGRAPHIC DESCRIPTION: Drainages into the north bank of the Tanana River between Delta Creek and Manley Hot Springs

BACKGROUND

Moose numbers increased in Unit 20B throughout the 1950s and early 1960s after extensive wildfires improved moose habitat and federal predator reduction programs reduced wolf predation on moose (McNay 1993). Moose numbers declined following severe winters in 1965, 1970, 1971, and 1974. Increasing wolf predation and liberal either-sex hunting seasons contributed to the moose population decline. By 1976 moose densities were low and the hunting season had been reduced to 10 days in most of Unit 20B. Moose populations again increased following wolf reduction programs conducted from 1980 to 1986. Hunting seasons were extended from 10 days in 1981 to 20 days from 1983 to 1987. Reported harvests increased to approximately 300 bulls per year from 1983 to 1986. Harvests increased further from nearly 400 bulls in 1987 and 1988 to over 700 bulls in 1998, despite a 5-day reduction in the season.

Demand for moose hunting opportunities is high and increasing in Unit 20B. Extensive road systems and trails provide overland access, and numerous waterways such as the Tolovana, Tatalina, Chatanika, Goldstream, Salcha, and Chena Rivers provide boat access.

There were 2 permit moose hunts in Unit 20B during this reporting period, 1 in the Minto Flats Management Area (MFMA) and 1 in the Fairbanks Management Area (FMA). The MFMA was established in 1979 to restrict harvest in a low-density moose population. In 1988 the Alaska Legislature established the Minto Flats State Game Refuge to ensure the protection and enhancement of habitat; the conservation of fish and wildlife; and to guarantee the continuation of hunting, fishing, trapping, and other compatible public uses within approximately 900 mi^2 of the Minto Flats area.

The FMA was established in 1983 to provide moose hunting opportunities around the Fairbanks urban area by bow and arrow only. The area was closed to hunting in the late 1970s and early 1980s. Boundaries of the FMA changed numerous times, with the most recent changes going into effect in July 2002. The FMA currently encompasses about 300 mi^2, of which about 50 mi^2

has a relatively dense human population. Even though harvest is generally low, this hunt is popular.

For management purposes, Unit 20B is divided into 3 geographic zones: Unit 20B West (2942 mi^2), including the Minto Flats, Tatalina Creek drainage, Tolovana River drainage, and areas west; Unit 20B East (2425 mi^2) including the Little Salcha and Salcha River drainages; and Unit 20B Central (3829 mi^2), the remainder. Game management unit boundaries changed in 1981, increasing the size of Unit 20B and creating Unit 25C. Prior to 1981, the eastern and western portions of present-day Unit 20B and all of Unit 25C were considered part of Unit 20C. In 1993 the Unit 20B Central boundary was shifted westward. During regulatory year (RY) 2000, which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001), Unit 20B West and Unit 20B Central boundaries were modified to coincide with Uniform Coding Unit (UCU) boundaries. As a result, the area of Unit 20B West decreased by approximately 1000 mi^2 and Unit 20B Central increased by that same amount.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide for continued subsistence use of moose by Alaska residents who have customarily and traditionally used the population.
- Provide the greatest sustained opportunity to participate in hunting moose.
- Provide an opportunity to view and photograph moose.
- Protect human life and property in human–moose interactions.

MANAGEMENT OBJECTIVE

- Manage for a posthunting sex ratio of ≥30 bulls:100 cows unitwide and ≥20 bulls:100 cows in each count area (i.e., Unit 20B East, Unit 20B Central, Unit 20B West, and MFMA).

METHODS

POPULATION STATUS AND TREND

1999 Stratification Surveys

We stratified 649 sample units (SU) (3644 mi^2) in Unit 20B West on 9–11 November 1999. Unit 20B was subdivided into SUs with north–south boundaries every 2 degrees of latitude and east–west boundaries every 5 degrees of longitude. This resulted in nearly square SUs that were approximately 5.5 mi^2. They included all areas of suitable moose habitat ≤4500 feet elevation. Sample units entirely above 4500 feet elevation were excluded from the survey because land above that elevation is not considered suitable moose habitat (Gasaway et al. 1986). However, if any portion of an SU was ≤4500 feet, the entire SU was included in the survey. Surveys were flown in a Cessna 206 traveling at approximately 90 nautical mi/h, generally, 400–500 feet above ground level (AGL). Surveys were conducted with 2 observers (aft port and starboard) and 1 recorder (fore starboard). Criteria used to define strata within SUs included number of moose observed, number of tracks observed, and overall habitat quality (low, medium, or high with respect to the relative abundance of browse observed). Sample units were stratified as either low or high moose density.

1999 Population Estimation Survey

We surveyed 54 (26 low and 28 high moose density; 304 mi^2) of 649 SUs (3644 mi^2) in Unit 20B West, including 42 (20 low and 22 high density; 236 mi^2) of 169 SUs (951 mi^2) in the MFMA on 14–23 November 1999. We used the Geostatistical Population Estimator method (GSPE; Ver Hoef 2001), a modification of the standard Gasaway et al. (1986) technique. A simple random sample of SUs was selected from each stratum using Microsoft®Excel for Windows®98 software. Previous analyses suggest survey effort and the precision of population estimates are optimized when the survey effort includes approximately 40% low density and 60% high-density sample units. However, during this survey, sampling effort of low- and high-density strata was comparable due to statistical constraints requiring a minimum sample size of approximately 25 SUs per stratum.

The GSPE method does not employ a sightability correction factor (SCF), so does not correct for moose not seen during the survey. Rather, the GSPE method employs greater search intensity of 8–10 min/mi^2 vs. 4–6 min/mi^2 (Gasaway et al. 1986), resulting in a higher level of sightability.

Search intensity averaged 4.8 min/mi^2, considerably less than the recommended 8–10 min/mi^2. Interior Alaska received adequate snowfall (>12") for surveys by early November. Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were mostly excellent (32%) and good (39%) with the remainder fair (22%) or poor (7%). Turbulence was not a factor during surveys, although surveys were suspended several days due to high or turbulent winds.

2000 Stratification Surveys

We stratified 979 SUs (5385 mi^2) in Units 20B East and 20B Central on 13 and 16 October and 21, 24, and 28 November using the methods described above. This completed stratification of Unit 20B.

2000 Population Estimation Survey

We surveyed 50 (20 low and 30 high density; 281 mi^2) of 169 SUs (951 mi^2) in the MFMA during 24–30 October using the methods described above.

Search intensity averaged 7.6 min/mi^2, slightly less than the recommended 8–10 min/mi^2. The Minto Flats received adequate snowfall for surveys by the third week of October and additional snow fell periodically throughout the remainder of the month. Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were primarily good (93%) with the remainder fair (4%) or poor (2%). Turbulence was not a factor during surveys.

2001 Population Estimation Survey

We surveyed 138 (54 low- and 84 high-density; 780 mi^2) of 1628 SUs (9196 mi^2) in Unit 20B on 6–26 November 2001 using the methods described above. Search intensity averaged 7.8 min/mi^2, slightly less than the recommended 8–10 min/mi^2. Survey conditions with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were reported primarily as fair (34%) and good (46%) with the remainder reported as excellent (13%) or poor (7%). Snow conditions tended to deteriorate as the survey period progressed. Turbulence was not a factor, although surveys were suspended several days due to high or turbulent winds.

Twinning Rate Surveys

Twinning rates were estimated from surveys conducted in traditional twinning survey trend count areas on the Minto Flats. Surveys consisted of roughly parallel transects flown at approximately ½-mile intervals at ≤500 feet AGL in PA-18 or Scout aircraft by experienced contract pilots. All moose observed were classified as bull, yearling cow, adult cow without a calf, or adult cow with single, twin or triplet calves. Twinning rate surveys were flown for 5.0 hr on 30 and 31 May 2000, 3.25 hr on 31 May 2001 and 4.8 hr on 29 May 2002. We terminated surveys and excluded the data if <15% of the cows had calves. For statistical reasons, we established, a priori, a minimum sample size of 50 cows with calves. Twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows with calves.

MORTALITY

We estimated harvest based on harvest report cards. This included data from report cards from the general season, the FMA drawing hunt, and the MFMA Tier II permit hunt. Reminder letters were sent to nonreporting general season hunters, and up to 2 letters were sent to permit holders who failed to report. When antler size of bulls was reported, we considered bulls with antler spreads of <30 inches to be yearlings. Harvest data were summarized by regulatory year.

We estimated accidental mortality from Department of Public Safety records of collisions with motor vehicles and Alaska Railroad records of collisions with trains.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The 2001 population estimate for Unit 20B was 10,261 moose (8517–12,005; 90% CI) or about 1.1 $moose/mi^2$. However, because snow conditions for surveys were marginal the estimate may have been low. Even so, it is not likely we met the Intensive Management population objective established by the Board of Game for Unit 20B of 12,000–15,000 moose.

Prior to 2001, a unitwide population estimate had not been conducted since 1990 (McNay 1993). The population at that time was estimated at 9800 moose or about 1.1 moose/mi^2. Error bounds could not be calculated for that estimate because it included extrapolation; thus, the 1990 and 2001 estimates cannot be statistically compared. However, moose densities appeared similar between years.

Estimated moose densities were higher in Unit 20B West than in Units 20B Central or 20B East (Table 1). High moose density in the MFMA (1.9 moose/mi^2) likely influenced the overall Unit 20B estimate. Moose densities in Unit 20B West outside the MFMA were probably similar to densities observed throughout the remainder of Unit 20B. In Unit 20B Central, estimated densities were lower in 2001 (1.0 moose/mi^2) than in 1990 (1.2 moose/mi^2; McNay 1993) and 1994 (1.3 moose/mi^2). In contrast, estimated moose densities in Unit 20B West were higher in 1999 and 2001 (1.3–1.4 moose/mi^2) than in 1990 (0.9 moose/mi^2; McNay 1993).

Moose densities in the MFMA appeared to increase between 1989 (1.65 moose/mi^2; McNay 1993) and mid 1990s and then decline thereafter (Table 1). Productivity and early calf survival estimates support this observation. For instance, calf:100 cow ratios declined from 47:100 in 1994 and 1996 to 28:100 in 2001. Despite the apparent declines observed in the late 1990s, moose densities remained relatively high. Gasaway et al. (1992) reported that areas of Interior Alaska and the Yukon have densities of 0.1–1.0 moose/mi^2 where predators are lightly harvested. Higher densities occurred where wolves and/or bears were below food-limited levels.

Lower densities observed in 1999 and 2001 were likely artifacts of low survey intensity (1999) and marginal snow conditions (2001). As a result, actual moose densities in the MFMA during those years were likely higher than estimated and probably exceeded 2 moose/mi^2. However, surveys in the MFMA also may have been influenced by changes in moose distribution, due to the migratory nature of moose in the area (P Valkenburg and R Boertje, ADF&G, personal observation). Therefore, inconsistent results may occur regardless of sampling effort. This problem was exacerbated because of the relatively small size of the survey area. In addition, surveys were not directly comparable across years. For instance, the 1996 survey included 898 mi^2; whereas, the 1997 survey included 967 mi^2, of which most of the additional area (7.7%) included habitat with lower moose densities. Furthermore, the 1999 and 2001 surveys (951 mi^2) used the GSPE method, whereas previous surveys used Gasaway et al. (1986) methodology.

Moose densities in the FMA followed a trend similar to that observed in the MFMA (i.e., a decline in densities, productivity and early calf survival between the mid 1990s and 2001; Table 1). However, density in the FMA remained high, approaching or exceeding 1.5 moose/mi^2 since at least 1993.

I am uncertain whether the apparent trends in density, productivity and early calf survival observed in the MFMA and FMA occurred throughout Unit 20B because unitwide surveys were conducted too infrequently to evaluate long-term trends in the data.

Population Composition

<u>Bull:Cow Ratios</u>. In 1990, McNay (1993) estimated the overall Unit 20B bull:cow ratio averaged 40:100, well above the management objective of ≥30:100. The ratios varied by harvest intensity

within the unit. For instance, the less intensively harvested Salcha River and Minto Flats had bull:cow ratios of 44:100 (1990) and 49:100 (1989), respectively, and the MFMA had 47:100 in 1994 (Table 1). In contrast, the more intensively harvested Chena River had 28:100 (1990), and the most intensively harvested FMA had 9–14:100 (1989–1994).

Surveys conducted in 2001 indicate we met our management objective of a posthunting sex ratio of ≥30 bulls:100 cows unitwide and ≥20 bulls:100 cows in each count area (i.e., Unit 20B East, Unit 20B Central, Unit 20B West, and MFMA), except in the FMA (Table 1).

Bull:cow ratios in the FMA have been low (≤15:bulls:100 cows) since the early 1990s (Table 1). Hunting pressure was intense during fall prior to surveys, and most bulls killed are yearlings. Low yearling bull:cow ratios observed during November surveys (e.g., 4:100 in 1993, 3:100 in 1994, 7:100 in 2001) resulted largely from the high proportion of yearling bulls killed in September, and did not reflect poor calf recruitment. For example, we observed 39 calves:100 cows in 2001.

Calf:Cow Ratios. In general, calf:cow ratios declined between the mid 1990s and 2001 (Table 1). Calf:cow ratios tended to be higher in Unit 20B Central than Units 20B East and 20B West. The lowest ratios were observed in Unit 20B East (2001) and the highest were in the FMA (1994 and 1996). This is probably a function of lower predation rates in the FMA due to low predator abundance and poorer habitat in Unit 20B East.

Twinning Rates

Twinning rates in the MFMA appeared to decline dramatically between 1997 and 2001 (Table 2). Higher estimates in 1997 and 1998 may be an artifact of low sample sizes, although the apparent decline in the MFMA was consistent with a similar decline observed on the Tanana Flats in Unit 20A, where twinning rates fell from 18% in 1996 to 3% in 1999 (Young 2000). Twinning rates improved in 2002.

Distribution and Movements

Moose are distributed throughout Unit 20B, consisting of nonmigratory and migratory subpopulations (Gasaway et al. 1983). From February to April, some bull and cow moose migrate from the Chena and Salcha River drainages to calving areas on the Tanana Flats in Unit 20A. They remain there for the summer and return to the foothills from August through October. Although we do not know what proportion of the moose migrate, Gasaway et al. (1983) estimated that seasonal migrants probably increase the density of moose on the Tanana Flats 2- to 4-fold. Therefore, the summer densities in Unit 20B are probably much lower than during winter.

MORTALITY

Harvest

Season and Bag Limit. Seasons and bag limits in Unit 20B during RY99 were:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Fairbanks Management Area.		
1 antlerless moose by bow and arrow by drawing permit, or	1 Sep–30 Sep	1 Sep–30 Sep
1 bull with antlers by bow and arrow.	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov
Minto Flats Management Area.		
1 moose by Tier II permit only; or	1 Sep–20 Sep 10 Jan–28 Feb	No open season
1 bull with spike-fork or 50-inch antlers, or with at least 4 brow tines on 1 side.	11 Sep–20 Sep	No open season
Middle Fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek.		
1 bull.	1 Sep–20 Sep	1 Sep–20 Sep
Remainder of Unit 20B.		
1 bull.	1 Sep–15 Sep	5 Sep–15 Sep

Seasons and bag limits in Unit 20B during RY00 were:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Fairbanks Management Area.		
1 antlerless moose by bow and arrow by drawing permit; or	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull with antlers by bow and arrow.	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov
Minto Flats Management Area.		
1 moose by Tier II permit only; or	1 Sep–20 Sep 10 Jan–28 Feb	No open season
1 bull with spike-fork or 50-inch antlers, or with at least 4 brow tines on 1 side.	11 Sep–20 Sep	No open season
Middle Fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek.		
1 bull.	1 Sep–20 Sep	1 Sep–20 Sep
Remainder of Unit 20B.		
1 bull.	1 Sep–15 Sep	5 Sep–15 Sep

In RY95, 60 MFMA Tier II permits could be issued. The number of Tier II permits was increased to 100 in RY96 and has remained at 100 through RY00.

Alaska Board of Game Actions and Emergency Orders.

Historical Board of Game Actions — In the MFMA, the department issued 150 Tier II permits per year from RY90 through RY92 to provide for an annual harvest quota of 50 bulls. However, harvests were only 28–42 per year. In spring 1993 we calculated a new harvest quota of 100 bulls and recommended the Alaska Board of Game authorize up to 250 permits. The board passed our recommendation and the department issued 200 permits in RY93 and RY94. In spring 1995 the board approved changes for the MFMA and FMA. The Tier II bag limit was changed from any bull to any moose and the number of permits was reduced to 60. A general hunt was added for bulls with spike-fork or 50-inch antlers or antlers with 4 or more brow tines with a shorter season than the Tier II hunt. The MFMA general season was further reduced in RY96. The board also approved a drawing hunt for antlerless moose in the FMA beginning in RY95 and replaced the registration hunt with a general season.

Spring 2000 Board of Game Actions — In RY00, the FMA was enlarged from approximately 217 mi^2 to 318 mi^2 to clarify boundaries in the Cripple Creek and Goldstream areas and to address safety issues in developed areas in the Goldstream Valley and Chena Hot Springs Road/Nordale areas. The number of FMA antlerless moose permits that could be issued was increased from 25 to 100 in response to high moose densities and the increasing number of moose–vehicle collisions and moose–human conflicts in the Fairbanks area. Also, the FMA antlerless moose hunt was liberalized to include a 21–27 November season to align the bull and antlerless seasons, increase the harvest of cows, and provide additional hunting opportunity.

In November 2000 the Board of Game adopted Intensive Management (IM) population (12,000–15,000 moose) and harvest (600–1500 moose) objectives for Unit 20B.

Spring 2002 Board of Game Actions — During the spring 2002 meeting, the board modified the boundaries of the FMA in the Cripple Creek, Fox, and Steele Creek areas; added a 21–30 September hunt by bow and arrow only in the drainage of the Middle (East) Fork of the Chena River and Salcha River upstream from and including Goose Creek; and created a 3–6 August youth (8–17 years of age) hunt for any bull in Unit 20B, excluding the FMA and MFMA.

<u>Hunter Harvest</u>.

General Season — Reported harvests during general season hunts increased from 426 bulls in RY94 to 679 in RY98 (Table 3). The increase was due largely to expanded opportunity created by added general seasons, increased hunting effort, and increasing moose numbers. Reported harvest declined in RY99 and RY00. Those trends were apparent in the MFMA, but not the FMA. Reported harvest in the MFMA increased from 18 to 57 bulls annually (RY94–RY98), then dropped to 47 bulls in RY00. However, in the FMA, harvest was relatively stable (35–48 bulls annually), except for RY95 when harvests were lower.

The majority of harvest was in Unit 20B Central followed by Unit 20B West and then Unit 20B East (Table 3). Harvest density in Unit 20B Central was roughly 2.5 times that reported in Units 20B East and 20B West. As stated above regarding calf:cow ratios, this is likely a function of higher moose densities due to lower predator densities and better habitat in Unit 20B Central than in Unit 20B West and 20B East.

Drawing Permit Hunts — In the antlerless hunt DM788, success rates increased 14% between RY96 and RY98 (Table 4). Similarly, success rates improved in hunt TM785, but to a lesser extent (9% RY96–RY98). No trends were apparent in success rates from RY98 through RY01 in hunts DM788 or TM785.

<u>Hunter Residency and Success</u>. Primarily local residents hunted moose in Unit 20B (Table 3). Participation by nonlocal residents and nonresidents was relatively low.

Hunter success during the general season was generally lower in Unit 20B than elsewhere in Unit 20. For example, annual success rates in Units 20A and 20C typically exceed 35% (Young 2000). Between RY94 and RY00, 15–23% of the hunters in Unit 20B were successful (Table 3). During RY99 and RY00, success rates were within the range observed in RY94 through RY98. Unit 20B Central had lower success rates ($\bar{x}$ = 19%) than Units 20B West ($\bar{x}$ = 23%) and Unit 20B East ($\bar{x}$ = 28%). Typically, success rates are lower in areas with higher hunter densities and/or lower bull:cow ratios, such as Unit 20B Central, and higher in areas with lower hunter densities and/or higher bull:cow ratios, such as Unit 20B East.

In the FMA, harvests were relatively high during the past 8 years (Young 2000; this report). The high harvests were likely the result of high densities and survival rates of moose in the FMA during that period. Population estimates and anecdotal information indicate that moose densities, productivity, and early calf survival were high in the FMA between 1993 and 2001 (Table 1).

Harvest Chronology. Between RY97 and RY00, more bull moose were killed during the first 5 days of the season than during any other 5-day period (Table 5). Although data are preliminary, the 11–15 September period ranked highest in RY01.

Transport Methods. Highway vehicles were the primary method of transportation used by successful hunters (Table 6). Since RY97 the proportion of successful hunters using 3- or 4-wheelers and boats (traditional and airboats) increased slightly, while the proportion using highway vehicles and airplanes declined somewhat. No other trends were apparent.

Other Mortality

The number of moose killed in accidents with motor vehicles and trains has been substantial in some years (Table 7). The number of moose reported killed on highways in the FMA approached or exceeded 100 animals annually in RY97 through RY00. By comparison, only 53–75 moose were reported harvested annually by hunters in the FMA during that period. An additional 52–75 moose were killed each year on roads in the remainder of Unit 20B. Few moose were reported killed by trains during RY97 through RY00, with the exception of RY99 when 61 were reported killed.

HABITAT

Assessment/Enhancement

The department is planning and/or conducting moose habitat enhancement for portions of the Fairbanks area. These efforts include use of prescribed fire and regeneration of decadent willows by planting willows in recently logged areas. In addition, existing habitat improvement projects for grouse in Unit 20B have positive benefits for moose.

The proposed Nenana Basin Gas Lease could potentially fragment important moose habitat in the Minto Flats area. Development could affect moose in 2 ways. First, pipelines and roads may improve access. More importantly, increased fire suppression near wells and structures may adversely affect habitat capability for moose. The Division of Wildlife Conservation forwarded these concerns via comments submitted in response to the Alaska DNR, Division of Oil and Gas Preliminary Best Interest Finding.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

We have been collecting more systematic information on nonhunting mortality of moose because of its potential influence on harvest quotas and population trends. Motor vehicle and railroad kills continue to be an important source of mortality (Table 7). Within the Fairbanks urban area, we also receive a considerable number of complaints about human–moose conflicts, such as moose in gardens or yards, moose attacking dogs along dogsled trails, and moose "trapped" within the confines of the urban area. For instance, in RY00 the department received 129 complaints involving moose within Unit 20B. Department policy for the treatment of nuisance moose should be formalized for public consideration. Mitigation measures, including public education, are continuing.

CONCLUSIONS AND RECOMMENDATIONS

Surveys conducted in 2001 indicate we met our management objective of a posthunting sex ratio of ≥30 bulls:100 cows unitwide and ≥20 bulls:100 cows in each count area (i.e., Unit 20B East, Unit 20B Central, Unit 20B West, and MFMA), except in the FMA. Low bull:cow ratios in the FMA, a relatively small area, are of less concern than in larger areas because the FMA is small in relation to the annual home range of moose. If there are not enough bulls available in the FMA for breeding, cows in estrous can easily move to the periphery or outside the FMA where bull:cow ratios are higher, and bulls seeking females can readily immigrate into the FMA. High calf:cow ratios (Table 1) also indicate there have been sufficient bull moose in the FMA to breed cows in estrous. As a result, in the next reporting period the FMA will be deleted from the management objective mandating ≥20 bulls:100 cows in each count area.

We did not meet the IM population objective established for Unit 20B by the Board of Game, although the population likely approached the lower limit of 12,000 moose. Estimated harvest exceeded the IM harvest objective lower limit of 600 moose.

I concur with Dale (1998) that we need to collect unitwide population data on an annual basis to better assess the status of the population, then reevaluate management objectives, and gain public approval of those management objectives.

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Table 1 Unit 20B aerial moose fall composition counts and estimated population size, regulatory years 1993–1994 through 2001–2002

Count area	Regulatory year	Bulls:100 Cows	Yearlings: 100 Cows[a]	Calves:100 Cows	Percent calves	Adults	Moose observed	Moose/mi^2	Estimated population size (90% CI)
Unit 20B	2001–2002	33	15	30	18	751	914	1.1[b]	10261 (±17%)
Unit 20B East[c]	2001–2002	47	15	24	11	271	305	1.0[b]	2454 (±22%)
Unit 20B Central[d]	1994–1995	18	5	47	28		428	1.3[e]	
Unit 20B Central[f]	2001–2002	27	13	34	26	205	278	1.0[b]	4005 (±25%)
Unit 20B West[g]	1999–2000	27	14	34	20	438	546	1.4[b]	4881 (±20%)
Unit 20B West[h]	2001–2002	30	16	29	17	274	331	1.3[b]	3802 (±22%)
MFMA[i,j]	1994–1995	47	11	47	24		489	2.9[k]	
MFMA[j]	1996–1997	27	27	47	27			3.0[l]	2627 (±14%)
MFMA[m]	1997–1998	33	15	34			647	2.7[l]	2604 (±45%)
MFMA[n]	1999–2000	31	16	36	19	374	463	1.9[b]	1778 (±20%)
MFMA[n]	2000–2001	31	8	39	24	546	714	2.4[b]	2200 (±14%)
MFMA[n]	2001–2002	30	16	28	17	191	230	1.9[b]	1877 (±21%)
FMA[o,p]	1993–1994	9	8	30	27		65	1.3	
FMA[q]	1994–1995	14	6	61	40		165	2.6[e]	
FMA[q]	1996–1997	15	23	52	32	101	150	1.9	
FMA[r]	2001–2002	12	13	39	28	70	99	1.4[b]	461 (±34%)

[a] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[b] Geostatistical Population Estimation method does not incorporate a SCF (see methods).
[c] A 2425-mi^2 count area.
[d] A 642-mi^2 count area north and west of Fairbanks.
[e] Corrected for sightability (SCF = 1.23).
[f] A 3829-mi^2 count area.
[g] A 3644-mi^2 count area encompassing most of Unit 20B West (3955 mi^2), including the MFMA.
[h] A 2942-mi^2 count area.
[i] Minto Flats Management Area.
[j] An 898-mi^2 count area.
[k] Corrected for sightability (SCF = 1.13).
[l] Corrected for sightability (SCF = 1.18).
[m] A 967-mi^2 count area.
[n] A 951-mi^2 count area.
[o] Fairbanks Management Area.
[p] A 52-mi^2 count area within the FMA.
[q] A 78-mi^2 count area within the FMA.
[r] A 318-mi^2 count area.

Table 2 Results of twinning rate surveys for moose in Unit 20B (Minto Flats Management Area), 1997–2002

		Cows			
Year	Date	w/Single calf	w/Twins	Total	% Twins[a]
1997	22 May	17	9	26	35
1998	31 May	18	5	23	22
1999	27–29 May	59	4	63	6
2000	30–31 May	74	10	84	12
2001	31 May	58	5	63	8
2002	29 May	38	10	48	21

[a] Percentage of cows with calves that had twins.

Table 3 Unit 20B moose hunter[a] residency and success, regulatory years 1994–1995 through 2001–2002

Area/ Regulatory year	Successful Local[b] resident	Successful Nonlocal resident	Successful Nonresident	Successful Unk	Successful Total	% Successful	Unsuccessful Local[b] resident	Unsuccessful Nonlocal resident	Unsuccessful Nonresident	Unsuccessful Unk	Unsuccessful Total	Total hunters
Unit 20B East (UCUs 601, 602, 603, 604, 605)												
1999–2000	70	12	6	1	89	27	214	17	10	2	243	332
2000–2001	76	14	9	0	99	28	222	20	9	0	251	350
2001–2002[c]	51	3	8	0	62	20	211	18	15	3	247	309
Unit 20B Central (UCUs 207, 208, 209, 211, 212, 213, 301, 401, 402, 403, 404, 405, 406, 501)												
1999–2000	281	22	25	2	330	19	1263	74	77	7	1421	1751
2000–2001	269	30	28	0	327	19	1257	75	90	8	1430	1757
2001–2002[c]	263	14	23	3	303	19	1131	82	87	5	1305	1608
Unit 20B West (UCUs 101, 201, 202, 203, 204, 205, 206, 210)												
1999–2000	92	14	8	0	114	26	269	41	19	2	331	445
2000–2001	69	17	5	1	92	19	305	59	28	2	394	486
2001–2002[c]	58	17	9	0	84	20	238	66	23	2	329	413
FMA general archery hunt (UCUs 0212, 0213, 0300, 0301, 0401, 0402, 0403, 0501; archery only)												
1994–1995	45	0	0	0	45	11	332	26	4	0	363	407
1995–1996	27	0	1	1	29[d]							
1996–1997	41	1	1	1	44[d]							
1997–1998[e]	44	0	0	0	44[d]							
1998–1999[e]	35	1	1	0	37[d]							
1999–2000[e]	35	0	0	0	35[d]							
2000–2001[f]	46	1	1	0	48[d]							
2001–2002[c,f]	44	1	1	0	46							
MFMA general hunt (UCUs 0201, 0205, 0210; Nonresident hunters and antlerless harvest censored)												
1994–1995	16	2	0	0	18	19	66	11	0	1	78	96
1995–1996	32	2	0	0	34	23	105	10	0	1	116	150
1996–1997	35	3	0	1	39	37	59	8	0	0	67	106
1997–1998	37	7	0	0	44	39	65	4	0	0	69	113
1998–1999	44	12	0	1	57	32	112	6	0	1	119	176
1999–2000	43	5	0	0	48	27	119	10	0	1	130	178
2000–2001	40	6	0	1	47	28	109	13	0	0	122	169
2001–2002[c]	26	9	0	1	36	27	77	18	0	1	96	132

Area/ Regulatory year	Successful						Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	
Unit 20B remainder general hunt (Includes FMA general archery hunt, but excludes MFMA)												
1994–1995	362	16	27	3	408	15	2132	122	88	21	2363	2771
1995–1996	419	42	36	5	502	21	1684	104	111	20	1919	2421
1996–1997	489	45	46	2	582	21	1927	105	124	8	2164	2746
1997–1998	446	31	34	2	513	19	1925	124	92	20	2161	2674
1998–1999	529	44	46	3	622	22	1943	131	123	17	2214	2836
1999–2000	457	46	47	4	554	20	1907	156	113	13	2189	2743
2000–2001	433	69	43	1	546	20	1866	162	134	17	2179	2725
2001–2002[c]	384	33	43	3	463	18	1776	185	140	9	2110	2573
All general hunts												
1994–1995	378	18	27	3	426	15	2198	133	88	22	2441	2867
1995–1996	451	44	36	5	536	21	1789	114	111	21	2035	2571
1996–1997	524	48	46	3	621	22	1986	113	124	8	2231	2852
1997–1998	483	38	34	2	557	20	1990	128	92	20	2230	2787
1998–1999	573	56	46	4	679	23	2055	137	123	18	2333	3012
1999–2000	500	51	47	4	602	21	2026	166	113	14	2319	2921
2000–2001	473	75	43	2	593	20	1975	175	134	17	2301	2894
2001–2002[c]	410	42	43	4	499	18	1853	203	140	10	2206	2705

[a] Excludes drawing and Tier II permit hunt harvest.
[b] Residents of Unit 20.
[c] Preliminary data.
[d] Subtracted number of bulls reported harvested by bow and arrow on Eielson AFB (in UCU 0501, but outside FMA).
[e] FMA approx. 230 mi^2.
[f] FMA approx. 330 mi^2.

Table 4 Unit 20B moose harvest data by permit hunt, regulatory years 1996–1997 through 2001–2002

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk (%)	Harvest
DM788	1996–1997	15	1 (7)	7 (50)	7 (50)	0 (0)	7 (100)	0 (0)	7
	1997–1998	25	2 (8)	9 (39)	14 (61)	0 (0)	14 (100)	0 (0)	14
	1998–1999	25	0 (0)	9 (36)	16 (64)	0 (0)	16 (100)	0 (0)	16
	1999–2000	25	2 (8)	12 (52)	11 (48)	0 (0)	11 (100)	0 (0)	11
	2000–2001	50	5 (10)	18 (40)	27 (60)	0 (0)	27 (100)	0 (0)	27
	2001–2002	75	13 (17)	34 (55)	28 (45)	2 (7)	26 (93)	0 (0)	28
TM785	1996–1997	100	20 (20)	30 (38)	50 (62)	27 (54)	23 (46)	0 (0)	50
	1997–1998	100	17 (17)	30 (36)	53 (64)	30 (57)	23 (43)	0 (0)	53
	1998–1999	100	17 (17)	24 (29)	59 (71)	32 (54)	27 (46)	0 (0)	59
	1999–2000	100	22 (22)	21 (27)	57 (73)	34 (60)	23 (40)	0 (0)	57
	2000–2001	100	15 (15)	31 (36)	54 (64)	28 (52)	25 (46)	1 (2)	54
	2001–2002	100	17 (17)	26 (31)	57 (69)	31 (54)	26 (46)	0 (0)	57
Totals for all permit hunts	1996–1997	115	21 (18)	37 (39)	57 (61)	27 (47)	30 (53)	0 (0)	57
	1997–1998	125	19 (15)	39 (37)	67 (63)	30 (45)	37 (55)	0 (0)	67
	1998–1999	125	17 (14)	33 (31)	75 (69)	32 (43)	43 (57)	0 (0)	75
	1999–2000	125	24 (19)	33 (33)	68 (67)	34 (50)	34 (50)	0 (0)	68
	2000–2001	150	20 (13)	49 (38)	81 (62)	28 (35)	52 (64)	1 (1)	81
	2001–2002	175	30 (17)	60 (41)	85 (59)	33 (39)	52 (61)	0 (0)	85

Table 5 Unit 20B moose harvest[a] chronology percent by month/day, regulatory years 1997–1998 through 2001–2002

Regulatory	Harvest chronology percent by month/day						
year	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25	Unk/Other	*n*
1997–1998	33	25	27	6	3	6	557
1998–1999	35	25	28	6	1	4	679
1999–2000	33	25	30	7	1	4	602
2000–2001	37	22	28	6	2	5	593
2001–2002[b]	27	26	32	5	2	8	499

[a] Excludes drawing and Tier II permit hunt harvest.
[b] Preliminary data.

Table 6 Unit 20B moose harvest[a] percent by transport method, regulatory years 1997–1998 through 2001–2002

	Harvest percent by transport method									
Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Other/ Unknown	Airboat	*n*
1997–1998	5	0	18	26		5	42	3	1	557
1998–1999	3	0	20	30		3	41	2	2	679
1999–2000	3	1	19	29	0	4	39	3	2	602
2000–2001	3	0	21	29	0	4	35	4	3	593
2001–2002[b]	3	0	21	31	0	4	35	2	3	499

[a] Excludes drawing and Tier II permit hunt harvest.
[b] Preliminary data.

Table 7 Estimate of Unit 20B moose harvest[a] and accidental death, regulatory years 1997–1998 through 2001–2002

Regulatory year	Harvest by hunters							Accidental death					
	Reported				Estimated			Road[b]					
	M	F	Unk	Total	Unreported[c]	Illegal/ Other[d]	Total	FMA[e]	Unit 20B remainder	Total	Train[f]	Total	Total
1997–1998	586	37	1	624	110	79	189	97	70	167	15	182	995
1998–1999	709	43	2	754	133	65	198	93	73	166	13	179	1131
1999–2000	624	34	12	670	119	96	215	117	75	192	61	253	1138
2000–2001	611	31	9	651	115	44	159	105	52	157	7	164	974
2001–2002[g]	522	55	6	583	103	26	129	43[h]	32[h]	75[h]	8[i]	83[g]	795[g]

[a] Includes general and permit hunt harvest.
[b] Documented kills; actual number killed by vehicles is certainly greater.
[c] Based on 17.7% unreported harvest (including wounding loss) estimated by Gasaway et al. (1992).
[d] Includes illegal, DLP, dispatched, potlatch, stickdance, and other reported deaths.
[e] Fairbanks Management Area.
[f] Confirmed dead between Alaska Railroad mileposts 411.8 and 470.0; "Missing" (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[g] Preliminary data.
[h] Number of moose killed through December 2001.
[i] Number of moose killed through April 2002.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 20C (11,902 mi^2), 20F (6267 mi^2), and 25C (5149 mi^2)

GEOGRAPHIC DESCRIPTION: Unit 20C includes drainages into the west bank of the Nenana River, and into the south bank of the Tanana River west of the Nenana River. Most of Denali National Park and Preserve is within Unit 20C. Unit 20F includes drainages into the north bank of the Tanana River west of Manley, and into the Yukon River approximately between the village of Tanana and the Dalton Highway bridge. Unit 25C includes drainages into the south bank of the Yukon River upstream from Circle to, but not including the Charley River drainage. The subunit also includes the Birch Creek drainage upstream from the Steese Highway bridge, the Preacher Creek drainage upstream from and including the Rock Creek drainage, and the Beaver Creek drainage upstream from and including the Moose Creek drainage.

BACKGROUND

Moose densities in Units 20C, 20F, and 25C have been low for many years, presumably because of combined predation from wolves and bears (Gasaway et al. 1992) and habitat limitations. Wolf and bear populations are lightly harvested. Bull moose harvest is low relative to population size, and the proportion of large bulls in the harvest remains relatively high. Therefore, harvest is a minor factor affecting population dynamics relative to predation.

These subunits contain large tracts of mature black spruce that are poor quality moose habitat. However, many riparian areas, subalpine hills, and old burns appear to have habitat capable of supporting moose at relatively high densities ($\geq$2 moose/mi^2).

Trends in moose populations have been difficult to identify, but densities probably fluctuate within 0.1 and 1 moose/mi^2 based on Alaska and Yukon studies in areas with 2 or more lightly-harvested predators (Gasaway et al. 1992).

Moose within Denali National Park and Preserve (DNPP) have been studied more intensively than moose in the rest of the subunits. These studies include movement and behavior of radiocollared moose, composition surveys, and population estimates conducted by DNPP biologists since 1970.

Moose are an important source of food for many local rural residents. In addition, people throughout the Interior hunt moose in these subunits for food and/or trophies.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Provide for a sustained harvest of these low-density populations.

- Promote moose habitat enhancement by allowing natural fires to alter vegetation.

MANAGEMENT OBJECTIVE

- Maintain a bull:cow ratio of 30:100.

METHODS

A Geostatistical Population Estimator (GSPE; Ver Hoef 2001) was completed in Unit 25C (5000 mi^2) during November–December 1997. A census using Gasaway methods (Gasaway et al. 1986) was conducted during November 1994 by DNPP biologists in the Lake Minchumina Area (1007 mi^2) of Unit 20C. Stratification flights associated with the GSPE technique were completed for that portion of Unit 20C outside of DNPP on 19 December 2000 and a GSPE census is scheduled for November 2002.

We estimated annual moose mortality using data from harvest report cards (after sending reminder letters to increase response), and using calls to our office concerning nonhunting mortality of moose, records of moose/motor vehicle collisions (Fish and Wildlife Protection log sheets), and Alaska Railroad records of moose/train collisions between railroad mile posts 327–371 in Unit 20C. Data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001).

In 1987 a Subsistence Division study was conducted to assess wild resource use in the village of Tanana. This study was used to estimate unreported harvest.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We estimated 3500–4500 moose inhabited Unit 20C; 2000 within Denali National Park and 1500–2500 outside Denali National Park (including Denali National Preserve). These estimates assumed an average density of 0.58 moose/mi^2 inside Denali National Park (October 1991 census; T Meier, personal communication) and 0.25 moose/mi^2 outside Denali National Park.

During a November 1994 survey of the Lake Minchumina area, Denali Park biologists estimated the density at 0.34 moose/mi^2 (K Stahlnecker, personal communication). Budget requests for RY02–RY03 include funds to conduct a GSPE survey in Unit 20C outside DNPP.

We estimated 1000–2000 moose resided in Unit 20F. This assumed 0.25–0.50 moose/mi^2, with roughly 4250 mi^2 of moose habitat (McNay 1990).

The density estimate for Unit 25C was 0.46 moose/mi^2 based on the 1997 GSPE, with a total population estimate of 2279 moose (90% CI ±16.5%). This low estimate was expected because nearly half the subunit contains mountainous non-moose habitat or open mountainous tundra interspersed by small drainages with localized, good moose habitat. The 1997 estimate was a cooperative effort between the Bureau of Land Management (BLM) and the Alaska Department of Fish and Game (ADF&G).

Population Composition

Population composition data in Units 20C and 20F were limited to the percentage of large bulls in the harvest (Fig 1). The percentage of large bulls in the reported harvest has been relatively stable in Unit 20C since 1995 (30–40%) and variable in Unit 20F (24–55%). A possible reason for the variability in Unit 20F is a small annual sample size (29–45). Results from the 1997 GSPE in Unit 25C included estimates of 53 bulls:100 cows and 37 calves:100 cows (Table 1). We conclude that harvest has minimal impact on these populations. If harvest rates of bulls were high, the percentage of large bulls in the harvest would decline within a few years.

Distribution and Movements

No movement data were collected in any of the units and no distribution data were collected in Unit 20F during this reporting period. Distribution data for the other 2 units were limited to the 1997 census in Unit 25C and the stratification flights in Unit 20C. In both areas moose were most abundant in the limited areas of good riparian habitat.

MORTALITY

Harvest

<u>Season and Bag Limit</u>. Hunting seasons and bag limits have not changed since RY93 (Table 2).

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20C		
RESIDENT HUNTERS: 1 bull; however, white-phased or partial albino (more than 50% white) moose may not be taken.	1 Sep–20 Sep	
NONRESIDENT HUNTERS: 1 bull; however, white-phased or partial		5 Sep–15 Sep

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
albino (more than 50% white) moose may not be taken.		
Unit 20F, drained by the Yukon River excluding the Tanana River drainage downstream from the drainage of Hess Creek.		
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep or 1 Dec–10 Dec	No open season
Unit 20F, drained by the Tanana River.		
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep	No open season
Remainder of Unit 20F		
RESIDENT HUNTERS: 1 bull.	1 Sep–15 Sep	No open season
Unit 25C		
RESIDENT HUNTERS: 1 bull.	1 Sep–15 Sep	
NONRESIDENT HUNTERS: 1 bull.		5 Sep–15 Sep

Alaska Board of Game Actions and Emergency Orders. No Board of Game actions were taken and no emergency orders were issued during this reporting period.

Hunter Harvest. Recently, hunting pressure has increased in these units (Table 3). During RY97, 143 moose were reported killed by 382 hunters in Unit 20C, 29 moose were reported killed by 118 hunters in Unit 20F, and 57 moose were reported killed by 212 hunters in Unit 25C. In RY00, 130 moose were reported killed by 457 hunters in Unit 20C, 40 moose were reported killed by 166 hunters in Unit 20F, and 79 moose were reported killed by 323 hunters in Unit 25C. Harvest levels are near historic highs for Units 20F and 25C, but below historic highs in Unit 20C.

Nuchalawoyya Potlatch — In spring 1989 the Board of Game authorized the department to issue permits to take up to 3 moose/year for the Nuchalawoyya potlatch. No potlatch was held during RY97–RY98 and data for RY99–RY00 were not available when this report was written.

Federal Permit Hunt 790 — In RY92 the Federal Subsistence Board created a 1–25 September moose season on federal public land in Unit 20F for qualified local subsistence users by federal registration permit. The federal public land is located within the Dalton Highway corridor. In RY96, 2 permits were issued with 1 successful permittee. During RY97, 3 permits were issued, but no permittees hunted. During RY98 no permits were issued (C Miller, US Fish and Wildlife Service, personal communication, May 2000) and data for RY99–RY00 were not available when this report was written.

Harvest data for a federal hunt for RY99–RY00 in Unit 20C were not available when this report was written. Efforts will be made to obtain these data for the next reporting period.

Unreported Harvest and Estimated Nonhunting Mortality — The number of unreported kills in Units 20C, 20F, and 25C is not easily estimated. Harvest report card returns from Tanana, Rampart, Manley, Livengood, Central, Circle, and Circle Hot Springs within these subunits were minimal. For example, ADF&G's Division of Subsistence research information from the village of Tanana illustrates the magnitude of the nonreporting problem. They found that only 10–20% of the actual harvest for Tanana residents was reported. The reporting rate for other rural communities in this area is unknown.

Illegal, other, and motor vehicle deaths were obtained from the Fairbanks Fish and Wildlife Protection wildlife mortality logs. Data concerning deaths caused by train collisions (only applicable for Unit 20C) were obtained from the Alaska Railroad. Documented causes of accidental mortality were minimal (0–3 annually) in Unit 20F and Unit 25C, but higher in Unit 20C (4–21 annually) due to deaths caused by train collisions.

<u>Hunter Residency and Success</u>. The number of hunters in all units has increased during the last 5 years (RY96–RY00), while success rates decreased in Unit 20C, remained relatively stable in Unit 20F, and were variable but decreasing in Unit 25C (Table 3). During the last 5 years, 9% (292/3258) of the hunters reporting in Units 20C and 25C were nonresidents, and there were no nonresident seasons in Unit 20F. The 5-year average success rate for hunters was 33% (667/2003) in Unit 20C, 25% (177/699) in Unit 20F, and 27% (349/1273) in Unit 25C.

Most successful hunters in Units 20C, 20F, and 25C continued to be Alaska residents (Table 3). During RY99–RY00, 90% of the reported successful hunters in Unit 20C were Alaska residents, and about 75% in Unit 25C were Alaska residents. In addition, most successful hunters were "nonlocal" hunters, primarily from Fairbanks (Table 4).

<u>Harvest Chronology</u>. Since RY93 most reported harvest in all units was during the second week of the season, with the first and third weeks being similar, but at a lower level for Units 20C and 20F (Table 5).

<u>Transport Methods</u>. In Unit 20C most successful hunters used boats, airplanes, and 3- or 4-wheelers for transportation (Table 6). Extensive river systems, many lakes, gravel bars, and an expanding trail system make these transport methods most useful. In Unit 20F boats were the primary mode of transportation for successful hunters, and in Unit 25C successful moose hunters utilized highway vehicles, 3- or 4-wheelers, and boats. The transportation methods used throughout this area reflected access options.

HABITAT

BLM is reclaiming mine tailings within the White Mountains National Recreation Area in Unit 25C. Native willows are being planted to enhance the revegetation process and increase moose browse.

The most recent habitat improvements in these units have been associated with wildfire. For a history of wildfires in this area, refer to BLM's URL: ftp://borealis.ak.blm.gov/pub/gis/ and download file "firehist99.tar".

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Harvest reporting in these subunits has been poor. We need to contact more people in remote areas to emphasize the importance and benefits of reporting harvest. It would be especially helpful to contact young people in the village schools to establish harvest reporting as a responsibility of all hunters and to promote the positive aspects of reporting.

Fire is an integral part of Interior ecosystems and is essential to producing good moose habitat in areas of climax spruce forests. We should continue to coordinate wildlife needs with fire suppression activities and encourage more controlled burns to enhance habitat. Eastern Unit 25C should be evaluated for its potential for a controlled burn. This area presently contains wide expanses of black spruce with only small areas of moose habitat.

Collisions with trains has been a significant mortality factor for moose in some areas of Unit 20C (Table 7). Efforts to reduce these mortalities should continue, and we need to establish better reporting and data management strategies when accidents do occur.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations in Units 20C, 20F, and 25C are at low densities. Hunting pressure was relatively low, but increasing. Regulations in place during this reporting period addressed our current management objectives, and no regulatory changes are recommended at this time.

We met our objective to estimate hunting and nonhunting mortality, and we worked to gather information on reporting rate from rural communities so a more comprehensive total estimate of harvest could be produced.

We completed the stratification for Unit 20C outside of DNPP, but we did not initiate stratification of relative moose abundance in Unit 20F. We made progress on our goal to promote natural fires to enhance moose habitat through the department's efforts on the Interagency Fire Management Team.

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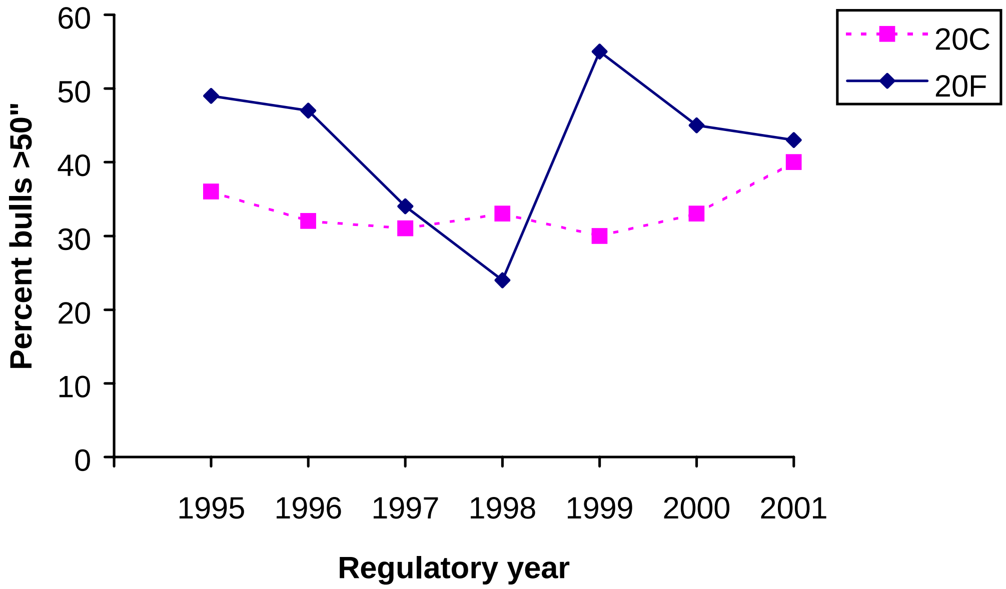

Figure 1 Percent of bull moose in the reported fall harvest with an antler spread >50 inches in Units 20C and 20F, regulatory years 1995–1996 through 1999–2000

Table 1 Unit 25C fall aerial moose composition counts, 1986–1997

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2	Survey area size (mi^2)
1986[a]	103	13	21	8	9	77	85	1.49	57.0
1987[a]	77	11	28	13	14	83	96	1.68	57.0
1988[a]	129	37	33	16	13	112	128	2.25	57.0
1996[a]	119		11	3	5	57	60	1.05	57.0
1997[b]	53	13	37	80	20	319	399	0.46	5000

[a] O'Brien Creek count area.
[b] Geostatistical Population Estimator moose population estimate conducted 2 November 1997 through 3 December 1997.

Table 2 Units 20C, 20F and 25C moose hunting seasons, regulatory years 1990–1991 through 2001–2002

Regulatory year	Unit 20C Season[a]	Unit 20C Hunters allowed[b]	Unit 20F Season	Unit 20F Hunters allowed[b]	Unit 25C Season	Unit 25C Hunters allowed[b]
1990–1991	1–15 Sep	R	1–15 Sep	R	1–15 Sep	R
	5–15 Sep	N[c]	1–10 Dec	R (Tier II)	5–15 Sep	N[c]
1991–1992	1–20 Sep	R	1–15 Sep	R	1–15 Sep	R
	5–15 Sep	N	1–10 Dec[d]	R	5–15 Sep	N
			1–25 Sep	FS[e]		
1992–1993	1–20 Sep	R	1–15 Sep	R	1–15 Sep	R
through	5–15 Sep	N	1–10 Dec[f]	R	5–15 Sep	N
2001–2002	1–30 Sep	FS[g]	1–25 Sep	FS[e]		

[a] Since 1987 the taking of white-phased or partial albino (more than 50%) white moose has been prohibited.
[b] R = residents, N = nonresidents, and S = subsistence.
[c] Bag limit bulls with ≥50-inch antler spread.
[d] Only that portion of Unit 20F drained by the Yukon River downstream from the mouth of Hess Creek.
[e] Federal subsistence season for residents of Minto, Manley, and Stevens Village to hunt moose in Unit 20F on federal public lands.
[f] Only that portion of Unit 20F drained by the Yukon River excluding the Tanana River drainage downstream from the drainage of Hess Creek.
[g] Federal subsistence season for residents of Cantwell, Lake Minchumina, Telida, and Nikolai to hunt moose in Unit 20C on federal public lands within Denali National Park and Preserve.

Table 3 Units 20C, 20F, and 25C reported moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory	Successful hunters				Unsuccessful hunters				Total
year	Resident	Nonresident	Unk	Total (%)	Resident	Nonresident	Unk	Total (%)	hunters
Unit 20C									
1990–1991	108	4	4	116 (38)	178	6	5	189 (62)	305
1991–1992	131	9	2	142 (37)	229	2	3	234 (63)	376
1992–1993	56	5	5	66 (21)	228	9	8	245 (79)	311
1993–1994	118	9	3	130 (33)	247	9	3	259 (67)	389
1994–1995	131	9	12	152 (36)	241	9	17	267 (64)	419
1995–1996	108	9	4	121 (32)	254	7	0	261 (68)	382
1996–1997	114	9	0	123 (35)	221	11	0	232 (65)	355
1997–1998	125	17	1	143 (37)	224	12	3	239 (63)	382
1998–1999	125	14	1	140 (35)	242	13	1	256 (65)	396
1999–2000	118	13	0	131 (32)	262	17	3	282 (68)	413
2000–2001	117	13	0	130 (28)	301	25	1	327 (72)	457
2001–2002[a]	107	14	0	121 (38)	159	13	22	194 (62)	315
Unit 20F									
1990–1991[b]	38	0	0	38 (31)	84	0	2	86 (69)	124
1991–1992	36	1	0	37 (24)	109	3	6	118 (76)	155
1992–1993	25	0	2	27 (20)	104	1	2	107 (80)	134
1993–1994	22	0	2	24 (26)	65	1	1	67 (74)	91
1994–1995	29	2	0	31 (23)	100	3	3	106 (77)	137
1995–1996	39	0	0	39 (32)	83	0	0	83 (68)	122
1996–1997	30	0	0	30 (23)	99	1	0	100 (77)	130
1997–1998	28	1	0	29 (25)	89	0	0	89 (75)	118
1998–1999	44	1	0	45 (29)	106	3	0	109 (71)	154
1999–2000	31	1	1	33 (25)	96	2	0	98 (75)	131
2000–2001	36	4	0	40 (24)	125	1	0	126 (76)	166
2001–2002[a]	24	0	1	25 (31)	51	1	4	56 (69)	81
Unit 25C									
1990–1991	38	4	1	43 (23)	129	7	7	143 (77)	186
1991–1992	43	3	0	46 (28)	108	7	3	118 (72)	164
1992–1993	32	7	0	39 (19)	161	5	1	167 (81)	206
1993–1994	47	7	1	55 (25)	157	7	0	164 (75)	219
1994–1995	45	9	1	55 (24)	158	12	1	171 (76)	226
1995–1996	51	5	0	56 (28)	130	11	0	141 (72)	197
1996–1997	47	11	0	58 (27)	138	18	0	156 (73)	214
1997–1998	47	10	0	57 (27)	140	13	2	155 (73)	212
1998–1999	73	11	1	85 (34)	152	13	2	167 (66)	252
1999–2000	55	14	1	70 (26)	177	19	6	202 (74)	272
2000–2001	59	19	1	79 (24)	224	20	0	244 (76)	323
2001–2002[a]	41	8	8	57 (25)	146	15	14	175 ((75)	232

[a] Preliminary results.
[b] Excludes hunters in permit hunts.

Table 4 Residency of successful moose hunters in Units 20C and 20F, 2000–2001

Unit	Town	Successful hunters
20C	Nonlocal	
	Fairbanks, North Pole, Salcha, Two Rivers	51
	Wasilla, Palmer, Eagle River, Anchorage, Big Lake, Chugiak, Elmendorf AFB	25
	Other residents	6
	Nonresidents	13
	Subtotal	95
	Local	
	Denali Park	1
	Nenana	4
	Tanana	2
	Manley Hot Springs	0
	Healy/Clear/Anderson	21
	Lake Minchumina	7
	Kantishna	0
	Subtotal	35
20F	Nonlocal	
	Fairbanks, North Pole, Eielson AFB, Fort Wainwright, Delta Junction	18
	Anchorage, Eagle River, Chugiak, Big Lake, Wasilla, Palmer	7
	Other residents	2
	Nonresidents	4
	Subtotal	31
	Local	
	Tanana	6
	Rampart	2
	Manley Hot Springs	1
	Subtotal	9
25C	Nonlocal	
	Fairbanks, North Pole, Fort Wainwright, Eielson AFB, Two Rivers	32
	Anchorage, Wasilla, Palmer, Chugiak	17
	Other residents	4
	Nonresidents	19
	Subtotal	72
	Local	
	Central	5
	Circle	1
	Subtotal	6

Table 5 Units 20C, 20F, and 25C reported moose harvest chronology by month/day, regulatory years 1992–1993 through 2001–2002

Regulatory	Harvest chronology by month/day						
year	9/1–9/7	9/8–9/15	9/16–9/20	9/21–9/30	12/1–12/10	Unknown	Total
Unit 20C							
1992–1993	28	15	19				62
1993–1994	40	53	32	3			128
1994–1995	32	70	40	1			143
1995–1996	33	49	35	3			120
1996–1997	37	52	31	4			124
1997–1998	38	54	39	1			132
1998–1999	35	54	42	3			134
1999–2000	35	52	39				126
2000–2001	41	48	36				125
2001–2002[a]	26	52	44				122
Unit 20F							
1992–1993	9	10	2	1	4		26
1993–1994	8	12	1		3		24
1994–1995	15	15			1		31
1995–1996	7	19	14		1		41
1996–1997	6	23	6		0		35
1997–1998	4	13	10	1	0		28
1998–1999	11	25	6		3		45
1999–2000	5	18	4		5		32
2000–2001	10	21	5		4		40
2001–2002[a]	5	12	9		0		26
Unit 25C							
1992–1993	20	19					39
1993–1994	23	25	6	1			55
1994–1995	27	23	1	1			52
1995–1996	23	29	3				55
1996–1997	20	34	1	1		2	58
1997–1998	22	34	0	1			57
1998–1999	35	47	2				84
1999–2000	31	37					68
2000–2001	28	50					78
2001–2002[a]	21	33					54

[a] Preliminary results.

Table 6 Units 20C, 20F, and 25C reported moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

	Harvest percent by transport method								
Regulatory year	Airplane	Horse/Dogsled	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unk/other	*n*
Unit 20C									
1990–1991	24	0	41	11	0	11	9	3	116
1991–1992	23	0	39	20	0	7	8	3	142
1992–1993	32	0	32	12	6	8	10	0	66
1993–1994	22	2	44	15	1	13	3	0	130
1994–1995	26	1	37	21	0	7	5	1	152
1995–1996	29	0	37	14	0	12	7	0	121
1996–1997	28	0	26	21	0	11	8	6	127
1997–1998	21	0	38	21	0	13	6	2	143
1998–1999	16	1	33	24	0	19	5	2	140
1999–2000	15	2	38	20	0	18	5	2	131
2000–2001	22	0	36	23	1	12	5	1	130
2001–2002[a]	23	2	31	21	0	13	11	0	131
Unit 20F									
1990–1991	11	0	63	16	0	0	11	0	38
1991–1992	8	3	57	11	3	3	14	3	37
1992–1993	7	4	44	7	15	0	19	4	27
1993–1994	4	4	38	13	8	4	29	0	24
1994–1995	3	0	39	23	0	13	22	0	31
1995–1996	3	0	54	20	0	3	22	0	41
1996–1997	3	3	57	14	6	0	17	0	35
1997–1998	3	0	45	31	0	3	17	0	29
1998–1999	0	2	56	16	4	2	20	0	45
1999–2000	3	0	33	27	12	6	15	3	33
2000–2001	5	0	45	30	8	0	10	2	40
2001–2002[a]	0	0	48	24	0	8	16	4	25
Unit 25C									
1990–1991	2	0	9	35	0	14	37	2	43
1991–1992	11	0	22	44	0	0	20	4	46
1992–1993	18	0	13	33	0	8	26	3	39
1993–1994	9	0	36	24	0	5	24	2	55
1994–1995	13	0	24	38	0	9	15	1	55
1995–1996	9	0	29	25	0	9	27	2	56
1996–1997	9	0	22	36	0	5	28	0	58

	Harvest percent by transport method								
Regulatory year	Airplane	Horse/Dogsled	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unk/other	*n*
1997–1998	7	0	18	53	0	7	14	2	57
1998–1999	4	0	21	40	0	5	28	2	85
1999–2000	9	0	26	39	0	3	24	0	70
2000–2001	5	0	24	38	0	6	25	1	19
2001–2002[a]	7	0	26	53	0	7	5	2	57

[a] Preliminary results.

Table 7 Estimate of Units 20C, 20F, and 25C moose harvest and accidental death, regulatory years 1997–1998 through 2001–2002

Regulatory year	Harvest by hunters							Accidental death			Total
	Reported[a]				Estimated						
	M	F	Unk	Total	Unreported[b]	Illegal/Other[c]	Total	Road[d]	Train[e]	Total	
Unit 20C											
1997–1998	143	0	0	143	25	0	25	1	8	9	177
1998–1999	140	0	0	140	25	1	26	0	3	3	169
1999–2000	125	0	0	125	22	0	22	0	21	21	168
2000–2001	130	0	0	130	23	0	23	0	0	0	153
2001–2002[f]	131	0	0	131	23	0	23	0	0	0	154
Unit 20F											
1997–1998	29	0	0	29	5	1	6	1	0	1	36
1998–1999	45	0	0	45	8	1	9	0	0	0	54
1999–2000	33	0	0	33	6	2	8	1	0	1	42
2000–2001	40	0	0	40	7	0	7	0	0	0	47
2001–2002[f]	25	0	0	25	4	0	4	0	0	0	29
Unit 25C											
1997–1998	57	0	0	57	10	0	10	0	0	0	67
1998–1999	85	0	0	85	15	0	15	3	0	3	103
1999–2000	66	0	0	66	11	0	11	0	0	0	77
2000–2001	79	0	0	79	14	1	15	0	0	0	94
2001–2002[f]	57	0	0	57	10	0	10	0	0	0	67

[a] Data from ADF&G harvest reports.
[b] Based on 17.7% unreported harvest (including wounding loss) estimated by Gasaway et al. (1992).
[c] Data from Fairbanks Fish and Wildlife Protection wildlife mortality logs.
[d] Documented kills from Fairbanks Fish and Wildlife Protection wildlife mortality logs.
[e] Confirmed dead between Alaska Railroad mileposts 327.0–370.9; "missing" (moose hit but not recovered) are not included. Data provided by the Alaska Railroad and summarized by ADF&G office in Palmer. Data were not available for May and June 2000.
[f] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 20D (5637 mi^2)

GEOGRAPHIC DESCRIPTION: Central Tanana Valley near Delta Junction

BACKGROUND

Unit 20D was created in 1971 from a portion of Unit 20C. During 1962–1970, the moose hunting season in the area that is currently Unit 20D consisted of a 70–72 day bull season and a 1–8 day antlerless moose season. Most (51–74%) of the harvest during 1964–1970 came from the highly accessible areas near Delta Junction (Clearwater Lake, Donnelly Dome, and the Delta farming area). However, several severe winters in the mid 1960s and early 1970s killed many moose throughout this subunit and other portions of Interior Alaska and set the stage for predation and hunting to compound and aggravate already widespread population declines. Poor recruitment of yearlings to the population in combination with intense bulls–only hunting depressed the bull:cow ratio to only 4:100 in the more accessible portions of the subunit. The moose hunting season was closed during 1971–1973 because the depressed moose population could no longer support any significant harvest (McIlroy 1974).

Despite restrictions on hunting, the moose population in Unit 20D continued to decline because of chronically high moose mortality from other causes. In 1973 the moose population in the area south of the Tanana River and between the Johnson and Delta Rivers was estimated at only 600. When limited moose hunting was resumed in 1974, it was conducted under a registration permit system for the entire unit, however, an area around Delta Junction was closed to the taking of antlerless moose. The moose population decline in the western portion of the subunit was gradually reversed by a combination of continued hunting restrictions, mild winters, and wolf control efforts in adjacent Unit 20A (1976–1982) and western Unit 20D (1980–1983).

In 1978 the subunit was enlarged by moving the eastern boundary from the Johnson River to the Robertson River. It was further enlarged in 1981 to include all drainages north of the Tanana River from the mouth of the Robertson River to Banner Creek.

In 1983 the closed area around Delta Junction, which had been established in 1974, was formally named the Delta Junction Management Area (DJMA). The name of the DJMA was changed to the Delta Junction Closed Area (DJCA) in 1990 to more accurately reflect its status as an area closed to hunting. In 1991 the DJCA was reduced in size to provide more hunting opportunity in the area. In 1996 the DJCA was renamed the DJMA and a drawing permit hunt was established in the area.

Unit 20D has been subdivided into 4 areas for moose management purposes: southwestern Unit 20D, the area south of the Tanana River from the Johnson River to the Delta River; southeastern Unit 20D, the area south of the Tanana River from the Robertson River to the Johnson River; northwestern Unit 20D, the area north of the Tanana River from Banner Creek to and including the Volkmar River; and northeastern Unit 20D, the area north of the Tanana River and east of the Volkmar River.

As moose populations recovered during the mid–1970s and early 1980s, hunting opportunities were expanded in southwestern Unit 20D by first eliminating the registration permit requirement and then by lengthening the season. Antler restrictions were implemented in 1988 to stabilize the increasing harvest and to improve the age structure in the bull segment of the population. In southeastern and northern Unit 20D, the seasons were also increased.

In March 1995 the Alaska Board of Game determined that the preferred use of moose in Unit 20D was for human consumption and they established a moose population objective of 8000–10,000 and an annual harvest objective of 240–500. The harvest objective was increased to 500–700 moose in 2000.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

- Increase the fall moose population to 8000–10,000 moose with an annual reported sustainable harvest of 500–700 moose per year.

METHODS

The primary method of collecting moose population data in Unit 20D during the approximate period 1980–1994 was aerial surveys of Trend Count Areas (TCA). Trend count areas were usually surveyed annually or biennially to collect sex and age composition data and population trend. Moose composition and population trends within the TCA were then extrapolated to a larger area. Trend count areas were 40–100 mi^2 and were subdivided into sample units (SU) of approximately 12 mi^2. Although TCAs were searched in their entirety, SUs within TCAs were surveyed individually with standardized search effort and survey conditions so survey variables were constant and their influence was minimized. One disadvantage of TCA surveys was inaccuracy extrapolating moose population estimates outside of TCA boundaries.

Aerial survey techniques were developed in the mid–1980s that allowed precise estimates of moose population size and unbiased composition data to be collected over large areas using stratified random sampling (Gasaway et al. 1986). This technique, known as the Gasaway method, was expensive and labor intensive; therefore, Gasaway population estimates were conducted only occasionally in the highest priority areas.

When the Alaska Board of Game established Unit 20D moose management goals, it became important to have a moose population estimate that could be monitored for compliance. There are also other advantages to calculating population estimates for an area. Gasaway and DuBois (1987) stated that “the primary moose population parameters required to make timely and effective management decisions are abundance, sex and age composition (including recruitment), rate of change in abundance, and mortality rates.” Unlike TCA data, population estimates provide 3 of the 4 population parameters recommended by Gasaway and DuBois. However, funding had never been provided to conduct a Gasaway population estimate for all of Unit 20D. Therefore, in fall 1995 I decided to divide Unit 20D into 3 portions and use annual TCA survey funds to conduct Gasaway population estimates in each portion on a rotational basis. Once I had calculated population estimates for each portion of the unit, I could combine the individual estimates to calculate a total unit estimate.

I conducted the first Gasaway-method population estimate in fall 1995 in Unit 20D south of the Tanana River and estimated 2522 moose. Again using the Gasaway method, in fall 1996 I conducted an estimate in northwestern Unit 20D and estimated 1143 moose and in fall 1997 I conducted an estimate in northeastern Unit 20D and estimated 883 moose. The combined 1995–1997 Unit 20D population estimate was 4548 moose (range = 3847–5249).

In the mid–1990s, Ver Hoef (2001) worked to modify the Gasaway method to compensate for its disadvantages. He developed the Geostatistical Population Estimator (GSPE) based on the Gasaway method, but modified it to incorporate spatial statistics and autocorrelation. In previous reports, the GSPE method was called the spatial statistics method (SSM). Geostatistical population estimator advantages over the Gasaway method include: 1) autocorrelation produces a more accurate population estimate; 2) stratification is not required to be as accurate or time sensitive; 3) the GSPE can be conducted for lower cost and manpower; 4) the GSPE can be conducted over a longer survey period, making interruptions due to poor weather less problematic; 5) complete random sampling is not necessary and old survey areas can be incorporated in the GSPE; 6) more accurate estimates of population abundance, composition, and trend are achievable because GSPEs can be conducted more frequently; and 7) application of data from 1 survey area to adjacent survey areas is possible. Based on the advantages of the GSPE, I decided to replace Gasaway population estimates with the GSPE in 1998.

Guidelines recommended by Ver Hoef (personal communication) to maximize accuracy and precision of GSPE surveys were to 1) sample at least 25 SUs in each stratum and 2) sample a smaller number of units annually, rather than a larger number biennially. Therefore, based on Unit 20D funding levels, he recommended that I alternate primary and secondary survey areas with the goal of sampling 40 SUs in the primary area and 10 SUs in the secondary area each year. This would allow data to be collected from each area annually, thus allowing more precise calculation of population trends in the future. Of the 40 SUs in the primary survey area, 60% would be sampled in the high-density stratum and 40% in the low-density stratum. Of the 10 SUs in the secondary area, 80% would be sampled in the high-density stratum and 20% in the low stratum. This sample design did not provide for 25 SUs in each stratum but was the best design possible with available funds.

One significant difference between the Gasaway method and the GSPE surveys is that GSPE surveys do not employ a sightability correction factor (SCF) at this time, and thus it does not correct for moose not seen during the survey. The Gasaway method attempted to maintain consistently high sightability of moose during surveys by flying SUs at a standard search intensity of 4–6 min/mi^2 (Gasaway et al. 1986). A SCF was then calculated independently of the sampling effort by resurveying a portion of each SU at an intensive search effort of 12 min/mi^2. The SCF was based on the number of moose not seen during the standard search but seen on the intensive search. During the GSPE survey, the standard search effort was increased to 8–10 min/mi^2 to achieve an initial higher level of sightability during the survey than the Gasaway method standard search of 4–6 min/mi^2. Ver Hoef and others plan to research the assumption that 8–10 min/mi^2 of search effort is adequate to negate the need for a SCF (Ver Hoef, personal communication).

Geostatistical Population Estimator SUs are square in shape and drawn with boundaries every 2 degrees of latitude on even latitude increments and every 5 degrees of longitude on multiples of 5 degrees. Sample units vary in size from approximately 5.7–5.9 mi^2. Each SU is identified by the latitude and longitude of its southeast corner.

Sample units were stratified as high or low density of moose based on previous stratifications and existing knowledge of the area. In general, SUs were stratified low if I expected to count <5 moose in them. Sample units were stratified high if I expected to count ≥5 moose in them. In an attempt to keep variance as small as possible in the low stratum estimate, I placed borderline SUs in the high stratum.

Sample units were surveyed with a Piper PA–18 Super Cub and a Robinson R-22 helicopter. Aerial surveys were flown at altitudes of approximately 300–800 ft above ground level, depending on vegetative cover. Flight speed was 60–70 mph in the PA–18 and 50–60 mph in the R-22. When terrain permitted, east–west linear transects were flown every 0.15 degrees of latitude, or north–south every 0.3 degrees of longitude. A global positioning system (GPS) was used to follow transect headings. In hilly or mountainous terrain, the flight path followed terrain contours within SU boundaries, rather than transects. Our goal was to spend 8–10 min/mi^2 of search effort in SUs to achieve consistently high sightability of moose. However, large areas of nonmoose habitat (i.e., lakes, areas covered with ice) within a SU were not surveyed.

We circled all moose seen to look for additional moose and to classify moose as bulls, cows, or calves. Bulls were further classified into 5 categories based on antler size and morphology that included: 1) yearlings with spike–fork antlers, 2) yearlings with nonspike–fork antlers, 3) medium bulls with antler spread of 31–40 inches, 4) medium bulls with antler spread 41–49 inches, and 5) large bulls with antler spread ≥50 inches. We estimated antler spread on all medium and large bulls. We identified yearling bulls as those with antler spread <30 inches and with no antler brow palm development.

Information recorded for each SU included: 1) survey start and stop times, 2) snow and light conditions, 3) major habitat type, 4) location, and 5) survey rating of excellent to poor based on the observer's general impression.

Sample unit data were entered into a Microsoft®Excel spreadsheet and analyzed with S-PLUS 2000 software (Mathsoft, Seattle, WA, spatial statistics model) using a spatial statistics model developed by Ver Hoef.

1999 POPULATION SURVEYS

Northern Unit 20D. I established northern Unit 20D as the primary GSPE survey area and southern Unit 20D as the secondary area. Northern Unit 20D included all of Unit 20D north of the Tanana River.

Based on funding availability, the goal of the 1999 survey was to sample approximately 40 SUs in the primary survey area of northern Unit 20D. A random selection of SUs was drawn with 40% of planned effort in the low stratum and 60% of effort in the high stratum. Also, a small secondary survey was conducted in southern Unit 20D. Ten SUs were randomly selected and surveyed in southern Unit 20D, with 20% in the low stratum and 80% in the high stratum.

Shaw Creek Flats and Central Creek Survey. Teck Resources Inc. provided funds and requested that the department conduct aerial moose surveys in the Shaw Creek drainage and in the area previously surveyed as the Central Creek TCA. The purpose of the surveys was to collect moose distribution and population data comparable to standard department surveys, to be used by Teck Resources Inc. to evaluate transportation options to the Pogo Mine Project in the Goodpaster River drainage.

Survey objectives were to 1) estimate moose distribution within the Shaw Creek drainage, 2) calculate a population estimate for the Shaw Creek drainage with precision ≥ 90% confidence interval and with a width less than ±25%, with no precision goals for sex and age composition, and 3) count observable moose within the Central Creek TCA for comparison to earlier surveys.

Moose distribution within the Shaw Creek drainage was determined by stratifying the area based on GSPE SUs established during northern Unit 20D population estimates. We stratified SUs by flying east–west transects through the midpoint of each SU. Sample units were stratified as either high or low moose density relative to the study area, based on aerial observations of habitat, tracks, moose seen during the stratification flight and current knowledge about the area. The flight was made in a Robinson R-22 helicopter at an altitude of approximately 800 ft above ground level and an airspeed of approximately 50–60 mph.

After the stratification, we randomly selected SUs from each stratum with the goal of placing 60% of the sampling effort into the high-density stratum and 40% into the low stratum. Additional SUs were also counted within the study area during the department's northern Unit 20D population survey.

All survey and data analysis techniques were the same as described above for the 1999 northern Unit 20D population estimate.

The Central Creek TCA was flown in a Piper Super Cub PA–18, with the goal of applying 4–6 min/mi^2 of search effort in each SU to be consistent with previous TCA surveys in this area.

Surveys were flown at an airspeed of 70–80 mph at an altitude of approximately 500–700 ft above ground level. We plotted all moose seen on 1:63,360 scale USGS topographic maps.

Data analysis consisted of comparing the number of moose seen during this survey to data from 1992 through 1994.

2000 POPULATION SURVEYS

A GSPE survey was conducted in southern Unit 20D. All survey techniques were the same as for 1999 except the sampling design.

The optimum GSPE spatial sampling design is adjacent pairs of SUs distributed evenly, rather than randomly, throughout the survey area (Ver Hoef, ADF&G, personal communication). The paired SUs allow for optimum spatial comparisons and calculation of autocorrelation. However, in past GSPE surveys, Ver Hoef recommended random sampling of SUs because it 1) generally achieves an adequate spatial sampling pattern, 2) eliminates bias in SU selection, and 3) allows calculation of a population estimate based on the Gasaway-method randomized sampling design, if desired. However, it is possible to draw a random selection of SUs that is far from optimum for spatial sampling. This occurs if there are large unsampled blocks within the survey area and if there are few adjacent SUs.

For the 2000 population estimate in southern Unit 20D, I identified 4 high-density areas of special interest. These included the Hajdukovich Creek burn, the Granite Creek burn, the Delta Agricultural Project, and the subalpine zone of the Macomb Plateau. I identified those SUs that encompassed these areas and randomly selected 1 SU from each area. I then randomly selected an adjacent SU to form a pair of SUs within the area of interest. Repeating this process for each area of interest resulted in 8 SUs being assigned of the 24 available to be sampled in the high-density stratum. I then randomly assigned the remaining 16 high density SUs throughout the remainder of the survey area. I did not identify any areas of special interest within the low-density stratum, and 14 of 16 low density SUs were assigned randomly, but I placed 2 SUs randomly in large areas that were unsampled in the original allocation.

Individual GSPE population estimates were calculated for southwest and southeast Unit 20D because moose hunting regulations differ in southern Unit 20D east and west of the Johnson River.

<u>Moose Twinning Surveys</u>. Moose twinning surveys were conducted for the first time in Unit 20D. Southwestern Unit 20D was chosen for the survey because it had the highest density of moose. Southwestern Unit 20D does not have a core moose calving area, so survey areas were drawn on 1:63,360 scale USGS topographic maps to be representative of habitat throughout the area. Survey areas with their approximate size in square miles were established as follows: Jarvis Creek West (7.4), Butch Lake (9.5), Granite/Rhodes Creek (9.0), Big Lake (20.8), Clearwater Creek (13.0), Sawmill Creek North (16.2), Sawmill Creek South (12.4), and the Delta Agricultural Project (156). In addition, an exploratory survey was conducted without specific boundaries in the Tanana Loop area north of Delta Junction.

Survey transects were flown approximately 0.5 mi apart in a Piper Super Cub PA–18, at an altitude of 300–700 ft above ground level and an airspeed of 70–80 mph. Large areas with little chance of having a moose (i.e., large agricultural grain fields) or little chance of spotting a moose (i.e., dense stands of spruce) were not surveyed. When moose were spotted, a pass was made over the moose to look for a calf and to look for antler growth to determine if the moose was a bull. If the moose was a cow, a low pass was made over the cow to stimulate calves to stand up. Typically, about 1–2 additional passes were made over the cow to look for a calf and to determine if the cow had a single calf or twins.

Moose Browse Surveys. Moose browse surveys were conducted in southwestern Unit 20D during April and early May to assess relative browsing pressure. The technique used was developed by C.T. Seaton as part of his thesis at the University of Alaska Fairbanks to evaluate browse over large areas such as game management units.

The 1987 Granite Creek fire and Donnelly Dome areas in southwestern Unit 20D were selected to be surveyed because of the high density of moose in these areas. Trails and roads were identified through the areas that could be accessed by snowmachine or 4–wheeler. Survey plots were established by systematically preselecting stopping points along trails and roads (i.e., every mile along a trail). At each stop, a random compass heading and number of paces from the trail, not to exceed 100 paces, was selected as the center point of the plot. A GPS was used to identify the latitude and longitude for the center. The plot consisted of a circle having a radius of 15 m from the center point. The approximate boundaries of the plot were identified by pacing 15 m from the center in 4 cardinal directions and tying flagging tape to a plant at that point.

Once the plot was identified, preferred browse species within the plot were identified. Preferred species were considered to be *Salix* spp., *Betula paperifera,* and *Populus* spp. that were >0.5 m in height but not taller than 3 m. The number of each preferred species within the plot was estimated and recorded. Nonpreferred species and their number were also recorded within the plot. Nonpreferred species consisted of spruce (*Picea* spp.), tamarack (*Larix laricina*), alder (*Alnus* spp.), and resin birch (*Betual grandulosa*).

Browse use was assessed by sampling current annual growth (CAG) leaders from at least 3 different plants for each preferred species if possible. The 3 plants for each preferred browse species to be sampled were randomly selected from within the plot. The following information was recorded for each plant: height from the ground, number of CAG leaders present before browsing, proportion of dead plant material, and plant architecture (broomed, browsed, or unbrowsed). Next, 10 CAG leaders were selected from each plant and the following information was recorded for each stem: stem diameter at the base of the CAG, was the stem browsed or unbrowsed, and the diameter of the stem at the point of browsing. Finally, nonpreferred browse species were observed for evidence of browsing.

2001 POPULATION SURVEYS

Southern Unit 20D was again selected as the primary survey area because of the intensive moose management and regulatory concerns in this area. A GPSE population survey was conducted using the same survey methodology described for 2000, except for SU selection. SUs were selected to optimize GSPE spatial sampling design by selecting adjacent pairs of SUs distributed evenly, rather than randomly, throughout the survey area.

The number of SUs to be surveyed in each stratum was divided by 2 to determine the number of SUs pairs that would be sampled. Then the total number of SUs in each stratum was divided by the number of pairs to be sampled, to determine how many SUs would be grouped together to be represented by 1 sampled pair. I grouped SUs with similar anticipated moose densities, habitat types, and topographic features.

For example, in 2001 funding was available to survey 24 SUs in the high-density stratum, which consisted of 119 SUs. The 24 SUs to be surveyed in the high stratum equaled 12 paired SUs. Therefore, a pair of SUs were allocated for approximately every 10 high density SUs. I then used a map of SUs to identify SU groups, averaging 10 SUs (range 8–12). The following SU groups were established with the number of SUs in each: Robertson River (9), Berry Creek (10), Knob Ridge (10), Johnson–Gerstle (11), Upper Sawmill Creek (8), Cummings Road (11), Jarvis Creek (11), Delta River (10), 12–mile Crossing (10), 33–mile Loop Road (9), 1408 Road (8), and Clearwater Lake (12). Once groups were identified, an adjacent pair of SUs was selected from within each group to be sampled.

This process was repeated for the low density stratum, which had 7 SU groups, ranging from 23–27 SUs each. The following low density groups and their number of SUs were established as follows: Robertson River (23), Dot Lake (26), Independent Ridge (27), Gerstle River (25), Jarvis Creek (25), Delta Agricultural Project (25), and Delta Junction (25).

Additional moose survey funds became available after completion of the 2001 GSPE survey, and southern Unit 20D was stratified from 24 November–12 December using a Piper PA–18 Super Cub. The stratification was conducted using GSPE SUs. We stratified by flying east–west transects through the midpoint of each SU. The proportion of habitat in each SU was estimated and classified as low shrub (generally *Salix* spp.), tall shrub, deciduous forest, sparse spruce forest, spruce forest, or nonmoose habitat. The presence of moose tracks and number of moose seen in the SU were recorded. Before exiting the SU, it was stratified as either high or low density.

<u>Moose Twinning Surveys</u>. Moose twinning surveys were conducted in southwest Unit 20D using the same methodology described for 2000. Survey areas with their approximate size in square miles were flown as follows: Jarvis Creek West (7.4), Butch Lake (9.5), Granite/Rhodes Creek (9.0), Big Lake (20.8), Clearwater Creek (13.0), Sawmill Creek North (16.2), and the Delta Agricultural Project (156.0).

<u>Moose Browse Surveys</u>. Moose browse surveys were conducted in southwestern Unit 20D during April and early May to assess relative browsing pressure in the 1994 Hajdukovich Creek burn. The methodology was the same as described for 2000.

<u>Harvest Monitoring</u>. Harvest of moose by hunters during the general hunting seasons was monitored by requiring hunters to acquire moose harvest tickets and report hunting activities that included: the location hunted, how long they hunted, their mode of transportation, whether they killed a moose, where and when they killed a moose, the antler spread and number of brow tines

on moose killed, and the type of weapon used to kill the moose. Hunters participating in permit hunts provided the same information via permit report forms. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000). Reminder letters were sent to holders of harvest tickets and permits.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

1999

In fall 1999 we estimated 2395 moose (2070–2719) in northern Unit 20D (Table 1).

After completion of the northern Unit 20D population estimate I combined it with the 1998 population estimate of southern Unit 20D to calculate a Unit 20D population estimate of 6025 moose (4856–7194). An assumption of this calculation is that no significant change occurred in the southern Unit 20D population during this time. This calculation was made by determining the standard error of the sum of the variances for the 2 population estimates. The standard error was then multiplied by the Student *t*-test statistic of 1.68 to obtain the 90% confidence interval ±25% (Gasaway et al. 1986). The confidence interval was then added and subtracted to the population estimate.

Unit 20D has been designated for intensive management by the Board of Game with a population objective of 8000–10,000 moose. The 1998–1999 Unit 20D population estimate is below the population objective.

The Shaw Creek population estimate was conducted during 13–24 November 1999. The population estimate for the drainage was 119 moose (range = 103–136). Confidence intervals were ±14% of the estimate and met the precision goal. Composition in the area was 49 bulls:100 cows (range = 35–63) and the calf:cow ratio was 24:100 (range = 18–30). Moose were distributed throughout the Shaw Creek drainage at relatively low densities.

The Central Creek TCA was flown on 18 November 1999. Search time totaled 2 hr 46 min for a search effort of 4.0 min/mi^2 which met the search intensity goal. We observed 61 moose in the TCA, which was substantially fewer than the 118–139 seen in 1992–1994 when the area was last surveyed by the department.

2000

In fall 2000 I estimated 3932 moose (3245–4618) in southern Unit 20D (Table 2).

Search effort in the SUs that were searched in their entirety (i.e., did not have large areas of nonmoose habitat) averaged 8.0 min/mi^2. This effort meets the minimum goal of 8–10 min/mi^2 of search effort.

Funding did not allow SUs in the northern Unit 20D secondary survey area to be sampled.

Cost to conduct the population estimate was $10,298 for aerial surveys and $122 for miscellaneous expenses, totaling $10,420. On a SU basis, the survey cost $274/SU. On an area basis, the survey cost \$5.51/mi^2. Aircraft charter rates were higher this year than in past years because of increased fuel costs. Poor flying conditions also resulted in more ferry time causing higher cost this year than in previous years.

The 2000 southern Unit 20D population estimate was combined with the 1999 northern Unit 20D population estimate to calculate a new Unit 20D total population estimate of 6327 moose (5551–7103). An assumption in this calculation is that the northern Unit 20D population estimate had not changed significantly since 1999. This population estimate did not meet the Unit 20D moose population goal established by the Board of Game.

2001

In fall 2001 I estimated 3435 moose (2643–4227) in southern Unit 20D (Table 2).

The 2001 southern Unit 20D population estimate was combined with the 1999 northern Unit 20D population estimate to calculate a new Unit 20D total population estimate of 5830 moose (4956–6704). An assumption in this calculation is that the northern Unit 20D population estimate had not changed significantly since 1999. This population estimate did not meet the Unit 20D moose population goal established by the board.

Twinning surveys were flown on 29 and 31 May, and 1, 2, and 4 June 2000 for 12.6 hr of survey time. Most flights began in the evening from 1815 hr to2100 hr and concluded from 2224 hr to 2335 hr. One morning flight was conducted from 0555–0807 hr. Two hundred eighty–two moose were seen at the rate of 22.4 moose/hr of survey time. Forty–seven cow/calf groups were seen, with 7 (15%) being cows with twins.

2002

Twinning surveys were flown on 25, 27, 28, and 29 May 2002 for a total of 11.9 hr of survey time. Flights began in the morning from 0610 hr to 0640 hr and concluded from 0800 hr to 1215 hr. Moose were seen at the rate of 22.5 moose/hr and 268 total moose were seen. Sixty–one cows/calf groups were seen, with 13 (21%) being cows with twins.

Population Composition

<u>1999</u>. The bull:cow ratio in northern Unit 20D was 81:100 (range = 69–93) and the calf:cow ratio was 18:100 (range = 14–22) during fall 1999 (Table 1).

<u>2000</u>. The population composition during fall 2000 in southern Unit 20D was 27 bulls:100 cows (range = 19–34) and 27 calves:100 cows (range = 22–31) (Table 3).

<u>2001</u>. The population composition during fall 2001 in southern Unit 20D was 16 bulls:100 cows (range = 10–22) and 24 calves:100 cows (range = 16–32) (Table 3). This is the lowest bull:cow ratio recorded in southern Unit 20D since population estimates began in the area.

Distribution and Movements

No data were collected on moose distribution or movements during this reporting period.

Mortality

Harvest

Season and Bag Limit. Hunting seasons and bag limits were unchanged during RY99–RY01 and are listed in Table 2.

Alaska Board of Game Actions and Emergency Orders. At the March 2000 Alaska Board of Game meeting, the board considered proposal 99 to raise the Unit 20D moose harvest objective from 240–500 moose/year to 500–700 moose/year, with no time frame for accomplishing the objective. The proposal was adopted.

At the March 2002 board meeting there were 5 proposals pertaining to moose regulations in Unit 20D. Proposal 4 was adopted by the board and created the Bison Range Youth Hunt Management Area on a portion of the Delta Junction Bison Range. The purpose of the proposal was to allow the department to better meet bison management objectives by regulating moose hunting. Proposal 5 was adopted to increase the number of drawing permits from 10 to 30 for hunting moose in the DJMA. Proposal 6 was adopted and created a nonresident moose hunting season in the upper Robertson River drainage. This area had previously been closed to nonresident moose hunters because of customary and traditional use considerations in southeastern Unit 20D. Proposal 7 to change the brow tine restriction in southwestern Unit 20D from 4 to 3 brow tines was not adopted. Proposal 12 to create a controlled use area in northern Unit 20D to regulate the use of airboats was not adopted.

Human-Induced Mortality

RY99. Estimated moose mortality from all human causes in Unit 20D during RY99 was 264 moose (Table 4). This included 184 moose reported killed by hunters, an estimated 33 unreported hunter kills, illegal harvest of 7 moose reported by Fish and Wildlife Protection, and 40 road kills reported by Department of Public Safety (DPS). Most illegal kills and road kills occurred in southwestern Unit 20D. Total reported hunting harvest of 184 moose did not meet the harvest objective of 240–500. Reported hunting harvest was 3.1% of the estimated population. Total human-induced mortality was 4.4% of the estimated population.

RY00. Estimated moose mortality from all human causes increased during RY00 to 347 moose (Table 4). This included 246 moose reported killed by hunters during the hunting season, an estimated unreported harvest of 44 moose, 20 moose reported by Fish and Wildlife Protection to have been killed illegally, and 37 road kills reported by DPS. Most illegal kills and road kills occurred in southwestern Unit 20D. Total reported hunting mortality of 246 was slightly below the harvest objective. Reported hunting harvest was 3.9% of the estimated population. Total human-induced mortality was 5.5% of the estimated population.

RY01. Estimated moose mortality from all human causes during RY01 was 263 moose (Table 4). This includes 182 moose reported killed by hunters during the hunting season, an estimated 32 moose harvested but unreported, 17 moose reported by Fish and Wildlife Protection to have been killed illegally, and 32 road kills reported by DPS. Most illegal kills and road kills occurred in southwestern Unit 20D. Total reported hunting mortality of 182 was well below the harvest objective of 500–700. Reported hunting harvest was 3.1% of the estimated population. Total human-induced mortality was 4.5% of the estimated population.

Southwestern Unit 20D Hunter Harvest. Reported hunter harvest in RY99 was 114 moose with 107 taken during the general season and 7 taken during permit hunt DM790 (DJMA) (Tables 5 and 6). During the general season, 358 hunters harvested 107 moose (Table 5), for a 29.9% hunter success rate. Hunters that participated had a 70% success rate during permit hunt DM790 (Table 6).

Reported hunter harvest during RY00 increased to 146 moose, with 140 taken during the general season and 6 taken during permit hunt DM790 (DJMA) (Tables 5 and 6). This is the highest harvest in southwestern Unit 20D since at least 1984. During the general season, 355 hunters killed 140 moose (Table 5) for a 39.4% success rate. Hunters had a 75% success rate during hunt DM790 (Table 6).

Reported hunter harvest during RY01 was 105 moose, with 101 taken during the general season and 4 taken during permit hunt DM790 (DJMA) (Tables 5 and 6). During the general season, 425 hunters killed 101 moose (Table 5) for a 23.8% success rate. This is the second highest number of hunters reported for this area since at least 1984. Hunters that participated had a 50% success rate during hunt DM790.

Southwestern Unit 20D had the most restrictive hunting regulations in the subunit in the form of antler restrictions, yet moose harvest and number of hunters has continued to increase since the regulations were implemented. The increase is likely due to increased numbers of moose and good access in the area.

Southeastern Unit 20D Hunter Harvest. Moose harvest remained low in southeastern Unit 20D. During the general seasons, only 10–12 moose were killed annually during RY99–RY01 (Table 5). Hunter success rates varied from 28% to 32% during this period. No moose were killed in Tier II hunt TM787 (Table 7). Harvest during the general hunting season was low in this area primarily because of motorized access restrictions in the Macomb Plateau Controlled Use Area, which makes moose hunting difficult.

Northwestern Unit 20D Hunter Harvest. During the RY99 general season, 42 moose were killed by 177 hunters (Table 5) for a 23.7% success rate. During the RY00 general season, 65 moose were killed by 194 hunters for a 33.5% success rate. During the RY01 general season, 52 moose were killed by 221 hunters for a 23.5% success rate. There were no permit hunts in northwestern Unit 20D.

Northeastern Unit 20D. Number of hunters and harvest remained low in northeastern Unit 20D during the RY99–RY01 general season. Harvest ranged from only 12 to 18 moose, with hunters ranging from 29 to 41, and success rates ranging from 34 to 51% (Table 5). This area is difficult to access during the hunting season except along the Tanana River, along a few small creeks and rivers flowing into the Tanana River, and at a few ridgetop airstrips.

Moose hunters did not appear to take advantage of the August and January–February moose hunting seasons in the Healy River drainage during RY99–RY01. The Healy River drainage is Uniform Coding Unit (UCU) 501. The number of hunters in UCU 501 ranged from 21 to 24 and reported harvest increased to 5–7/year (Table 8). Harvest in the area increased from a mean of 2.8 (range = 2–5) for the 5 years prior to the increased hunting seasons, to a mean of 6/year moose harvested in RY99–RY01. However, all moose were reported killed during the 1–15 September general hunting season, and none were reported killed during the August and January–February season.

A problem was discovered in the Wildlife Conservation Information Management database that has created difficulty separating the residency of hunters from Fairbanks versus Healy Lake. However, it appears that during RY99–RY01, Healy Lake residents reported killing 3 moose, local residents of Unit 20D killed 2, Fairbanks residents (which may include some Healy Lake residents) killed 9, nonlocal residents killed 2, and nonresidents killed 2.

In discussions I had with Healy Lake residents, they estimated a community need of 20 moose/yr. Part of the reason for establishing the additional August and January–February seasons in this drainage was to provide an opportunity for them to meet this need during legal hunting seasons.

Hunter Residency. Hunter residency changed significantly from previous reports due to changes in the method of calculating unit residency by Wildlife Conservation Information Management staff (B Lieb, ADF&G, personal communication). The previous method included many nonlocal Unit 20 residents, and particularly Fairbanks residents, as local residents of Unit 20D. This change in data tabulation has been corrected, and Table 9 has been recalculated for all years to reflect the change.

The proportion of local hunters (residing in Unit 20D) has been decreasing since the mid–1980s (Table 9). In 1986–1987, 59% of Unit 20D hunters were local residents. That proportion was fairly stable during the 1990s ranging from 48 to 55%. However, during RY99–RY01, the proportion of local hunters declined to a low of 39% in RY01, due primarily to more nonlocal hunters. An average of 86 nonlocal hunters per year were successful in RY94–RY98, but increased to an average of 116 per year during RY99–RY01 (Table 9).

Hunter Effort. Mean days hunted by all hunters during RY99–RY01 was very similar to the previous 5 years (Table 10).

Permit Hunts. Tier II permit hunt number TM787 was conducted during 1 January–15 February of RY99–RY01. Fifteen permits were issued annually, with a harvest quota of 5 bulls. Participation in the hunt was low with 47% and 60% of permittees not hunting during RY99–RY00. No moose were killed in either year (Table 7). Data were not available for RY01.

Ten permits were issued each year from RY99 through RY01 for hunt DM790. The number of applications increased from 458 in RY98 to 672 in RY99, 784 in RY00, and 697 in RY01. Hunters killed 7 bull moose in RY99, 6 in RY00, and only 4 moose in RY01 (Table 6).

Harvest Chronology. During this reporting period, general season harvest chronology remained similar to previous years, with most harvest occurring during the first 5 days of the 15–day general season (Table 11).

Transport Methods. During this reporting period, highway vehicles, 3- or 4-wheelers, and boats continued to be the most common modes of transportation used by successful hunters (Table 12).

Natural Mortality

No estimates of natural mortality were calculated during this reporting period. However, predation by wolves, grizzly bears, and black bears is believed significant in Unit 20D. Predation is thought to limit moose population growth in the northern half of Unit 20D and account for reduced calf survival in portions of southern Unit 20D.

HABITAT

Assessment

Browse survey data collected in 2000 and 2001 had not been analyzed at the time of this report. Although twinning rates in southwestern Unit 20D indicate browse is limiting production of this high-density moose population, initial impressions from browse surveys is that forage is plentiful.

Enhancement

During RY99-00 we conducted no habitat enhancement projects.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates were completed for Unit 20D and results indicated that the moose population did not meet the objective established by the Board of Game. Unitwide harvest of moose increased but is below the objective established by the board. However, harvest and the number of hunters have been increasing.

The bull:cow ratio in southern Unit 20D was likely declining. The decline was likely due to increasing number of hunters and harvest in southwestern Unit 20D. This situation should be monitored closely in the future and may require further regulatory changes if the ratio gets lower than the present 16 bulls per 100 cows.

Participation in the Tier II permit hunt in southeastern Unit 20D continued to be low and no moose were harvested during RY99–RY00. The necessity for this hunt should be evaluated with consideration given to eliminating the hunt. Extra hunting seasons in the Healy River drainage did not appear to be utilized by residents of Healy Lake, with no moose reported taken during the extra seasons. Therefore, eliminating the August and January–February season in this drainage should be considered.

The unitwide population objective needs to be subdivided, as a minimum, into northern and southern Unit 20D objectives. The unitwide population objective of 8000–10,000 moose does not account for differences in moose density, habitat quality, harvest rates, predation rates, and other factors that are substantially different between these areas.

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Table 1 Results of 1999 Geo–Statistical Population Estimator (GSPE) survey for northern Unit 20D

Parameter	1996–1997 Gasaway method estimate	1999 GSPE
Total $_{\text{pop est}}$	2026	2395
LCI	1583	2070
UCI	2469	2719
Total $_{\text{calf}}$	268	213
LCI	171	165
UCI	365	262
Total $_{\text{cow}}$	1255	1181
LCI	967	979
UCI	1543	1384
Total $_{\text{bull}}$	504	957
LCI	364	805
UCI	644	1109
Bulls:100 Cows		81
LCI		69
UCI		93
Calves:100 Cows		18
LCI		14
UCI		22

Table 2 Unit 20D moose hunting seasons and bag limits, regulatory years 1999–2000 through 2001–2002

Regulatory year	Area	Season		Bag limit
1999–2000 through 2001–2002	South of Tanana River and west of Johnson River, except Delta Junction Management Area	Resident:	1–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least 1 side.
		Nonresident:	5–15 Sep	1 bull with 50-inch antlers[a].
	Within Delta Junction Management Area	Resident:	1–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines by drawing permits.
		Nonresident:	5–15 Sep	1 bull with 50-inch antlers[a] by drawing permit DM790.
	South of Tanana River and east of Johnson River	Resident:	1–15 Sep	1 bull.
			1 Jan–15 Feb	1 bull by Tier II permit TM787.
		Nonresident:	No open season	
	Within the Healy River drainage	Resident:	15–28 Aug	1 bull with spike-fork antlers.
			1–15 Sep	1 bull.
			1 Jan–15 Feb	1 bull.
		Nonresident:	1–15 Sep	1 bull.
	Remainder of Unit 20D (north of Tanana River)	Resident:	1–15 Sep	1 bull.
		Nonresident:	1–15 Sep	1 bull.

[a] 50-inch antlers defined as having a spread of at least 50 inches or at least 4 brow tines on at least 1 side.

Table 3 Results of population estimates for southern Unit 20D using a "Gasaway" Method survey and Geostatistical Population Estimator (GSPE) surveys, 1995–2001

Parameter	1995 Gasaway method	1998 Gasaway method	1998 GSPE	2000 GSPE	2001 GSPE
Total pop est	2522	4050	3630	3932	3435
LCI	1979	2826	2533	3245	2643
UCI	3065	5275	4727	4618	4227
Total calves	552	937	863	676	575
LCI	411	682	630	498	453
UCI	693	1191	1097	855	697
Total cows	1626	2580	2321	2530	2424
LCI	1271	1741	1570	2021	1840
UCI	1981	3418	3072	3039	3009
Total bulls	343	530	479	671	392
LCI	249	350	305	530	281
UCI	437	710	653	813	504
Bulls:100 Cows	21	21	21	27	16
LCI	17	16	16	19	10
UCI	25	25	25	34	22
Calves:100 Cows	34	36	37	27	24
LCI	29	32	32	22	16
UCI	39	41	42	31	32

Table 4 Unit 20D moose harvest and accidental death, regulatory years 1986–1987 through 2001–2002

Regulatory year	Harvest by hunters							Accidental death			Total
	Reported				Estimated						
	M	F	Unk	Total	Unreported[a]	Illegal	Total	Road	Train[b]	Total	
1986–1987	130	0	0	130	23	4	27	15	0	15	172
1987–1988	126	0	0	126	22	10	32	26	0	26	184
1988–1989	126	0	0	126	22	13	35	27	0	27	188
1989–1990	128	0	0	128	23	9	32	16	0	16	176
1990–1991	118	1	0	119	21	4	25	11	0	11	155
1991–1992	143	1	0	144	25	11	36	13	0	13	193
1992–1993	143	0	1	144	25	5	30	32	0	32	206
1993–1994	154	0	1	155	27	14	41	30	0	30	226
1994–1995	128	0	0	128	23	7	30	31	0	31	189
1995–1996	138	0	0	138	24	20	44	25	0	25	207
1996–1997	214	0	0	214	38	22	60	39	0	39	313
1997–1998	210	0	0	210	37	15	52	48	0	48	310
1998–1999	234	0	0	234	41	11	52	31	0	31	317
1999–2000	184	0	0	184	33	7	40	40	0	40	264
2000–2001	246	0	0	246	44	20	64	37	0	37	347
2001–2002	182	0	0	182	32	17	49	32	0	32	263

[a] Based on 17.7% unreported harvest estimated by Gasaway et al. (1992).
[b] Not applicable in Unit 20D.

Table 5 Southwestern (SW), southeastern (SE), northwestern (NW), and northeastern (NE) Unit 20D reported moose harvest and number of hunters during general seasons, regulatory years 1984–1985 through 2001–2002

Regulatory	Moose harvest						Hunters					
year	SW	SE	NW	NE	Unk	Total	SW	SE	NW	NE	Unk	Total
1984–1985	39[a]	9[b]	40[c]	14[c]	0	102	236[a]	47[b]	294[c]	48[c]	10	635
1985–1986	48[d]	8[b]	60[d]	14[d]	0	130	236[d]	37[b]	272[d]	50[d]	9	604
1986–1987	76[d]	10[b]	40[d]	10[d]	1	137	250[d]	45[b]	232[d]	57[d]	12	596
1987–1988	66[d]	8[b]	43[d]	9[d]	0	126	296[d]	35[b]	208[d]	35[d]	17	591
1988–1989	60[e]	12[b]	39[d]	12[d]	3	126	244[e]	45[b]	201[d]	37[d]	28	555
1989–1990	60[e]	11[b]	41[d]	10[d]	5	127	303[e]	47[b]	191[d]	39[d]	40	620
1990–1991	58[f]	9[c]	40[g]	7[d]	4	118	270[f]	29[c]	195[g]	26[d]	28	548
1991–1992	54[f]	12[c]	66[g]	9[d]	3	144	331[f]	51[c]	231[g]	26[d]	19	658
1992–1993	59[f]	12[c]	58[g]	5[d]	9	143	329[f]	49[c]	257[g]	34[d]	48	717
1993–1994	74[h]	9[c]	58[c]	11[c]	2	154	324	33[c]	259[c]	29[c]	47	692
1994–1995	61[h]	7[c]	49[c]	9[c]	2	128	339	42[c]	267[c]	33[c]	28	709
1995–1996	60[h]	14[c]	50[c]	12[c]	2	138	301	32[c]	237[c]	42[c]	33	645
1996–1997	103[h]	13[c]	74[c]	16[c]	5	211	320	40[c]	267[c]	35[c]	31	693
1997–1998	88[h]	13[c]	72[c]	19[c]	10	202	325[h]	38[c]	241[c]	46[c]	33	683
1998–1999	122[h]	17[c]	64[c]	16[i]	8	227	431[h]	43[c]	231[c]	43[i]	47	795
1999–2000	107[h]	12[c]	42[c]	12[i]	4	177	358[h]	43[c]	177[c]	29[i]	37	644
2000–2001	140[h]	12[c]	65[c]	18[i]	5	240	355[h]	41[c]	194[c]	35[i]	32	657
2001–2002	101[h]	10[c]	52[c]	14[i]	1	178	425[h]	31[c]	221[c]	41[i]	26	744

[a] Season 1–6 Sep; 1 bull.
[b] Season 1–20 Sep; 1 bull.
[c] Season 1–15 Sep; 1 bull.
[d] Season 1–10 Sep; 1 bull.
[e] Season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 3 brow tines on 1 antler.
[f] Subsistence/resident season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 3 brow tines on 1 antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on 1 antler.
[g] West of pipeline season 1–15 Sep; 1 bull. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on 1 side. Remainder area 1–10 Sep; 1 bull.
[h] Resident season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 4 brow tines on 1 antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 4 brow tines on 1 antler.
[i] Resident season within 1–15 Sep; 1 bull. Within Healy River drainage: resident season 15–18 Aug, 1 bull with spike-fork antlers; 1–15 Sep, 1 bull; 1 Jan–15 Feb, 1 bull; nonresident season, 1–15 Sep; 1 bull. Remainder area is resident and nonresident 1–15 Sep, 1 bull.

Table 6 Unit 20D Delta Junction Management Area moose drawing permit harvest, regulatory years 1996–1997 through 2001–2002

Hunt /Area	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Percent bulls	Percent cows	Unk	Harvest
DM790	1996–1997	5	0	40	60	100	0	0	3
DM790	1997–1998	10	20	0	80	100	0	0	8
DM790	1998–1999	10	0	0	100	100	0	0	10
DM790	1999–2000	10	0	30	70	100	0	0	7
DM790	2000–2001	10	20	20	60	100	0	0	6
DM790	2001–2002	10	20	40	40	100	0	0	4

Table 7 Unit 20D moose Tier II permit harvest, regulatory years 1989–1990 through 2001–2002

Hunt number	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Percent bulls	Percent cows	Unk	Harvest
988	1989–1990	15	27	91	9	100	0	0	1
987T	1990–1991	15	20	86	14	100	0	0	1
987T	1991–1992	15	67	100	0	0	0	0	0
987T	1992–1993	15	20	91	9	100	0	0	1
787	1993–1994	15	47	100	0	0	0	0	0
787	1994–1995	15	27	91	9	100	0	0	1
TM787	1995–1996	15	47	100	0	0	0	0	0
TM787	1996–1997	15	53	86	14	100	0	0	1
TM787	1997–1998	15	73	100	0	0	0	0	0
TM787	1998–1999	15	67	100	0	0	0	0	0
TM787	1999–2000	15	47	53	0	0	0	0	0
TM787	2000–2001	15	60	40	0	0	0	0	0
TM787	2001–2002	15	NA	NA	NA	NA	NA	NA	NA

Table 8 Unit 20D Healy River (Uniform Coding Unit 501) reported moose harvest, regulatory years 1993–1994 through 2001–2002

Regulatory year	Unit 20D Healy River	
	Hunters	Harvest
1993–1994[a]	9	2
1994–1995[a]	13	2
1995–1996[a]	24	2
1996–1997[a]	10	2
1997–1998[a]	14	3
1998–1999[b]	19	5
1999–2000[b]	21	7
2000–2001[b]	24	6
2001–2002[b]	23	5

[a] Resident moose hunting season 1–15 Sep, 1 bull.
[b] Resident moose hunting season: 15–28 Aug, 1 spike-fork bull; 1–15 Sep, 1 bull; 1 Jan–15 Feb, 1 bull.

Table 9 Unit 20D moose hunter residency and success[a], regulatory years 1986–1987 through 2001–2002

Regulatory year	Successful						Unsuccessful						Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
1986–1987	83	51	1	2	137	(23)	270	175	12	3	460	(77)	597
1987–1988	64	48	7	6	125	(21)	279	156	18	15	468	(79)	593
1988–1989	71	43	10	2	126	(23)	215	176	31	7	429	(77)	555
1989–1990	53	62	8	4	127	(20)	263	198	23	9	493	(80)	620
1990–1991	64	55	4	3	126	(21)	243	193	31	3	470	(79)	596
1991–1992	72	67	4	1	144	(22)	280	215	13	7	515	(78)	659
1992–1993	65	67	8	3	143	(20)	306	218	37	14	575	(80)	718
1993–1994	82	68	2	2	154	(22)	298	221	17	2	538	(78)	692
1994–1995	59	65	2	2	128	(18)	319	247	11	4	581	(82)	709
1995–1996	66	63	9	4	142	(21)	249	256	20	12	537	(79)	679
1996–1997	91	108	11	1	211	(29)	277	224	14	2	517	(71)	728
1997–1998	102	90	11	0	203	(29)	264	213	26	2	505	(71)	708
1998–1999	105	104	13	4	226	(28)	278	267	24	3	572	(72)	798
1999–2000	70	96	11	0	177	(22)	311	303	24	6	644	(78)	821
2000–2001	86	144	10	0	240	(27)	283	341	29	4	657	(73)	897
2001–2002	54	108	14	2	178	(19)	301	391	47	5	744	(81)	922

[a] Excludes hunters in permit hunts.
[b] Local means reside in Unit 20D.

Table 10 Southwestern, southeastern, northwestern, and northeastern Unit 20D moose hunter success and mean days hunted[a], regulatory years 1986–1987 through 2001–2002

Regulatory	Successful hunters					Unsuccessful hunters				
year	SW	SE	NW	NE	Total	SW	SE	NW	NE	Total
1986–1987	3.8	3.0	5.3	4.1	3.9	5.5	10.5	6.1	7.0	6.0
1987–1988	4.4	7.3	4.8	3.9	4.7	5.3	7.5	6.7	6.5	6.1
1988–1989	4.6	6.2	5.3	4.5	5.0	5.9	6.3	5.8	6.5	6.0
1989–1990	4.7	4.5	4.1	5.1	4.6	9.7	5.7	5.9	5.3	5.9
1990–1991	4.9	6.6	3.9	6.5	4.7	3.5	5.6	5.8	6.3	5.9
1991–1992	6.0	4.9	5.5	4.2	5.6	5.9	7.0	6.8	5.6	6.3
1992–1993	4.7	5.7	5.4	4.9	5.0	5.9	5.1	6.8	5.2	6.2
1993–1994	5.4	4.4	6.2	7.5	5.7	6.2	7.5	6.6	9.4	6.5
1994–1995	5.1	6.3	5.9	4.2	5.4	5.9	4.9	6.2	7.2	6.1
1995–1996	7.2	5.4	5.6	4.5	6.3	6.9	4.9	7.2	7.2	6.9
1996–1997	4.9	4.2	4.9	6.6	5.0	6.5	5.0	6.7	6.9	6.6
1997–1998	5.3	5.3	6.9	5.1	5.9	7.0	5.5	6.7	7.4	6.9
1998–1999	6.9	13.4	7.6	3.8	7.3	8.0	5.3	7.1	9.5	7.7
1999–2000	5.5	8.5	5.7	4.5	5.7	7.7	7.8	7.8	5.4	7.7
2000–2001	5.1	4.6	5.3	4.0	5.0	6.9	7.9	6.9	5.9	6.9
2001–2002	6.4	5.4	6.0	5.5	6.1	6.9	5.8	7.2	5.5	6.9

[a] Excludes permit hunt harvest.

Table 11 Unit 20D moose harvest[a] chronology percent by month/day, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest chronology percent by month/day				*n*
	9/1–9/5	9/6–9/10	9/11–9/15	Unk	
1990–1991	57	20	23	0	109
1991–1992	57	22	16	5	141
1992–1993	50	30	18	3	139
1993–1994	42	26	28	4	154
1994–1995	45	25	22	8	128
1995–1996	41	20	33	6	138
1996–1997	51	23	23	3	208
1997–1998	44	24	30	3	196
1998–1999	44	30	24	2	223
1999–2000	41	30	24	5	175
2000–2001	49	27	23	4	237
2001–2002	44	34	21	2	172

[a] Excludes permit hunt harvest.

Table 12 Unit 20D moose harvest percent[a] by transport method, regulatory years 1987–1988 through 2001–2002

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboats	Unknown	*n*
1987–1988	8	2	27	20	0	8	29		6	126
1988–1989	10	2	24	18	0	9	29		9	126
1989–1990	10	3	29	13	0	12	29		3	127
1990–1991	7	0	25	20	0	12	33		3	118
1991–1992	13	3	23	25	0	8	24		3	144
1992–1993	8	1	26	18	<1	8	36		1	143
1993–1994	6	1	30	25	1	7	29		2	154
1994–1995	4	2	29	28	0	11	23		3	128
1995–1996	6	2	33	18	0	8	28		5	142
1996–1997	4	<1	27	28	0	8	31		2	210
1997–1998	5	1	23	32	0	5	31	<1	2	202
1998–1999	7	1	26	26	0	4	34	0	2	227
1999–2000	5	2	21	38	0	5	27	1	2	177
2000–2001	5	1	19	34	0	5	32	2	2	240
2001–2002	3	2	25	34	0	7	24	2	4	178

[a] Excludes permit hunt harvest.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 20E (10,680 mi^2)

GEOGRAPHIC DESCRIPTION: Charley, Fortymile, and Ladue River drainages

BACKGROUND

During the 1950s to the early 1960s, synchronous to the federal predator control program, the moose population in Unit 20E increased to a minimum of 12,000 moose. The population declined rapidly during 1965 through 1976, reaching an estimated low of 2200 moose. During 1976–2001 the moose population in Unit 20E remained at low densities (0.2–0.6 moose/mi^2). Gasaway et al. (1992) evaluated the roles that predation, nutrition, snow, harvest, and disease played in maintaining the moose population at low densities. They concluded that predation was the primary limiting factor and that other variables had little to no impact.

During the early 1980s, in response to declining moose and caribou populations, the Alaska Department of Fish and Game initiated 2 predator management programs. Between 1981 and 1983 the wolf population was reduced by 54% in a 3800-mi^2 area of Unit 20E using a combination of aerial gunning and public trapping. In addition, grizzly bear hunting regulations were liberalized in 1981, causing moderate harvest increases in portions of the subunit, probable local declines in grizzly bear numbers, and changes in the bear population age and sex structure (Gardner 1999).

Between 1981 and 1990 the moose population increased by about 4–9% per year. The increase was probably due to combined effects of favorable climatic conditions, reduced predation, and an increased number of alternate prey, i.e., Fortymile caribou. During this period the moose population did not increase beyond the ability of wolves and bears to maintain the population at low densities, and between 1990 and 2001 it remained at 0.5–0.6 moose/mi^2.

Prior to 1992, moose in Unit 20E were primarily hunted by local residents as well as residents from Fairbanks and Southeast Alaska. Historically, harvest was low in relation to the moose population and was largely restricted to the Taylor Highway corridor and the Mosquito Fork drainage. During 1992–2000, more hunters from Southcentral Alaska traveled to Unit 20E to hunt moose in response to more restrictive moose hunting regulations in the southcentral units and for the opportunity to hunt both moose and caribou simultaneously.

During the 1960s, high moose densities supported a long hunting season and a bag limit of 1 moose. As moose numbers began to decline, harvests were first reduced by shortening the season length in 1973 and then by eliminating cow seasons in 1974. However, the population continued to decline throughout Unit 20, and in 1977 moose hunting in Unit 20E (then a portion of Unit 20C) was terminated. A 10-day bulls-only season was opened in 1982 and continued until 1991. The season was lengthened to 15 days during 1991–2000. In response to increasing number of hunters and harvest, in most of Unit 20E, the fall moose season was split in 2001 into a 5-day August season and a 10-day September season and was managed under a registration permit.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population in concert with other components of the ecosystem.
- Continue sustained opportunities for subsistence use of moose.
- Maximize sustained opportunities to participate in hunting moose.
- Maximize opportunities for the nonconsumptive use of moose.

MANAGEMENT OBJECTIVES

- Maintain a posthunting ratio of at least 40 bulls:100 cows in all survey areas.

INTENSIVE MANAGEMENT OBJECTIVES

In that portion of Unit 20E within the Fortymile and Ladue River drainages.

- Population: 8000–10,000 moose.
- Harvest: 500–1000 moose annually.

METHODS

POPULATION STATUS

We conducted moose population estimation surveys in southwestern and western Unit 20E (Mosquito Flats and Tok West Study Areas) in 1981, 1988, 1992, 1995 and 1998–2001 and in southeastern and central Unit 20E (Ladue River and Tok Central Study Areas) in 1992, 1996, and 1998–2001. We used the standard Gasaway et al. (1986) technique in 1981 and 1989 and modifications of that technique developed by Mark McNay (ADF&G, personal communication) in 1992 and by Rod Boertje, Jay Ver Hoef, and Craig Gardner (ADF&G) in 1995–1996. During 1998–2001 we used a technique developed by Jay Ver Hoef (2001) that is based on spatial correlation.

The Ladue River Study Area was expanded in 1998 and in 2000 to include more area than was being intensively hunted during the fall and winter moose seasons. To reduce confusion, we renamed this larger area, Tok Central.

During 1999, Yukon Department of Renewable Resources staff used the spatial correlation sampling technique (Ver Hoef 2001) in a 900-mi^2 area adjacent to our Tok Central study area. This allowed us to expand the moose population size and composition estimates to include more of the White and Ladue River drainages in the Yukon.

These data were used to determine population trends and composition in the study areas, to evaluate the effects of wolf and grizzly predation, habitat quality, and harvest, and in combination, to estimate total number of moose in Unit 20E. The different count areas differed in habitat quality, wolf and grizzly bear population densities, and hunter use.

To evaluate the effects on moose of a nonlethal wolf control program (Boertje and Gardner 1999), we surveyed portions of western Unit 20E and northern Unit 20D (referred to Tok West Study Area) using the spatial correlation method (Ver Hoef 2001). This area will be surveyed annually until 2005 to determine moose population and composition trends. The nonlethal wolf control program was conducted in western Unit 20E, northern Unit 20D, and eastern Unit 20B during 1997–2001.

During 1997 and 1999, moose population trend and composition was monitored in northern Unit 20E within the Yukon–Charley Rivers National Preserve by the National Park Service (NPS) (J Burch, NPS, personal communication).

COMPOSITION SURVEYS

Sex and age composition was estimated in 2–10 traditional trend count areas during October and November 1993, 1994, 1996, and 1999, and in 1995, 1996, 1998, and 1999–2001 while conducting population estimation surveys in the Tok West and Tok Central study areas. All moose observed were classified as large bulls (antlers >50 inches), medium bulls (antlers larger than yearlings but <50 inches), yearling bulls (spike, cerviform, or small palmate antlers without brow separation), cows without calves, cows with 1 calf, cows with 2 calves, lone calves, or unidentified moose.

HARVEST

Harvest was estimated using harvest report cards (after reminder letters were sent) and in 2001, within most of Unit 20E, by registration permit reports. Information obtained from the reports was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001).

HABITAT ENHANCEMENT

Natural wildfires were managed under the Alaska Interagency Fire Management Plan. Three prescribed burns were ignited in Unit 20E during 1997 and 1998 using aerial firing from a Ping-Pong sphere dispenser. Firing activities were conducted following a strict burn prescription developed specifically for each of the 3 areas and based on the Fire Weather Index and Fire Behavior Prediction modules of the Canadian Forest Fire Danger Rating System (Stocks et al. 1989).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During 1981–1995, 4 population estimation surveys were conducted in a 964–2978 mi^2 (2500–7700 km^2) area in southwestern Unit 20E (Gardner 1998). The annual rate of increase during 1981–1987 was 1.08, and during 1988–1995 it was 1.01 indicating the moose population in southwestern Unit 20E increased through the 1980s until 1988 and remained relatively stable during 1989–1995.

In 1992 we conducted the first population estimation survey in a 735-mi^2 area in southeastern Unit 20E. The estimated moose population was 652 ± 21% (90% CI). Mean density was 0.89 moose/mi^2, 29% greater than the density found in the adjacent southwestern portion of the subunit. We conducted a population estimate survey in southeastern Unit 20E again in 1996 (944 ± 26%, 90% CI), but results are not directly comparable because during 1992 we did not estimate a sightability correction factor. Based on estimates generated from observed moose, moose numbers in this area increased by 12.9% during 1992–1996, an annual rate of increase of 1.03.

A combination of nonlethal wolf control (fertility control and relocation) and public trapping occurred in western Unit 20E, northeastern Unit 20D, eastern Unit 20B and southeastern Unit 25C during November 1997–April 2001. Wolf numbers were reduced by about 80% within 15 wolf pack territories. Prior to wolf reduction efforts, moose population estimates (0.2–0.5 moose/mi^2) were obtained from portions of this area (Gardner 1998). Brown and black bear harvest records indicate harvest was below sustainable levels in most of the wolf control area. The 1998 through 2001 Tok West (the southern portion of the wolf control area) moose population estimates ranged from 824 ± 19% (90% CI) to 1115 ± 23% (90% CI), 0.43–0.58 moose/mi^2. Regression analysis indicates no change ($p = 0.75$) in population size since wolves were reduced. Also, the confidence limits of the 4 population estimates overlap indicating no change. Mean densities were 0.43/mi^2.

The 1998 Tok Central (Alaska only) moose population and density estimates were 1444 ± 22% (90% CI) and 0.52 moose/mi^2. Including the Yukon data, the 1999 density estimate within the White and Ladue River drainages and along the Alaska Highway in both Alaska and Yukon was 0.48 moose/mi^2. These data indicate little difference between moose densities across the border and that little change in moose numbers occurred between 1998 and 1999.

The Tok Central area was expanded during both 2000 and 2001 to include areas where more hunting occurs. This increased area offered more high quality moose habitat (previously burned areas) resulting in higher density estimates. The 2000 and 2001 density estimates were 0.70/mi^2 and 0.75/mi^2, respectively.

The NPS conducted population estimation surveys in northern Unit 20E within the Yukon–Charley Rivers National Preserve west of Washington Creek and south of the Yukon River in 1994 and 1997. They found about 0.30 moose/mi^2 during both years (Bruce Dale, ADF&G, personal communication). The NPS surveyed both north and south of the Yukon River in 1999 and the estimate for the entire area was 0.37 moose/mi^2.

No formal surveys were conducted in the northeastern portion of Unit 20E (approximately 15% of the unit). I estimated moose population size (0.3 moose/mi^2) in that area by using a combination of data including the amount of suitable moose habitat, harvest, and the number of moose concentration areas in comparison to the areas in the subunit that were sampled.

Combining the population estimates, the 2001 population estimate for Unit 20E was 4500–5300 moose (0.42–0.53 moose/mi^2 of moose habitat). The 1999 estimate was 4600–5500 moose. The difference between estimates could be due to either sampling (more area was surveyed in 2001, increasing accuracy) or a moose population decline. McNay and DeLong's (1998) PredPrey model incorporating what we know about predator and harvest levels and moose calf and yearling recruitment indicated the population declined by 1–4% annually over the past 4 years.

The Alaska Board of Game identified the moose population within the Fortymile and Ladue River drainages as important for high levels of human consumptive use under the Intensive Management Law (AS 16.05.255[e]–[g]). This designation means the board must consider intensive management if regulatory action to significantly reduce harvest becomes necessary because the population is depleted or has reduced productivity. The board established the population and harvest objectives for Unit 20E moose within the Fortymile and Ladue River drainages at 8000–10,000 and 500–1000 moose. In RY01 neither the population nor harvest objectives were met and, based on moose, caribou, wolf, and grizzly bear population trends, these objectives will not be met in the foreseeable future unless predation is reduced.

Gasaway et al. (1992) reported that the Unit 20E moose population was maintained at a low density dynamic equilibrium (0.2–1.0 moose/mi^2) by wolf and grizzly bear predation and that habitat, harvest, and disease were not limiting population growth. They determined predator management was necessary to increase the moose population and to maintain it at a higher abundance level. There has been much public and scientific debate over whether wolf control combined with public grizzly bear harvest would cause a moose population increase in Unit 20E. Gasaway et al. (1992) recommended altering wolf and bear predation simultaneously. Reducing predation of only 1 species may result in compensatory predation by another species. Opponents of wolf control argue that reducing wolves will not benefit the moose population because grizzly bears are the primary predator on calves, which is the major limiting factor. Additional arguments have been made that wolf control was tried and failed in Unit 20E. They based their conclusions on results of the wolf control program conducted in Unit 20E during 1981–1983. Unfortunately, this program was terminated prematurely due to political decisions.

To simulate potential consequences of different methods of intensive management on moose numbers in the Fortymile/Ladue drainages, I modeled current population status and trend data for moose and their predators using the McNay and DeLong (1998) Predprey model. Results indicate that the Unit 20E moose population continues to be primarily limited by grizzly bear predation on calves. Gasaway et al. (1992) estimated that between 1981 and 1988, 65% of calf mortality was due to grizzly bears. In order for the model to track current population status, grizzly bears had to cause 58–62% of the calf mortality during 1997–2001.

The effects of wolf predation on Unit 20E moose trend are expected to increase. During 1997–2001, wolf control activities reduced wolf numbers in the western portion of the unit. Wolf numbers will increase substantially in that area once the effects of wolf control end. Throughout the unit, wolf numbers will probably increase because caribou numbers are high and increasing allowing for high wolf productivity and survival. It is highly probable that the Unit 20E moose population will decline to 0.2–0.3 moose/mi^2 unless wolf numbers, grizzly numbers, or both are reduced.

Assuming grizzly bear predation rates remain relatively constant during the next 5 years, the model predicts that the effect of nonlethal wolf control will be minimal on population trend (annual growth rates = 0.97–1.00). Calf:cow ratios will range in the high teens to low-20s:100 cows and the bull:cow ratio will decline due to harvest.

The factors that appear to limit the effects of the nonlethal wolf control program (1997–2001) on moose are high predation rates on calves by grizzly bears, wolf preferences for caribou as their primary prey, and that the program was conducted in only a portion of the subunit. If 80% of the wolves were removed throughout the subunit and bear mortality continued at current rates, the moose population is estimated to increase 3–10% annually. This growth rate is well below levels (λ = 1.15) observed in areas where wolf control was conducted and grizzly bears were not the primary predator on moose (Boertje et al. 1996). It is possible the model is not an accurate predictor in this situation. It may not be able to accurately predict the effects of reducing the current moderate wolf predation rates throughout the year on all moose sex and age classes in relation to continued high grizzly bear predation on calves.

Moose numbers would remain stable or slightly increase (1–3% annually) if the number of grizzly bears or their predation efficiency were reduced by 2–3% annually and wolf predation increased at the expected rate. More significant decrease in grizzly bear numbers (25%) could cause a 5–10% increase. This was the objective for liberalizing the Unit 20E grizzly bear regulations in 1981, i.e., to try to reduce the grizzly bear population through harvest.

Grizzly bear harvest did increase in portions of the unit after bear hunting regulations were liberalized. Sex and age composition data collected from harvested bears indicate that in the area where the greatest harvest occurred, the bear population declined and composition changed to a greater proportion of young males (Gardner 1999). If the intensive management law is implemented in Unit 20E, bear predation rates on calves must be reduced before substantial increases in the moose population can occur. Even with liberalized grizzly bear harvest regulations during 1982–2001, harvest was not high enough to consistently improve moose calf survival, although some improved calf survival was observed.

To reduce the effects of grizzly bear predation on calves, either the number of bears would have to be reduced to a level at which compensatory bear predation is no longer a factor, or the efficiency with which bear kill calves would have to be reduced. Based on personal observations during moose calf mortality studies where grizzly bears were translocated, fewer bears can kill more calves per bear. There must be a point where bear reduction is great enough that fewer calves will be killed by grizzly bears. Since females with cubs are protected from harvest but are efficient predators on moose calves (Boertje et al. 1988), a greater percentage of males and unaccompanied females would have to occur. Beginning in RY02, grizzly bear regulations will be more liberal by not requiring a trophy tag fee for Alaskan residents. This direction is being attempted again because the number of hunters in the field during the fall is currently over 1,600 and is expected to increase to over 2000 in RY02, the highest since 1972. If through a public awareness campaign the number of grizzly bears incidentally harvested by moose and caribou hunters increases, it may reach a level necessary to cause substantial declines in bear numbers, resulting in increased moose calf and adult survival.

Model results continue to support the recommendation that moderate reductions of wolves and bears would better suit moose management in Unit 20E compared with strong reductions in either predator population (Gasaway et al. 1992). If trappers could remove 30–35% of the wolf population annually and grizzly bear numbers were reduced by 25%, moose numbers could increase 3–12% annually.

If harvest does not prove to be effective in reducing grizzly bear predation on moose, other methods may help reduce bear predation efficiency. Two possibilities for Unit 20E are supplementary feeding of bears (Boertje et al. 1996) or creating a situation where bears are not as efficient a predator. Bear predation efficiency declined in early successional habitats following wildfires (Schwartz and Franzmann 1989). Combining liberal grizzly bear harvests with habitat enhancement programs may increase moose calf survival.

Population Composition

During 2000 and 2001 we collected composition data in the Tok West and Tok Central survey areas (Table 1). Calf recruitment was poor, ranging between 10–21 calves:100 cows. Calf survival to 5 months has been poor (≤23:100) since 1998. Composition data collected during the population estimation surveys indicate cows with calves selected areas away from the large concentrations of moose. In 1999 the calf:cow ratio was 42 calves:100 cows in the low strata compared to 12 calves:100 cows in the high strata. Calf:cow ratios may be underestimated if based entirely on results collected from traditional trend count areas, which were selected on the basis of high moose density.

The Unit 20E bull:cow ratio remained above the management objective, but was declining in portions of the unit. The number of hunters has increased since 1992 and access into Unit 20E increased as new trails and landing areas were pioneered. In the most popular hunting areas (Nine Mile Trail, Mitchell’s Ranch, and along the Yukon River and Taylor Highway) bull populations declined most noticeably, but still met or exceeded the management objective of 40:100. The bull:cow ratio in the Nine Mile Trail area declined to 27:100 by 1992 due to harvest but subsequently increased to about 40 bulls:100 cows by 1999, probably because of access restrictions enacted in 1993. Access into much of Unit 20E continues to be difficult but moose hunters are beginning to find more of the moose concentration areas and the effects of harvest is becoming more noticeable unitwide.

Modeling data indicates that if calf recruitment remains below 30 calves:100, the bull:cow ratio will decline with current harvest levels. Even with hunting season and access restrictions, I expect the bull population to decrease and the bull:cow ratio to decline below 50 bulls:100 cows in many areas of the unit by 2005.

The long-term calf survival trend in Unit 20E is as follows. The average calf:cow ratios increased from 12.7:100 during 1973–1981 to 19.3:100 during 1982–1988, and 28.7:100 during 1989–1993. Average calf ratios declined to 21:100 between 1994 and 1999 and 15:100 during 2000 and 2001. The increase in calf survival during 1982–1993 was attributed to several factors, including a possible decline in the grizzly bear population in the central part of the subunit (Boertje et al. 1985). In contrast, the grizzly bear population in the eastern portion of the subunit was lightly harvested and probably remained stable. If reducing bear numbers by harvest reduced bear predation on calves, there may have been a difference in calf recruitment between the areas that received high versus low bear harvests. I analyzed this data for 1981–1997 (Gardner 1999) and found no significant difference in calf recruitment between the 2 areas. However, the area of low bear harvests was extensively burned and had a much higher moose density, possibly because of decreased efficiency of predators (Boertje et al. 1985). Since 1997, grizzly bear harvest has been within sustainable levels throughout the unit.

Distribution and Movements

Moose are distributed throughout Unit 20E below elevations of 4500 feet. Most radiocollared moose moved seasonally from lowland summer habitat to upland rutting areas, where they remained until winter conditions caused them to move back to lower elevations. In fall 1988, 1992, 1999, and 2000 early deep snowfall (>22 inches) caused moose to move to lower elevations during November. During 1995 and 1998, low snowfall allowed moose to remain at higher elevations until at least January.

MORTALITY

Harvest

<u>Season and Bag Limit</u>.

RY99–RY00

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 20E, in the Ladue River Controlled Use Area. 1 bull per regulatory year, only as follows:		
1 bull with spike-fork antlers.	15 Aug–28 Aug	
1 bull.	1 Sep–15 Sep	
1 bull by drawing permit only.	1 Nov–30 Nov	

Units and Bag Limits	Resident Open Season	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.		5 Sep–15 Sep
Unit 20E, that portion draining into the Yukon River upstream from and including the Charley River drainages to and including the Boundary Creek drainages and the Taylor Highway from mile 145 to Eagle.		
RESIDENT HUNTERS: 1 bull with spike-fork antlers.	15 Aug–28 Aug	
1 bull.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.		5 Sep–25 Sep
Remainder of Unit 20E		
RESIDENT HUNTERS: 1 bull with spike-fork antlers.	15 Aug–28 Aug	
1 bull.	1 Sep–15 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.		5 Sep–15 Sep

RY01

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 20E, that portion within the Ladue River Controlled		

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Use Area.		
RESIDENT HUNTERS: 1 bull per regulatory year, only as follows:		
1 bull by registration permit only.	24 Aug–28 Aug 8 Sep–17 Sep	
1 bull by drawing permit only.	1 Nov–30 Nov	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by registration permit.		8 Sep–17 Sep
Unit 20E, that portion draining into the Yukon River upstream from and including the Charley River drainages to and including the Boundary Creek drainages and the Taylor Highway from mile 145 to Eagle.		
RESIDENT HUNTERS: 1 bull by registration permit only	24 Aug–28 Aug 5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by registration permit only		5 Sep–25 Sep
Unit 20E, that portion draining into the Middle Fork of the Fortymile River upstream from the drainage of the North Fork of the Fortymile River.		
RESIDENT HUNTERS: 1 bull.	24 Aug–28 Aug 8 Sep–17 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow		8 Sep–17 Sep

Units and Bag Limits	Resident Open Season	Nonresident Open Season
tines on at least 1 side.		
Remainder of Unit 20E		
RESIDENT HUNTERS: 1 bull by registration permit only	24 Aug–28 Aug 8 Sep–17 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side by registration permit only.		8 Sep–17 Sep

Alaska Board of Game Actions and Emergency Orders. During the spring 2000 meeting, the Board of Game created a registration permit hunt in Unit 20E, excluding the Middle Fork Fortymile River. The board also split the moose season into 2 periods: 24–28 August and 8–17 September, except within the Yukon River drainage where the season became 24–28 August and 5–25 September. The board made it a stipulation of the registration permit that a hunter had to choose to hunt either moose or caribou. Also during spring 2000, the board set the intensive management population and harvest objectives for the Unit 20E moose population within the Fortymile and Ladue River drainages as 8000–10,000 moose and 500–1000 harvested. During the spring 2002 meeting, the board reduced the season length within the Yukon River drainage to match the season in the remainder of Unit 20E (24–28 Aug and 8–17 Sep). The board also eliminated the grizzly bear trophy tag requirement in Unit 20E excluding the Yukon-Charley Rivers National Preserve with the objective of harvesting more bears to benefit moose calf survival.

Hunter Harvest. During RY99–RY01 the reported fall harvest in Unit 20E ranged between 131 and 138 bulls (Table 2) or about 2.7% of the 2001 estimated early winter population. The average reported harvest for the last 5 years (RY97–RY01) was 140 (131–150), a 27% increase from the previous 5 years (RY92–RY96). Higher harvests and participation rates began in RY91. Greater participation and harvest by nonlocal residents explains most of the increase. Probable causes for the higher harvest were 1) hunters were displaced by stricter regulations throughout Southcentral Alaska, especially in nearby Unit 13; 2) the Fortymile caribou season was open concurrently with the moose season, which attracted hunters interested in hunting both species simultaneously; 3) maintaining a 1 bull bag limit with relatively liberal season dates gave hunters a false impression about the number of moose in the area; and 4) more hunters came to the area looking for large antlered bulls.

The Board of Game created 2 winter drawing permit hunts (DM794 and DM796) within the Ladue River Controlled use area in spring 1994. The harvest objective was to allow greater hunting opportunity in an area that supported a high number of bulls (bull:cow ratio >60:100) but was rarely hunted due to difficult access during the fall. The hunts were managed so winter harvest would not affect the bull numbers in areas commonly hunted during the fall.

During RY95–RY99, 10 winter permits were offered annually for DM794. Due to the low number of permits and difficult access, harvest was 0–4 bulls annually. Even though harvest was low it was concentrated in areas that were hunted during the fall because of easier access. Many unit hunters voiced concern that the winter harvest was affecting local moose numbers. In response, the number of permits was reduced to 8 in 2000 and to 6 in 2001. During 2001, 5 of the 6 permit recipients participated and all were successful. Harvest was again concentrated in areas hunted during the fall and the number of permits was reduced to 3 for RY02. The DM794 hunt area does not lend itself for subdivision to distribute hunters into areas not hunted during the fall. Reducing the number of permits to 3 should limit any impacts on moose numbers in this area regardless of where harvest occurs. I plan to continue to encourage hunters to travel to the more remote areas and attempt to harvest large, trophy bulls (antlers ≥60 inches) that are not accessible in the fall.

During RY95–RY98, 50 winter permits were offered annually for DM796. Access into the central portion of this area is difficult but the southern and northern portions are readily accessible by several snowmachine trails. Moose hunters used these trails extensively in the fall. During the first 2 seasons (RY95 and RY96) only 4 bulls were taken each year. There was no impact on bull numbers. During RY97 and RY98, 14 (35 hunters) and 10 (20 hunters) bulls were taken and harvest was concentrated along the 2 trails used extensively by hunters during the fall hunt. This level of harvest reduced the number of large bulls along these trails.

During RY99 we attempted to reduce the winter harvest of moose along these trails by reducing the number of DM796 permits to 35 and by requesting that all DM796 permit recipients consider hunting more remote areas. The harvest was 8 bulls and half were taken in more remote areas. During RY00 the number of DM796 permits was reduced to 25 and use of the 2 most popular trails into the area was prohibited. Fifteen hunters participated, taking 9 bulls, 6 of which were taken in remote areas.

Historically, most hunters accessed the DM796 hunt area by snowmachine and the 2 best trails to access the remote areas were the 2 that were closed in RY00. In RY01 we established a hunt area within the permit area but allowed any method of legal access including use of all trails. Because the hunt area was more confined, the number of permits was reduced to 10 to guard against an overharvest. During RY01, 7 hunters participated taking 3 bulls. To ensure against DM796 affecting moose numbers, the required hunt area will be changed every 2 years but will be located away from areas most hunted in the fall.

In spring 1994 the board extended the Unit 20E moose season to include an early August season for spike-fork bulls. During RY95–RY98, the season dates were 20–28 August. Only 0–1 spike-fork bulls were harvested annually. The season was extended to 15–28 August during RY99 and RY00 but harvest remained at 0 and 1 spike-fork bulls, respectively. The August spike-fork season was eliminated in RY01 and was replaced by a 5-day any bull season.

Of the 131 and 135 moose harvested during the general season in RY99 and RY00, 33 and 44 (26% and 33% of the harvest) were taken in the Mosquito Fork and 22 and 24 (17% and 18% of the harvest) were taken in the Dennison drainages. In northern Unit 20E, 34 moose (27% and 26% of the harvest) were taken along the Yukon, Charley, and Seventymile Rivers. The combined take in these 5 drainages was 70% of the annual harvest in RY99 and 77% in RY00.

Traditionally, 60–70% of the annual harvest comes from these 5 drainages and the remainder of the harvest is usually spread out across the subunit. Since 1992 the Ladue River drainage is becoming more popular and 7–17% of the fall harvest is coming from that area.

During RY99, RY00, and RY01 the mean antler spread of bulls taken in Unit 20E during the fall hunt was 47.1, 45.8, and 46.3 inches, respectively. The 5-year mean was 46.4 inches. There was no change in average antler size in the harvest during 1987–2001 ($P = 0.432$) or in the percent antlers ≥50 inches ($P = 0.848$) or ≥60 inches ($P = 0.852$). In the RY01 harvest 13 bulls (9.9%) were yearlings (antlers <30 inches), 58 (43.9%) were 2–4 years old (antler spread 30.0–49.9 inches), and 61 (46.2%) were mature bulls (antler spread >50 inches). Of the mature bulls, 14 (11%) had antler spreads >60 inches. Antler spreads were estimated for 297 and 386 bulls observed during posthunting aerial composition surveys in fall 2000 and 2001, respectively. Age composition was 24% and 12% yearlings, 35% and 42% 2- to 4-year-olds, and 41% and 46% mature bulls. Based on RY01 harvest results, hunters did not select for any particular size class. During RY96–RY00 it appeared that hunters either selected against yearlings or yearlings were less vulnerable to harvest than large or medium bulls. Yearlings comprised 7–10% of the harvest but represented 20–25% of the bull population. Spike/forked yearlings were particularly underrepresented in the harvest. Because moose density was low in Unit 20E and most hunters were state residents primarily looking for meat, I doubt many hunters were selective.

Average antler size of moose harvested under DM794 (51.5 inches) and DM796 (55.9 inches) were significantly larger ($P = 0.025$ and .0003, respectively) compared to the general fall season. Bulls are more concentrated during the permit season allowing hunters to be more selective. Comparing the 2 permit areas, bulls taken in the Prindle Volcano area had larger antlers ($P = 0.067$).

Antler data also indicates that a 50-inch regulation in Unit 20E would not stop a declining bull:cow ratio. Much of the bull population is comprised of mature bulls that would be vulnerable to harvest. Calf recruitment has been poor since the 1970s resulting in few bulls growing into the 50-inch class each year.

Maintaining a sustainable moose harvest in Unit 20E has become the greatest management challenge in Unit 20E. Our primary concern is the increasing number of hunters. Regulatory changes reduced the chance of high incidental take of moose by caribou hunters but as harvest regulations become more restrictive in other units along the road system more moose hunters are being displaced to Interior units including Unit 20E. Our objective by splitting the season and shortening the season along the Yukon River is to reduce hunter efficiency resulting in lower harvest. If these harvest management methods do not stabilize the harvest, more restrictive regulations will be necessary.

Preliminary data indicate that requiring hunters to hunt either moose or caribou during RY01 caused a reduction in opportunity to incidentally harvest moose. During RY93–RY95, prior to caribou hunting being substantially restricted, 1500–2000 hunters hunted Unit 20E and 12–17% ($\bar{x} = 14\%$) hunted moose and caribou during the same hunt. During 2001, 10% of the hunters hunted both moose and caribou.

Hunter Residency and Success. Of the 131, 135, and 138 bulls harvested during the general season in RY99, RY00, and RY01, 59%, 62% and 64% were taken by nonlocal Alaskan residents. Prior to 1992, most nonlocal hunters were from Interior and Southeast Alaska, but since RY92 most of the nonlocal hunters were from Southcentral Alaska. During RY99-RY01 general season hunts, hunters from Southcentral Alaska represented 39%, 33%, and 35% of the hunters and took 31%, 35%, and 42% of the harvest each year. Local hunters comprised 24–34% of the hunters and took 24–27% of the harvest. Nonresident hunters were prohibited from hunting moose in Unit 20E during RY83–RY90. During RY91–RY96, nonresidents represented 6% of the hunters and accounted for an average of 7% of the harvest. During RY97–RY01, nonresidents represented 8–11% of the hunters and took 8–13% of the harvest.

During RY99–RY01, 562, 522, and 745 hunters reported hunting moose in Unit 20E during the general season (Table 3). The 5-year average was 556. Since RY90 the number of hunters increased significantly ($P = 0.001$). During RY83–RY89 an average of 258 (range = 151–350) persons hunted Unit 20E. Most of the increase was nonlocal hunters, primarily from Southcentral Alaska. The 3 most voiced reasons during informal discussions with Southcentral hunters why they traveled to Unit 20E to hunt were 1) more restrictive regulations in Southcentral units, 2) declining moose numbers in Unit 13, and 3) more opportunity to hunt caribou.

Hunter success was 23%, 26%, and 19% during RY99, RY00, and RY01, respectively. The 5-year average was 26%. During RY99–RY01 success rates of local residents averaged 22% compared with a 22% success rate for nonlocals and 30% for nonresidents. The success rates for local (13%) and nonresidents (22%) were relatively low during RY01.

Harvest Chronology. During RY90–RY94, an average of 35 bulls were harvested during 1–6 September (Table 4) representing 40% (range = 27–50%) of the fall harvest. During RY95–RY00, harvest total during this time period remained the same (36 bulls) but represented only 25% (16–33%) of the harvest. Apparently, as hunter numbers increased in Unit 20E a greater percentage chose to hunt later in the season.

In an attempt to maintain or reduce the fall harvest in Unit 20E, during RY01 the hunting season in most of the subunit was split into 2 periods: 24–28 August and 8–17 September. Our intention was to reduce harvest during the 5-day August season to less than the harvest during the previous 1–5 September season. During RY93–RY00, 16–42 ($\bar{x} = 31$) bulls were harvested during 1–5 September. In RY01, 14 bulls were harvest during 24–28 August (13–67% reduction).

During RY91–RY98, harvest during 16–25 September in northern Unit 20E was 10–20 bulls annually. Harvest increased to 27–29 bulls during this period in RY99–RY01. The greater harvest was due to more nonlocal Alaska resident hunters. During informal interviews we identified the reason for this increase harvest—the season was open later than anywhere else along the road system. This portion of Unit 20E supports the lowest density of moose (0.3–0.37 moose/mi^2) in the subunit and this increase was not sustainable. Beginning in RY02, the hunting season in northern Unit 20E will be shortened to mirror the season in the remainder of the unit.

Transport Methods. During RY99–RY01, 129, 133, and 138 successful hunters reported the type of transportation used to access Unit 20E. The 3 types most used were 4-wheelers (28–49%), airplanes (17–24%), and boats (10–21%) (Table 5). There has been little change in transport use since RY95. During RY99–RY01 hunters using highway vehicles had the lowest success rate (8–11%), while hunters using airplanes (31–39%) and ORVs (25–50%) had the highest success rates. Hunters using 4-wheelers had success rates of 24–30%. The success rates in Unit 20E during these 3 years ranged from 19–26%.

In RY94 the number of hunters who used 4-wheelers increased and remained between 120 and 125 through RY98. The number of hunters using 4-wheelers increased to 142–224 during RY99–RY01. During RY92 and RY93 an average of 82 hunters used 4-wheelers. Hunters who used highway vehicles to access the area during the early 1990s began using 4-wheelers or were replaced by hunters using 4-wheelers. During RY99-RY01 hunters using 4-wheelers for access comprised 27–30% of the total hunters. The number of hunters using the other transportation types remained constant. Hunters using 4-wheelers or highway vehicles were responsible for the greatest harvest (Table 5).

In combination with the increasing number of hunters, increasing access is a growing management concern, especially by hunters who use 4-wheelers. The increasing quality and dependability of the machines and the riding ability of the hunters have allowed hunters to access areas that historically have been refugia for moose. This group of hunters tends to have a greater effect on local populations of moose because they tend to concentrate their efforts more than other hunters.

Other Mortality

Predation by wolves and grizzly bears was the greatest source of mortality for moose in Unit 20E and maintained the population at a low density (0.42–0.53 moose/mi^2). Using the model presented by McNay and DeLong (1998), I estimated about 33% of the postcalving moose population was killed by wolves and grizzly bears each year and harvest was about 1.6%. The percentage killed by wolves and grizzles increased during 2000 and 2001 due to an increased wolf population in the central, northern, and eastern portions of the subunit.

HABITAT

Assessment

Availability of browse in Unit 20E is not limiting moose population growth. Recent browse studies found that use of preferred browse plants was less than 5% (Boertje et al. 1985). The greatest expanse of excellent habitat is in the southeastern portion of the subunit resulting from 2 large wildfires (>1,000,000 acres) that occurred during the mid-1960s. This area supports the greatest moose densities in the subunit (about 0.7–1.0 moose/mi^2). Prescribed and wildfires burned over 400,000 acres in Unit 20E during 1998–1999. Moose were using these areas during winter 2001–2002. Habitat quality in these areas is expected to improve during the next 15 years. There are still areas within the northeastern portion of the unit where the habitat has degraded to poor moose habitat due to wildfire suppression activities during the 1970s and 1980s.

Enhancement

The Alaska Interagency Fire Management Plan restored a near-natural wildfire regime to over 60% of Unit 20E. Under the plan, most state and federal land was accorded limited fire protection. This agreement allowed nearly 300,000 acres to burn naturally during 1998 and 1999. Nearly all land selected by or conveyed to Native corporations was accorded modified or full-suppression status. However, Native corporations in Units 20E and in adjacent Unit 12 have recently consented to allow fire on their land, except in areas where there is marketable timber. More acceptance of fire as a management tool has occurred throughout local communities because of the well-known increase in moose numbers near Tetlin and Tok as a result of the 1990 Tok Wildfire. This change in attitude allowed us to prescribe burn 90,000 acres during 1998 and 1999 in central Unit 20E. These fires were completed within prescription. Costs of the prescribed burns were 35 cents/acre for the 52,000-acre East Fork Burn, 46 cents/acre for the 7000-acre Mosquito Flats burn, and 38 cents/acre for the 31,000-acre Ketchumstuk burn. Moose densities in these areas are expected to increase within 5–15 years.

CONCLUSIONS AND RECOMMENDATIONS

During RY99–RY01 the moose population remained stable or declined slightly and was estimated at 0.42–0.53 moose/mi^2 in fall 2001. Research has shown that predation by wolves and grizzly bears was the primary factor limiting the subunit's moose population. Wolf predation is expected to increase on moose during the next few years. Wolf numbers are increasing in most of Unit 20E because of elevated productivity and survival and relatively low harvest. I recommend both wolf and grizzly bear numbers be reduced if the objective is to substantially increase moose numbers. Reducing either grizzly or wolf numbers would allow the moose population to remain stable or possibly to increase slowly depending on the level of reduction. Combined wolf and bear predation took about 33% of the postcalving moose population annually.

In an attempt to reduce effects of predation on the area's moose population, grizzly bear hunting regulations were liberalized in 1981. As a result, bear harvest increased and possibly caused bear numbers to decline and altered the male age structure toward younger bears. Moose calf survival increased during 1982–1989. Modeling indicated that the reduced bear population may have increased adult moose survival but was inadequate to consistently improve calf survival. We do not know how much a grizzly bear population must be reduced before the predation rate on moose calves will decline substantially. However, modeling predicts the moose population in Unit 20E could grow 8–10% annually if grizzly bear predation rates on calves were reduced 25% in combination with 20–25% wolf harvest by trappers. Beginning in RY02, grizzly bear regulations will be more liberal, allowing resident hunters to incidentally harvest grizzly bears without a $25.00 trophy tag. Because of more liberal caribou hunting regulations, we project that over 2000 hunters will hunt Unit 20E annually during RY02–RY05. If through a public awareness program, grizzly bear harvest increases substantially, it is possible that the bear population will be reduced sufficiently to benefit moose.

Human-induced mortality had little impact on the subunit's moose population but caused some reduction in local bull populations. Annual harvest rates were historically less than 2% of the fall population estimate but increased above 2% in RY95 and has been about 2.5–2.7% during RY97–RY01. The bull:cow ratio declined in portions of Unit 20E due to moderate harvest rates in more accessible areas.

The number of moose hunters in Unit 20E increased significantly ($P = 0.001$) since RY91. Most of the additional hunters were from Southcentral Alaska. The preferred transportation type became 4-wheelers. Twenty-eight percent of the hunters used 4-wheelers to gain access and they took 28–49% of the harvest.

Regulation changes in RY01 appeared to reduce harvest success and stabilize harvest. Harvest declined by 13–67% during a 5-day hunt in August compared to harvest during the first 5 days when the season opened 1 September. Initial results indicated the primary cause of the reduced harvest was fewer hunters participating during the August season. Requiring hunters to choose either to hunt moose or caribou appeared to reduce the incidental take of moose by caribou hunters. During the first year under this regulation fewer hunters (29%) took the opportunity to hunt both moose and caribou compared to RY93–RY95. To further reduce hunters in northern Unit 20E, the moose season will be shortened and will mirror the season in the remainder of the subunit, 24–28 August and 8–17 September beginning in RY02.

Increased hunter participation and harvest during the Unit 20E winter drawing permit hunts caused hunt management changes during RY99–RY01. The intent to allow hunters to hunt moose in areas inaccessible in fall was no longer met. In RY99 the number of DM796 permits was reduced but harvest distribution still did not meet the management intent. Additional reductions in permit numbers and hunt area occurred in RY00 but still was insufficient to meet hunt objectives. In RY01 the hunt area was limited to a small portion of the permit area and only 10 permits were offered. Under this scenario, harvest was limited to areas not hunted in the fall. To guard against an overharvest, the hunt area will be moved periodically, based on harvest success and moose population trend. The number of DM794 permits was reduced in RY01 because harvest amount and distribution became a concern.

More community acceptance of fire has occurred during the past 5 years in Unit 20E. During 1998 and 1999, 3 prescribed burns covering about 90,000 acres were completed in areas that traditionally supported high moose densities. In addition, over 300,000 acres were allowed to burn by wildfire in 1999. Under the current Division of Forestry and Bureau of Land Management leadership, the interagency fire management plan has a great chance of benefiting wildlife and people.

The Unit 20E moose goals and objectives were met during this report period. Population trends were monitored and necessary changes to hunt structure were implemented. Habitat enhancement programs were designed and will be presented to the Interagency Fire Team for possible implementation. Hunting seasons and bag limits were established that allowed maximum hunting opportunity and met subsistence needs. Moose-watching opportunities were shared with visitors and local residents and several oral presentations were given annually to local schools and tourist groups. The intensive management objectives were not met. Changes in grizzly bear harvest regulations were made to increase bear harvest and possibly increase moose calf survival. Before the intensive management objectives can be met, wolf and grizzly bear predation must be reduced.

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Table 1 Unit 20E aerial moose composition counts, fall 1988–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/hr
1988[a]	78	13	22	117	11	931	1048[a]	30
1989[b]	56	11	43	43	21	158	201	22
1990[b]	64	9	30	105	16	566	671	30
1991[b]	65	14	28	120	14	714	834	42
1992[c]	59	11	17	19	12	141	160	
1992[d]	75	15	28	32	14	200	232	
1993[b]	63	10	28	126	15	727	854	40
1994[c]	74	16	23	65	12	488	553	48
1995[e]	70	16	15	29	8	329	358	
1996[f]	61	10	19	44	10	377	421	
1996[b]	56	6	27	47	15	270	317	45
1997[b]	61	14	26	70	14	438	508	49
1998[g]	64 (53)[h]	18 (10)[h]	19 (23)[h]	36	13	242	278	
1998[i]	59 (51)[h]	14	23 (26)[h]	67	15	383	450	
1999[g]	80 (74)[h]	16 (17)[h]	22 (14)[h]	27	7	338	365	
1999[b]	54	13	17	38	10	340	378	60
2000[g]	60	11	14	44	8	517	561	
2000[i]	49	11	21	37	11	310	347	
2001[g]	76	9	14	38	7	493	531	
2001[i]	51	6	10	39	6	585	624	

[a] Mosquito Flats Study Area sampled using stratified random sampling (Gasaway et al. 1986).
[b] Various trend count areas were sampled using contour sampling.
[c] Mosquito Flats Study Area sampled using superstratification sampling.
[d] Ladue River Study Area sampled using superstratification sampling (Mark McNay, ADF&G, personal communication).
[e] Mosquito Flats Study Area sampled using prestratification sampling (Jay Ver Hoef and Rod Boertje, ADF&G, personal communication).
[f] Ladue River Study Area sampled using prestratification sampling (Jay Ver Hoef and Rod Boertje, ADF&G, personal communication).
[g] Tok West sampled using spatial sampling (Ver Hoef 2001).
[h] Number in parenthesis is the observed ratio.
[i] Tok Central sampled using spatial sampling (Ver Hoef 2001).

Table 2 Unit 20E moose harvest and accidental death, regulatory years 1990–1991 through 2001–2002

Regulatory	Harvest by hunters							Drawing				
	Reported				Estimated			permit hunts		Accidental death		
year	M (%)	F (%)	Unk	Total	Unreported	Illegal	Total	DM794	DM796	Road	Total	Total
1990–1991	46 (100)	0 (0)	0	46	0–5	5–15	9–22			0	0	54–61
1991–1992	90 (99)	0 (0)	1	91	0–5	5–15	9–22			0	0	100–113
1992–1993	68 (99)	0 (0)	1	69	0–5	5–15	9–22			1	1	79–92
1993–1994	128 (99)	0 (0)	1	129	0–5	5–15	5–20			0	0	134–149
1994–1995	93 (99)	0 (0)	1	94	0–5	5–15	5–20			0	0	99–114
1995–1996	139 (99)	0 (0)	1	140	0–5	5–10	5–15	0	4	0	0	149–159
1996–1997	116 (99)	0 (0)	1	117	0–5	5–10	5–15	2	4	0	0	128–138
1997–1998	144 (99)	1 (1)	0	145	0–5	5–10	5–15	4	14	0	0	168–178
1998–1999	145 (96)	0 (0)	5	150	0–5	5–10	5–15	1	10	0	0	166–176
1999–2000	127 (97)	0 (0)	4	131	0–5	5–10	5–15	3	9	0	0	148–158
2000–2001	135 (100)	0 (0)	0	135	0–5	5–10	5–15	2	6	0	0	148–158
2001–2002	137 (99)	0 (0)	1	138	0–5	5–10	5–15	5	3	0	0	151–161

Table 3 Unit 20E moose hunter residency and success during the general season, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful				Unsuccessful				Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Total[b] (%)	Local[a] resident	Nonlocal resident	Nonresident	Total (%)	
1990–1991	16	28		46 (16)	65	176	2	249 (84)	295
1991–1992	34	54	3	91 (21)	112	219	9	343 (79)	434
1992–1993	15	45	4	69 (24)	52	135	9	220 (76)	289
1993–1994	38	77	14	129 (30)	93	188	17	300 (70)	429
1994–1995	27	58	9	94 (19)	97	272	17	393 (81)	487
1995–1996	36	93	9	140 (31)	72	208	34	318 (69)	458
1996–1997	40	70	7	117 (29)	97	165	24	286 (71)	403
1997–1998	42	85	18	145 (30)	112	189	31	332 (70)	477
1998–1999	47	91	12	150 (32)	76	205	39	322 (68)	472
1999–2000	36	77	17	131 (23)	98	299	30	431 (77)	562
2000–2001	36	84	15	135 (26)	98	255	33	387 (74)	522
2001–2002	33	88	16	138 (19)	222	323	58	607 (81)	745

[a] Residents of Unit 12 and Units 20E and eastern 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.
[b] Difference in total and sum of residency categories equals numbers with unknown residency.

Table 4 Unit 20E moose harvest chronology by month/day during the general hunt, regulatory years 1990–1991 through 2001–2002

Regulatory	Harvest chronology by month/day						
year	8/15–8/27	9/1–9/6	9/7–9/13	9/14–9/20	9/21–9/27	9/28–10/5	Total[a]
1990–1991		20	9	7	6	0	46
1991–1992		25	26	22	14	0	91
1992–1993		29	28	5	5	0	69
1993–1994		52	40	24	8	0	129
1994–1995		47	21	16	8	0	94
1995–1996	0	46	58	27	3	0	140
1996–1997	1	33	49	23	6	0	118
1997–1998	1	48	50	36	6	0	144
1998–1999	0	35	78	23	6	2	150
1999–2000	0	30	57	28	13	0	131
2000–2001	1	22	61	41	8	0	135
2001–2002	14	0	71	43	7	0	138

[a] Difference between total and summation of harvests by week represents moose taken on unknown dates.

Table 5 Unit 20E moose harvest and percent by transport method during the general season, regulatory years 1990–1991 through 2001–2002

Regulatory year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1990–1991	7 (15)	3 (7)	10 (22)	6 (13)	0 (0)	8 (17)	7 (15)	5 (11)	46
1991–1992	11 (12)	2 (2)	18 (20)	10 (11)	0 (0)	15 (16)	35 (38)	0 (0)	91
1992–1993	17 (25)	1 (1)	4 (6)	21 (30)	1 (1)	7 (10)	15 (22)	3 (4)	69
1993–1994	31 (24)	0 (0)	15 (12)	34 (26)	0 (0)	15 (12)	32 (25)	2 (2)	129
1994–1995	24 (26)	0 (0)	14 (15)	26 (28)	0 (0)	13 (14)	15 (16)	2 (2)	94
1995–1996	29 (21)	0 (0)	19 (14)	39 (28)	1 (1)	16 (11)	34 (24)	2 (1)	140
1996–1997	26 (22)	3 (3)	18 (15)	26 (22)	0 (0)	13 (11)	30 (26)	1 (1)	117
1997–1998	29 (20)	3 (2)	13 (9)	46 (32)	0 (0)	15 (10)	36 (25)	3 (2)	145
1998–1999	32 (21)	0 (0)	23 (15)	40 (27)	1 (1)	12 (8)	41 (27)	1 (1)	150
1999–2000	31 (24)	1 (1)	26 (20)	37 (28)	0 (0)	19 (15)	15 (11)	2 (2)	131
2000–2001	29 (21)	2 (1)	28 (21)	40 (30)	0 (0)	14 (10)	20 (15)	2 (1)	135
2001–2002	23 (17)	0 (0)	14 (10)	68 (49)	0 (0)	15 (11)	18 (13)	0 (0)	138

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 21B (4871 mi^2)

GEOGRAPHIC DESCRIPTION: Lower Nowitna River, Yukon River between Melozitna and Tozitna Rivers

BACKGROUND

In this portion of Interior Alaska, even the earliest accounts of the area mentioned the presence of moose. Moose had apparently become abundant by the time gold seekers converged on the area in the early 1900s. The village of Ruby had a population of 10,000 people during the 1910 Gold Rush, and many moose were hunted to supply the townsfolk and miners with meat. The area supported a large moose population from the early 1900s to late 1970s. Several severe winters in the late 1960s and early 1970s initiated widespread declines in moose populations throughout the Interior, including Unit 21B.

Historically, wildfires were a major force affecting the productivity and diversity of moose habitat in this area. Large fires burned a major portion of the area before the 1950s; effective fire suppression substantially altered this fire regime. The 1982 Tanana–Minchumina Fire Plan has allowed some fires to burn with minimal interference.

The Nowitna River to the east of Ruby is a popular hunting area for residents of Ruby, Tanana, and, to a lesser extent, Galena. It is also a popular hunting area for Fairbanks residents who use boats and aircraft for access. Because of its long history of use by both local and nonlocal hunters, this area was the focus of much of the management effort in Unit 21B over the years.

Aerial moose surveys during 1977–1979 indicated moose numbers were declining in the Nowitna. Wolves were abundant compared to the number of moose available, and predation by wolves was believed responsible for the decline in moose numbers.

A moose population estimation survey in 1980, using methods described by Gasaway et al. (1986), estimated 2386 ± 429 moose in a 2774-mi^2 portion of the subunit in the lower Nowitna drainage. A 1986 population estimation survey conducted in a 1556-mi^2 portion of the 1980 survey area indicated a further reduction in moose numbers. A 1990 population estimation survey in the same area surveyed in 1980 indicated a decline that was significant at the 80%

probability level, but not at the 90% level. Results of a 1995 population estimation survey in a 1338-mi^2 portion of the subunit were not significantly different (90% confidence) from those of the 1990 survey.

In addition to the lower portion of the Nowitna drainage, Unit 21B includes the area east of the Ruby–Poorman Road, the banks of the Yukon River from Ruby to Tanana, the Blind River, and the Boney River. These areas produce 36–46% of the reported Unit 21B harvest.

MANAGEMENT DIRECTION

MANAGEMENT GOAL

- Manage Unit 21B moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and that minimizes disruption of local residents' lifestyles.

MANAGEMENT OBJECTIVES AND RELATED ACTIVITY

- Maintain a moose population of 3000–4000.

  Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

- Provide for harvest not to exceed 150 moose or 5% of the annual moose population estimate.

- In combination with Unit 21C, implement at least 2 habitat enhancement activities every 5 years.

METHODS

Established trend count areas were surveyed cooperatively with US Fish and Wildlife Service to assess population status and trend. Piper PA-18 (or equivalent) aircraft were used, and contiguous survey units of approximately 12 mi^2 each were searched at a rate of at least 4 min/mi^2 to ensure reasonably high sightability, minimal bias, and data comparability between years. A moose population estimation survey was conducted in November 1995 using a regression survey method developed by ADF&G biometricians that uses a probability sample and regression estimator (Särndal et al. 1992).

Moose population estimation surveys conducted over 4754 mi^2 of Unit 21B in 2001 utilized Geostatistical Spatial Population Estimator (GSPE) techniques (Ver Hoef 2001). Survey techniques were modified from those outlined by Gasaway et al. (1986). An important change from the Gasaway methodology was, instead of geographical land characteristics, a grid system based on latitude and longitude coordinates was used to locate sample units (~5.7 mi^2 in size), with search intensity of ~6 min/mi^2.

We monitored harvest by checking moose harvest reports and operating a moose hunter checkstation on the Nowitna River.

Survey and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY01 = 1 Jul 2001–30 Jun 2002).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Using the results of the 1995 population estimation survey and one conducted in 1990, Woolington (1998) estimated there were 2324–3530 moose in the subunit. A density of 0.20 moose/mi^2 was applied to the portion of the Little Mud River drainage not included in the population estimation survey, and a density of 0.64 moose/mi^2 was applied to the remainder of the subunit that was not surveyed. Higher moose densities exist in favorable habitat along the Nowitna floodplain and immediately adjacent to the Yukon River. Densities are low to moderate away from the river.

Results from the population surveys conducted in November 2001, estimated a total of 3160 moose (1828–4493; 90% CI) over 4754 mi^2 of Unit 21B (Table 1). This was close to the estimate reported for RY97-RY98. For the entire survey area the GSPE analysis resulted in the following: the calf:cow ratio was 18.3:100 (7.9–28.8:100; 90% CI), the yearling bull:cow ratio was 9.0:100 (2.5–15.6:100; 90% CI), and the adult bull:cow ratio was 38.2:100 (12.5–63.8:100; 90% CI).

Survey data collected in early winter from established trend count areas (TCA) along the lower Nowitna suggested stable or slightly increasing moose densities during 1991–1998 (Tables 2 and 3). However, surveys conducted from 1999 to 2001 indicated the trajectory of the population may be changing. For example, recruitment indicators such as the number of calves per 100 cows have begun to decline; however, because of inadequate snow coverage, the 1999 results were not reliable.

In combination with the GSPE results, the TCA data indicate that the population declined during RY99–RY00. The TCA results indicated the number of cows in the population declined by as much as 23% from 2000 to 2001. Because of the decline in the number of cows, most of the ratio indicators estimated by the GSPE and TCAs were maintained at a higher level than would be expected for a declining population.

Population Composition

Composition data were available from aerial surveys we conducted with FWS staff in established TCAs on the Nowitna National Wildlife Refuge (Tables 2 and 3). Fall 2001 survey results indicated bull:cow ratios along the river decreased from the previous year while calf:cow ratios increased. Yearling bull:100 cow ratios were relatively unchanged empirically, but the decline in the denominator value of the ratio (cows) suggests overwinter survival was poor. The occurrence of twin calves among moose observed in these early winter surveys has been very poor since the trend areas were established in 1992, particularly at the Nowitna Mouth TCA.

The 2001 population estimation data indicated the sex and age composition over the entire area was not as depressed as the area along the river. The bull:cow ratio was 38:100, the yearling bull:cow was 9:100, and the calf:cow ratio was 18:100.

Distribution and Movements

Based on movements of radiocollared cow–calf pairs, most cows spend their summer months around open grass and brush meadows on the floodplain, but away from the river (Woolington 1998). In October they move to the riparian areas, where they remain until early May. Relatively few cow moose wintered in the hills to the north and south of the Nowitna River.

MORTALITY

Harvest

Season and Bag Limit.

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 21B that portion within the Nowitna River drainage:		
RESIDENT HUNTERS: 1 bull.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–20 Sep
Remainder of Unit 21B:		
RESIDENT HUNTERS: 1 bull	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Subsistence and general registration hunts were established for the Nowitna River drainage in Unit 21B by the Alaska Board of Game in March 1996. This action was to counter the possibility of the Federal Subsistence Board closing federally managed lands in the Nowitna River drainage to nonlocal hunters because of perceived declines in moose. Two separate registration hunts were established. The subsistence registration hunt was opened to all Alaska residents, with a season of 5–25 September and a bag limit of 1 bull. All the meat had to remain on the bones, the head had to be salvaged, and the antlers were to be cut to destroy the trophy value. The general registration hunt was opened to all hunters, with a season of 5–20 September and a bag limit of 1 bull moose with spike fork antlers or antlers at least 50 inches wide, or 4 brow tines on at least 1 side for residents. For nonresidents the bag limit was 1 bull with antlers at least 50 inches wide or 4 brow tines on at least 1 side.

Registration hunts were discontinued in RY98. Seasons and bag limits for the remainder of the subunit remained unchanged. In 2002 the board adopted a regulation for all of Unit 21B requiring hunters to leave the meat on the bone of the four quarters and the ribs until the meat is transported from the field.

Harvest. Reported harvest for the subunit was fairly stable and averaged 57 (range = 47–69) moose annually during RY97–RY01 (Table 4). The Unit 21B unreported harvest was estimated at 5 moose per year for Ruby residents, and 15 moose per year for Tanana residents. The Nowitna drainage produced 65–90% ($\bar{x}$ = 77%) of the subunit's reported harvest during RY97–RY01 (Tables 5 and 6).

The estimated RY99 harvest by residents of Unit 21B was about 47 moose (Anderson et al. 2001). The estimated unreported harvest (Table 4) incorporates the RY99 Division of Subsistence estimated moose harvest data for Ruby and Tanana (approximately 36 moose annually; 3 year $\bar{x}$), less the reported harvest by those same villages (approximately 15 moose annually). Because subsistence harvest remained relatively constant, the difference of approximately 20 unreported moose between the RY99 subsistence data and the local reported harvest was extrapolated for RY99–RY01.

Checkstation Results. Since RY88 a moose hunter checkstation has been located at the mouth of the Nowitna. During RY96–RY97 the checkstation was mandatory because it was the only place Nowitna River registration hunt permits were available. Except for RY97, hunter numbers and success rate of hunters passing through the Nowitna checkstation was relatively constant (Table 5). It is unclear why there was a brief decline in the number of hunters in RY97.

Hunter Residency and Success. Based on harvest reports, the majority of Unit 21B hunters were Alaska residents who resided outside the subunit, particularly Fairbanks (Table 6). Average success rate during RY97–RY01 was 43.6% (range = 35–60%). This was expected because a majority of the harvest in Unit 21B occurred along the river.

Harvest Chronology. During RY99–RY00, hunter reports indicated that most moose were shot in the last half of the September season (Table 7). This was probably due to relatively little movement of bulls in the earlier part of the season compared to the later part of the season.

Harvest was not reported for the winter months, but it was probably close to 20% of the annual kill. Winter harvest likely occurred during October–March (Anderson et al. 2001).

Transportation Methods. Not surprisingly, the majority of hunters used boats to hunt moose (Table 8). It is undetermined why a relatively large proportion of transportation methods were unknown in RY98 (33%), but I do not believe any significant changes in the mode of transportation occurred. Snowmachines were used during the winter, but winter reporting rates were low and therefore snowmachine use was underrepresented.

Other Mortality

Predation mortality on moose calves is significant in the subunit (Osborne et al. 1991). During calf mortality studies of radiocollared newborn moose, black bears were the main predator, killing 38% of all calves. Wolves killed 11% of all calves, unidentified predators killed 8%, grizzly bears killed 2%, and 5% died from other natural causes. A single pack of 25 wolves was observed during the fall 1999 moose trend count survey at the mouth of the Nowitna. Wolf surveys conducted in neighboring Units 21D and 24 during RY99 and RY00, demonstrated an increase in wolves (ADF&G files, Galena, 30 May 2000). Local residents have reported similar observations regarding wolf numbers in Unit 21B.

HABITAT

Assessment

No new data were collected on habitat conditions during this reporting period. Observations indicated browse availability was not limiting the moose population. Regeneration from a fire that burned in 1986 east of the Nowitna River in the Little Mud River drainage provided excellent moose browse. During November 1995 surveys, this area was classified as high moose density. Several adjacent sample units were classed as medium. There is a dense stand of black spruce between the 1986 burn and the Nowitna River that should be considered for a prescription burn.

CONCLUSIONS AND RECOMMENDATIONS

Density data from 1991–2001 fall surveys of permanent trend count areas was greatly variable from year to year and did not provide a clear picture of what the population trend may be. However, classification data showed the number of calves declined in 2000 and 2001. Although yearling bull:100 cow ratios appeared to be stable, data from the last 2 years was heavily influenced by the low number of cows counted. Bull:cow ratios were low for the last several years in both TCAs along the heavily hunted portion of the Nowitna River. Away from the river the bull:cow ratio was slightly higher.

Population estimation surveys conducted in 2001 supported the trend area conclusions. In the western half of the unit where the peak estimate was calculated in 1990, moose numbers declined in 1995 and again in 2001. The current estimate for the entire unit of 3160 (1828–4494; 90% CI) is within the range of the management objective, albeit the lower end. The goal for RY99–RY00 was met. The moose population continued to support the consumptive demands as well as the nonconsumptive uses identified.

We met the harvest objective not to exceed 150 moose or 5% of the annual moose population estimate. Harvest that was monitored through the harvest reporting system and at checkstations demonstrated a harvest rate of less than 3% of the total Unit 21B estimated population for RY99–RY00.

The objective to implement habitat enhancement projects was limited to review of fire management plans and fire suppression policies. I recommend a prescribed burn in the upland area east of the Nowitna floodplain and north of the Little Mud River to Bering Creek. This area is adjacent to several old burns that are reaching peak browse production. The area west of the Nowitna in the upper Big Creek drainage is also dominated by late seral spruce and birch and should be allowed to burn to enhance potential moose habitat.

Maintaining a moose population of 3000–4000 will be changed from an objective to a monitoring activity for the next reporting period. We will continue to monitor the population, conduct trend count surveys annually and population estimation surveys when funding is available. We will also notify relevant wildlife agencies, boards, and advisory committees if the moose population declines below 3000–4000 moose. However, it does not appear feasible at this time to maintain the moose population at this level if predator control is necessary to do so.

Predators remain abundant and continue to be the primary factor limiting moose abundance in the area. Harvest of wolves within the subunit is very low and few black bears are harvested. The moose calf mortality study indicated black bears were the major predator of moose calves (Osborne et al. 1991). Efforts should be made to increase the harvest of predators if more moose are desired.

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Table 1 Unit 21B Lower Nowitna River moose population estimate, October–November 2001

Unit	Area mi^2	Population	90% CI[a]	Bulls:100 Cows	Calves:100 Cows	Yrlg Bulls:100 Cows	Density
West	1531	759	19.6	25.8	19.4	7.2	0.50
Total	4754	3161	42.2	38.2	18.3	9.0	0.67

[a] Confidence interval (% ±).

Table 2 Unit 21B Nowitna/Sulatna confluence (75.5 mi^2) aerial moose composition counts, regulatory years 1991–1992 through 2001–2002[a]

Regulatory year	Bulls:100 cows	Yrlg bulls: 100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi^2
1991–1992	21	9	29	8	20	200	2.7
1992–1993	18	1	48	7	29	171	2.3
1993–1994	22	7	20	0	14	195	2.6
1994–1995	16	6	20	4	15	191	2.5
1995–1996	15	4	33	6	22	148	2.0
1996–1997	18	8	23	6	13	216	2.9
1998–1999	19	2	28	6	19	180	2.5
1999–2000[b]	6	1	23	12	18	106	1.5
2000–2001	30	6	7	0	5	185	2.5
2001–2002	19	9	13	0	10	137	1.8

[a] US Fish and Wildlife Service.

[b] Poor snow conditions during survey

Table 3 Unit 21B Nowitna mouth (59 mi^2) aerial moose composition counts, regulatory years 1992–1993 through 2001–2002[a]

Regulatory year	Bulls:100 cows	Yrlg bulls:100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi^2
1992–1993	21	0	31	0	20	138	2.9
1993–1994	32	6	32	6	20	189	3.2
1994–1995	19	8	23	0	22	148	2.5
1995–1996	16	5	26	0	18	116	2.0
1996–1997	21	7	22	0	16	185	3.1
1998–1999	20	3	12	0	9	182	3.0
1999–2000[b]	11	8	21	0	16	87	1.4
2000–2001	22	4	8	0	7	170	2.9
2001–2002	13	6	28	2	20	154	2.6

[a] US Fish and Wildlife Service.

[b] Poor snow conditions during survey

Table 4 Unit 21B moose harvest, regulatory years 1990–1991 through 2001–2002

Regulatory	Harvest by hunters					
year	Bull	Cow	Unk	Total	Unreported	Total
1990–1991	81	0	0	81	15	96
1991–1992	65	0	0	65	15	80
1992–1993	46	0	0	46	15	61
1993–1994	71	1	0	72	15	87
1994–1995	63	0	0	63	15	78
1995–1996	66	0	0	66	15	81
1996–1997	63	0	0	63	15	78
1997–1998	58	1	0	59	15	74
1998–1999	53	2	2	57	15	72
1999–2000	69	0	0	69	20	89
2000–2001	49	1	2	52	20	72
2001–2002[a]	47	0	0	47	20	67

[a] Preliminary results.

Table 5 Unit 21B Nowitna River checkstation hunters (R), harvest (H) and success (S%), regulatory years 1990–1991 through 2001–2002[a]

Regulatory	Local villages[a]			Fairbanks			Other residents			Nonresident			Total		
year	R	H	S%	R	H	S%	R	H	S%	R	H	S%	R	H	S%
1990–1991	23	7	30	67	32	48	26	12	46	14	4	29	130	55	42
1991–1992	21	9	43	72	24	33	44	11	25	17	2	12	154	46	30
1992–1993	24	3	12	38	19	50	53	10	19	10	2	20	125	34	27
1993–1994	19	7	37	58	26	45	35	19	54	20	1	5	133	53	40
1994–1995	16	6	37	63	27	43	41	16	39	13	5	38	134	54	40
1995–1996	16	3	19	63	24	38	44	9	20	9	2	22	132	38	29
1996–1997	19	2	11	54	21	39	36	12	33	20	2	10	129	37	29
1997–1998	16	1	6	57	29	51	21	8	38	7	3	43	101	41	41
1998–1999	17	4	24	57	26	46	27	17	63	22	3	14	123	50	41
1999–2000	24	3	13	57	21	37	60	17	28	14	4	29	155	45	29
2000–2001	11	2	18	59	21	36	56	18	32	28	6	21	154	47	31
2001–2002[a]	27	0	0	62	21	34	48	8	17	23	5	22	160	34	21

[a] US Fish and Wildlife Service.

[b] Tanana, Ruby, and Galena.

Table 6 Unit 21B moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total	Local resident[a]	Nonlocal Resident	Nonresident	Unk	Total	
1990–1991	22	48	8	3	81	10	41	1	1	53	134
1991–1992	21	34	8	2	65	21	56	8	1	86	151
1992–1993	12	31	2	1	46	24	55	10	1	90	136
1993–1994	23	45	3	1	72	7	47	11	0	65	137
1994–1995	12	44	5	2	63	7	44	2	0	53	116
1995–1996	15	43	8	0	66	11	60	6	0	77	143
1996–1997	16	44	3	0	63	38	68	17	0	123	186
1997–1998	9	46	4	0	59	27	73	8	0	108	167
1998–1999	7	46	3	1	57	10	24	4	0	38	95
1999–2000	13	49	6	1	69	10	66	11	3	90	159
2000–2001	9	30	12	1	52	3	48	17	0	68	120
2001–2002[b]	11	27	8	1	47	11	53	15	0	79	126

[a] Tanana, Ruby, and Galena.
[b] Preliminary results.

Table 7 Unit 21B moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2001–2002

Regulatory year	Harvest chronology percent by month/day		
	9/1–9/14	9/15–9/25	*n*
1996–1997	42	58	59
1997–1998	31	69	55
1998–1999	39	61	49
1999–2000	37	63	68
2000–2001	37	63	49
2001–2002[a]	17	83	46

[a] Preliminary results.

Table 8 Unit 21B moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	*n*
1990–1991	11	1	78	0	0	2	6	1	81
1991–1992	9	1	75	0	0	0	10	4	65
1992–1993	10	0	76	1	0	0	8	4	46
1993–1994	9	0	82	3	1	0	3	1	72
1994–1995	21	0	69	2	0	0	6	3	63
1995–1996	12	0	79	3	0	0	4	1	66
1996–1997	4	0	92	2	0	0	0	2	63
1997–1998	5	0	88	0	0	0	5	5	59
1998–1999	4	0	60	0	0	0	4	33	57
1999–2000	7	1	78	0	0	1	9	3	69
2000–2001	31	0	67	0	0	0	0	0	52
2001–2002[a]	15	0	70	0	2	0	13	0	47

[a] Preliminary results.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 21C (3671 mi^2)

GEOGRAPHIC DESCRIPTION: Dulbi River above Cottonwood Creek and Melozitna River above Grayling Creek

BACKGROUND

Moose have been present in Unit 21C throughout the recent history of Interior Alaska (S Huntington, personal communication). Moose densities are low due to limited habitat and predation by bears and wolves, and population trends are unknown. Access into the subunit is limited and is mostly by aircraft. Thus, hunter numbers and harvest has been low and probably does not adversely impact the moose population. Because of low harvest, there has been little need to extensively monitor the moose population in this area.

Terrain in the subunit is hilly and mountainous, with peaks as high as 5000 feet. Corridors along 2 large rivers, the Melozitna and the Dulbi, represent the main summer habitat. Numerous fires have resulted in large expanses of potentially good winter habitat.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem.
- Provide a sustained opportunity to participate in hunting moose.

MANAGEMENT OBJECTIVE

- Maintain a harvest of bulls that is ≤6% of the estimated population.

METHODS

POPULATION STATUS AND TREND

We conducted a moose stratification survey on 18 and 19 April 2000 using the Geostatistical Population Estimator (GSPE), a modification of the "Gasaway" technique (Gasaway et al. 1986) using spatial statistics (Ver Hoef 2001). The stratification provided the basis for a rough population estimate of the subunit, and will be used to conduct population estimation surveys in the future. It was conducted in a Cessna 206 flown at 95–120 mph at altitudes of 500–1000 ft above ground, with 2 observers in the back seat and 1 observer/recorder in the front seat. Prior to the flight, we divided Unit 21C into a grid of 658 sample units (3671 mi^2) that were approximately 5.5 mi^2. We flew on the north–south boundary between 2 sample units, and each sample unit was classified as low or high moose density, based on number of moose observed, number of tracks observed, and habitat. If moose were spotted in the sample unit during the flight, it was designated a high moose density unit. Alternatively, if there were no moose observed it was typically designated a low moose density unless it was judged to be good habitat and >5 sets of tracks were observed. We surveyed 438 sample units (1971 mi^2). The area not surveyed was primarily high mountainous terrain in the Kokrine Hills. It will be stratified based on known habitat type and type of habitat estimated from a topographic map. Sex and age of moose were not recorded. No other surveys were completed in Unit 21C.

HARVEST

We monitored harvest and hunting pressure using harvest reports submitted by hunters. Total harvest, residency and success, chronology, and transportation were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000–30 Jun 2001).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

No surveys were completed in Unit 21C this reporting period. Survey conditions for the April 2000 stratification were only fair because hilly and mountainous terrain and bright light adversely affected sightability of moose. However, conditions were not poor because the bright light was an advantage for locating fresh tracks, which are a stratification criteria. Because moose distribution may be dependent on seasonal influences, this stratification will apply best to a spring survey.

We identified 39 sample units as high density and 399 as low density from a total of 438 sample units. Moose were concentrated on the north side of the Melozitna River on the hills that divide the drainages of the Melozitna and Dulbi Rivers. Additional moose and tracks were observed on the western end of the subunit within the Dulbi River drainage as we approached the Koyukuk River. However, only 31 moose were observed during the survey. This was lower than expected for the area and was probably partially a result of low sightability.

Estimated moose density was 0.35–0.45/mi^2 (1284–1651 moose) using the results of this survey and by comparing similar habitat to known densities elsewhere in the state where bears and wolves are lightly harvested (Gasaway et al. 1992). This density is lower than previously estimated (0.5–1.0 moose/mi^2; Osborne 1996).

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
RY90–RY99		
Unit 21C RESIDENT AND NONRESIDENT HUNTERS: 1 bull.	5 Sep–25 Sep	5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Seasons and bag limits remained the same during the past 12 years (RY90–RY01). During the March 2000 Board of Game meeting, harvest of 600–800 moose was established as the amount reasonably necessary for subsistence uses in Unit 21. During the March 2002 Board of Game meeting, (after this report period) a regulation was adopted that will require hunters to keep the meat on the bone of the 4 quarters and ribs, until they remove the harvested moose from the field.

Hunter Harvest. Harvest was relatively stable with a mean kill of 24 ± 7.7 ($\bar{x}$ ± 1*s*) moose annually for the past 12 years (RY90–RY01; Table 1). Two seasons that fluctuated dramatically from the mean were RY92, when only 9 moose were harvested, and RY97, when 41 moose were harvested. The high harvest in RY97 may have been caused by an additional big game guiding operation in the Melozitna drainage. In RY00 and RY01, 25 and 28 moose were harvested, respectively. Number of hunters was also stable during the past 10 years with a mean of 41 ± 7.7 ($\bar{x}$ ± 1*s*) and a range of 31–54.

Annual harvest during RY99–RY00 was <5% of the estimated number of moose in the subunit. If harvest was excessive, the proportion of large bulls in the harvest would be expected to decline. Instead, the proportion of large bulls (≥50") has remained high (*r* = 61–85%) during the past 7 years (RY95–RY01).

Hunter Residency and Success. During the report period, no one lived within the subunit; however, residents from Ruby in adjacent Unit 21B occasionally hunted the Melozitna River. Nonresidents comprised an average of 38% ± 16% ($\bar{x}$ ± 1*s*) of the hunters during RY90–RY01. Although nonresident hunters increased to 45% in RY99–RY01, the total number of hunters increased little (Table 1). Percent success was >50% for RY90–RY01, except in RY92 when success was 29%. High success rates were probably due to relatively low hunter numbers and concentrations of moose along the river corridors in September.

Harvest Chronology. Moose were harvested throughout the season, but the highest percent of harvest occurred during mid-September (Table 2).

Transport Methods. Hunters mainly used aircraft for transport (Table 3). A waterfall near the mouth of the Melozitna River restricts travel up the river and extensive sandbars impede boat access into the upper Dulbi River.

Other Mortality

Wolves and grizzly and black bears live throughout the subunit. In 1995, Osborne (1996) estimated a minimum of 60 wolves in the subunit and a grizzly bear density of 1/40 mi^2. Numbers of wolves and black bears have increased in adjacent Units 21D and 24 and have probably increased in Unit 21C. Predation presumably influenced population status in the past and may be increasing. Wolf and bear harvests were low (<10 annually) because hunter access is limited.

CONCLUSIONS AND RECOMMENDATIONS

Moose density in Unit 21C was low (0.35–0.45 moose/mi^2) with an estimated 1284–1651 moose present in the subunit. Human use of the moose population was low and recent harvest could be sustained even if the population experienced a substantial reduction.

For example, if harvests were not sustainable, the proportion of large bulls in the harvest would be expected to decline. Instead, large bulls (≥50" antler spreads) comprised most of the harvest (62–85%) during RY97–RY01. We achieved our first management goal to protect, maintain, and enhance the moose population and its habitat by monitoring moose harvest pressure, by maintaining open seasons for bear and wolf hunting and trapping, and by encouraging the Department of Natural Resources/Division of Forestry to let wildfires burn. We achieved our second goal to provide a sustained opportunity to participate in hunting moose by maintaining long hunting seasons. In addition, we achieved the management objective to maintain a harvest of bulls that is ≤6% of the estimated population. We estimated the harvest rate to be less than 2% annually. Although harvest has remained low, we recommend obtaining a population estimate and/or a bull:cow ratio to monitor effects of harvest on the population.

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Table 1 Unit 21C moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total	
1990–1991	1	18	5	1	25 (67)	0	9	3	0	12	37
1991–1992	0	15	5	0	20 (50)	0	17	3	0	20	40
1992–1993	0	7	2	0	9 (29)	0	15	7	0	22	31
1993–1994	0	11	9	0	20 (51)	0	13	6	0	19	39
1994–1995	0	17	10	0	27 (57)	4	14	2	0	20	47
1995–1996	0	12	13	0	25 (61)	0	13	3	0	16	41
1996–1997	0	10	5	0	15 (56)	0	9	3	0	12	27
1997–1998	1	14	26	0	41 (76)	0	10	3	0	13	54
1998–1999	1	8	12	0	21 (58)	0	9	6	0	15	36
1999–2000	0	15	16	0	31 (63)	0	13	5	0	18	49
2000–2001	0	9	16	0	25 (61)	0	11	5	0	16	41
2001–2002[b]	0	13	15	0	28 (55)	0	16	7	0	23	51

[a] Local resident resides in Units 21C or 21B.
[b] Preliminary data.

Table 2 Unit 21C moose harvest chronology percent by month/day, regulatory years 1995–1996 through 2001–2002

Regulatory	Harvest chronology percent by month/day				
year	9/5–9/10	9/11–9/15	9/16–9/20	9/21–9/25	*n*
1995–1996	29	33	25	12	24
1996–1997	7	33	40	20	15
1997–1998	12	36	34	17	41
1998–1999	25	35	30	10	20
1999–2000	20	30	27	23	30
2000–2001	21	25	50	4	24
2001–2002[a]	16	20	32	32	25

[a] Preliminary data.

Table 3 Unit 21C moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

	Harvest percent by transport method							
Regulatory year	Airplane	Horse	Boat[a]	3- or 4-wheeler	Snowmachine	ORV	Unknown	*n*
1990–1991	90	0	10	0	0	0	0	21
1991–1992	83	0	4	0	0	0	13	23
1992–1993	89	0	11	0	0	0	0	9
1993–1994	70	10	20	0	0	0	0	20
1994–1995	89	0	11	0	0	0	0	27
1995–1996	84	0	4	0	0	0	12	25
1996–1997	93	7	0	0	0	0	0	15
1997–1998	85	0	10	0	0	0	5	41
1998–1999	90	0	10	0	0	0	0	21
1999–2000	74	0	23	3	0	0	0	31
2000–2001	60	0	40	0	0	0	0	25
2001–2002[b]	61	0	36	0	0	4	0	28

[a] Includes airboats.
[b] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 21D (12,113 mi^2)

GEOGRAPHIC DESCRIPTION: Yukon River from Blackburn to Ruby and Koyukuk River drainage below Dulbi Slough

BACKGROUND

Moose are abundant in much of Unit 21D. However, high densities are a relatively new occurrence. Local residents first reported seeing occasional moose tracks during winters in the 1930s. During the 1940s and early 1950s, numbers of moose and wolves slowly increased (Huntington 1993). During the 1950s, federal wolf control and aerial shooting reduced the wolf population, allowing a rapid expansion of the moose population during the late 1950s and on through the 1960s. Expansion may have begun slowing in 1959 when statehood brought an end to federal wolf control. The moose population reached peak numbers about 1970 (S Huntington, personal communication to T Osborne, ADF&G) and then stabilized or declined slightly in localized areas in response to increased predation and hunting pressure. Increased predation may have been related to passage of the Federal Airborne Hunting Act in 1972, which halted aerial shooting of predators.

Moose trend count areas (TCA) established in 1981 in the Three Day Slough and Yukon floodplain areas indicated generally increasing moose densities through about 1993 (Tables 1–8). Initially, we thought this increase was due to better surveys, but a population estimation survey of the Kaiyuh Flats and the lower Koyukuk River in 1987 supported data from the TCAs (Osborne 1996). Moose densities were high along the Yukon River floodplain (3–6 moose/mi^2) and were very high on the Koyukuk River in the Three Day Slough TCA, where densities reached 13.3 moose/mi^2 in early winter 1993. We estimated that 6340 moose inhabited the survey area, and extrapolation of the data suggested a unitwide population of 9000–10,000 in 1993.

Results from a second survey in fall 1997 in the lower Koyukuk drainage and the Kaiyuh Flats indicated moose numbers were similar to the 1993 estimate (Huntington 1998). However, declining recruitment parameters from the TCAs since 1997 and a population estimation survey conducted in 2001, indicated the population was closer to 8500–9500 moose by winter 2001–2002.

There are 4 villages within the subunit (Kaltag, Nulato, Koyukuk, and Galena) and the residents of each village have traditional hunting areas. However, Galena residents tend to travel farther afield in the direction of the Koyukuk River. Nonresidents and Alaskans residing outside Unit 21D, primarily hunt the Koyukuk River between the Kateel River and the Dulbi Slough. Hunting pressure appears to be gradually shifting further upriver as hunters from outside the unit learn to deal with the logistics of accessing the area. In 1979 the Koyukuk Controlled Use Area (KCUA) was established in an attempt to reduce participation of nonlocal hunters by prohibiting the use of aircraft. However, by 1986 the hunters arriving by boat from outside the unit equaled the number of hunters who previously accessed the area by aircraft.

Reported harvest prior to 1981 was largely inaccurate because many local residents either did not obtain licenses or failed to report. In 1981 a program was initiated that made it easier for residents of the area to obtain hunting licenses and harvest reports. Educational and enforcement efforts improved the reporting rate by local residents, but at least 25% of the harvest is still unreported.

A hunter checkstation has been operating on the Koyukuk River since 1983. In 1990 the Ella's Cabin checkstation on the Koyukuk River became a mandatory stop for all hunters. The checkstation enables accurate determination of the number of hunters using the river to access the KCUA within Unit 21D. It is also used to educate local residents concerning licensing and reporting requirements, and to inform nonlocal hunters about regulations specific to the area and about the locations of private property near the river.

The fall hunting season dates changed several times between 1975 and 1981. From 1981 through 1996 there was a 21-day fall season for the entire subunit. Harvest of cows was allowed during the last 5 days. A 10-day season in early March also provided hunting opportunity for Alaska residents. In 1991, nonresidents were restricted to bulls with an antler spread of ≥50-inches, or at least 3 brow tines on 1 side. In 1992 the minimum number of brow tines on 1 side was increased to 4. Also beginning in 1992, meat of the hindquarters, forequarters, and ribs of any moose taken in the KCUA had to remain on the bone. In 1996, due to increasing moose hunter numbers and moose harvest, subsistence and general registration hunts were established for the KCUA, downstream from Huslia. In 2000, 2 resident and 2 nonresident drawing hunts replaced the general registration hunt and the subsistence registration hunt was shifted to open 5 days earlier.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Koyukuk River Drainage

Management goals and objectives were formulated during the previous reporting period, as part of the planning process.

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

Objective 1: Maintain a moose population of 9000–10,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

Objective 2: Provide for a harvest of moose, not to exceed 700 moose or 7% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 21D.

Objective 3: Provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

Objective 1: In combination with Unit 24, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

Objective 1: Reduce the amount of spoiled meat observed at Ella's Cabin and at hunting camps by 10% each regulatory year.

Activity 1: Implement a program at Ella's Cabin checkstation to monitor percentage of meat lost due to spoilage.

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

Objective 1: Increase the number of people engaging in nonconsumptive uses of wildlife by >1% each regulatory year.

Activity 1: Implement a program to monitor long-term trends and establish a baseline of the current level of nonconsumptive use, through collaboration with the Koyukuk/Nowitna National Wildlife Refuge and commercial operations in Unit 21D.

METHODS

Previously established TCAs, of 4–6 contiguous "Gasaway" sample units, were surveyed from small fixed-wing aircraft (PA-18 or similar aircraft) to assess moose population parameters (Gasaway et al. 1986). Surveys were flown at an altitude of approximately 500 feet and at ground speeds of 70–80 mi/hr. Moose were classified as cows, calves, yearling bull (<30" antler spread and no brow tine definition), medium bull (<50" antler width), or large bull (≥50" antler width). Sample units of approximately 12 mi^2 each were searched at a rate of approximately

5 min/mi^2 to ensure reasonably high sightability, minimal bias, and data comparability among years. Data was recorded on standard data forms and moose locations were also recorded on 1:63,000 USGS quadrangle maps. Surveys were not conducted until a minimum snow cover of approximately 12 inches had accumulated. This level of snow cover is important because snow depth influences sightability and moose distribution.

Population estimation surveys were conducted in October and November 2001 and 2002 using similar techniques described by Gasaway et al. (1986) but modified for analysis using the Geostatistical Spatial Population Estimator (GSPE) (Ver Hoef 2001). Sample units averaged 5.6 mi^2 in size, with search intensity of ~6 min/mi^2. Sample units were located by latitude–longitude coordinates using in-flight GPS units. Of the 975 sample units in the survey area, 291 sample units were surveyed intensively with an average survey time of 30.8 minutes per 5.6 mi^2 sample unit. Nine hundred seventy-five sample units were stratified in advance of the intensive survey, with 255 of the sample units classified as high moose density, while the remaining 720 sample units were classified as low moose density.

Twinning surveys were flown in May to determine the proportion of moose calf twins in the TCA. Search and survey techniques and sample units were similar to those used in early winter. Observation of 50 cows with calves was the desired minimum, but funding and weather often prevented us from achieving that goal. Moose were classified as bull, yearling, calf, cow, cow with 1 calf, or cow with 2 calves. The timing of the surveys was critical. The surveys occurred when calving progressed to the point that approximately 50% of the cows observed had calves, yet mortality factors such as early black bear predation did not strongly influence the results.

Hunting mortality and harvest distribution were monitored through the statewide harvest ticket system, registration permits, limited drawing permits, door-to-door subsistence surveys, and a checkstation. General season hunters received 1 reminder letter to report harvest. Hunters with registration, drawing, or Tier II permits received 1 postcard reminder, a telephone call, and a certified letter. The permittee was prohibited from receiving the following year's permit if no harvest information was relayed to ADF&G. Information obtained from the reports and surveys was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000). Data collected at the checkstation included hunter residency, harvest chronology, time in the field, hunting party size, sex and age structure of harvest, antler size, method of harvest, location of harvest, caliber of firearm, and method of transportation.

We evaluated predation by interviewing trappers, by field observations, and through aerial wolf surveys flown in cooperation with the US Fish and Wildlife Service (FWS).

Vegetation surveys were conducted in spring 2002 in the Lower Koyukuk River drainage. Several browse communities were evaluated to determine species that occur, vigor of the stand, current annual production and the amount of browsing that plants had incurred (CT Seaton, personal communication).

We continued with the planning process during the reporting period to address concerns over continued increase of hunters in the Koyukuk River Drainage. The planning process was initiated in winter 1999, and a Koyukuk River Moose Hunter's Working Group (KWG) was formed from members of the state's advisory committees, the Federal Western Interior Subsistence Council, and a local guide representative. The planning group developed a draft 5-year Koyukuk River Moose Management Plan (ADF&G files) that was submitted to the Alaska Board of Game during the March 2000 meeting. The draft plan was used as a guide for management goals, objectives, activities, and biological decision-making criteria in this management report. The board, in their January 2001 meeting, endorsed the plan.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

As noted in the previous report, the unitwide moose population increase that was observed for almost 2 decades had ended and some localized areas showed marked declines. Peak densities of moose were apparently reached between 1993 and 1997, but declining calf numbers and recruitment of yearlings began to be apparent in fall 1998 and 1999 in most TCAs (Tables 1–8). Estimates of the number of calves and yearlings that were apparently lost during 1998–2001 in the Three Day Slough area suggested a decline of as much as 25%. Since 1997 the total population may have declined by 10–15%, and the population trend is downward. Counts from several TCAs during 1999–2001 supported this conclusion, as did the population estimation survey conducted in 2001. However, steep declines that were first observed in the TCAs between 1997 and 2001 seemed to be largest in the high-density areas, while the low-density areas appeared to remain stable and productive. Those areas of productivity may have mediated the decline over the whole population.

My population estimate of 8500–9500 moose is based on previously reported values, trend count surveys conducted in RY01 and RY02, and the population estimation survey completed in 2001. Declining recruitment of moose among the trend areas was a key indicator of the apparent overall decline in the population. However, the 2001 survey showed that in the low-density areas not surveyed annually, moose numbers apparently remained relatively stable. In fall 2001, 5526 mi^2 were surveyed in Unit 21D and the southern portion of Unit 24. Of the 975 sample units in the survey area, 291 sample units were surveyed intensively. We counted 4524 moose during the intensive surveys with an average survey time of 30.8 minutes per 5.6 mi^2 sample unit. Nine hundred seventy-five sample units were stratified in advance of the intensive survey, with 255 of the sample units classified as high moose density, while the remaining 720 sample units were classified as low moose density. In the 3577-mi^2 portion of Unit 21D that was surveyed, we estimated 5203 moose (Table 9). In the remaining 8536 mi^2 of Unit 21D not surveyed, I estimated an average density of 0.45 moose/mi^2 or 3841 moose.

Population Composition

The following guidelines were used to interpret sex and age indices (Franzmann and Schwartz 1998).

- Bull:cow ratios in some of the high density TCAs were in excess of 30–40 bulls:100 cows after the fall hunting season. Ratios of 15 bulls:100 cows are sufficient for breeding

(Woolington 1998) in these areas, with higher ratios providing increased harvest or trophy hunting opportunity. High numbers of bulls are sometimes misleading in terms of harvest effects on the population because Unit 21D is subject to either-sex hunting which can inflate bull ratios.

- The calf:cow ratio observed during November surveys provides an index to calf survival during the calves' first 5 months. Black bears, grizzly bears, and wolves were the primary predators that reduced calf numbers (Osborne et al. 1991). A November calf:cow ratio of 20–40 calves:100 cows will usually allow a population to remain stable. Calf:cow ratios may indicate population change if subsequent overwinter mortality is either consistent or negligible. Ratios of <20 calves:100 cows may indicate a decreasing population and ratios of >40 calves:100 cows can be found in growing populations.

- The percentage of yearling bulls within the herd provides an index of the recruitment of young adults to the breeding population. It can also provide an indication of overwinter survival of calves, if the calf:cow ratio for the previous fall is known. Generally, the yearling bull percentage averages 4–8%, with anything less indicating poor recruitment and with anything higher indicating good recruitment.

- The number of twins born in May is often used as an indication of herd nutritional status. In general, the twinning rates are 25–90% in populations below carrying capacity, 5–25% in populations near carrying capacity, and <5% in populations above carrying capacity (Gasaway et al. 1992).

Since 1995 the post hunt bull:cow ratio for the Three Day Slough TCA was generally declining, with the fall 1999 ratio being the lowest recorded (Table 1). Bull:cow ratios vary widely between other TCAs (Tables 2–8), but most indicate some level of decline since 1995 or 1996. The percentage of large bulls (antlers ≥50") observed in the Three Day Slough TCA was 15–30% in the 1990s, while the percentage of large bulls in the harvest from Three Day Slough was 40–68% (Table 10). The drop in RY01 may be attributed to extremely warm weather during the fall hunting season. Bull:100 cow ratios from the 2001 GSPE survey were estimated at 33:100, well above the minimum needed for adequate productivity. For the survey area of 2001, the calf:100 cow ratio was estimated at 18:100. That calf ratio was lower than the target range (20–40:100) for maintaining a stable population. Data from most of the TCA's had even lower ratios however, which suggested the low density areas away from the TCA's maintained higher levels of productivity and probably acted to moderate the overall decline of the population.

Calf twinning rates in spring 2002 suggested declining productivity in the Three Day Slough area and the Huslia Flats area just to the north in Unit 24. Twinning rates appeared to be consistently in the low teens. Although only 16 cow/calf groups were observed in the Three Day Slough area in the 2002 survey, additional groups counted in the Huslia Flats area to the north had similar results (Table 11). In both areas, early leaf-out on the willows, birch and cottonwoods made sighting moose difficult.

Distribution and Movements

Movement patterns of moose in the Three Day Slough area are based on data from radiocollared animals (Osborne and Spindler 1993). Most adult and young moose remain in the floodplain area of Three Day Slough from late August until May each year. During May most moose move 10–60 miles north or south to upland areas where they spend the summer. In August they return to the floodplain area.

Moose movements are unknown in other portions of the subunit. However, local residents suspect some moose observed on the Kaiyuh Flats migrate seasonally to the south.

Generally, moose congregate along the river corridors in late fall with the approach of peak rutting season. With the accumulation of snow, moose are in high concentrations within the riparian corridor of the Yukon and Koyukuk Rivers, where they remain throughout the winter. With spring break-up, bulls are the first to leave the riparian areas, followed by cows that have calved. Osborne and Spindler (1993) found approximately 58% of the cows migrated after calving and approximately 83% of all moose were migratory.

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 21D, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 moose per regulatory year, only as follows:		
1 moose by registration permit only; or	27 Aug–31 Aug (Subsistence hunt only)	
1 bull by registration permit only; or	1 Sep–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Unit 24, that portion within the Koyukuk Controlled Use Area; or	5 Sep–25 Sep (General hunt only)	
1 moose during a 5-day season to be announced by emergency order during the period 1 Feb–28 Feb.	(To be announced) (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
by drawing permit; up to 80 permits may be issued in combination with Unit 24, that portion within the Koyukuk Controlled Use Area;		
Remainder of Unit 21(D)		
RESIDENT HUNTERS: 1 moose per regulatory year; however, antlerless moose may be taken only during the periods 21 Sep–25 Sep and during a 5-day season during the period 1 Feb–28 Feb to be announced by emergency order;	5 Sep–25 Sep (To be announced)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. The antlerless moose hunting seasons were reauthorized by the Alaska Board of Game for RY00 and RY01, but the board was notified that the antlerless season would be closed by emergency order for the fall 2002 season for conservation concerns.

The board adopted several changes proposed by the KWG at the March 2000 meeting. Key among those changes was the elimination of the general registration hunt and implementation of 4 drawing hunts within the KCUA. Drawing hunts DM827 and DM829 were the nonresident hunts and DM828 and DM830 were the resident hunts. The DM827 and DM828 hunts were for the first half of the season, while DM829 and DM830 hunts were for the second half of the season. The total number of permits were determined annually by the department based on population estimates and were allocated on a 80:20 ratio for resident and nonresidents. All drawing hunts were for bulls-only hunts, with nonresidents limited to bulls with 50-inch antlers or 4 or more brow tines on at least one side. The board shifted the RM832 registration hunt forward 5 days to begin 27 August and close 20 September. Finally, the permit area was expanded to include all of the Koyukuk Controlled Use Area. Previously, the permit area ended at the village of Huslia.

At the 2002 meeting, the board adopted more changes to the moose regulations in Unit 21D, requiring all the meat to remain on the bone of the 4 quarters and the ribs for the remainder of the unit. The regulation that applied to the winter seasons requiring hunters to stay one-half mile from the main stem of the Yukon River was dropped. The final action of the board was to prohibit the harvest of cows accompanied by calves.

Hunter Harvest. The reported harvest of moose in Unit 21D increased substantially since the early 1990s (Tables 12–14). Increased hunter numbers occurred primarily in the lower Koyukuk River drainage and to a lesser degree in the remainder of the unit. Interest in hunting the Koyukuk River grew particularly in the last decade. The decline in the bull segment of the population in some TCAs is probably linked to this increased harvest. Cow harvest was reduced in RY00 primarily due to elimination of the antlerless moose seasons in the KCUA.

Wounding loss was a concern of the KWG. During their meetings, they established that wounding loss constituted an important portion of the harvest that should be evaluated and documented. Values in the literature for wounding loss were 10–20% (Franzmann and Schwartz 1998). Gasaway et al. (1983) estimated 15% wounding loss and unreported harvest in Alaska.

Checkstation Results. Ella's Cabin checkstation, located 15 miles upstream from the village of Koyukuk on the Koyukuk River, was made mandatory in RY90. Hunters checking in at Ella's reached an all-time high in RY99, but the number dropped significantly with the implementation of the limited drawing hunts in RY00. The additional hunters in the KCUA were primarily nonlocal Alaska residents and, secondarily, nonresidents (Table 14). Numbers of local residents (residents of Unit 21D) remained relatively constant. Harvest success was high (>60%) for nonresidents and nonlocal residents. Local resident harvest success that was reported for the fall hunt was low, because they can hunt in both fall and winter seasons. Success rates remained high except for RY01, but that was due to the extremely warm weather during the fall hunting season.

The Three Day Slough area is well known as an excellent area to hunt for large (≥50-inch antlers) moose. One-fifth to one-third of the bulls observed in the Three Day Slough TCA had large antlers (Table 10). Consistently over the past 18 years, more than 16% of the bulls checked at Ella's Cabin had antler spreads >60 inches.

Three regulations monitored closely at the checkstation were antler width, salvage of meat, and destruction of trophy value of bulls harvested under subsistence registration permits. The regulation requiring meat to be left on the bone improved enforcement efforts to stop waste of moose meat. This regulation was passed in 1992 to address the increase of moose hunters and harvest in the KCUA, and to address the problem of some hunters removing only part of the meat from the carcass so they could carry lighter loads in their boats. All hunters coming through the checkstation were notified of this regulation at the time permits were distributed. Hunters were then checked for compliance of the regulation upon departure. Destruction of the trophy value of antlers at the checkstation was a controversial regulation when applied and seldom resulted in a positive public contact for the department. Beginning in RY00, hunters were required to cut the antlers at the kill site, which improved that aspect of the hunter contact.

Permit Hunts. Use of the subsistence registration permit (RM832) hunt was required in the fall within the entire Koyukuk Controlled Use Area. The number of RM832 permits issued for RY01 increased by 13.5% from the previous year (Table 15). Continued increases in the number of Alaska resident hunters using the subsistence permit alternative may exceed the sustainable yield of the moose population and has been a critical management issue. With the implementation of the 4 drawing hunts DM827, DM828, DM829 and DM830, hunter numbers can be better regulated.

Hunter Residency and Success. Hunter residency and success can be misleading because Unit 21D residents often did not report unsuccessful hunt information (Table 16). Harvest and hunter participation by Unit 21D residents was relatively constant according to Subsistence Division surveys (Anderson et al. 1998; Table 16). In contrast, nonresident and nonlocal resident hunter participation increased steadily since 1983. The increase in nonlocals created tension among user groups in the area and was the impetus for creating the KWG.

Harvest Chronology. Harvest reporting rate was low during the winter seasons and was probably 20% of the annual harvest (Table 17). Much of the unreported harvest was likely taken during October–March (Anderson et al. 1998).

Transportation Methods. The presence of the KCUA and the area's extensive river system made boats the primary transportation method (Table 18). Snowmachines were the main transportation during the winter hunt.

Other Mortality

Unit 21D has high populations of wolves and black bears. Grizzly bears were common in the upland areas of the Nulato Hills and Kaiyuh Mountains. Wolves and grizzly bears prey heavily on both calf and adult moose. Black bears were shown to kill more than 40% of moose calves annually (Osborne et al. 1991). Hunters continued to report increased observations of grizzly bears during the fall moose season. Anecdotal reports from Unit 21D residents also suggested grizzly bears were increasing and becoming more common intruders at their fish camps.

We estimated 208–304 wolves in 37 packs in a portion of Unit 21D during 1994 (Becker et al. 1998). Local residents with intimate knowledge of the unit's game populations report wolf numbers substantially increased since then. Packs in excess of 20 wolves were observed during fall 1999 moose surveys. We counted 126 wolves during a wolf reconnaissance survey in March 1999. This minimum count indicates an increase of at least 17% in the number of wolves in packs also observed during the 1994 survey.

HABITAT

Assessment

Feltleaf willow is an important browse species for moose due to its nutritional quality and use (Kielland 1997). Chemical analysis of 0.08- to 0.32-inch diameter twigs typically browsed by moose in Three Day Slough found crude protein was 8–12%, twice as much as found in the same willow species on the Tanana River. Consumption in Three Day Slough survey areas was 24–28% of the annual twig production (Kielland 1997). These factors may partly explain the sustained high numbers of moose in the Three Day Slough area. Annual forage production for a measurable area is unknown.

In April 2002 we conducted 6 browse transects in Unit 21D to evaluate sampling techniques that could potentially be used in the Galena Management Area.

MANAGEMENT PLANNING

The KWG met twice in RY01 and RY02, and the Management Plan (ADF&G files) developed by the working group was formally endorsed by the Board of Game at their winter 2001 meeting. The plan was the basis for developing goals and activities for moose management in Unit 21D. Although the KWG's area of concern was specifically within the Koyukuk River drainage, the issues were characteristic of concerns throughout Unit 21D and nearby Unit 24.

CONCLUSIONS AND RECOMMENDATIONS

Moose were relatively numerous in the riparian lowlands of Unit 21D. I estimated 8500–9500 moose in the unit. However, unitwide populations were declining as a result of declining recruitment. Four years of liberalized cow harvest removed an important reproductive component of the population. Also, declining recruitment parameters such as calf:cow ratios and yearling bull:cow ratios indicated predation was having an increasingly negative influence on the moose population. This conclusion is supported by the increase in wolves observed during the aerial wolf reconnaissance survey in 1999, observations of black bear predation during spring twinning surveys, observations of black bears in the field, and increased observations of grizzly bears by hunters. The population will continue to decline unless an effort to control predation is implemented and the harvest of antlerless moose continues to be decreased.

All hunters in the KCUA use boats, and during years with low water levels there is competition for camping sites and moose calling areas, and other problems associated with crowded hunting conditions. Historically, the area has been known for its remote qualities, where people had the opportunity to select a bull, watch bulls rut, and hunt and observe other wildlife such as bears and waterfowl.

The objective of maintaining the population at 9000–10,000 moose was achieved by a narrow margin. Poor recruitment, due in part to unregulated predation, appears to be the primary factor, although declining twinning rates suggest habitat could be linked to the decline. The objective to provide for a harvest of moose not to exceed 700 moose was achieved. From RY99–RY01, harvest was highest in RY99 at 619 moose, a harvest rate of no more than 6.9%, even if the population was at it lowest point of 9000 moose. Objective 3 was achieved with a total of only 588 hunters in RY00 and 509 in RY01.

The long-term objective of implementing at least 2 habitat enhancement activities was not achieved directly, but baseline data were collected on browse communities in Unit 21D and observations were made during survey flights that will be used in developing plans for potential treatment areas. Coordination with the FWS concerning potential treatment is in progress.

The objective of reducing spoiled meat will be monitored in RY02. It is believed that regulations adopted by the board that required salvage of meat on all 4 quarters and the ribs in all of Unit 21D was a positive move toward achieving this objective. Finally, as with the previous objective, a monitoring program to evaluate the number of people engaged in nonconsumptive activities is being developed. Coordination with the FWS on this objective has taken place and survey forms have been developed to monitor nonconsumptive wildlife activities.

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Table 1 Unit 21D Three Day Slough trend count area aerial moose composition counts, regulatory years 1981–1982 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1981–1982[a]	85.1	35	12	42	10	24	327	3.8
1982–1983[a]	85.1	43	13	24	2	14	415	4.9
1983–1984	84.8	31	9	37	12	22	530	6.3
1984–1985	57.8	30	13	31	10	19	332	5.7
1985–1986	83.3	39	11	17	4	11	501	6.0
1986–1987	83.3	39	7	45	13	25	660	7.9
1987–1988[a]	83.3	36	13	32	11	19	791	9.5
1988–1989	83.3	33	13	45	14	25	832	10.0
1989–1990	83.3	28	8	25	11	16	763	9.2
1990–1991[b]								
1991–1992[a]	83.3	34	10	31	6	19	909	10.9
1992–1993	83.3	35	10	31	7	18	1088	13.1
1993–1994[a]	83.3	38	8	25	4	16	1106	13.3
1994–1995	83.3	36	9	28	5	17	1026	12.3
1995–1996	83.3	23	7	36	6	23	1054	12.7
1996–1997	83.3	24	8	23	4	15	928	11.1
1997–1998	83.3	20	9	24	3	17	721	8.7
1998–1999	83.3	30	9	13	0	9	990	11.9
1999–2000	83.3	17	3	17	18	13	568	6.9
2000–2001[b]								
2001–2002	83.3	22	7	13	0	8	678	8.0

[a] Huntington and Spindler 1997.
[b] No survey.

Table 2 Unit 21D Dulbi River mouth trend count area aerial moose composition counts, regulatory years 1982–1983 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1982–1983	42.1	36	7	29	12	17	166	3.9
1983–1984	57.1	39	7	29	8	17	230	4.0
1984–1985	42.1	36	4	44	10	24	184	4.4
1987–1988	38.9	55	17	44	15	22	283	7.3
1992–1993	51.7	41	6	43	21	23	271	5.2
1996–1997	51.7	34	11	36	6	21	281	5.4
1997–1998	52.4	28	6	32	4	20	283	5.4
1999–2000	52.4	24	2	42	2	25	225	4.3
2000–2001	52.4	16	6	15	6	12	307	5.9
2001–2002	52.4	25	6	14	5	10	217	4.1

Table 3 Unit 21D Kateel River mouth aerial moose composition counts, regulatory years 1984–1985 through 1997–1998 (Huntington and Spindler 1997)

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1984–1985	47.8	21	8	54	5	31	68	1.4
1987–1988	38.0	41	20	41	12	23	84	2.2
1996–1997	49.4	46	15	29	14	16	152	3.1
1997–1998	61.1	26	10	34	0	21	188	3.1

Table 4 Unit 21D Long Stretch (Koyukuk River) aerial moose composition counts, regulatory years 1984–1985 through 1997–1998 (Huntington and Spindler 1997)

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1984–1985	51.5	94	31	31	25	14	36	0.7
1996–1997	51.3	36	6	61	25	31	65	1.3
1997–1998	62.5	47	7	33	0	18	77	1.2

Table 5 Unit 21D Koyukuk River mouth aerial moose composition counts, regulatory years 1984–1985 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1984–1985	65.5	27	10	41	5	25	183	2.8
1987–1988	37.8	28	8	49	12	28	69	1.8
1993–1994	51.2	43	10	36	6	20	175	3.4
1996–1997	51.2	42	6	45	7	24	181	5.1
1997–1998	66.5	35	6	50	10	27	284	4.3
1999–2000	66.5	36	10	19	6	13	288	4.4
2001–2002	66.5	41	8	17	0	11	267	4.0

Table 6 Unit 21D Squirrel Creek aerial moose composition counts, regulatory years 1981–1982 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1981–1982	40.7	93	49	34	8	15	93	2.3
1982–1983	37.3	57	18	41	0	21	87	2.3
1983–1984	37.3	58	14	35	14	18	137	3.7
1985–1986	49.3	78	30	11	13	6	185	3.8
1987–1988	38.4	76	20	67	20	27	131	3.4
1993–1994	37.2	49	4	22	0	13	195	5.2
1995–1996	48.8	43	14	31	8	18	222	4.6
1997–1998	48.6	54	24	32	8	17	253	5.2
1998–1999	48.6	41	12	31	13	18	283	5.9
1999–2000	48.6	69	19	24	3	13	246	5.1
2000–2001	48.6	47	9	14	6	9	223	4.6
2001–2002	48.6	46	5	25	2	15	289	6.0

Table 7 Unit 21D Pilot Mountain Slough aerial moose composition counts, regulatory years 1983–1984 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1983–1984	36.5	21	8	52	11	30	133	3.6
1984–1985	36.5	11	2	47	39	30	84	2.3
1985–1986	36.5	27	11	9	0	7	90	2.5
1987–1988	35.7	36	18	49	11	26	185	5.2
1991–1992	23.2	24	8	54	14	30	161	6.9
1993–1994	35.4	21	1	39	10	24	135	3.8
1995–1996	34.3	20	14	57	14	32	203	5.9
1997–1998	47.3	12	4	32	11	22	222	4.7
1998–1999	47.3	18	6	28	2	19	297	6.3
1999–2000	47.3	18	8	39	3	25	243	5.1
2001–2002	47.3	26	9	40	7	24	238	4.8

Table 8 Unit 21D Kaiyuh Slough aerial moose composition counts, regulatory years 1985–1986 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 Cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1985–1986	50.8	54	17	8	0	5	78	1.5
1987–1988	39.1	28	7	33	7	20	74	1.9
1992–1993	50.8	36	18	24	22	15	72	1.4
1994–1995	50.8	44	12	31	0	18	119	2.3
1996–1997	64.3	60	13	67	6	30	125	1.9
1997–1998	64.3	35	12	39	10	23	146	2.3
1998–1999	64.3	42	18	48	10	25	173	2.7
1999–2000	64.3	39	12	22	13	14	123	1.9
2000–2001	64.3	41	9	31	15	18	127	2.0
2001–2002	64.3	55	4	7	0	5	112	1.8

Table 9 Unit 21D moose population estimates of 1997 and 2001 population estimation surveys

Survey area	1997 Population estimate[a]	1997 Survey area (mi^2)	2001 Population estimate[b]	2001 Survey area (mi^2)
Kaiyuh Slough Sub-Area	1335 ± 230	1582	1800 ± 591	1843
Western Galena Sub-Area	3250 ± 403	1508	3403 ± 603	1734
Upper Koyukuk Sub-Area[c]	n/a	n/a	3642 ± 572	1949
Total Survey Area	4585 ± 633	3090	8924 ± 1161	5526

[a] Regression Analysis Estimate
[b] Spatial Analysis Estimate
[c] Predominantly within Unit 24

Table 10 Unit 21D large bull[a] moose percent harvested and number measured during the hunting season and percent counted during aerial surveys in the Three Day Slough area, regulatory years 1990–1991 through 2001–2002

Regulatory year	% Harvested (Sep)	Number measured (Sep)	% Counted (Nov)
1990–1991	54	91	–[b]
1991–1992	45	134	15
1992–1993	54	88	15
1993–1994	53	107	18
1994–1995	67	88	28
1995–1996	61	150	27
1996–1997	68	123	20
1997–1998	63	120	16
1998–1999	61	209	30
1999–2000	65	220	21
2000–2001	37	119	–[b]
2001–2002	40	83	30

[a] 50-inch or greater antler spread.
[b] No survey.

Table 11 Unit 21D moose aerial twinning surveys in the Three Day Slough trend count area, regulatory years 1989–1990 through 2001–2002

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[a]	Yearlings	Dates in May
1989–1990		24	21	47		21–25
1991–1992		22	23	51		22–23
1992–1993	296	23	19	44	100	23–25
1993–1994	110	39	11	22	55	23–24
1994–1995	78	37	18	33	38	22
1995–1996	200	39	13	26[b]	51	22,24
1996–1997	180	30	9	23	58	23–24
1997–1998	70	29	4	12	11	20–30
1998–1999	28	37	3	8	14	4–7[c]
1999–2000	101	53	8	13	47	27–29
2000–2001		38	6	14		28–30
2001–2002	30	13	3	19	2	29–1

[a] Percent of cows with calves that had twins.
[b] Including 1 cow w/3 calves.
[c] The 1999 survey was delayed to 4–7 June due to weather.

Table 12 Unit 21D moose harvest, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest by hunters				Unreported harvest	Potlatch stickdance	Total
	Bull	Cow	Unk	Total			
1990–1991	258	24	1	283	40	4	327
1991–1992	269	34	0	303	40	11	354
1992–1993	193	22	1	216	40	11	267
1993–1994	235	23	2	260	40	9	309
1994–1995	248	26	1	275	40	8	323
1995–1996	329	21	1	351	40	4	395
1996–1997	315	110	1	426	150[a]	4	580
1997–1998	336	73	1	410	150[a]	4	564
1998–1999	340	80	3	423	150[a]	1	574
1999–2000	336	127	3	466	150[a]	3	619
2000–2001	320	35	0	355	150[a]	10	515
2001–2002[b]	206	40	2	248	150[a]	13	411

[a] Unreported harvest based on Subsistence Division's door-to-door survey.
[b] Preliminary data.

Table 13 Ella's Cabin checkstation moose harvest, regulatory years 1990–1991 through 2001–2002[a]

Regulatory year	Bull	Cow	% Cow	Total
1990–1991	177	6	3	183
1991–1992	199	10	5	209
1992–1993	161	6	4	167
1993–1994	179	6	3	185
1994–1995	192	10	5	202
1995–1996	279	8	3	287
1996–1997	263	90	25	353
1997–1998	257	49	16	306
1998–1999	284	61	18	345
1999–2000	275	94	25	369
2000–2001	266	11	4	278
2001–2002	183	3	2	187

[a] Contains moose harvested in Units 21D and 24.

Table 14 Ella's Cabin checkstation[a,b] moose hunter residency and success, regulatory years 1983–1984 through 2001–2002

Regulatory	Unit 21D resident		Alaska resident[c]		Nonresident		Total	
year	Hunter	Moose	Hunter	Moose	Hunter	Moose	Hunter	Moose
1983–1984[d]	132	43	29	20	3	2	164	65
1984–1985[d]	92	61	67	36	9	9	168	106
1985–1986[d]	117	32	74	37	4	3	195	72
1986–1987[d]	140	48	80	51	9	7	229	106
1987–1988[d]	151	68	92	61	21	16	264	145
1988–1989[d]	158	73	121	88	20	20	299	181
1989–1990	154	55	125	89	23	14	302	158
1990–1991	137	48	133	105	36	30	306	183
1991–1992	136	49	189	121	55	38	380	209
1992–1993	145	45	173	103	39	19	357	167
1993–1994	115	48	132	109	34	28	281	185
1994–1995	106	34	194	127	56	41	356	202
1995–1996	124	49	260	188	63	50	447	287
1996–1997	213	90	306	198	89	66	608	354
1997–1998	157	66	278	185	89	55	524	306
1998–1999	155	58	344	213	126	74	625	345
1999–2000	180	68	383	210	173	91	736	369
2000–2001	203	77	261	175	43	26	507	278
2001–2002	199	49	287	124	35	14	521	187

[a] Includes hunters from both Units 21D and 24.
[b] Includes hunters reporting at Huslia.
[c] Other than Unit 21D residents.
[d] Check not mandatory prior to 1990.

Table 15 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2001–2002[a]

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Unk	Total harvest
RM832	1998–1999	295	0	45	55	125	(77)	38	(23)	0	163
	1999–2000	356	0	49	51	127	(70)	54	(30)	1	182
	2000–2001	355	8	44	48	157	(93)	11	(7)	1	169
	2001–2002[b]	403	8	60	32	126	(97)	3	(2)	1	130
RM830	1998–1999	330	0	45	55	159	(87)	23	(13)	0	182
	1999–2000	380	0	51	49	148	(79)	39	(21)	0	187
DM827	2000–2001	26	15	42	38	10	(100)	0	(0)	0	10
	2001–2002[b]	26	19	50	23	5	(83)	1	(7)	0	6
DM828	2000–2001	103	51	11	37	38	(100)	0	(0)	0	38
	2001–2002[b]	103	63	19	17	17	(100)	0	(0)	0	17
DM829	2000–2001	26	15	23	62	16	(100)	0	(0)	0	16
	2001–2002[b]	26	15	31	31	8	(100)	0	(0)	0	8
DM830	2000–2001	103	41	15	44	45	(100)	0	(0)	0	45
	2001–2002[b]	103	51	19	25	26	(100)	0	(0)	0	26
Total	1998–1999	625	0	45	55	284	(82)	61	(18)	0	345
	1999–2000	736	0	50	50	275	(75)	93	(25)	1	369
	2000–2001	613	22	28	45	266	(96)	11	(4)	1	278
	2001–2002[b]	661	24	41	28	182	(97)	4	(2)	1	187

[a] RM830 ended in RY00 and was replaced by Drawing Hunts DM827, 828, 829, and 830.
[b] Preliminary data.

Table 16 Unit 21D moose hunter residency and success, regulatory years 1990–1991 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	
1990–1991	103	135	35	10	283	34	27	4	6	71	354
1991–1992	105	150	42	6	303	60	97	16	3	176	479
1992–1993	72	111	23	10	216	56	82	14	15	167	383
1993–1994	87	141	24	8	260	55	27	7	2	91	351
1994–1995	80	148	44	3	275	47	68	13	0	128	403
1995–1996	90	203	54	4	351	41	77	9	0	127	478
1996–1997	135	218	70	3	426	127	143	34	1	305	731
1997–1998	127	226	57	0	410	110	104	52	0	266	676
1998–1999	100	232	88	3	423	124	180	76	1	381	804
1999–2000	126	232	104	4	466	140	202	121	1	464	930
2000–2001	111	198	45	1	355	78	107	48	0	233	588
2001–2002[b]	77	145	21	5	248	68	152	40	1	261	509

[a] Subunit resident only.
[b] Preliminary data.

Table 17 Unit 21D moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2001–2002

Regulatory year	Harvest chronology percent by month/day 9/1–9/14	9/15–9/25	2/1–2/10	*n*
1996–1997	53	43	4	423
1997–1998	59	37	4	446
1998–1999	50	49	1	386
1999–2000	48	47	5	456
2000–2001	48	47	4	348
2001–2002[a]	33	63	5	243

[a] Preliminary data.

Table 18 Unit 21D moose harvest percent by transport method, regulatory years 1990–1991 through 2001–2002

Regulatory year	Harvest percent by transport method Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	Total
1990–1991	4	0	88	0	3	0	2	2	283
1991–1992	5	0	86	0	5	0	2	2	303
1992–1993	3	0	88	1	3	0	2	3	216
1993–1994	3	0	88	1	5	0	1	2	260
1994–1995	4	0	85	0	7	1	2	1	275
1995–1996	3	0	91	1	2	1	2	0	351
1996–1997	2	0	91	1	4	0	2	1	426
1997–1998	4	0	90	1	4	0	1	0	410
1998–1999	5	0	88	0	3	1	2	1	423
1999–2000	2	0	90	0	5	1	1	2	466
2000–2001	3	0	90	1	4	1	1	1	355
2001–2002[a]	2	0	92	1	4	0	1	0	248

[a] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 22 (25,230 mi^2)

GEOGRAPHIC DESCRIPTION: Seward Peninsula and the adjacent mainland drained by all streams flowing into Norton Sound

BACKGROUND

Before 1930 very few moose were observed on the Seward Peninsula. However, by the late 1960s much of the suitable habitat in Unit 22 contained moose. Moose populations grew rapidly in the 1960s through the early 1980s and peaked in the mid 1980s in most parts of the unit. Severe winters in 1989, 1990 and 1992 caused declines in moose densities because winter browse was insufficient to maintain such large populations in Units 22B and 22D (Nelson 1995). Populations in these areas never recovered and recent data indicates these populations and others in the unit are currently declining. Habitat is no longer believed to be a major limiting factor at current population levels, rather brown bear predation on calves is thought to be a significant factor suppressing Unit 22 moose populations.

Although moose have been present in Unit 22 for a relatively short time, they rapidly became an extremely important food source for many Seward Peninsula residents, and demand for moose by subsistence and sport hunters is high throughout the unit. Gravel roads, trails, navigable rivers and snow machines provide hunters with easy access to suitable moose habitat (Machida, 1997). Annual harvests reported from 1969 through 2000 ranged from a low of 44 moose in 1972 to a high of 408 moose in 1986 (Table 1). However, in November 2001 declining moose populations prompted the Board of Game to implement restrictions intended to reduce harvest in the most accessible parts of Unit 22. In recent years unit residents have accounted for 70% or more of the annual reported harvest.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The following population objectives and bull:cow ratios presented to the Board of Game are the management goals for Unit 22:

- Maintain a combined population of 5100–6800 moose in Unit 22.

- Maintain a population of 600–800 moose in Unit 22A.

- Increase and stabilize the population at 1000–1200 moose in western Unit 22B.

- Insufficient data exists to develop a specific management goal for eastern Unit 22B, however increased recruitment rates and population growth are desired.

- Slightly reduce and maintain a population of 450–475 moose in Unit 22C.

- Increase and stabilize the population at 2000–2500 moose in Unit 22D.

- Increase and stabilize the population at 200–250 moose in Unit 22E.

- Maintain a minimum bull:cow ratio of 30:100 in Units 22A, 22B, 22D, and 22E.

- Maintain a minimum bull:cow ratio of 20:100 in Unit 22C.

The Unit 22 population objective (5100-6800 moose) recommended by the department was adopted by the Board of Game in November 2001 (after the reporting period). This objective was revised downward slightly from our previous management goal of 5700–7300 moose, which may be slightly larger than the habitat can support. In Unit 22A, the current population size in unknown, but is believed to be below our goal. In western Unit 22B, Units 22D and 22E our goal is to increase and stabilize the population from a period of steady decline in total moose numbers. In Unit 22C, the goal is to slightly reduce numbers and maintain a population within winter browse carrying capacity. We attempt to maintain a minimum bull:cow ratio of 30:100 in all units except Unit 22C where a minimum bull:cow ratio of 20:100 is acceptable.

MANAGEMENT OBJECTIVES

The management objectives for survey and inventory activities in Unit 22 are:

- In selected areas of the unit, make annual estimates moose abundance, sex and age composition, and yearling recruitment and determine trends in population size and composition.

  - Complete censuses in the 5 subunits of Unit 22 on a rotational basis to estimate moose abundance.

  - Complete late fall and/or early spring aerial surveys in selected portions of the unit to provide an index of moose population status and trends, sex and age composition, and yearling recruitment.

- Monitor human and natural mortality factors affecting the population.

  - Evaluate hunting mortality by analyzing all moose harvest data.

  - Improve harvest reporting through public education, vendor support and improved communication, and by conducting community-based harvest assessment surveys in selected villages.

- Evaluate hunting regulations and recommend changes if necessary for conservation purposes.

- Improve public understanding of hunting regulations and the reasons they are necessary.

METHODS

We conducted aerial surveys in the spring and fall to estimate sex and age composition and short yearling recruitment in portions of Unit 22 during the report period. In March of 2001, a moose census of Unit 22C was completed using the geostatistical population estimator technique (J. VerHoef, ADFG, pers. commun.). A thorough survey of all riparian habitat in Unit 22E was completed during April 2001 to estimate population size and recruitment. We summarized harvest reports returned by hunters and harvest data collected during big game harvest surveys in Brevig Mission, Elim, Shaktoolik, Shishmaref, Teller, Wales and White Mountain. Numerous public meetings were held throughout the unit to discuss declining moose populations and to form recommendations to the Board for changes to hunting regulations.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

In Unit 22A, censuses in 1989 and 1994 show the population remained stable at 600–800 moose. Since no recent density data have been obtained for Unit 22A the current status of moose in the subunit is unknown. In spring 2000, when Unit 22A drainages were surveyed, recruitment estimates were low, similar to those in Units 22B and 22D. These data and reports of declining numbers of moose from longtime unit residents suggest the population may now be below our management goal of 600–800 moose for the unit. Historically moose densities have been lower in Unit 22A than in many other parts of the unit, possibly due to less suitable habitat and higher predator densities. No collaring studies have been conducted in Unit 22A and we lack data on moose movements, however longtime local residents report that some of the moose present in the Unalakleet River drainage in the summer and fall, spend the winter in the Anvik and Yukon River drainages in Unit 21.

Moose densities in Units 22B and 22D have declined since the dramatic increases observed in the 1980s. The winters of 1989, 1990, and 1992 were particularly severe on moose, and winter mortality was reported to be higher than normal during those years. Census data from western Unit 22B show a 50% decline between 1987 and 1999 with continued low recruitment. The 1999 population estimate for western Unit 22B was 802 moose (90% C.I. ±19%). Although we have no density estimates for eastern Unit 22B, recruitment estimates in 1999 and 2000 in the Koyuk drainage were similar to those in the western portion of the unit. Based on this information and comments by local residents we suspect poor calf survival may also be affecting moose densities in eastern Unit 22B.

In Unit 22D census data from the Kuzitrin and American river census areas showed a 35% decline in moose numbers between 1988 and 1993. A census in 1997 indicated the population had stabilized 35% below 1988 densities. However, since 1999 surveys in the Kuzitrin River drainage have shown poor recruitment and low calf:cow ratios, and the public has become increasingly concerned about fewer moose in the area. We believe that moose are declining in the Kuzitrin drainage.

The Unit 22C moose population has grown steadily throughout the 1990s and in spring 2001 was estimated at 557 moose. This estimate exceeds our management goal by 18% and adds to concern that the population may exceed the carrying capacity of the winter range. Yearling recruitment is highest in Unit 22C and generally exceeds 20%. However, the bull:cow ratio is low, varying between 10–20 bulls:100 cows.

A spring 2001 survey of moose habitat in Unit 22E indicates the population declined by 23% to 169 moose since the last population survey in 1996, and is below our management goal.

Population Size

A census of Unit 22A scheduled for March 2000 was cancelled due to poor flying weather.

In March 2001 a census of Unit 22C was completed using the geostatistical population method developed by Jay VerHoef. An estimate of 557 moose (90% C.I. 491–623, ±11.9%) indicates the population increased since 1995 when an estimate of 479 moose was obtained. Also 34 calves:100 adults were found. The recruitment rate was 25%. Unit 22C is currently the only place in Unit 22 where recruitment is consistently high enough to result to steady population growth, and the only place where moose are believed to be at or above our population goal. The large number of moose wintering in the Snake River drainage, high recruitment rates and condition of browse create concern that the population in Unit 22C may be approaching the carrying capacity of the winter range.

In April 2001 a survey of moose habitat in Unit 22E was completed to determine population size and short yearling recruitment. This survey resulted in a direct count of 169 moose (157 adults and 12 calves. The recruitment rate was 8%.

Records from the previous Unit 22E surveys in 1991 and 1996 indicate moose were not previously surveyed in the Nugnugalugtuk drainage. When the 17 moose found in the Nugnugalugtuk drainage in 2001 are removed from the 2001 estimate, the population of 152 moose showed a 23% decline since the 1996 estimate of 196 moose. The recruitment rate was half the previous estimate of 16%. Survey data indicates the Unit 22E moose population has been declining steadily since the first population survey in 1991 when 226 moose were counted.

In spring 2001 snow cover was unusually deep throughout Unit 22E. Moose habitat west of the Serpentine River drainage was largely snow covered with little browse available. The number of moose found in the western part of the Unit was down by 35% (from 60 in 1996 to 39 in 2001). The moose that were present generally appeared to be in poor condition. Moose in the Serpentine drainage had more available browse and appeared to be in better condition.

Population Composition

In November 2000, for the first time since the mid 1990s, adequate snow cover enabled us to complete fall composition surveys in portions of Units 22B, 22C and 22D. In November 2001, we surveyed the same areas, but snow cover was light and moose were still widely dispersed throughout the upper drainages. As a result our sample sizes in Units 22B and 22D were small

(Table 2). Fall composition surveys were flown during both years in an R44 helicopter, which greatly improved our ability to find moose in willow thickets. In spring 2000, recruitment surveys were flown in Units 22A, 22B, 22C and 22D. Results from these surveys were reported in the previous management report. A recruitment survey of the Snake River drainage in March 2001 was the only other composition survey completed (Table 3).

In November 2000 we surveyed portions of the Niukluk River drainage in western Unit 22B, finding 8 calves:100 cows and 27 bulls:100 cows (N=115). In fall 2001 the same area was surveyed and we found 14 calves:100 cows and 30 bulls:100 cows (N=81). These data indicate the bull:cow ratio has remained close to our management goal in spite of population declines in this area. The low calf :cow ratio continues to be of concern.

A fall 2000 survey of the Snake and Eldorado/Flambeau River drainages in Unit 22C found 25 calves:100 cows and 10 bulls:100 cows (N=85). In 2001 we surveyed the Snake River drainage again and the Stewart River drainage for the first time. In the Snake and Eldorado/Flambeau drainages the bull:cow ratio (17 bulls:100 cows) remains below our management goal of 20 bulls:100 cows, which has been the case for over 10 years. However in 2001, in the nearby Stewart River drainage we observed 39 bulls:100 cows (N=64). The Stewart drainage is relatively inaccessible and receives little hunting pressure, but is in close proximity to the Snake and Eldorado/Flambeau drainages. The discovery of numerous bulls, including large, mature bulls in the Stewart drainage alleviates some of our concern about other parts of Unit 22C where bull:cow ratios are chronically very low. In 2001, the overall calf:cow ratio for Unit 22C was 21calves:100 cows (N=164). This is down somewhat from previous years, but not unexpected due to affects of greater than normal snow accumulation and delayed breakup in spring 2001. Many moose in Unit 22C appeared to be in poor condition by March, as a result, by April winter mortality was thought to be higher than normal and observations indicated calving was generally delayed until the second week of June.

In November 2000 and 2001 (after the reporting period) we surveyed portions of the Kuzitrin River drainage in Unit 22D. In 2000 16 bulls:100 cows were found (N=216) and in 2001 15 bulls:100 cows were seen (N=114). The bull:cow ratio in the Kuzitrin River drainage declined substantially since the mid 1990s and is well below our management goal of 30 bulls:100 cows, necessitating regulatory action. In November 2000 we found 11 calves:100 cows in the Kuzitrin drainage. This low calf:cow ratio, low recruitment rates in the springs of 1999 and 2000, and reports of few calves seen in recent years by long time users of the area alert us to a probable decline in moose numbers in the Kuzitrin drainage since our last census in 1997. Our most recent survey in November 2001 found improved calf survival; 19 calves:100 cows.

In November 2000 and 2001 (after the reporting period) we also surveyed portions of the American and Agiapuk River drainages in Unit 22D, which are relatively remote and receive less hunting pressure than many other parts of the unit. In 2000 we found 44 bulls:100 cows (N=318) and in 2001, 30 bulls:100 cows (N=112). In 2000 we found 23 calves:100 cows, but in 2001 only 6 calves:100 cows were seen.

In the past we have used composition data from the Snake River drainage in Unit 22C as an indicator of composition in Unit 22C as a whole. For purposes of comparison we flew a recruitment survey of the Snake River drainage immediately after completing the Unit 22C census in March 2001. The Unit 22C census found 34 calves:100 adults and a recruitment rate of 25%. The recruitment survey of the Snake River drainage found 26 calves:100 adults and a recruitment rate of 21%.

Distribution and Movements

No specific studies were undertaken during this reporting period to evaluate distribution or movements of moose in Unit 22. However, some observations were made during census work.

During spring 2001, the southern Seward Peninsula had greater than normal snow accumulation. During the March 2001 census of Unit 22C we noted an unusual winter distribution of moose. Although some riparian areas were being used, many moose were dispersed on relatively barren hillsides and in upland valleys where food was sparse. Presumably, these animals left lowland areas to avoid deep snow in favor of upland sites where wind-packed snow allows easier movement. Many moose in Unit 22C were noted to be in poor condition in April and May and overwinter mortality appeared to be higher than normal.

MORTALITY

Harvest

Season and Bag Limit. The 1999–2000 seasons and bag limits were unchanged from the previous reporting period. In 2000–2001, changes were implemented in Units 22B, 22C and 22D.

1999–2000 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22A		
Residents: 1 bull	1 Aug–30 Sep 1 Dec–31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Aug–30 Sep
Unit 22B, that portion west of the west bank of the Fish River and west of the southwest shore of Golovin Bay from the mouth of the Fish River to Rocky Point		
Residents: 1 antlered bull	1 Aug–31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Aug–31 Jan
Remainder of Unit 22B		
Residents: 1 antlered bull or 1 moose	1 Aug–31 Jan 1 Dec–31 Dec	
Nonresidents: 1 bull with 50-		1 Aug–31 Jan

1999–2000 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
inch antlers or with 4 or more brow tines on at least one side		
Unit 22C		
Residents: 1 bull	1 Sep–14 Sep	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side		1 Sep–14 Sep
Unit 22D,that portion within the Kougarok, Kuzitrin and Pilgrim River drainages		
Residents: 1 antlered bull	1 Aug–31 Jan	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side		1 Aug–31 Jan
Remainder of Unit 22D,		
Residents: 1 antlered bull or	1 Aug–31 Jan	
1 moose	1 Dec–31 Dec	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side however, antlerless moose may be taken only from 1 Dec–31 Dec.		1 Aug–31 Jan
Unit 22E		
Residents: 1 moose, however no person may take a cow accompanied by a calf	1 Aug–31 Mar	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side however, antlerless moose may be taken only from 1 Dec–31 Dec.		1 Aug–31 Mar

2000–2001 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22A		
Residents: 1 bull	1 Aug–30 Sep 1 Dec–31 Jan	

2000–2001 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Aug–30 Sep
Unit 22B, that portion east of the Darby Mountains, including the drainages of the Koyuk and Inglutalik Rivers		
Residents: 1 bull	1 Aug–30 Sep 1 Nov–31 Dec	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Nov–31 Dec
Remainder of Unit 22B		
Residents: 1 bull	1 Aug–30 Sep 1 Dec–31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Sep–30 Sep
Unit 22C		
Residents: 1 bull	1 Sep–14 Sep	
Or one antlerless moose by registration permit	15 Sep–30 Sep	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side		1 Sep–14 Sep
Unit 22D, that portion within the Kougarok, Kuzitrin and Pilgrim River drainages		
Residents: 1 antlered bull	1 Aug–31 Jan	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side		1 Sep–30 Sep
Remainder of Unit 22D		
Residents: 1 antlered bull or	1 Aug–31 Jan	
1 moose	1 Dec–31 Dec	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side however, antlerless moose may		1 Aug–31 Jan

2000–2001 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
be taken only from 1 Dec–31 Dec.		
Unit 22E		
Residents: 1 moose, however no person may take a cow accompanied by a calf	1 Aug–31 Mar	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side however, antlerless moose may be taken only from 1 Dec–31 Dec.		1 Aug–31 Mar

Board of Game Actions and Emergency Orders. In October 1999 the Board of Game made a number of changes to Unit 22 moose seasons and bag limits that went into affect in regulatory year 2000–2001: 1) in all of Unit 22B the antlerless moose season was eliminated due to the continued decline in moose densities; 2) in Unit 22B west of the Darby Mountains (Remainder of Unit 22B), the resident moose season was shortened to 1 Aug–30 Sep and 1 Dec–31 Jan. and the nonresident season was shortened to the month of September; 3) in Unit 22B east of the Darby Mountains, the resident season was shortened to 1 Aug–30 Sept. and 1 Nov–31 Dec and the nonresident season was shortened to 1 Nov–31 Dec; 4) in Unit 22D the nonresident moose season was shortened to the month of September to prevent increased harvest by nonresident hunters displaced by the shortened nonresident season in Unit 22B; and 5) in Unit 22C a registration hunt for up to 20 antlerless moose was established from 15 Sep–30 Sep to help stabilize the growing population and prevent over utilization of winter habitat.

In October 2000 the resident moose season in the Kuzitrin River drainage in Unit 22D was closed by emergency order from 21 Oct–30 Nov, 2000. This action was taken because the September closure of the Unit 22B moose season, increased harvest pressure in Unit 22D and the moose population in the Kuzitrin drainage could not support increased harvest.

After the reporting period in July 2001 an emergency order was issued shortening the upcoming resident and nonresident moose seasons in the most heavily hunted parts of Units 22B and 22D. In western Unit 22B, Unit 22D in the Kuzitrin River drainage and in southwestern Unit 22D, the resident season was shortened to 20 Aug–14 Sep. The nonresident season was reduced to 1 Sep–14 Sep. In Unit 22E the shortened season for all hunters was 1 Aug–31 Dec and the bag limit was changed from 1 moose to one antlered bull.

After the reporting period in November 2001, after a lengthy process of public input and review, the Department recommended permanent regulatory changes for the areas which we believe cannot support recent harvest levels. The board adopted the following regulations, which will go into affect in regulatory year 2002–2003:

In Unit 22B, west of the Darby Mountains two resident registration permit hunts with quotas were established. The fall season is 10 Aug–23 Sep for any antlered bull and there is a winter hunt from 1 Jan–31 Jan for any bull. The nonresident moose season in western Unit 22B was closed.

In the portion of Unit 22D that includes the Kuzitrin drainage and the area west of the Tisuk River drainage a resident registration moose hunt with a quota was established. The season is 20 Aug–14 Sep for any antlered bull. If the quotas for these areas are not reached, a winter season from 1 Jan–31 Jan will be announced. The nonresident moose season in these portions of Unit 22D was closed. In the remainder of Unit 22D the resident season was shortened to 10 Aug–14 Sep and 1 Oct–31 Jan. The nonresident season will be 1 Sep–14 Sep. This was an attempt to prevent increased harvest by displaced hunters from other areas of Unit 22D where seasons were shortened.

The resident moose season in Unit 22E was shortened by 3 months to 1 Aug–31 Dec and the bag limit was changed from one moose to one antlered bull. The nonresident season was closed.

In 1999 and 2001 the board also liberalized brown bear hunting regulations in Unit 22, partly in an attempt to reduce predation on moose. In 1999 the resident tag fee requirement was eliminated for all of Unit 22 and the number of nonresident brown bear drawing permits was increased for Units 22B/22C and Units 22D/22E. After the reporting period in 2001 the bag limit for residents and nonresidents was changed from 1 bear every 4 years to one every year except in Unit 22C where the bag limit remains 1 bear every 4 years. The subsistence and general seasons were lengthened by one month and will open on 1 Aug. Unit 22C was added to the Northwest Brown Bear Management Area and the number of nonresident brown bear drawing permits for Units 22D and 22E was increased.

Hunter Harvest. During the 1999–2000 season, harvest ticket data shows that 581 hunters harvested 252 moose (244 males, 5 females and 3 of unknown sex). A harvest of 221 moose (194 males and 27 females) was reported taken by 536 hunters during the 2000–2001 season (Table 1).

Hunter effort and harvest peaked in the mid 1980s when the Unit 22 moose population was at its height. Harvests during this reporting period were slightly higher than recent years, but were 38%–46% lower than the peak harvest of 408 moose in 1986. The number of moose hunters also increased over recent years, but is still 57% below the peak of 1,292 hunters in 1983. Declining numbers of moose in easily accessible areas is largely responsible for the reduction in hunter effort and harvest. Although the size of the harvest and the number of hunters declined in Unit 22, hunter success rates have remained fairly constant and relatively high over the last 16 years, ranging from 39–50%. During this reporting period the hunter success rate was 42% (Table 1).

Compliance with license and harvest reporting requirements by Nome residents is believed to be high, but harvest reporting by village residents has always been incomplete. During this reporting period, the department and Kawerak Inc. continued a community-based harvest assessment program begun in April 1999 to obtain more accurate big game harvest data from Unit 22 villages. In April 2000 household surveys were conducted in Elim, Shaktoolik and White

Mountain. Elim residents reported harvesting 14 moose and 42% of the households that hunted moose were successful. None of the harvest was reported through our traditional harvest ticket reporting system. Shaktoolik residents reported harvesting 14 moose and 68% of the households that reported hunting moose were successful. Only 14% (2 moose) of the moose taken by Shaktoolik residents was reported with harvest tickets. White Mountain hunters reported a harvest of 17 moose. Success rate in White Mountain was 55%. Ninety-four percent of the White Mountain harvest (16 moose) was reported with harvest tickets (Georgette 2000).

In Spring 2001, community-based harvest assessments (big game harvest surveys) were conducted in Brevig, Teller, Shishmaref and Wales (Georgette 2001). Brevig residents reported harvesting 23 moose, and 79% of the households that hunted moose were successful. Seventeen percent of the harvest (4 moose) was reported by harvest ticket. Teller residents reported a harvest of 7 moose and a 32% success rate. In Teller 86% of the harvest (6 moose) was reported by harvest ticket. In Shishmaref 44 moose were reported harvested and the success rate was 76%. Only 23% of the moose (10) were reported by harvest ticket. Wales residents reported harvesting 14 moose, 69% (9) of which had been reported by harvest ticket. The success rate of Wales hunters was 78%. Compliance with harvest ticket reporting varies widely between villages, but it is clear that actual harvest is likely significantly higher than reported harvest in Unit 22. Although community-based harvest assessments are costly and labor intensive to conduct, it is the most reliable method we have found to collect accurate harvest data in Unit 22.

The reported cow harvest in Unit 22 increased noticeably in 2000, because 16 cows were harvested in a new registration hunts for antlerless moose in Unit 22C. Since the early 1990s when antlerless moose seasons were shortened, the reported cow harvest in Unit 22 has been small. In 1999–2000, 2% (5 cows) of the reported harvest was cows and in 2000–2001 the harvest of cows was 12% (27 cows) (Table 1). However big game harvest surveys show that more cows are harvested than are reported and in some areas the cow harvest is significant. In 2000 Elim reported a harvest of 3 cows, Shaktoolik hunters harvested 4 cows and a White Mountain hunter harvested one cow. In 2001 community-based harvest assessment reported the harvest of 2 cows in Teller, in Brevig 6 cows were harvested, in Shishmaref 18 cows were harvested and in Wales 3 cows were harvested. Of the 29 cow moose reported in these 4 villages, 9 (31%) were reported on harvest tickets.

Permit Hunts. In September 2000 two registration permit hunts were initiated for antlerless moose in Unit 22C. Hunt RM850 occurs in the portion of Unit 22C in the Nome and Snake River drainages with up to 5 available permits. RM852 is in the remainder of Unit 22C and up to 15 permits may be available. In 2000 all 20 permits were issued, with 4 cows taken in RM850 and 12 cows taken in RM852. In 2001 only 10 permits were issued (3 in RM850 and 7 in RM852) due to concern about higher than normal winter mortality in spring 2001. In RM850, 3 cows were harvested and 5 cows were harvested in RM852.

Hunter Residency and Success. During 1999–2000 Unit 22 residents accounted for 69% of the harvest and in 2000–2001, 71% of the harvest (Table 4). The proportion of the harvest attributable to local residents has remained remarkably constant during the last 10 years, ranging from 69%–74% of the harvest. Nonresidents accounted for 11%–13% of the harvest during this reporting period.

Harvest Chronology. During this reporting period most of the hunter effort and reported harvest (85%) occurred during August, September, and October when access by roads and rivers is most favorable (Table 5). In 2000 the October harvest was greatly reduced because the season in Unit 22B closed 30 Sept. and the season in the Kuzitrin drainage in Unit 22D was closed by emergency order 21 Oct. Some hunting activity also occurred during December and January when snow machine access is possible and antlerless moose hunting is allowed in December in parts of Unit 22D. In Unit 22E where there are no roads and river access to moose habitat is limited, most of the harvest occurs during January, February and March when hunting is possible by snowmachine.

Data from 1999 and 2000 community-based harvest assessment in Koyuk, Shaktoolik, Elim and White Mountain indicate August is the favored month for moose harvest in those villages. Most of the remaining harvest there occurs in September (Georgette 1999 and 2000). The 2001 surveys of Teller, Brevig, Shishmaref and Wales found different harvest timing in the western villages. In Teller October was the favored month for moose harvest, followed by Sept. and August. In Brevig the highest harvest was in September, followed by December and October. In Shishmaref and Wales harvests were highest in March (Georgette 2001).

Transport Methods. During this reporting period 32% of successful moose hunters used four wheelers, 29% used boats, 17% used highway vehicles and 13% used snowmachines (Table 6). Only 3% of the harvest was by hunters using airplanes. The number of moose harvested by hunters using only highway vehicles for transportation has declined steadily over the last decade. Moose densities are now very low along the road corridor and hunters often must travel to areas far from the road system for successful hunts. Four-wheel-drive four wheelers provide access to remote areas, particularly areas characterized by open terrain, such as Unit 22D.

Other Mortality

No surveys were attempted to determine natural mortality rates of Seward Peninsula moose. The winter of 1999–2000 was colder than average with little snowfall until mid January. Moose remained dispersed at higher elevations until snow accumulation late in January drove them to the river bottoms. Snow accumulation for the remainder of the season was average and moose observed during spring surveys in Units 22A, 22B, 22C and 22D generally were lively and appeared to be in good condition. In the winter 2000–2001 heavy snow accumulation and late spring snow melt on the Seward Peninsula west of the Darby Mountains appeared to result in higher than average overwinter mortality. During the Unit 22C and 22E censuses, moose were found in areas with little available browse and many appeared to be in poor condition. Examination of bone marrow from leg bones of 19 dead moose found in the Snake, Penny and Nome River drainages in April and May 2001 indicated most of those moose either died of starvation or were severely malnourished when they died.

We believe that bear density in Unit 22 has increased over the last decade and that predation by bears on calf and adult moose is a significant factor suppressing moose populations in many parts of the unit. Recruitment rates are generally very low. A 1996–1998 radio collar study of cow moose in western Unit 22B found that up to 75% of the moose calves observed, died within 3 months of birth and 71% of calf mortality occurred within a month of birth. Although calf viability may be a factor, such high mortality shortly after birth suggests points to predation (Persons 1998). During years such as spring 1999 and 2001 when deep, soft snow persists well into May, bear predation on adult moose may be significant. Wolves are becoming more numerous on the Seward Peninsula, especially in areas occupied by wintering caribou from the Western Arctic herd. Predation by wolves was not previously believed to be a significant factor in moose mortality, but that may be changing as wolves become more abundant.

HABITAT

Assessment

No browse surveys or quantitative range assessments were undertaken to determine availability and quality of winter range in Unit 22. In the past during winters of heavy snow accumulation, winter ranges have been heavily browsed but at current population levels, in most parts of the unit we do not believe that habitat limitations are suppressing moose populations. However, the growing moose population in Unit 22C and the increasingly heavy utilization of winter habitat there raises concerns that the carrying capacity may be exceeded.

Enhancement

There were no habitat enhancement activities conducted in Unit 22 during the reporting period. Members of the public have requested that the department investigate possibilities for habitat enhancement in Unit 22C.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

In Units 22B and 22D the Federal Subsistence Board adopted regulations or special actions that differ from state moose regulations. While this has not resulted in biological problems, it has increased the complexity of the regulations and created significant public confusion. State and federal managers need to work cooperatively to produce and distribute maps and simplified explanations on which regulations apply where.

CONCLUSIONS AND RECOMMENDATIONS

The moose population on the Seward Peninsula grew steadily in size from the 1960s, through the early 1980s and began to decline during the late 1980s and early 1990s. We estimate the population reached a maximum size of 7000–10,000 moose on the Seward Peninsula during the mid to late 1980s. Subsequent declines likely caused by a combination of winter mortality, reduced productivity, low recruitment and increased predation reduced the population size to between 4500 and 6500 animals. Low recruitment rates found in Units 22A, 22B, 22D and 22E indicate a widespread problem with calf survival in the unit. In a large portion of Unit 22 it is likely that harvest and natural mortality are currently exceeding recruitment and populations are believed to be declining.

Results from a research study in western Unit 22B in the late 1990s indicate several factors are contributing to low recruitment in that portion of the unit. Predators, especially bears, are believed to be increasing in numbers in the area, and bear predation on calves is probably the most significant factor in calf mortality. However, the factors of a population dominated by older cows, frequent severe winter snow conditions, and poor winter range quality may be acting in combination to lower productivity and produce calves that are less vigorous at birth and with subsequent lowered survival (Persons 1998). Some or all of these factors may influence recruitment in other parts of the unit.

Concern about declining moose numbers in the most accessible parts of Units 22B, 22D and 22E, led the Board in November 2001 (after the reporting period) to adopt significant changes to hunting regulations in the most heavily hunted portions of these units. The nonresident seasons were closed, resident seasons were shortened, registration hunts with quotas were established in Units 22B and 22D, and in Unit 22E the antlerless season was closed. In other parts of the unit, although moose are believed to be declining, access is limited and harvest rates are low. In those areas moose abundance and population trends are probably regulated by natural factors such as weather, range and predation, so reductions in hunting opportunity were not recommended. The public is well aware of declining moose numbers and played an active role in developing the regulations adopted by the Board. Additionally, brown bear hunting regulations were liberalized in Unit 22.

Unit 22C is the only portion of Unit 22 where recruitment estimates remain high and the increasing population has exceeded our management goal. In 2000 an antlerless moose hunt in Unit 22C was initiated to help stabilize the population and prevent over-utilization of the limited winter habitat.

Declining population trends and the importance of moose to local users point to the need for more frequent population estimates throughout the unit. Presently, if weather is not a factor, each subunit is censused, at best, once every 5 years. This is not often enough to identify and respond promptly to downward trends. More frequent censuses over larger areas need to occur. This may necessitate reducing time and money spent on assessment of other species in the unit. During this reporting period we were able to resume fall composition counts in heavily hunted drainages of Units 22B, 22C and 22D in spite of less than ideal snow conditions, using an R-44 helicopter.

Compliance with regulations and harvest reporting is thought to be reasonably high in the Nome area. However, in the remainder of the unit some residents do not acquire licenses and/or harvest tickets prior to hunting and much of the harvest is unreported. Public education programs and a visible enforcement effort improve compliance with regulations, but we have found the community-based harvest assessment programs started in 1999 to be the most effective way to collect accurate harvest data from village residents. This program should be continued and expanded to provide more accurate estimates of moose harvest and subsistence use of moose by village residents. Eventual replacement of the harvest ticket reporting system with systematic community surveys is worthy of consideration.

If staff time and money permit, assessment of moose habitat in Units 22B and 22C should be initiated. It would be desirable to examine critical wintering areas and determine the quantity and quality of available browse and ultimately attempt to estimate carrying capacity for the most heavily hunted portions of the unit. In response to public interest, staff should consult with habitat specialists about the feasibility of moose habitat enhancement in Unit 22.

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Table 1 Unit 22 historical moose harvest by sex, hunter effort, and success rate for regulatory years 1969–2001

Regulatory year	Males	Females	Unknown sex	Total harvest	Total hunters[a]	Percent success
1969–1970	69	1	2	72	182	40
1970–1971	70	0	1	71	139	51
1971–1972	59	0	1	60	168	36
1972–1973	44	0	0	44	99	44
1973–1974	103	32	1	136	317	43
1974–1975	149	72	1	222	479	46
1975–1976	136	0	2	138	389	25
1976–1977	186	51	3	240	611	39
1977–1978	151	88	5	244	457	53
1978–1979	198	97	2	297	596	50
1979–1980	193	75	2	270	760	36
1980–1981	156	71	1	228	492	46
1981–1982	225	72	1	298	696	43
1982–1983	244	100	0	344	904	38
1983–1984	291	68	46	405	1292	31
1984–1985	298	91	6	395	1086	36
1985–1986	279	92	3	374	876	43
1986–1987	306	101	1	408	892	46
1987–1988	286	20	4	310	775	40
1988–1989	332	36	7	375	748	50
1989–1990	208	82	0	290	713	41
1990–1991	280	70	0	350	700	50
1991–1992	207	95	0	302	656	46
1992–1993	217	72	0	289	645	45
1993–1994	225	21	1	247	553	45
1994–1995	201	10	0	211	486	43
1995–1996	169	13	3	185	469	39
1996–1997	176	20	2	198	456	43
1997–1998	197	6	0	203	423	48
1998–1999	195	13	3	211	510	41
1999–2000	244	5	3	252	581	43
2000–2001	194	27	0	221	536	41

[a] Minimum known number of hunters.

Table 2 Unit 22 aerial moose composition surveys, fall of 1992, 1994, 2000 and 2001

Survey area	Year	Bulls per 100 cows	Calves per 100 cows	Total calves	Percent calves	Total adults	Total moose
Unit 22B							
American Creek	1992	58	10	4	10	38	42
	1994	28	28	8	18	37	45
Niukluk River	2000	27	8	7	6	108	115
	2001	30	14	8	10	73	81
Unit 22C							
Snake River	1992	11	30	11	21	41	52
	1994	14	32	12	22	42	54
	2000	10	25	16	20	69	85
	2001	17	24	17	17	83	100
Stewart River	2001	39	17	7	11	57	64
Unit 22D							
Henry/Washington Ck.	1994	40	23	22	14	133	155
Kougarok/Noxapaga	2000	16	11	19	9	197	216
	2001	15	19	16	14	98	114
Agiapuk	2000	44	23	43	14	275	318
	2001	30	6	5	4	107	112

Table 3 Unit 22 short yearling recruitment surveys, spring 1991–2000

Survey area and survey year	No. calves	No. adults	Total	Percent calves
Unalakleet, Egavik, Tagoomenik, Shaktoolik, Ungalik (Unit 22A)				
2000	14	160	174	8
Fish River (Unit 22B)				
1991	12	202	214	6
1993	11	227	238	5
1994	15	255	270	6
1995	16	384	400	4
Niukluk River (Unit 22B)				
1991	30	319	349	9
1995	13	133	146	9
1997	6	77	83	7
2000	9	81	90	10
Koyuk River (Unit 22B)				
1999	21	208	229	9
2000	19	223	242	8
Snake River (Unit 22C)				
1993	15	63	78	19
1994	18	39	57	32
1999	33	92	125	26
2000	21	98	119	18
2001	20	76	96	21
Lower Kougarok River (Unit 22D)				
1991	14	103	117	12
1994	33	153	186	18
1995	42	227	269	16
2000	16	168	184	9
Kuzitrin/Noxapaga River (Unit 22D)				
1991	23	191	214	11
1994	16	71	87	18
2000	14	203	217	6
Kuzitrin Below Bridge (Unit 22D)				
2000	17	271	288	6
American River (Unit 22D)				
1995	51	248	299	17

Table 4 Residency and success of moose hunters in Unit 22, regulatory years 1999–2000 and 2000–2001

Regulatory	Residency of successful hunters					Residency of unsuccessful hunters				
Year/Unit	Unit[a]	State[b]	Nonresident	Unknown	Total	Unit[a]	State[b]	Nonresident	Unknown	Total
1999–2000										
22A	31	0	9	1	41	49	4	4	0	57
22B	34	16	17	0	67	64	14	5	0	83
22C	32	3	1	2	38	45	10	6	1	62
22D	62	21	7	2	92	88	21	8	1	118
22E	14	0	0	0	14	2	0	0	0	2
22 unknown	0	0	0	0	0	4	2	1	0	7
Total	173	40	34	5	252	252	51	24	2	329
2000–2001										
22A	12	0	3	0	15	44	4	9	0	57
22B	25	16	11	2	54	45	17	6	1	69
22C	47	5	1	0	53	56	5	3	0	64
22D	54	13	9	0	76	89	21	2	2	114
22E	20	2	0	0	22	3	1	1	0	5
22 unknown	0	0	1	0	1	6	0	0	0	6
Total	158	36	25	2	221	243	48	21	3	315

[a] Resident of Unit 22

[b] Other Alaska resident

Table 5 Chronology of Unit 22 moose harvest, regulatory years 1999–2000 and 2000–2001

Regulatory year/	Month of harvest									
Unit	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unknown	Total
1999–2000										
22A	4	32	0	0	4	1	0	0	0	41
22B	9	41	8	7	1	1	0	0	0	67
22C	0	35	1	0	0	1	0	0	1	38
22D	8	48	25	2	5	0	0	0	4	92
22E	1	0	1	1	2	0	0	9	0	14
Total	22	156	35	10	12	3	0	9	5	252
2000–2001										
22A	2	13	0	0	0	0	0	0	0	15
22B	4	39	0	6	3	0	0	0	2	54
22C	0	52	0	0	0	0	0	0	1	53
22D	7	54	7	1	5	2	0	0	0	76
22E	3	4	0	1	1	0	2	11	0	21
Unknown	0	1	0	0	0	0	0	0	0	1
Total	16	163	7	8	9	2	2	11	3	220

Table 6 Means of transportation reported by successful Unit 22 moose hunters, regulatory years 1997–2000

Regulatory Year/Unit	Aircraft	Horse	Boat	3 or 4 Wheeler	Snowmobile	Off-road vehicle	Highway vehicle	Unknown	Total
1997–1998									
22A	0	0	16	3	2	0	1	0	22
22B	3	0	22	26	11	1	7	2	72
22C	1	0	2	9	0	3	10	2	27
22D	1	0	22	21	3	1	17	0	65
22E	1	0	4	3	7	0	0	1	16
Unknown	0	0	1	0	0	0	0	0	1
Total	6	0	67	62	23	5	35	5	203
1998–1999									
22A	0	0	10	6	0	0	0	0	16
22B	3	0	16	21	16	1	1	0	58
22C	0	0	11	6	0	3	19	0	39
22D	1	0	26	30	10	2	20	0	89
22E	0	0	1	2	6	0	0	0	9
Total	4	0	64	65	32	6	40	0	211
1999–2000									
22A	1	0	23	11	5	0	1	0	41
22B	6	0	25	24	5	1	5	1	67
22C	1	0	10	10	0	2	14	1	38
22D	3	0	17	42	4	0	22	4	92
22E	0	0	2	0	12	0	0	0	14
Total	11	0	77	87	26	3	42	6	252
2000–2001									
22A	0	0	12	3	0	0	0	0	15
22B	4	0	18	18	10	0	3	1	54
22C	0	1	10	13	0	5	23	1	53
22D	1	0	15	30	7	7	16	0	76
22E	0	0	4	2	15	1	0	0	22
Unknown	0	0	0	1	0	0	0	0	1
Total	5	1	59	67	32	13	42	2	221

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 23 (43,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Western Brooks Range and Kotzebue Sound

BACKGROUND

Moose began to recolonize the eastern portion of Unit 23 during the 1920s (J. Magdanz, personal communication) and had expanded their range to the Chukchi Sea coast by the mid- to late 1940s (W. Uhl, personal communication). Moose currently rank second to caribou as a source of meat for most residents of the unit. Moose are also avidly sought by resident and nonresident recreational hunters who live outside Kotzebue Sound. Commercial services associated with moose hunting provide substantial income to guides, outfitters and transporters who operate in Unit 23. The wide distribution and accessibility of moose throughout the Unit makes them important to nonconsumptive users, e.g., viewers and photographers.

From the time moose reappeared in Unit 23 through the late 1980s, public comments, trend count surveys and observations by department staff suggested moose populations increased throughout the region. Severe winters and extensive spring flooding occurred during 1988–1991. These factors, combined with high populations of grizzlies and wolves, likely caused moose populations to stabilize or begin declining throughout the Kotzebue Basin.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Maintain healthy age and sex structures for moose populations within Unit 23.
- Determine population size, trend, and composition of Unit 23 moose populations.

MANAGEMENT OBJECTIVES

- Monitor the size and sex/age composition of moose populations in the Noatak, Squirrel, Kobuk, Selawik/Tagagawik Rivers and Northern Seward Peninsula drainages through aerial censuses.

- Maintain a minimum November ratio of 40 bulls:100 cows and a minimum density of 0.5–1.0 moose/mi^2 in each major Unit 23 drainage.

METHODS

Population trend and sex/age composition data were obtained from aerial moose censuses. The Alaska Department of Fish and Game (ADF&G) with assistance from the National Park Service (NPS) and Selawik National Wildlife Refuge (SNWR) conducted censuses during April–May in the lower Noatak drainage (2000 and 2001) and in the lower Noatak/upper Squirrel drainages (2001). During spring censuses we used the geostatisical (spatial) population census technique (Ver Hoef, unpublished): 1) sample units were stratified as 'high' or 'low;' 2) 'desktop' stratification with aerial confirmation of questionable sample units (SUs) was employed; and 3) sightability was not estimated. In 2001 we expanded the lower Noatak spring moose census area to include the Kaluktavik drainage, the entire Eli and Aggasashok drainages, the upper portion of the Squirrel River drainage above and including the North Fork of the Squirrel, and Igichuk Hills/Cape Krusenstern area. I report results for the 2111 mi^2 subset of the expanded area as well as for the entire 5230 mi^2 area for temporal and spatial comparisons.

The SNWR with assistance from ADF&G and NPS conducted a fall census using the Gasaway technique (Gasaway et al. 1986) during November 1999 in the Tagagawik drainage.

The cooperative ADF&G/NPS Noatak moose telemetry project was terminated in 1999. Department involvement in the ADF&G/SNWR Tagagawik moose telemetry project was phased out during the last reporting period.

Harvest information was derived from statewide hunter harvest reports for nonlocal hunters and from community harvest assessments for unit residents. The term "nonlocal hunter" refers to all hunters who reside outside Unit 23 and "local hunter" refers to residents of Unit 23.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Census results indicate Unit 23 moose densities are currently 0.3–1.0 moose mi^2 (Tables 1 and 2). This is lower than many other portions of Alaska (ADF&G 1998). Although we began conducting rigorous Gasaway-type censuses in Unit 23 almost 10 years ago, most census areas have been completed only once or twice since that time. Therefore, these data are inadequate to evaluate population trends (J. Ver Hoef, personal communication) Even in the middle and lower Noatak drainage where we have the most census data, interpretation of density estimates is confounded by repeated modification of census areas.

The potential effect of modifying a census area on density estimates was illustrated in spring 2001. In April–May we estimated adult density was 0.63 moose/mi^2 in the 2111 mi^2 area (Table 2). This estimate relative to the November 1993 density estimate (Table 1) suggested the moose population had been stable. However, that interpretation was inconsistent with spring density estimates from 1999 and 2000, my observations, and many reports from the public all of which suggested the lower Noatak moose population had declined since the early 1990s. In spring 2001 deep snow concentrated moose in riparian habitat that comprises much of the 2111 mi^2 census area. Although we probably estimated density within the 2111 mi^2 census area reasonably accurately, I felt movement of moose into that area had masked the overall population decline. I added 3209 mi^2 to the 2111 mi^2 census area thus making the total size 5320 mi^2. The additional area included a lower proportion of high quality habitat than the 2111 mi^2 area. We found few moose in the additional area and adult density in the total area was only 0.30 moose/mi^2. I feel the density estimate for the expanded area better reflects overall density in the lower Noatak and upper Squirrel River drainages than the 2111 mi^2 census area.

The relatively small size of census areas we delineated prior to 2001 in relation to movements of moose, the limited number of replicate censuses within drainages, and inconsistent census boundaries have made the value of census data limited for monitoring abundance of moose in Unit 23.

My observations and many public reports suggest moose populations are declining throughout Unit 23. This decline appears to be most rapid and pronounced in the Noatak drainage and on the Seward Peninsula. Moose density has declined almost 50% in other portions of the Seward Peninsula (Unit 22) since about 1990 (K. Persons, personal communication). Moose may be stable in the Selawik drainage; however, my observations of fewer moose and fewer shed antlers in marginal habitat compared to the early 1990s suggests they are slowly declining in this area, too. Moose have reportedly declined in the upper Kobuk drainage since the early 1990s (G. Loughridge, E. Ward, R. Snyder and G. Bamford, personal communication) and calf recruitment has been low during this reporting period (G. Loughridge, personal communication).

Population Composition

Although census data are of limited value for monitoring density of moose in Unit 23, estimates of population composition (i.e., bull:cow, calf:cow and calf:adult ratios) are probably reasonably accurate. The mean 1997–2001 spring calf:adult ratio in the Noatak River drainage was 9:100 (Table 2). This is consistent with my observations and reports from many local residents and some long-term commercial operators that recruitment rates have been low in this portion of the unit. Similarly, we observed 10 calves:100 adults in the spring 2001 Tagagawik census (Table 2). Parturition rates appear to be high (B. Shults, personal communication) and I have observed more twins since 1998 than during the previous 10 years. During capture operations in the lower Noatak drainage during April 1998 cow moose were in excellent body condition which is consistent with high parturition rates. My observations are consistent with many local hunters and most commercial operators view that brown bear predation on calves is probably substantially contributing to low recruitment.

Fall censuses indicate bull:cow ratios are above or near the population objective of 40:100 throughout Unit 23 (Table 1). The low bull:cow ratio in the Noatak River drainage compared to other drainages in Unit 23 is probably attributable to its long history of commercial activity and trophy hunting by nonlocal hunters.

Distribution and Movements

Almost no moose now reside year round in that portion of the Noatak drainage above the Cutler and Aniuk Rivers. In April 2001 while on a snow machine trip through Ivishak Pass to the headwaters of the Noatak River and many tributaries I saw a total of 2 moose (both bulls) and no other tracks. Although large riparian willow thickets occur in this portion of the unit, the absence of spruce forests probably makes this marginal moose habitat. Additionally, both wolves and brown bears are abundant in the upper Noatak drainage.

Telemetry information collected during 1992–1997 from moose collared in the mid–lower Noatak drainage indicated moose occasionally moved from this area as far west as Cape Thompson, southwest to the mouth of the Noatak River, east to Howard Pass and southeast to the lower Salmon and Squirrel River area. A few moose collared in the lower Tagagawik drainage moved north to the Waring Mountains (L. Ayres, personal communication). Generally, though, moose collared in the Tagagawik and Selawik drainages showed greater fidelity to their annual ranges than Noatak moose.

Although moose densities have probably declined throughout Unit 23 during this reporting period, their general distribution has not substantially changed except possibly in the upper Noatak drainage.

MORTALITY

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1999–2000 & 2000–2001		
Unit 23 north of and including the Singoalik River drainage One moose; cows with calves may not be taken	1 Jul–31 Mar	
One antlered moose with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on one side		1 Sep–20 Sep
Noatak drainage One moose, however, antlerless moose may be taken only from 1 Nov–31 Mar.; cows with calves may not be taken	1 Aug–15 Sep 1 Oct–31 Mar	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
One antlered moose with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on one side		1 Sep–15 Sep
Remainder of Unit 23 One moose, cows with calves may not be taken	1 Aug–31 Mar	
One antlered moose with spike-fork or 50 inch antlers or antlers with 4 or more brow tines on one side		1 Sep–20 Sep

Board of Game Actions and Emergency Orders. The board reauthorized antlerless moose seasons for the 1999–2000 and 2000–2001 regulatory years. At the fall 2001 meeting (after this reporting period) the board: 1) shortened the resident antlerless moose season in the Noatak drainage to 1 Nov–31 Dec; 2) shortened the nonresident moose season in the Noatak drainage to 6–15 Sep; and 3) eliminated calf harvests throughout the unit. The board also made it illegal to bone the meat from the front or hindquarters of moose and caribou taken during July 1-September 30 in Unit 23. These changes became effective during the 2002–2003 regulatory year.

The board also implemented the second phase of the Intensive Management process during the November 2001 meeting (the board implemented the first phase at the fall 1999 meeting by identifying moose throughout Unit 23 as important for consumptive use). We estimated the long-term unitwide sustainable moose population ranges from 3545–9207 moose (Table 3). This was based on crude estimates of potential habitat by drainage and our best guess of high and low densities that could prevail or be sustainable on the order of decades.

Hunter Harvest. Community-based harvest assessments indicate approximately 335 moose were harvested annually by unit residents during this reporting period (Table 4). This is substantially higher than the 23 and 30 moose unit residents reported taking through the statewide harvest ticket system in 1999–2000 and 2000–2001, respectively. Although moose harvest ticket data appears to capture <10% of the actual harvest by unit residents, it probably reflects temporal trends in local harvests reasonably well. We think the accuracy of harvest ticket data is much better for nonlocal hunters than for local hunters. Combining harvest ticket data (to estimate harvests by nonlocal hunters) and community harvest assessment estimates (to estimate harvests by local hunters after subtracting moose reported through the harvest ticket system) indicates a minimum annual harvest of 451 moose in 1999–2000 and 470 moose in 2000–2001.

The community-based estimate of unit resident harvest was determined during a period when caribou were readily available. If caribou availability decreases through shifts in distribution or population decline, harvest of moose by local residents will almost certainly increase. Most Unit residents explain the 1979–1994 decline in local moose harvest as a function of increased availability of caribou during that time. Currently, subsistence need for moose in Unit 23 is 325–400 moose annually.

Total reported harvest generally increased from 1979–1980 through 1988–1989, then declined through 2000–2001 (Table 5, Fig 1). In contrast, total number of hunters increased from 1979–1980 through 2000–2001. There was a positive linear relationship between total number of hunters and total reported harvest during 1979–1980 through 1988–1989 ($F = 19.81$, $P = 0.002$, $n = 10$). There was no linear relationship between these parameters during 1989–1990 through 2000–2001 ($F = 1.08$, $P = 0.32$, $n = 12$). Since 1988–1989, as hunter numbers increased, total reported harvest decreased as hunter success declined. The total number of moose hunters reported during the 2000–2001 regulatory year (410 hunters) was the highest ever recorded, yet the reported harvest (165 moose) was substantially below the upper range recorded in 1988–1989 (222 moose) when the number of hunters was much lower (320 hunters; Table 5). As in the past, the reported harvest of female moose was small during 1999–2000 and 2000–2001 in terms of absolute numbers (11 females reported taken during each regulatory year, Table 5), and in relation to total harvest (8% and 7%, respectively).

Trends in hunter numbers have varied among drainages. The Noatak is the only drainage in Unit 23 where number of hunters has declined (Fig 2). Prior to the mid 1990s, more hunters used the Noatak drainage than any other drainage in Unit 23. During this reporting period more hunters used each of the Kobuk and Selawik drainages than the Noatak drainage. Hunter numbers have increased most rapidly in the Kobuk drainage although they increased in the Selawik drainage as well. Hunter numbers remained low and stable in Wulik/Kivalina drainages and northern Seward Peninsula drainages. The decline in effort in the Noatak River drainage is probably at least partly attributable to restricted access (i.e., Noatak Controlled Use Area). Also, moose hunting seasons and bag limits have been incrementally restricted there since the 1988–1989 regulatory year. Declines in effort and moose harvest in the Noatak drainage may also be partly attributable to declining numbers of moose and crowded hunting conditions causing highly mobile nonlocal hunters to find more productive and aesthetically pleasing portions of the Unit to hunt.

Not surprisingly, trends in reported harvest among drainages have generally followed trends in effort. Since the mid 1980s the reported moose harvest declined in the Noatak drainage and increased in the Kobuk and Selawik drainages. There has been no temporal trend, and harvest levels have been low, in the Wulik/Kivalina drainages and on the Seward Peninsula.

Hunters harvested a mean annual average of 14% (SD = 3) of collared bulls in the Noatak drainage between 1992 and 1997. This probably overestimates the actual harvest rate for bulls because only large bulls, which are strongly selected by nonlocal hunters, were collared.

<u>Permit Hunts</u>. There were no permit hunts for moose in Unit 23 during the reporting period.

<u>Hunter Residency and Success</u>: Numbers of nonresident and nonlocal Alaskan resident moose hunters continued to increase during this reporting period ($R^2 = 0.89$; Fig 3). The strength of this relationship is surprising given annual variability in hunting conditions (weather, onset of freeze-up, water levels, etc), regulatory changes, availability of commercial services, economic

considerations (e.g., the cost of airline tickets) and other factors that affect hunting in Unit 23. Factors contributing to these trends include: 1) increasing commercial services in Unit 23; 2) increasingly restrictive hunting regulations for moose and other species outside of Unit 23, especially for nonresident hunters; 3) word of mouth advertisement of good hunting in Unit 23; and 4) the scarcity of trophy bulls in other units. The number of nonlocal hunters who reported hunting in Unit 23 during 2000–2001 was the second highest on record.

Numbers of unit resident moose hunters were low during this reporting period compared to levels reported during the late 1970s and early 1980s. Although the number of local moose hunters has slowly increased since 1993–1994, the trend from 1979–1980 to 2000–2001 has generally declined ($R^2 = 0.69$; Fig 3).

Success rates peaked in 1988 at 69% but have declined since that time ($R^2 = 0.82$, all hunters). Success rates have been <50% since 1993–1994 (*n* = 8 years). Prior to 1993–1994 hunter success was <50% in only 2 of 14 years (1982 and 1983). During 1998–1999 through 2000–2001 hunter success was 39–40%, the lowest ever recorded.

The decline in hunter success has been most pronounced for nonresident hunters (Fig 4). This could be because disproportionately more nonresidents are hiring transporters rather than guides since 1992–1993. Prior to 1992–1993 nonresident hunters consistently had higher success rates than nonlocal Alaskan or Unit 23 resident hunters. Since 1992–1993 success rates have been similar and have generally declined for all 3 groups of hunters.

Recent widespread use of float-equipped airplanes by transporters, greater use of 4-wheelers by guides and increasing numbers of village residents transporting nonlocal hunters via boat continued to reduce the number of refugia available to moose in Unit 23. Nonlocal demand for transporter services continued to exceed availability despite growth of this industry. As in the past, we continued to receive reports of illegal transport of hunters via boat and airplane during this reporting period. The large disparity between transporter supply and demand by nonlocal hunters means Unit 23 could experience rapid and substantial increases in numbers of nonlocal hunters if transporter services suddenly increased. This could further reduce the quality of hunting in Unit 23, intensify conflicts between local and nonlocal hunters and increase moose harvests.

<u>Harvest Chronology</u>. As in the past, despite an 8-month moose season in most of the unit, the majority of moose were harvested in September during this reporting period. Virtually all sport hunting occurs during this time because weather is mild and conducive to airplane and boat access, it entirely encompasses the nonresident season, and bulls have completely developed antlers free of velvet. In 1999–2000, 85% of the reported harvest occurred during September, and in 2000–2001 this percentage was 84%. The percentage of total harvest taken during September has generally increased since the 1979–1980 regulatory year. This probably reflects increasing numbers of nonlocal hunters in Unit 23.

<u>Transport Methods</u>: Airplanes continued to be the primary mode of transportation for most hunters who reported hunting moose in Unit 23 (Table 6). Sixty-nine percent of all hunters reported using airplanes to access moose hunting areas in 1999–2000; in 2000–2001 this percentage was 65%. Most nonlocal hunters at least initially access hunting areas using

airplanes. The number of hunters who reported using airplanes has steadily increased since 1983–1984. This is probably correlated with increasing numbers of nonlocal hunters in Unit 23. As in the past, boats were the next most common means of transportation for hunting moose during this reporting period.

Other Mortality

From 1992–1997 the mean annual adult cow mortality rate was 15% in the Noatak moose telemetry study. No collared cows were harvested by hunters during the study; therefore, this estimate represents natural mortality. The age structure of the collared sample of moose was older than the overall population because we did not collar cows <24 months old or collar moose annually. Even so, we think these limitations did not substantially bias our estimate of adult cow mortality.

HABITAT

Assessment

Moose habitat was not evaluated by ADF&G in Unit 23 during this reporting period. In 2000 the NPS began to monitor moose browse through range exclosures in portions of the Noatak National Preserve (B. Shults, personal communication).

Enhancement

There were no habitat enhancement activities for moose in Unit 23 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

'User issues' continued to be the major nonregulatory management problem in Unit 23 during this reporting period. In previous years user issues were primarily conflicts between local and nonlocal hunters for hunting sites as well as airplanes disturbing local hunters and possibly wildlife. In recent years additional concerns have also been expressed:

1) New air transporters are reportedly impacting guides and established transporters by competing for hunting areas, dropping clients near existing camps and intentionally hazing wildlife away from their competitors' clients.

2) Village-based transporters using boats are disturbing subsistence users, guides and nonlocal hunters through high levels of boat traffic and high noise levels associated with some types of jet boats.

3) Waste of meat by trophy hunters has long been a sensitive issue in Unit 23. During this reporting period several blatant examples of waste by nonlocal clients of one transporter heightened concerns of local residents.

4) As numbers of nonlocal hunters have increased in Unit 23 the incidence of trespass on Native corporation lands and on private Native allotments has increased as well. The ADF&G, with assistance from the Department of Natural Resources, developed a map showing land ownership in the middle and upper Kobuk drainage. The SNWR produced a similar map for the Selawik drainage (J. Roberts, personal communication).

The Unit 23 user issues planning process initiated in January 1999 was temporarily suspended until a planner is hired in Region V.

CONCLUSIONS AND RECOMMENDATIONS

Declining moose and increasing hunter effort necessitate we improve our biological understanding of moose populations in Unit 23. I recommend we:

1. Census large areas (4,000–10,000 mi^2) to minimize the effects of moose movements on density estimates.

2. Census moose every 2–3 years in each census area. Potential census areas include 1) lower Noatak/upper Squirrel drainages, 2) Selawik/Tagagawik drainages, 3) upper Kobuk drainage, and 4) northern Seward Peninsula.

3. Reduce confidence intervals around density and composition estimates through intensive sampling and by incorporating trend information into point estimates as soon as possible.

4. Conduct spring and fall censuses to prevent long gaps between density estimates. Supplement spring censuses with low-intensity fall surveys to monitor bull:cow ratios.

5. Resume the Unit 23 user issues planning process once a planner has been hired for Region V.

6. Continue community-based harvest assessments in villages throughout Unit 23 to monitor local harvests, and employ the statewide harvest ticket system to monitor nonlocal harvests.

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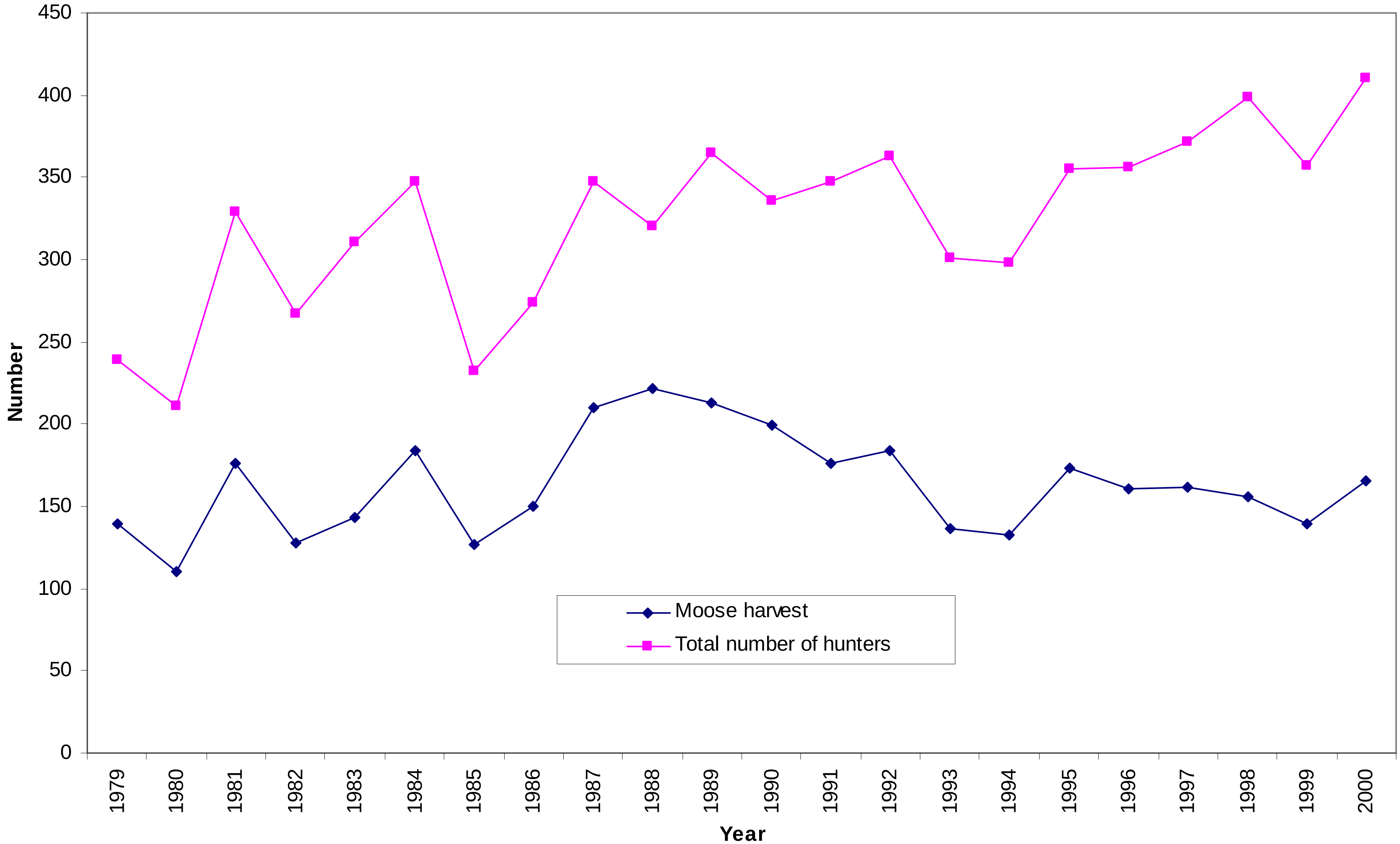

Figure 1 Unit 23 moose hunters and harvests reported through the statewide harvest ticket system, 1979–1980 through 2000–2001

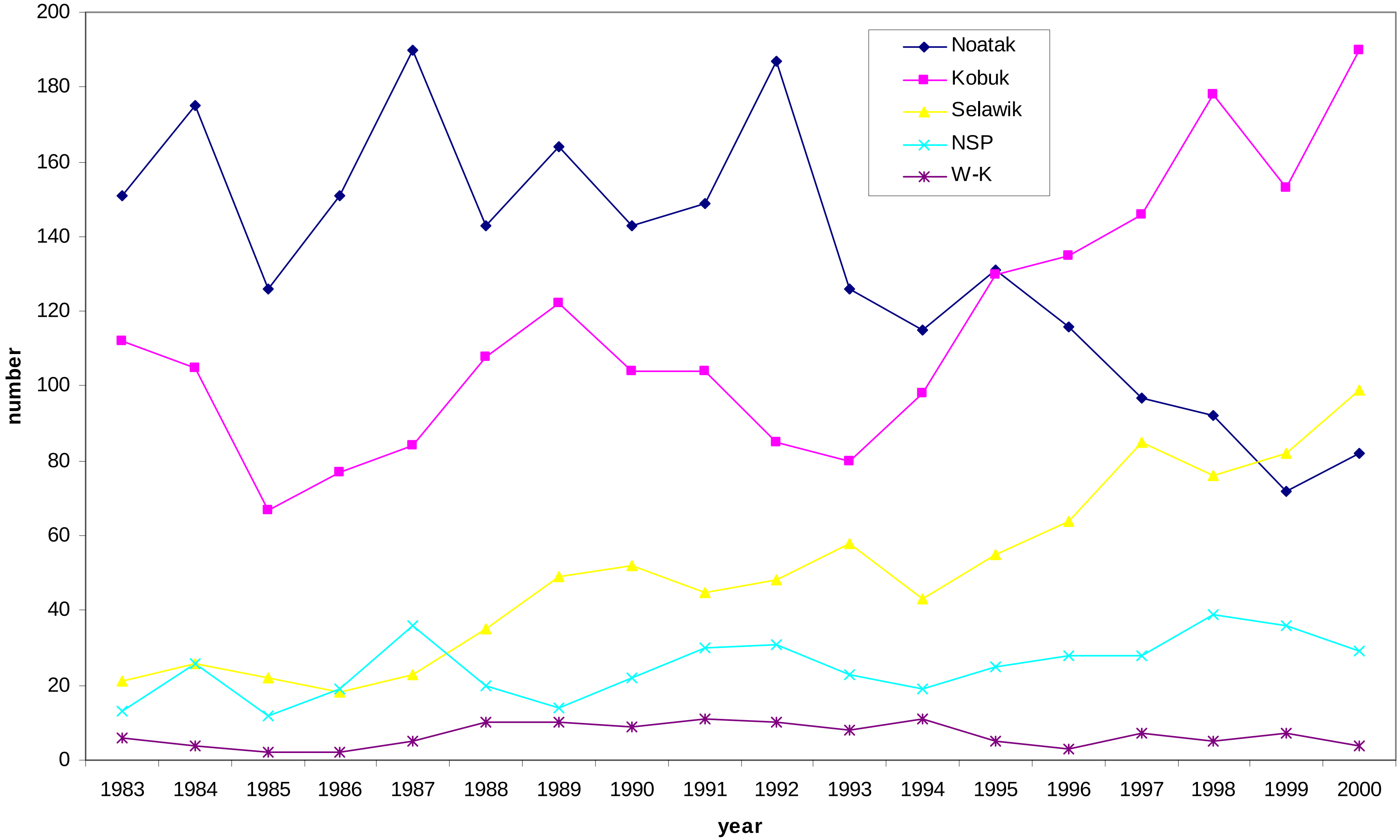

Figure 2 Unit 23 moose harvest by drainage (statewide harvest ticket system data), 1983–1984 through 2000–2001

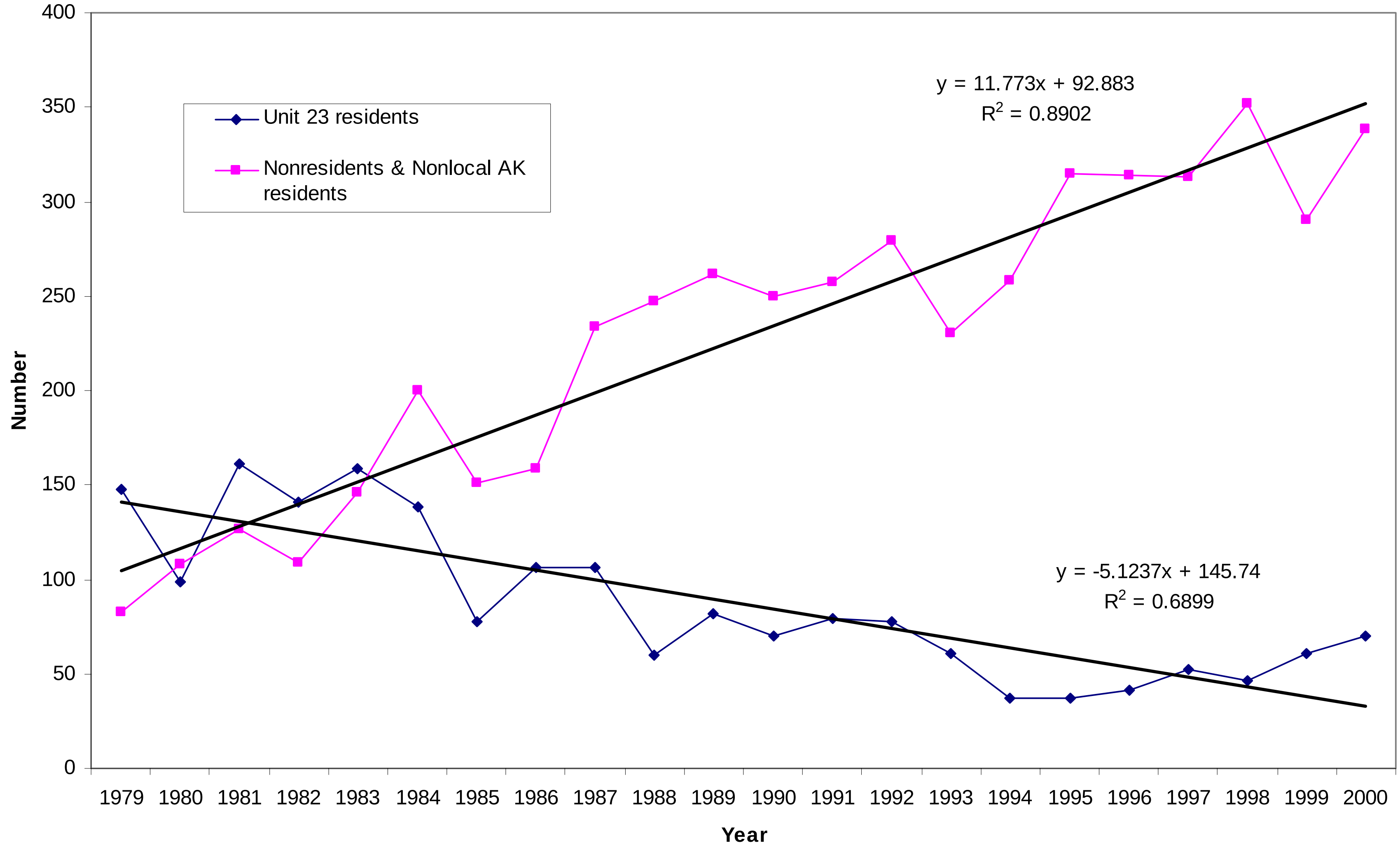

Figure 3 Numbers of Unit 23 moose hunters by residence (harvest ticket data), 1979–1980 through 2000–2001

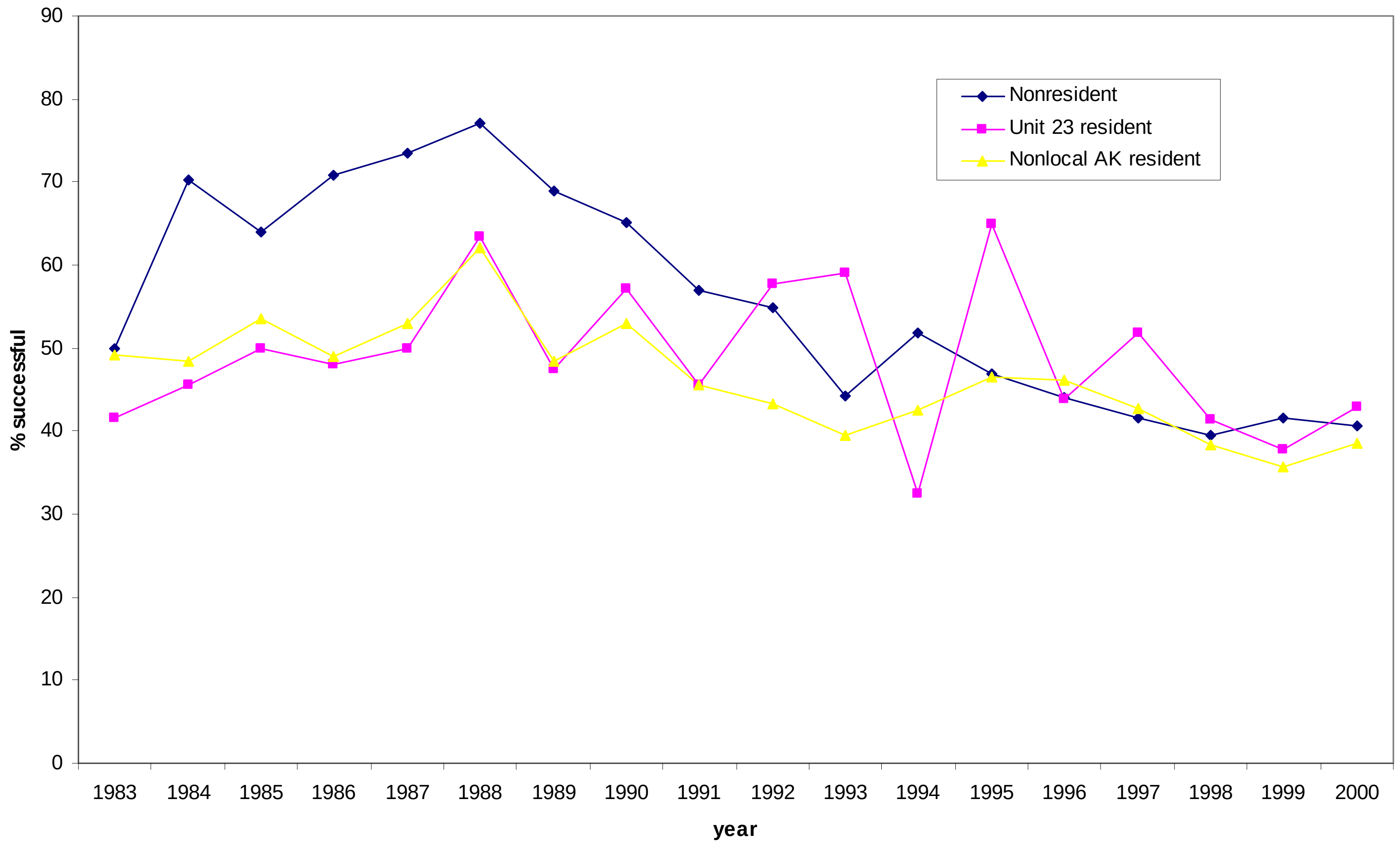

Figure 4 Unit 23 moose hunter success rate by residence (harvest ticket data), 1983–1984 through 2000–2001

Table 1 Summary of Unit 23 fall moose censuses, 1992–2001

Area	Year	Size (mi^2)	Est. # adults	Est. # calves	Total estimate	Total density ($no.mi^2$)	Adult density ($no.mi^2$)	Bulls:100 Cows	Calves: 100 Cows	Methods
Squirrel	1992	1440.9	1110	262	1372	0.95	0.77	37	33	Std. Gasaway
Squirrel	1998	1440.9	1304	233	1537	1.07	0.90	50	27	Spatial
Middle Noatak	1993	1627.9	956	169	1125	0.69	0.59	43	24	Std. Gasaway
Salmon	1995	891.4	594	186	780	0.87	0.67	78	56	Mod. Gasaway
Salmon	1997	891.4	895	129	1024	1.15	1.00	60	23	Std. Gasaway
Upper Kobuk	1995	1438.0	730	85	815	0.57	0.51	62	19	Linear Regression
Upper Selawik	1999	1045.9	569	80	648	0.62	0.54	68	23	Std. Gasaway

Table 2 Summary of Unit 23 spring moose censuses, 1997–2001

Area	Year	Size (mi^2)	Est. # adults	Est. # calves	Total estimate	Total density (no. mi^{-2})	Adult density (no. mi^{-2})	Calves:100 Cows	Method
Tagagawik	1997	1000.9	952	191	1145	1.14	0.95	20	Std. Gasaway
Tagagawik	2001	1692.6	1259	115	1374	0.76	0.70	9	Std. Gasaway
Lower Noatak	1997	1627.9						8	Mod. Gasaway
Lower Noatak	1998	1627.9						12	Mod. Gasaway
Lower Noatak	1999	2111.2	1126	65	1191	0.56	0.53	6	Mod. Spatial
Lower Noatak	2000	2111.2	710	59	779	0.37	0.34	8	Mod. Spatial
Lower Noatak	2001	2111.2	1325	130	1453	0.69	0.63	10	Mod. Spatial
Noatak/Squirrel	2001	5230.2	1580	151	1731	0.33	0.30	10	Mod. Spatial

Table 3 Unit 23 Intensive Management moose population objectives identified for the Board of Game, November 2001

Area	Total area (mi^2)	Area of Potential Moose Habitat (mi^2)	Low Adult Density (moose/ mi^2)	High Adult Density (moose/ mi^2)	Low Population Size (# moose)	High Population Size (# moose)
Noatak: mouth to Nimiuktuk	10440	4176	0.25	0.70	1044	2923
Noatak: Anisak to headwaters	2520	252	0.10	0.20	25	50
Wulik, Kivalina, Lisburne Hills	5940	594	0.05	0.10	30	59
Kobuk: mouth to Kiana	3096	1548	0.25	0.70	387	1084
Kobuk: Kiana to Ambler	4248	2124	0.25	0.70	531	1487
Kobuk: Ambler to headwaters	5292	2117	0.25	0.50	529	1058
Selawik (including Tagagawik)	6840	2736	0.25	0.70	684	1915
Northern Seward Peninsula	5040	1260	0.25	0.50	315	630
Total	43,416	14,807			3545	9207

Table 4 Estimated moose harvest in Unit 23 villages from community harvest estimates (Subs. Div. unpub. data except as noted)

Village	Year of	Village pop. in survey year	No. moose reported harvested	Per capita moose harvest	Estimated village pop. in 2000	Estimated moose harvest in 1999-2001
Kotzebue	1986	2681	65	0.024	3082	71
Noatak	1999	428	4	0.005	428	4
Kivalina	1992	344	17	0.049	377	19
Point Hope[a]	1992	685	14	0.020	757	15
Noorvik[b]	1998	598	37	0.062	634	39
Kiana[c]	1999	388	8	0.021	388	8
Ambler[d]				0.082	309	25
Shungnak	1998	257	21	0.082	256	21
Kobuk[d]				0.082	109	9
Selawik	1999	772	64	0.083	772	64
Buckland [e]				0.102	406	41
Deering	1994	148	15	0.102	136	15
Total					7654	335

[a] North Slope Borough, unpub. data
[b] Noorvik IRA, unpub. data
[d] estimated from Shungnak 1998 data
[e] estimated from Deering 1994 data

Table 5 Numbers of moose hunters by residency and success, and moose harvests by sex for Unit 23, 1979–1980 through 2000-2001

	Hunter residency					Hunter success			Sex of moose harvested		
Year	Unit 23 resident	Nonlocal resident	Non-resident	Unk	Total hunters	Succ.	Unsucc.	Succ. rate	Males	Females	Unk. Sex
1979–1980	148	51	32	8	239	139	100	58	129	10	0
1980–1981	99	61	47	4	211	110	101	52	97	6	7
1981–1982	161	80	47	41	329	176	153	53	160	15	1
1982–1983	141	81	28	17	267	128	139	48	119	8	1
1983–1984	159	116	30	6	311	143	168	46	131	12	0
1984–1985	138	126	74	9	347	184	163	53	162	17	5
1985–1986	78	101	50	3	232	127	105	55	112	12	3
1986–1987	106	94	65	9	274	150	124	55	142	8	3
1987–1988	106	102	132	7	347	210	137	61	194	15	1
1988–1989	60	116	131	15	320	222	98	69	207	15	6
1989–1990	82	120	142	21	365	213	152	58	200	11	2
1990–1991	70	115	135	16	336	199	137	59	185	14	1
1991–1992	79	136	121	11	347	176	171	51	143	33	0
1992–1993	78	157	122	6	363	184	179	51	159	25	0
1993–1994	61	144	86	10	301	136	165	45	118	17	1
1994–1995	37	148	110	3	298	133	165	45	127	6	0
1995–1996	37	189	126	3	355	173	182	49	164	8	1
1996–1997	41	178	136	1	356	161	195	45	145	15	1
1997–1998	52	171	142	7	372	162	210	44	154	8	0
1998-1999	46	167	185	1	399	156	243	39	146	8	2
1999-2000	61	129	161	6	357	139	218	39	127	11	1
2000-2001	70	166	172	2	410	165	245	40	154	11	0

Table 6 Number of moose hunters by transportation type in Unit 23, 1983-1984 through 2000-2001

Year	Airplane	Boat	Snow machine	Horse/dog team	3- or 4-wheeler	Off-road vehicle	Highway vehicle	Unknown	Total hunters
1983-1984	111	131	11	1	0	3	4	50	311
1984-1985	173	103	17	1	2	3	2	46	347
1985-1986	137	59	10	1	6	0	0	19	232
1986-1987	121	89	14	1	6	2	3	38	274
1987-1988	165	93	25	0	21	0	4	39	347
1988-1989	207	63	13	1	13	0	1	22	320
1989-1990	229	89	16	1	7	0	2	21	365
1990-1991	224	61	19	0	10	1	1	20	336
1991-1992	231	65	28	2	7	0	3	11	347
1992-1993	248	63	23	1	7	0	3	18	363
1993-1994	193	72	17	0	9	1	2	7	301
1994-1995	191	74	13	2	5	1	4	8	298
1995-1996	240	77	11	0	16	0	1	10	355
1996-1997	234	77	20	1	16	0	2	6	356
1997-1998	250	74	19	2	13	0	2	12	372
1998-1999	289	76	10	1	11	1	0	0	388
1999-2000	245	78	18	2	11	0	2	0	356
2000-2001	260	113	17	3	7	1	2	0	403

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: 24 (26,055 mi^2)

GEOGRAPHIC DESCRIPTION: Koyukuk River drainage above Dulbi River

BACKGROUND

Moose are broadly distributed throughout much of Unit 24 with densities (0.5–2.0 moose/mi^2) that are typical of Interior Alaska. Anecdotal evidence indicates the population was low prior to the 1930s, but increased during the 1930s–1950s (Huntington 1993). The rate of increase was probably slow until predator control efforts in the 1950s allowed rapid expansion of local populations, especially in the southern third of the unit. During the early 1970s the population reached a peak and mortality started to exceed recruitment in some areas. Populations apparently climbed again in the late 1980s, peaked around 1992, then fell gradually through the remainder of the 1990s.

Naturally occurring wildfires and floods are major forces affecting the productivity and diversity of moose habitat in this area. Habitat is excellent along most of the Koyukuk River lowlands, providing extensive areas of winter browse. Lightning-caused fire is a frequent event and large areas of the burned uplands are productive browse communities. Based on personal observations, browse production does not appear to be limiting the size of the moose population at current moose densities.

The Koyukuk River and major tributaries are popular moose hunting areas for unit residents, other Alaska residents, and nonresidents. The lower portion of the Koyukuk within Unit 24 has been the focus of most of our management effort because of the long history of use, higher moose densities, and increasing hunting activity. Hunting activity has also been increasing in other areas of the unit, including rivers accessible from the Dalton Highway. Two controlled use areas (CUA), the Koyukuk CUA and the Kanuti CUA, restrict use of aircraft for moose hunting activities. The Dalton Highway Corridor Management Area (DHCMA) prohibits use of off-road vehicles and firearms for hunting within 5 miles on either side of the Dalton Highway. Access to portions of the unit has increased with the opening of the highway.

There are several moose hunting seasons in Unit 24 that reflect the variety of moose densities and human-use patterns. In addition to the usual September hunting season, open seasons in December and March also provide hunting opportunity for residents of Alaska. A registration permit moose hunt was also established in 1996 in the Koyukuk CUA, downstream from Huslia.

Annual reported harvests during the past 25 years were 44–230, but did not exceed 100 moose until 1980. Unreported harvests during this period probably were 160–300 moose per year (Woolington 1998). Since 1980, reported harvests have exceeded 100 moose each year. Local residents have become more aware of the importance of harvest reporting, resulting in increased compliance with reporting requirements.

MANAGEMENT DIRECTION

Management goals and objectives were formed during the previous reporting period, as part of the planning process.

GOAL 1: Manage Koyukuk River drainage moose on a sustained yield basis to provide both hunting and other enjoyment of wildlife in a manner that complements the wild and remote character of the area and minimizes disruption of local residents' lifestyles.

Objective 1: Maintain a moose population of 10,000–12,000.

Activity 1: Conduct trend count surveys annually or population estimation surveys when funding is available.

Objective 2: Provide for a harvest of moose, not to exceed 360 moose or 5% of the annual moose population estimate each regulatory year.

Activity 1: Monitor hunter use levels in the Koyukuk River drainage.

Activity 2: Monitor impacts (social and environmental) to private property and local residents by Koyukuk River moose hunters.

Activity 3: Develop programs to improve population and harvest data for moose in Unit 24.

Objective 3: Provide for moose hunting opportunity, not to exceed 500 hunters per regulatory year.

GOAL 2: Protect and enhance moose habitat.

Objective 1: In combination with Unit 21D, implement at least 2 habitat enhancement activities every 5 years.

GOAL 3: Reduce meat spoilage by hunters.

Objective 1: Reduce the amount of spoiled meat observed at Ella's Cabin and at hunting camps by 10% each regulatory year.

Activity 1: Implement a program at Ella's Cabin checkstation to monitor percentage of meat lost due to spoilage.

GOAL 4: Maintain opportunities for wildlife viewing, photography and other nonconsumptive uses of wildlife within the Koyukuk River drainage.

Objective 1: Increase the number of people engaging in nonconsumptive uses of wildlife by >1% each regulatory year.

Activity 1: Implement a program to monitor long-term trends and establish a baseline of the current level of nonconsumptive use, through collaboration with the Koyukuk/Nowitna and Kanuti National Wildlife Refuges, the Gates of the Arctic National Park and Preserve, and commercial operations in Unit 24.

METHODS

We surveyed established trend count areas (TCA) of 4–6 contiguous "Gasaway" sample units from small fixed-wing aircraft (PA-18 or similar aircraft) to assess moose population parameters (Gasaway et al. 1986). Surveys were flown approximately 500 ft above ground level and at ground speeds of 70–80 mi/h. Moose were classified as cows, calves, yearling bull (<30" antler width and no brow tine definition), medium bull (<50" antler width), or large bull (≥50" antler width). Sample units of approximately 12 mi^2 each were searched at a rate of approximately 5 min/mi^2 to ensure reasonably high sightability, minimal bias, and data comparability among years. Data was recorded on standard data forms and moose locations were also recorded on 1:63,000 USGS quadrangle maps. Surveys were not conducted until a minimum snow cover of approximately 12 inches had accumulated. This level of snow cover is important because snow depth influences sightability and moose distribution.

We conducted a population estimation survey (ADF&G files, Galena, 12 May 2000) in fall 1999 in the northern portion of Unit 24 that covered 8390 mi^2. Data from that survey were analyzed using the Geostatistical Population Estimator (GSPE) (Ver Hoef 2001). Survey techniques were modified from those outlined by Gasaway et al. (1986). An important change from the Gasaway methodology was, instead of geographical land characteristics, a grid system based on latitude and longitude coordinates was used to locate sample units (~ 5.7 mi^2 in size), with search intensity of ~6 min/mi^2.

Hunter harvest was monitored through moose harvest reports and a moose hunter checkstation operated on the lower Koyukuk River. We encouraged local residents to increase their harvest reporting by providing information at public meetings, checkstations, and village meetings. Hunting mortality and harvest distribution were also monitored through the statewide harvest ticket system, registration harvest tickets, and door-to-door subsistence surveys. General season hunters were sent 1 reminder letter to return their harvest reports. Hunters of permit hunts (drawing, registration, and Tier II hunts) were sent 1 reminder postcard, then called via telephone, and then sent a certified letter. Their names were withdrawn from the following year's permit hunts if no response was received. Information obtained from the reports and surveys was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000).

Predation was evaluated by interviewing trappers, field observations, and aerial wolf reconnaissance surveys in cooperation with the US Fish and Wildlife Service.

No habitat assessment work was conducted during this reporting period.

We continued the intensive planning process implemented in 1998 to address concerns over increasing numbers of hunters in the Koyukuk River drainage. The planning process was initiated in winter 1999–2000, and a Koyukuk River Moose Hunters' Working Group (KWG) was formed with representatives from the state's advisory committees, the federal Western Interior Regional Advisory Council, and local commercial hunting guides. The planning group developed a draft 5-year Koyukuk River Moose Management Plan (ADF&G files) that was submitted to the Alaska Board of Game during their March 2000 meeting. The finalized plan was used as a guide for management goals, objectives, activities, and biological decision-making criteria in this management report, and was endorsed by the Alaska Board of Game at their winter 2001 meeting.

An additional outcome of the KWG was the development of 2 moose management zones within the Koyukuk River drainage (Fig 1). Management zones were established to allow analysis of data and application of management strategies in the 2 areas of the drainage where moose densities, distribution, and harvest patterns were substantially different. The boundary between the 2 units was defined according to uniform coding units. Uniform coding units are statistical reporting areas used for data analysis in the statewide harvest reporting system. Management Zone 1 was a high-density moose area, with moose concentrated heavily along the river corridor. Hunter use in this zone was very high and increasing rapidly over the past 10 years. Management Zone 2 was mostly a low-density moose area, with moose broadly dispersed throughout. Hunter use in this zone was low but has increased some in recent years.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Status and trends of the moose population in an area as large and diverse as Unit 24 are difficult to determine with any degree of certainty. Most often, population size is described using generalities, and trends are discernible only for the few areas surveyed.

During RY99–RY00, moose were numerous in the Koyukuk River lowlands in the southern third of the unit (south of Hughes). Based on recruitment parameters, the population probably declined in the Dulbi Slough, Huslia River Flats, and Treat Island areas (Tables 1–3). Moose densities often exceeded 5 moose/mi^2 in these areas. Further up river, in the Batza Slough and Mathews Slough TCAs, moose densities were 1.9 and 0.3 moose/mi^2, respectively (Tables 4 and 5), with no clear trend.

Moose densities were relatively low in the middle third of the unit (Hughes to Bettles, including the Kanuti CUA and the South Fork Koyukuk River drainage). Apparently, this portion of the population declined during the 1990s.

Population Size

In the previous reporting period, there were 5000–7000 moose in the southern portion of Unit 24. This estimate was based on the results of 1987 and 1997 population estimation surveys (Huntington 1998) and on extrapolations of density estimates obtained during trend count surveys (Woolington 1998). Additionally, there were 3000–4000 moose in the middle portion of Unit 24. This estimate was based on population estimation surveys of the Kanuti National Wildlife Refuge in 1989 and 1993 (Table 6) and the Dalton Highway Corridor in 1991 (Martin and Zirkle 1996). These surveys indicated a rather low overall early winter density of 0.42–0.76 moose/mi^2 (Woolington 1998).

There were an estimated 3000–4150 moose in the northern portion of Unit 24, including 1500–2000 moose within the Gates of the Arctic National Park. This estimate was based on the distribution of moose seen during a 1987 stratification survey, and a density estimate of 0.42 moose/mi^2 completed by Dale et al. (1995). Dale et al.'s estimate was based on 1990 data collected during their wolf predation study in the Alatna River drainage within Gates of the Arctic National Park.

I estimated there were 9000 moose ±1500 (7500–10,500) in Unit 24 in fall 1999 (Table 7). My estimate was based on our 1999 GSPE survey in 8390 mi^2 of the Upper Koyukuk drainage, and on Woolington’s (1998) data. Separate estimates were made for Management Zone 1 and for Management Zone 2 to facilitate planning discussions with the KWG (Fig 1). With recent declines, I estimate the population of the Unit 24 portion of Management Zone 1 was down to 3650 moose, and the population of Management Zone 2 was 4450 for a total population of 8100 moose ±1350 (6750–9450). The estimated declines were based on a 4.5% annual decline in Zone 1 and a 6.0% annual decline in Zone 2.

Population Composition

Composition data were available from aerial surveys conducted in cooperation with US Fish and Wildlife Service staff from the Koyukuk National Wildlife Refuge and Kanuti National Wildlife Refuge (Tables 1–5). Results from surveys conducted in RY99 were variable. Bull:cow ratios were high, as in previous years, in the Batza Slough and Huslia River Flats TCAs and on the Kanuti Refuge. However, the Dulbi Slough, Treat Island, and Mathews Slough bull:cow ratios declined substantially. Franzmann and Schwartz (1998) suggested a ratio of 20–30 bulls:100 cows is needed to ensure breeding of all available cows. Calf:cow ratios for the RY99 Mathews Slough TCA were unreliable due to small sample size.

Distribution and Movements

There is little data available on movements of moose within the unit. Thirteen moose radiocollared in winter 1984–1985 in northern Unit 21D migrated into the southwestern parts of Unit 24 during each summer. Generally, moose are found at treeline in the northern part of Unit 24 during early winter and move into the river bottoms during late winter and summer.

MORTALITY

Harvest

Season and Bag Limit.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 moose per regulatory year, only as follows:		
1 moose by registration permit only; or	27 Aug–31Aug (Subsistence hunt only)	
1 bull by registration permit only; or	1 Sep–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Unit 21(D) that portion within the Koyukuk Controlled Use Area; or	5 Sep–25 Sep (Subsistence hunt only)	
1 moose.	1 Dec–10 Dec 1 Mar–10 Mar (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side by drawing permit; up to 80 permits may be issued in combination with Unit 21(D), that portion within the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Unit 24, that portion of the John and Alatna River drainages within the Gates of the Arctic National Park.		
RESIDENT HUNTERS: 1 moose.	1 Aug–31 Dec	
NONRESIDENT HUNTERS:		No open season
Unit 24, all drainages to the north		

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
of the Koyukuk River upstream from the Henshaw Creek drainage, to and including the North Fork of the Koyukuk River, except that portion of the John River drainage within Gates of the Arctic Park.		
RESIDENT HUNTERS: 1 moose; however, antlerless moose may be taken only during the period 21 Sep–25 Sep.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep
Unit 24, all drainages to the north of the Koyukuk River between and including the Alatna River and Henshaw Creek drainages, except that portion of the Alatna River drainage within Gates of the Arctic National Park.		
RESIDENT HUNTERS: 1 moose; however, antlerless moose may be taken only during the periods 21 Sep–25 Sep and 1 Mar–10 Mar.	1 Sep–25 Sep 1 Mar–10 Mar	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep
Remainder of Unit 24.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Subsistence and general registration hunts were established in the Koyukuk CUA downstream of Huslia by the Board of Game in

March 1996. This action was to counter a moose hunting closure by the Federal Subsistence Board. The federal board closed federally managed lands within one-half mile of the Koyukuk River in nearby Unit 21D, from the Kateel River to 40 miles upstream from the mouth of the Koyukuk, for all but local rural residents. This closure was prompted by perceived declines in moose availability for local residents and by an increase in moose hunters. Two separate registration hunts were established. A subsistence registration hunt was opened to all Alaska residents during 1 September–25 September, with a bag limit of 1 moose. All the meat had to remain on the bones, the head had to be salvaged, and the antlers were cut to destroy the trophy value. A general registration hunt was opened to all hunters during 5 September–25 September, with a bag limit of either 1 antlerless moose or 1 bull with antlers at least 50 inches wide, or at least 4 brow tines on at least 1 side. Seasons and bag limits for the remainder of the unit were unchanged.

Moose hunter numbers and moose harvests for RY96 in the lower Koyukuk River area increased in spite of the new hunting regulations. The increase in hunters heightened concerns for the area. The Middle Yukon River Fish and Game Advisory Committee and the Western Interior Regional Advisory Council both petitioned the Board of Game to take up the Koyukuk moose issue at their next meeting even though it was not on the board's schedule. They asked the board to accept proposals, open discussion on moose hunting in the area, and to address the problems associated with increased hunter numbers and increased harvest. In response, the Board of Game allowed ADF&G to modify registration hunt requirements. The general registration hunt within Unit 24 was restricted to that portion of the Koyukuk River downstream from and including Dulbi Slough. Also, the department limited the number of general registration permits available at any one time to a maximum of 250. In RY99 the department used discretionary authority to further limit the number of available permits to 215, which also proved to be ineffective at limiting hunter participation. Similar modifications of the registration hunt requirement also occurred in nearby Unit 21D.

Several changes were made to the regulations during the 2000 and 2002 Board of Game meetings, due mostly to recommendations proposed by the KWG. Foremost among the changes was implementation of limited drawing hunts for the Koyukuk Controlled Use Area in RY00 and for the Dalton Highway Corridor Management Area in RY02. In RY00 the antlerless moose season for the general season drawing hunts, formerly RM830, was closed, and the antlerless season for the subsistence registration hunt RM832 was reduced to the first 5 days of the season. The RM832 hunt was also shifted forward 5 days so it opened on 27 August and closed on 20 September. Additional restrictions applied by department discretionary authority required hunters to saw through the middle of the palm of one of the antlers of bulls harvested under a RM832 permit. In RY00 and RY01 an Emergency Order closed the March season in the area north of the Koyukuk River between the Alatna and North Fork Rivers. Unexpected increases in hunter participation made it necessary to close that season early because of the excessive harvest of the relatively low number of moose in that area, especially in the lower portion of the Wild River drainage.

<u>Hunter Harvest</u>. Hunting seasons in the unit were diverse and reflected various moose densities and consumptive use patterns. Annual reported harvest during RY88–RY01 averaged 167 moose (123–240, Table 8).

Illegal and unreported harvests by local residents continued to hamper department efforts to manage moose. During some years, actual harvest was estimated to be about twice the reported harvest (Table 8). Moose taken during winter were rarely reported, even when the season was open. Several villages have never had a license vendor. This contributed to the problem of hunters hunting without licenses or harvest tickets.

Harvest Chronology. Over 95% of reported harvest occurred in the September seasons (Table 9). However, much of the unreported harvest likely occurred during October–March (Anderson et al. 1998).

Permit Hunts. In RY00 the drawing permit hunts replaced the general registration permit RM830. Beginning in RY00 either subsistence registration permit RM832 or one of the limited drawing permits (DM827, 828, 829, or 830) were required in the fall in the Koyukuk CUA. The number of permits issued for RY00 was 16.7% less than RY99, the last year of registration permit RM830 (Table 10). Total moose harvested in the 5 KCUA hunts decreased by 25% in RY00 and by another 33% in RY01. However, the decrease in RY01 was likely due primarily to warm weather during September. In fact, the number of RM832 permits issued increased by 48, or 13.5% from RY00. Due to concerns over the declining number of moose in the KCUA, the number of drawing permits issued for RY02 was reduced to 198, down from 258 in the previous 2 years.

Hunter Residency and Success. Based on harvest reports, there was an average of 301 moose hunters during RY91–RY01, the majority of which were Alaska residents (Table 11). The number of hunters was probably underreported because unit residents often did not report unsuccessful hunt information. Harvest and hunter participation by Unit 24 residents was relatively constant, according to Division of Subsistence surveys (Anderson et al. 1998). However, nonresident and nonlocal resident hunter participation increased steadily since RY88. The increase in nonlocal hunters has created tension among user groups and was the impetus for creating the KWG.

The estimated annual harvest by residents of Unit 24 is about 172 moose according to Marcotte (1986) and Marcotte and Haynes (1985). They estimated residents of Huslia, Hughes, Allakaket/Alatna, Bettles, and Wiseman annually took 84, 33, 35, 10, and 5 moose, respectively. An additional 5 moose were probably taken by residents of the unit who did not live in a village. Data reported by Anderson et al. (1998) was similar to earlier results. The estimated unreported harvest incorporated recent Subsistence Division data, less the reported harvest by unit residents (Table 8).

Transportation Methods. In RY99–RY00, boats continued to be the primary transportation method in Unit 24 because of the extensive river system, lack of roads, and restrictions on the use of aircraft within the 2 CUAs (Table 12). Highway vehicles were only used on the Dalton Highway where it crosses the eastern part of the unit. Snowmachines were the main transportation method used during the winter hunt.

The Dalton Highway was closed to the public at the Yukon River Bridge after construction was completed, but was opened to public use throughout Unit 24 in 1981. Number of hunters and moose harvest for hunters accessing Unit 24 by the Dalton Highway during RY88–RY98 was fairly stable at 78–128 hunters, taking 27–67 moose each year (Table 13).

Other Mortality

A minimum of 400–440 wolves in 55–60 packs and a large population of black bears inhabit the middle and southern portions of the unit. Grizzly bears are common throughout the montane areas. Predation on moose was thought to be high, keeping the moose population low throughout much of the central portion of the unit.

MANAGEMENT PLANNING

The KWG met twice during RY00–RY01, and the Management Plan (ADF&G files) developed by the Working Group was formally endorsed by the Board of Game at their winter 2001 meeting. The plan was the basis for developing goals and activities for moose management in Unit 24. Although the KWG area of concern was specifically within the Koyukuk River drainage, the issues were characteristic of concerns throughout Unit 24 and nearby Unit 21D.

CONCLUSIONS AND RECOMMENDATIONS

Unit 24 is larger than some states, with a wide range of habitats available to moose. Moose densities range from quite high in small portions of the unit to the typical low densities expected at these latitudes. Hunting activity was typically concentrated in areas accessible by boat, with the potential for creating conflicts between local subsistence hunters and nonlocal hunters. Conflicts between user groups, whether real or perceived, have the potential to greatly affect future management decisions.

Habitat was excellent throughout much of the unit, with an abundance of successional willow regrowth due to either fire or riverine erosion. Availability of browse was not limiting the moose population during the report period.

With the exception of limited areas around Allakaket, Bettles, and Huslia, predation on moose by wolves and bears was likely the major factor limiting Unit 24 moose populations. Unit residents met their wild food requirements, but hunting opportunities cannot be expanded for people living outside the unit until moose numbers increase. Where predators have been lightly harvested for long periods, predation seems to keep moose densities low (0.1–1.0 moose/mi^2 in areas >800 mi^2, Gasaway et al. 1992).

We need to obtain population estimates for the Hogatza River drainage and the northern area including Gates of the Arctic National Park. A population estimation survey should be undertaken in cooperation with National Park Service when funding is available. Trend data should also be collected in popular hunting areas such as the South Fork Koyukuk River upstream from the Dalton Highway, the Alatna River, the John River, and the Kanuti River area.

For the first goal concerning harvest within sustained yield principles, my estimated population of 9000 moose did not achieve the objective to maintain a population of 10,000–12,000 moose. We achieved the objective to provide for an adequate moose harvest without exceeding a 5% harvest rate. We also achieved the objective to provide for hunting opportunity that does not exceed 500 hunters. For the second goal relating to habitat, activities were limited to the review of burn plans but no enhancement projects were implemented. The objective of the third goal, to reduce meat spoilage, was not evaluated during the reporting period. Subjectively, regulations appear to have heightened awareness about proper meat care, but objective measures were not developed to evaluate whether this objective was met. This was also the case for the objective of the fourth goal to increase nonconsumptive activities. Measures will be developed in the next reporting period to begin evaluating these parameters.

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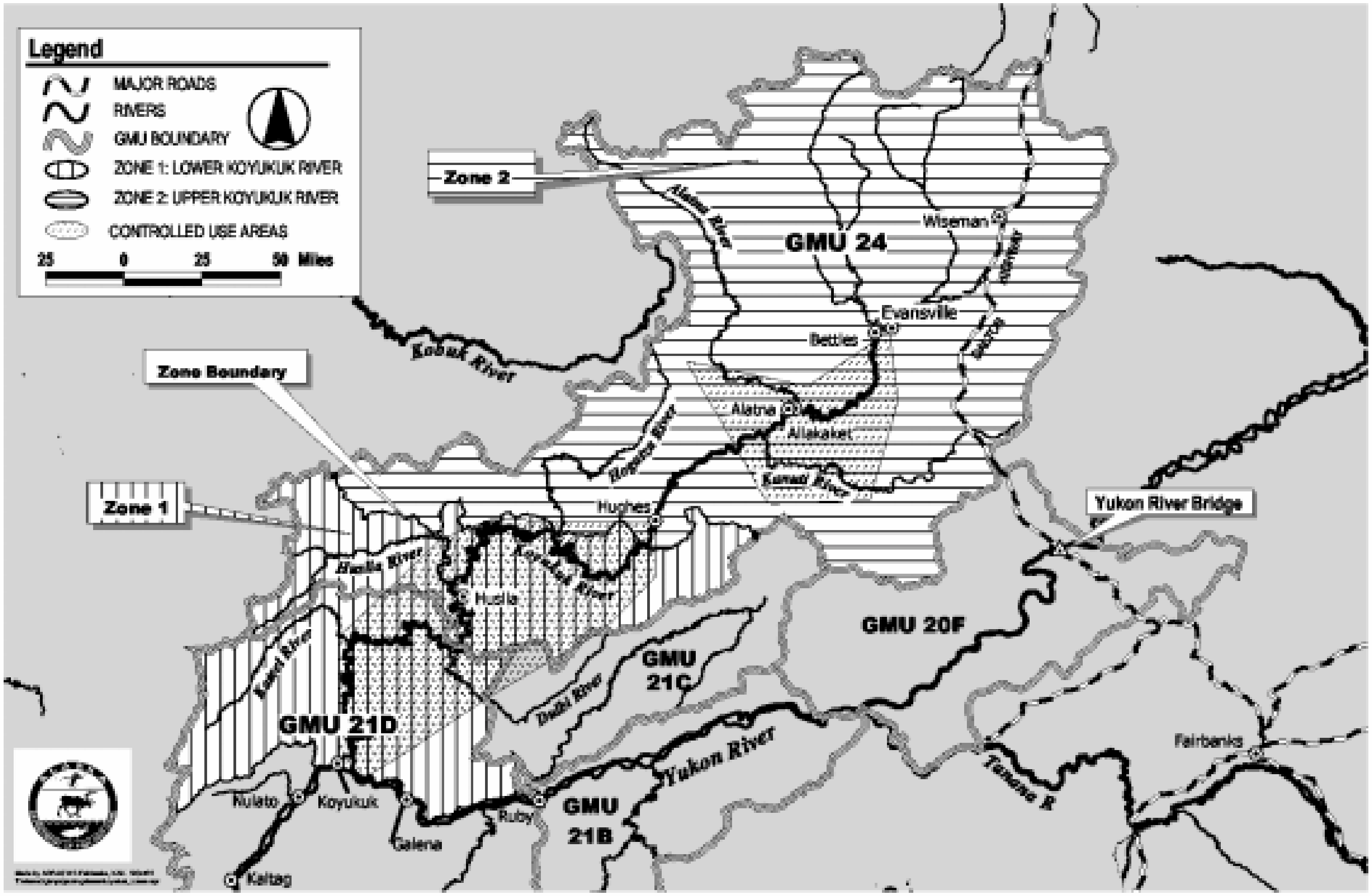

Figure 1 Units 21D and 24 management zones developed by the Koyukuk River Moose Hunters' Working Group

Table 1 Unit 24 Dulbi Slough aerial moose composition counts, regulatory years 1982–1983 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 Cows	Yearling bulls:100 cows	Calves:100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1982–1983	35.0	45	5	7	0	4.5	111	3.2
1983–1984	39.0	17	8	33	14	22.5	113	2.9
1984–1985	48.1	19	8	20	6	14.6	130	2.7
1985–1986	54.2	19	9	10	0	7.7	170	3.1
1989–1990	48.7	53	7	23	18	13.1	298	6.1
1996–1997	86.4	24	8	37	1	23.0	443	5.1
1999–2000	89.0	11	3	22	5	16.1	411	4.6
2001–2002	89.0	18	7	25	0	17.4	327	3.6

Table 2 Unit 24 Huslia River Flats aerial moose composition counts, regulatory years 1983–1984 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1983–1984	80.0	36	7	23	3	14.6	212	2.7
1985–1986	64.5	45	17	10	25	6.7	254	3.9
1989–1990	38.2	50	2	30	7	16.7	90	2.4
1993–1994	80.2	81	15	24	8	11.8	483	6.0
1997–1998	80.2	58	15	24	9	13.2	438	5.5
2000–2001	80.2	35	3	17	4	11.2	259	3.2
2001–2002	80.2	44	7	14	0	8.7	378	4.7

Table 3 Unit 24 Treat Island aerial moose composition counts, regulatory years 1985–1986 through 2001–2002

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins:100 cows with calves	Percent calves	Moose	Moose/mi^2
1985–1986	41.0	35	13	17	5	10.9	192	4.7
1993–1994	40.3	39	11	25	7	15.1	317	7.9
1998–1999	67.1	25	6	19	2	13.5	379	5.7
1999–2000	67.1	21	5	15	11	10.8	279	3.6
2000–2001	67.1	16	4	13	5	10.0	430	5.6
2001–2002	67.1	32	4	12	4	8.4	321	4.3

Table 4 Unit 24 Batza Slough aerial moose composition counts, regulatory years 1986–1987 through 1999–2000

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1986–1987	52.9	39	2	11	0	7.6	66	1.3
1997–1998	46.5	51	2	21	0	12.2	74	1.6
1998–1999	46.5	76	12	17	0	8.9	79	1.7
1999–2000	46.5	60	6	12	12	7.0	86	1.9

Table 5 Unit 24 Mathews Slough aerial moose composition counts, regulatory years 1983–1984 through 1999–2000

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1983–1984	51.8	85	19	15	0	7.4	54	1.0
1997–1998	61.9	60	7	7	0	4.0	25	0.4
1998–1999	61.9	69	16	22	0	11.5	61	1.0
1999–2000	50.8	15	0	8	0	5.9	17	0.3

Table 6 Unit 24 Kanuti National Wildlife Refuge population estimation surveys, regulatory years 1989–1990 through 1999–2000

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yearling bulls:100 cows	Calves:100 cows	Twins/100 cows with calves	Percent calves	Moose	Moose/mi^2
1989–1990[a]	2615	64	4.1	16.5	n/a	9.2	1172 (878–1467)	0.45
1993–1994[a]	2644	61	8.0	33.0	n/a	17.0	2010 (1716–2304)	0.76
1999–2000	2714	61	4.3	27.8	n/a	14.7	1188 (879–1497)	0.39

[a] Martin and Zirkle 1996.

Table 7 Unit 24 population estimation survey summaries, regulatory years 1989–1990 through 1999–2000 (Stout 2000)

Survey area	Area mi^2	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate
Management Zone 1 - **Subtotal**	4696				4000 ± 500
Management Zone 2					
1999 Survey block	8390	1585	65:100	28:100	3036 ± 647 (90% CI)
Moose habitat Unit 24/North[a]	4752		65:100	28:100	1720 ± 353
Remainder Unit 24/North[b]	8217		65:100	28:100	244 ± 50
Subtotal	21,359				5000 ± 1050
Unit 24 – **Total**	26,055				9000 ± 1500

[a] The estimated area of Unit 24 that could potentially support moose year-round.

[b] The area remaining in Unit 24 with very little year-round moose habitat, primarily the high altitude mountainous portion within Gates of the Arctic National Park.

Table 8 Unit 24 moose hunter harvest, regulatory years 1988–1989 through 2001–2002

Regulatory	Harvest by hunters				Unreported	
Year	Bull	Cow	Unk	Total	harvest	Total
1988–1989	132	5	0	137	131	268
1989–1990	119	8	1	128	132	260
1990–1991	141	2	1	144	129	273
1991–1992	141	2	1	144	129	273
1992–1993	118	5	0	123	124	247
1993–1994	139	12	0	151	116	267
1994–1995	134	8	0	142	135	277
1995–1996	161	8	0	169	129	298
1996–1997	176	14	0	190	117	307
1997–1998	168	10	2	180	100	280
1998–1999	213	17	0	230	100	330
1999–2000	228	10	2	240	100	340
2000–2001	211	7	1	219	100	319
2001–2002[a]	134	4	0	138	100	238

[a] Preliminary data.

Table 9 Unit 24 moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2001–2002

Regulatory	Harvest chronology percent by month/day				
year	9/1–9/14	9/15–9/25	12/1–12/10	3/1–3/10	*n*
1996–1997	48	46	2	5	187
1997–1998	49	46	1	4	170
1998–1999	49	47	0	5	219
1999–2000	43	52	0	4	231
2000–2001	46	49	0	4	205
2001–2002[a]	34	62	2	2	133

[a] Preliminary data.

Table 10 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2001–2002

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Unk	Total harvest
RM832	1998–1999	295	0	45	55	125	77	38	23	0	163
	1999–2000	356	0	49	51	127	70	54	30	1	182
	2000–2001	355	8	44	48	157	93	11	7	1	169
	2001–2002[a]	403	8	60	32	126	97	3	2	1	130
RM830[b]	1998–1999	330	0	45	55	159	87	23	13	0	182
	1999–2000	380	0	51	49	148	79	39	21	0	187
DM827	2000–2001	26	15	42	38	10	100	0	0	0	10
	2001–2002[a]	26	19	50	23	5	83	1	7	0	6
DM828	2000–2001	103	51	11	37	38	100	0	0	0	38
	2001–2002[a]	103	63	19	17	17	100	0	0	0	17
DM829	2000–2001	26	15	23	62	16	100	0	0	0	16
	2001–2002[a]	26	15	31	31	8	100	0	0	0	8
DM830	2000–2001	103	41	15	44	45	100	0	0	0	45
	2001–2002[a]	103	51	19	25	26	100	0	0	0	26
Total	1998–1999	625	0	45	55	284	82	61	18	0	345
	1999–2000	736	0	50	50	275	75	93	25	1	369
	2000–2001	613	22	28	45	11	96	11	4	1	278
	2001–2002[a]	661	24	41	28	4	97	4	2	1	187

[a] Preliminary data.
[b] RM830 ended in RY00 and was replaced by Drawing Hunts DM827, 828, 829, and 830.

Table 11 Unit 24 moose hunter residency and success, regulatory years 1988–1989 through 2001–2002

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	
1988–1989	41	57	16	23	137	13	63	18	25	119	256
1989–1990	40	68	17	3	140	28	107	16	4	155	283
1990–1991	43	71	22	8	144	17	81	16	9	123	267
1991–1992	43	77	23	1	144	14	138	16	3	171	315
1992–1993	48	62	7	6	123	27	129	27	3	186	309
1993–1994	56	68	25	2	151	24	94	23	1	142	293
1994–1995	37	78	25	2	142	10	90	21	3	124	266
1995–1996	43	97	30	0	170	12	93	18	0	123	293
1996–1997	55	95	38	2	190	24	98	26	0	148	338
1997–1998	40	97	41	2	180	18	81	20	0	119	299
1998–1999	41	125	59	5	230	20	120	25	2	167	397
1999–2000	40	119	77	4	240	25	143	39	3	210	450
2000–2001	57	124	38	1	220	36	141	55	0	232	452
2001–2002[b]	30	100	47	2	179	18	172	56	3	249	428

[a] Unit resident only.
[b] Preliminary data.

Table 12 Unit 24 moose harvest percent by transport method, regulatory years 1988–1989 through 2001–2002

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1988–1989	23	1	49	1	0	3	13	9	137
1989–1990	19	1	44	1	1	1	24	9	140
1990–1991	16	3	56	3	1	2	16	3	144
1991–1992	25	2	44	3	1	2	17	5	144
1992–1993	16	0	56	3	5	1	13	6	123
1993–1994	15	0	60	6	5	2	7	4	151
1994–1995	17	2	53	3	5	3	12	4	142
1995–1996	13	2	59	2	6	2	15	2	170
1996–1997	12	1	62	3	6	1	13	4	190
1997–1998	19	1	51	7	6	1	11	6	178
1998–1999	17	0	62	2	4	0	10	5	230
1999–2000	17	1	56	3	4	0	18	1	240
2000–2001	16	0	61	3	4	1	14	2	220
2001–2002[a]	18	1	62	2	3	0	15	1	179

[a] Preliminary results.

Table 13 Unit 24 moose harvest by hunters using the Dalton Highway for access, regulatory years 1988–1989 through 1996–1997

Regulatory year	Dalton Highway hunters	
	Successful	Unsuccessful
1988–1989	50	44
1989–1990	57	35
1990–1991	67	61
1991–1992	55	33
1992–1993	27	100
1993–1994	36	61
1994–1995	60	42
1995–1996	41	37
1996–1997	43	55

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNITS: 25A, 25B, and 25D (47,968 mi^2)

GEOGRAPHIC DESCRIPTION: Upper Yukon River Valley

BACKGROUND

Historically, moose have been relatively scarce in the upper Yukon River valley. Long-time residents of the area report moose were hard to find in the early 1900s, but were more common in recent years (F Thomas, H Petersen, K Peter, personal communication). However, moose density continues to be low compared with many other areas in Interior Alaska. A few population surveys were done in the late 1970s, and more extensive surveys began in 1981 when the Alaska Department of Fish and Game (ADF&G) established a Fort Yukon area office. Estimates of population density in survey areas on the Yukon Flats in Unit 25D have ranged from a low of 0.1 moose/mi^2 in the west in 1984 to 0.64 moose/mi^2 in the east in 1989 (ADF&G files). Extrapolations from trend surveys and stratification efforts resulted in estimates of 1253 moose in 1984 and 2000 moose in 1989 in a 5400-mi^2 area in Unit 25D East (Maclean and Golden 1991). Survey techniques have been modified to reflect advances in sampling techniques and to accommodate the area's relatively low moose density.

Population surveys and observations by local residents suggest that moose numbers increased somewhat during the 1970s and 1980s in Unit 25D. Trend counts and population estimates, as well as anecdotal information, indicate moose numbers were stable or declining in Unit 25D West and declining in Unit 25D East during the 1990s. Numbers currently appear to be declining in both areas, although the decline is greatest in Unit 25D East. Moose densities continue to be low compared to other areas in Alaska, making it difficult to simplify regulations.

Recent population trends in Units 25A and 25B are not well understood. Composition surveys were last conducted in Unit 25B in 1987. Reports from experienced guides and pilots indicate moose numbers in Unit 25B declined in recent years and are currently at a low level. Population surveys in Unit 25A suggest that numbers have declined during the last decade.

Based on knowledge of wolf numbers and food habits and moose mortality studies, limiting factors include predation by black bears, grizzly bears and wolves, as well as hunting. A recent moose calf mortality study showed that predation by black bears and grizzly bears is the major cause of calf moose mortality during summer (US Fish and Wildlife Service, unpublished data).

During 1999 and 2000, 30 radiocollared cows and their calves were monitored over a 2-year period in Unit 25D West. The results showed that only about 20% of calves born survived until 30 November. Major sources of mortality included black bears (45%), brown bears (39%), wolves (3%), drowning (8%) and abandonment (5%). Average annual survival of adult cows averaged 88%. In the first year, 2 cows were killed by brown bears and 1 was killed illegally by a hunter. Four were killed by wolves during the second year. The pregnancy rate was 89%, and 63% of the cows had twins. Vegetation surveys indicate that moose browse is abundant and browsing intensity is low (ADF&G, unpublished data; C Fleener, personal communication). The area is characterized by low to moderate snowfall.

Unit 25D was divided into Units 25D West and 25D East during the early 1980s to allow the use of regulatory schemes that reflected the different status of moose populations. The boundary between the 2 areas lies along Preacher and Birch Creeks south of the Yukon River and along the Hadweenzic River north of the Yukon. Low moose density in Unit 25D West, combined with the relatively high demand for moose by local residents, resulted in the use of permit systems that limited hunting largely to residents of the area.

A registration permit hunt was established in Unit 25D West in 1983, with a bag limit of 1 bull and a 25 August–5 October open season. Sixty permits were issued to residents of the 3 communities in the area. The fall season was shortened and 2 winter hunting periods were added in 1984. A harvest quota of 35 bull moose was established in 1986. A Tier II permit hunt was established in regulatory year (RY) 1990–1991 because the harvestable surplus was deemed insufficient to support all subsistence uses, and restrictions were thought to be necessary (RY = 1 Jul–30 Jun, e.g., RY90 = 1 Jul 1990–30 Jun 1991).

A harvest quota of 35 bull moose was established in Unit 25D West in 1986. Since 1990, moose have been hunted under a Tier II permit system with up to 125 Tier II permits issued each year. In 1990 the Federal Subsistence Board promulgated regulations for subsistence use on federal lands. These regulations took effect 1 July 1991, when a federal subsistence moose permit system was established in Unit 25D West. It provided an unlimited number of permits to residents of the 3 communities in Unit 25D West to hunt bull moose on federal lands. The state Tier II permit system remained in effect and applied to both private and federal lands. A maximum of 30 federal permits and 125 state Tier II permits were issued each year beginning in 1993. In 1993 there also was a change in the way regulations were applied in Unit 25D West. Federal permits were required on federal land and were issued only to residents of the 3 communities in the unit. However, state Tier II permits issued to residents of Unit 25D West were again recognized as valid on federal lands beginning in 2000, when 60 federal and 75 state Tier II permits were available, with a harvest quota of up to 60 bull moose.

Dual management also affected regulations in Units 25A, 25B, and 25D East. Seasons for eligible local residents hunting on federal land were longer (generally 25 Aug–25 Sep and 1 Dec–20 Dec) than the state season. The state season applied to all hunters on private and state lands and to nonlocal hunters on federal lands.

The cumulative effect of various annual permit application requirements, confusion over geographic boundaries, and other circumstances have resulted in low reporting and limited participation in the harvest management system. Discussions with local residents during 1999 helped identify a number of steps that could improve moose management on the western Yukon Flats. They included revising the harvest quota for moose, reducing the maximum number of Tier II permits available, and aligning state and federal hunting seasons.

In early 2001 the department initiated a cooperative effort to develop a moose management plan for the Yukon Flats. The plan was developed under the sponsorship of the Alaska Department of Fish and Game, Division of Wildlife Conservation, in cooperation with the Yukon Flats Fish and Game Advisory Committee (YFAC), through the Yukon Flats Moose Management Planning Committee. Other stakeholders involved in the project include the Council of Athabascan Tribal Governments, individual tribal governments, the Yukon Flats National Wildlife Refuge, the US Fish and Wildlife Service (FWS) Office of Subsistence Management and other interested users of the Yukon Flats moose resource. The Yukon Flats Moose Management Planning Team was established through consultation with the YFAC, local communities and other interests. The planning effort employed an extensive public consultation process, with local communities playing a key role in developing a plan to enhance moose numbers. Some of the key issues that were addressed include reducing predation on calf and adult moose, reducing the harvest of cow moose, and improving harvest reporting.

A study of local opinions on moose management issues in Fort Yukon during 1995–1996 indicated there was substantial concern about the status of moose populations, opposition to the taking of cow moose, and support for increased enforcement, biological studies, predator control and local involvement in moose management (C Fleener, unpublished report). The current moose management planning effort focused public concerns about moose management in local communities as well as among nonlocal hunters and other interested parties. The Yukon Flats Moose Management Plan was designed to promote increasing the Yukon Flats moose population in the following ways: 1) Improve moose harvest reporting to better document subsistence needs and improve management; 2) Reduce predation on moose by increasing the harvest of bears and wolves; 3) Minimize illegal cow moose harvest and reduce harvest of cows for ceremonial purposes so that more calves are born; 4) Inform hunters and others about the low moose population on the Yukon Flats and ways people can help in the effort to increase moose numbers; 5) Use both scientific information and traditional knowledge to help make wise management decisions.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

Unit 25 Overall

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

Unit 25A

- Provide an opportunity to hunt under aesthetically pleasing conditions and provide for subsistence use.

Units 25B and 25D

- Provide for subsistence use and for the greatest opportunity to harvest moose.

MANAGEMENT OBJECTIVES

Unit 25 Overall

- Continue efforts to communicate with and educate local residents about moose management and the effects of cow moose harvest.

- Monitor moose population status through annual surveys.

- Work with natural resource offices in local communities to obtain and exchange information on moose populations and management issues, develop a moose management plan, and improve harvest reporting.

METHODS

A moose population survey (Gasaway et al. 1986) was conducted in November 1992 in Unit 25D West using multiple PA-18 aircraft and a C-185 for stratification. Population surveys using similar techniques, including regression analysis (J Ver Hoef, ADF&G, personal communication), were conducted in Unit 25D West in fall 1996, spring 1999, and fall 1999, 2000, and 2001 and in Unit 25D East in fall 1995, 1997, 1999, 2000 and 2001. Ninety-percent confidence intervals were calculated for most estimates. Beginning in 1999, population surveys were conducted using a spatial analysis technique, referred to as the Geostatistical Population Estimator (GSPE), recently developed by Ver Hoef (2001). Survey areas were stratified according to moose density using C-185 or C-206 aircraft. Randomly selected sample units were counted with PA-18 or Scout aircraft flown about 500 feet above ground level at 70 miles per hour. We circled moose to determine sex, age, and antler size of bulls, and to locate other moose. Moose habitat in established count areas or sample units was searched systematically at an intensity of at least 4 minutes/mi^2. Sex and age composition observed during trend surveys is presented, as well as observed and estimated sex and age composition based on data collected during population surveys. Population sex and age composition were estimated using statistical and spatial analyses based on bull:cow, calf:cow, and yearling bull:cow ratios observed in different density strata and the area extent of each strata (Ver Hoef 2001). Population surveys in Unit 25A involve counting discrete survey areas that encompass the major moose habitat in a large area in the eastern part of the unit.

Harvest reports provided information on hunter effort, residency, success, transportation, and antler size. Harvest data were summarized by regulatory year. Informal visits and interviews with area residents provided additional insight into hunter effort and concerns about moose management issues.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

<u>Units 25A and 25B</u>. A population survey was completed in eastern Unit 25A in fall 2000 (Arctic National Wildlife Refuge, unpublished data). The survey area was identical to that used in 1989 and 1991 and survey conditions were excellent. The number of moose observed was about 50% lower than in the 1989 and 1991 surveys, suggesting that moose numbers declined during the last decade (Table 1). Reports from some knowledgeable observers indicate moose numbers in

southern Unit 25A also declined during this period. No population surveys were completed in Unit 25B during RY99–RY02. Reports from hunters in Unit 25B indicate that moose have declined south of the Porcupine River and in the upper Black River drainage, and are also relatively scarce north of the Porcupine River. Surveys in Yukon–Charley Rivers National Preserve in the southern part of Unit 25B resulted in estimated densities of 0.34 moose/mi^2 in 1994 and 0.23 moose/mi^2 in 1997 and 1999 (Burch 1999).

Unit 25D East. A population survey in Unit 25D East in 1995 resulted in an estimate of 704 moose (±33%) in a 1534-mi^2 area (0.46 moose/mi^2) encompassing important hunting areas near Fort Yukon (Table 2). Estimated moose density varied considerably among 3 subunits in the sample area, ranging from 0.12 moose/mi^2 around Fort Yukon to 0.75 moose/mi^2 in the Graveyard Lakes area. A similar survey in 1997 resulted in an estimate of 625 moose (±36%) and a density of 0.40 moose/mi^2. In fall 1999 the moose population in a 2936-mi^2 survey area was estimated at 829 (±20%) with an overall density of 0.28 moose/mi^2. A fall 2000 survey resulted in an estimate of 726 (±25%). The survey area used beginning in 1999 encompassed the smaller area used in 1995 and 1997. The lower density probably reflected both a decline in numbers and the addition of primarily low-density habitat to create the expanded survey area.

The fall 2001 population survey in the 2936-mi^2 area resulted in an estimate at 514 ± 27%. This is lower than 1999 and 2000 estimates. Estimated density in high and low strata was 0.37 and 0.03 moose/mi^2, respectively, with an overall density of 0.18 moose/mi^2 (Table 2). We also calculated a population estimate based on data from sample units representing the area surveyed in 1995 and 1997. This resulted in an estimate of 305 ± 32% moose (0.20/mi^2) in the 1550-mi^2 area. This compares to the 1999 and 2000 estimates of 516 ± 20% and 385 ± 26% and 1995 and 1997 estimates of 704 ± 33% (0.46/mi^2) and 625 ± 36%. These estimates suggest population density has declined from about 0.40 moose/mi^2 in 1995 to 0.20/mi^2 in 2001. Limited snow cover and reduced sightability may have contributed to the relatively low estimate in 2001.

The total population in Unit 25D East in 1999 was probably 2000–3000 moose, assuming the population densities estimated in the 1999 survey area (0.13 moose/mi^2 in low strata and 0.28 moose/mi^2 overall) represent the upper and lower limits of moose density in the remaining 8000 mi^2 outside the survey area. Subsequent surveys indicate the total population is nearer the lower end of this range.

The apparent downward trend in moose numbers in Unit 25D East probably reflects relatively high adult mortality from predation by wolves and grizzly bears, high hunter harvests and continued predation by bears on moose calves. Many local residents have observed a decline in moose numbers during the last decade. The population has the potential to increase if cow and calf mortality can be reduced.

Unit 25D West. In 1992 a population survey indicated there were an estimated 602 moose (± 22%) in 4544 mi^2 of Unit 25D West (Table 2). Density was 0.12 moose/mi^2. In 1996 we estimated a density of 0.44 moose/mi^2 in a 1531-mi^2 portion of the subunit. The survey area established in 1996 encompassed much of the high quality moose habitat in the subunit. Poor survey conditions in fall 1998 precluded surveys, but a survey was conducted in Unit 25D West in March 1999. This survey marked a transition to the recently developed spatial analysis survey (GSPE) technique, and employed a somewhat larger survey area that encompassed the previous area. The March survey resulted in an estimate of 735 ± 17%, or 0.32 moose/mi^2, in the 2269-mi^2 survey area. A fall 1999 survey in the same area resulted in a population estimate of 862 ± 19%, with a density of 0.38 moose/mi^2 (Bertram and Vivion 1999). Data gathered in the part of the area that had been surveyed in 1996 were used to generate an estimate of 0.40 moose/mi^2, which compares to the 1996 estimate of 0.44 moose/mi^2. A fall 2000 survey resulted in an estimate of 670 ± 24% moose in the 2269 mi^2 area, and 555 ± 24% in the original 1774 mi^2 area, suggesting the population was lower than in previous years. A fall 2001 survey yielded an estimate of 668 ± 24% in the 2269-mi^2 area, and 543 ± 25% in the 1774-mi^2 survey area, indicating little change in numbers compared to the previous year.

Moose population density in Units 25D East and 25D West continued to be low relative to habitat potential, but it appears that recent population trends and composition may differ between the 2 areas. Survey data suggest moose numbers have declined since 1995 in both Unit 25D East and Unit 25D West, with the steepest decline on the eastern flats. These trends may be related to differences in the level of harvest as well as other factors. Recent harvest surveys indicate that approximately 150–200 moose are harvested in Unit 25D East each year, while about 60 moose are taken in Unit 25D West. Assuming prehunt populations of at least 2500 moose in the east and 1700 in the west, this suggests harvest rates on the order of 6–8% in Unit 25D East and 3–4% in Unit 25D West.

Population Composition

Units 25A and 25B. Trend surveys conducted by FWS in Unit 25A in 1987, 1989, 1991, and 2000 showed high bull:cow ratios (63–91:100) and moderate calf and yearling survival (Table 1). Moderate to low harvests related to logistic limitations suggest that hunting has so far had a minor effect on bull:cow ratios. Surveys have not been conducted in northern Unit 25B in recent years, but surveys in Yukon–Charley Rivers National Preserve indicate calf:cow ratios of 36:100 and bull:cow ratios of 51:100 (Burch 1999).

Unit 25D East. Population parameters in Unit 25D East were calculated based on both estimates (Table 3) and observations (Table 4). Fall calf survival was relatively high in 1999, 2000 and 2001, with estimated calf:cow ratios of 59:100, 49:100, and 43:100. The estimated proportion of calves during these years was 27%, 21%, and 18%. We observed 30 cows with single calves and 8 (21%) with twins in 1999, 25 with single calves and 3 (12%) with twins in 2000, and 24 with single calves and 1 (4%) with twins in 2001. The estimated proportion of calves has ranged from 7% in 1997 to 27% in 1999. Low calf survival in 1997 was most likely caused by flooding adjacent to the Black River following almost 6 inches of rainfall during 9–15 June. The estimated proportion of calves in the population is likely higher than the proportion observed because there is usually a higher calf:cow ratio in low density habitat, which includes a large area compared to high density areas.

Calf and yearling survival rates were fairly high during 1998, 1999, 2000, and 2001. However, the decline in total population size indicates the absolute number of young moose also declined. The number of bulls, cows, and total adults generally declined during 1996–2001. The decline in the total number of cows and calves was relatively great and accounts for a large part of the reduction in total numbers that appears to have occurred over the last several years (Table 3).

The number of bulls in the population appears to have declined to a lesser degree, accounting in part for the increase in the bull:cow ratio over the last several years.

Composition data indicate a relatively high bull:cow ratio, with estimated ratios of 57:100 in 1999, 79:100 in 2000, and 95:100 in 2001. Small, medium, and large bulls were well represented in the population. We observed 24, 19 and 20 yearling bulls:100 cows in 1999, 2000, and 2001 (Table 3).

Unit 25D West. Surveys similar to those done in Unit 25D East were completed in Unit 25D West (Tables 3 and 5) (Bertram and Vivion 1999; 2000; 2001). Estimated bull:cow ratios in fall 1999, 2000, and 2001 surveys were 31:100, 71:100, and 52:100. There were an estimated 31 calves:100 cows in 1999, 22:100 in 2000, and 27:100 in 2001. Estimated calf:cow and bull:cow ratios, and the proportion of yearlings were lower in Unit 25D West than in Unit 25D East during 1999–2001 (Table 3).

Distribution and Movements

Moose are distributed throughout the area, but density varies. Large areas currently support densities of 0.1–0.3 moose/mi^2. Somewhat higher densities occur in localized areas in Unit 25D, particularly in late winter when moose tend to concentrate in riparian habitat. Moose also concentrate in relatively small areas during early winter along the upper Sheenjek and Coleen Rivers in Unit 25A, but the extent of these concentrations was limited. Telemetry studies in Units 25D East and Unit 25D West indicate some moose are migratory, moving between higher elevation early winter range and low elevation late winter and summer ranges (Maclean and Golden 1991).

In March 1995 FWS initiated a telemetry study to determine moose seasonal movements and distribution, fidelity to winter range, and relationship between fall moose concentrations and harvest in eastern Unit 25A. Fifty-seven moose (44 females and 13 males) were radiocollared in the Sheenjek, Coleen, and Firth drainages and relocated approximately once each month. A strong pattern of annual movement was evident during the 3-year study, with over 40 moose migrating to the Old Crow Flats in the Yukon during spring and remaining there until late August, when they began moving back into Alaska (Mauer 1998).

Mortality

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25A		
All hunters: 1 bull.	5 Sep–25 Sep	5 Sep–25 Sep

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25B Porcupine River drainage upstream from the Coleen River drainage:		
RESIDENT HUNTERS: 1 bull.	20 Sep–30 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.		20 Sep–30 Sep
Remainder of Unit 25B		
RESIDENT HUNTERS: 1 bull; or	5 Sep–25 Sep	
1 bull per community harvest report by community harvest permit in an established community harvest area.	1 Dec–15 Dec	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.		5 Sep–25 Sep
Unit 25D West		
ALL HUNTERS: 1 bull by Tier II subsistence hunting permit only; up to 75 permits will be issued.	25 Aug–28 Feb	No open season
Unit 25D East Remainder.		
RESIDENT HUNTERS: 1 bull; or	10 Sep–20 Sep	
1 bull per community harvest report by community harvest permit in an established community harvest area.	18 Feb–28 Feb	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least 1 side.		10 Sep–20 Sep

Alaska Board of Game Actions and Emergency Orders. In March 2000 the Alaska Board of Game lengthened the state season to 25 August–28 February, aligning it with the season on federal public lands, and agreed with the department's recommendations to increase the harvest guideline from 35 to 60 bull moose and reduce the number of Tier II permits available from 125 to 75. A proposal to include a maximum of 20 cow moose in the harvest quota was not approved by the board. The board also approved a regulation that established a Community Harvest Permit program, under which individual bag limits could be pooled so more than 1 moose could be taken by an individual hunter. The board established the Chalkyitsik Community Harvest Area and a community harvest bag limit for moose in the portion of Units 25D and 25B included in the community harvest area.

The Yukon Flats moose management planning process resulted in a number of regulatory proposals to the Alaska Board of Game. The board reviewed the Draft Yukon Flats Moose Management Plan in March 2002, and addressed proposals relating to moose, wolf, and bear regulations forwarded by the planning team. The board established a 50-inch/4 brow-tine minimum antler size limit for nonresident moose hunters in Unit 25A; changed the moose season from 20 September–30 September to 10 September–25 September season in northern Unit 25B; changed the brown bear season in Unit 25D to 1 March–30 November for residents, and 1 March–15 June and 1 September–30 November for nonresidents; designated Unit 25D as a community harvest hunt area with a community harvest permit hunt and season for black bear; added a 1 August–25 September fall baiting season for black bear; and increased the bag limit for wolf hunting from 5 to 10 wolves in Units 25A, 25B and 25D. The board also endorsed the draft management plan as a framework for managing the Yukon Flats moose population.

<u>Hunter Harvest</u>. The reported number of moose harvested was relatively stable in most of Unit 25 during RY96–RY00 (Tables 6, 7, 8). Reported harvest for Units 25A, 25B, and Unit 25D East was 72 moose in RY99 and 92 in RY00. The reported harvest in connection with the Tier II and federal permit hunts in Unit 25D West was small (Table 9), with 15–30 moose reported taken annually during RY96–RY00. The reporting rate in Unit 25D was generally low, but improved somewhat in Unit 25D West through the use of reminder letters and personal contacts. The actual number of moose harvested in Unit 25D West was not well documented, but reports by local governments, and preliminary results of the Council of Athabascan Tribal Governments (CATG) harvest monitoring study indicate that about 40 bulls and up to 20 cows were harvested each year during RY99–RY00.

Unreported harvest, particularly by local residents, is common in the upper Yukon River valley. Household interviews conducted by the CATG in the communities of Arctic Village, Beaver, Birch Creek, Canyon Village, Circle, Chalkyitsik, Fort Yukon, Rampart, Stevens Village, and Venetie provided relatively complete information on local moose harvest during RY93 and RY94 (CATG, unpublished data). These harvests included 98 and 84 bulls, respectively. A comparison of these data with harvest tickets returned by local residents indicates only 25–35% of the bull moose harvested by local residents in Units 25A, 25B, and 25D East were reported on harvest tickets. Combining the harvest reported by nonlocal residents with the more accurate data for local harvests obtained in the CATG study indicates the total harvest of bull moose in Units 25A, 25B, and 25D East was at least 152 in RY93 and 149 in RY94. A large proportion of the moose harvest in this region occurred in Unit 25D, where the total harvest in recent years appears to have been about 150–200 annually.

Current information indicates that cow moose were taken at any time of year, especially near communities. While the harvest of cow moose seems to have declined somewhat in recent years, it continues to be a concern to many local residents. Two educational videos were produced in 1993 in a cooperative effort between FWS and ADF&G. The adverse effects of shooting cow moose are a central message in each. These videos have been distributed in local communities and other parts of Alaska and Yukon. The need to minimize the harvest of cow moose has also been a major topic of discussion during the development of a moose management plan.

<u>Permit Hunts</u>. Although local residents largely supported the Tier II moose permit hunt in Unit 25D West, there were a number of problems associated with it (Table 9). These included

confusion about differences in applicability of federal and state permits and boundaries of federal and private lands, which are subject to different seasons and/or different permit requirements. These difficulties led to efforts to revise the harvest quota and simplify regulations. The Chalkyitsik Village Council administered a Community Harvest Permit hunt during RY00 and RY01. During RY00, 16 people participated in the hunt, and reported taking 3 bull moose. Twenty-eight people subscribed to the permit during RY01, with a reported harvest of 5 moose.

<u>Hunter Residency and Success</u>. As in previous years, most hunters reporting from Units 25A, 25B, and 25D during RY99–RY00 were Alaska residents (Tables 10, 11, 12). The proportion of nonresidents was greatest in remote parts of Unit 25A, where guiding activity and float trips were more common. Local residents outnumbered other hunters by a wide margin in Unit 25D East. As described above, the number of local moose hunters was underrepresented because of a low reporting rate. Success among reporting hunters was 37–45% in Unit 25A, 41–50% in Unit 25B, and about 25% in Unit 25D East.

<u>Harvest Chronology</u>. Most moose taken in Unit 25 were killed during the first 3 weeks of September, with a few reported killed before and after this period (Tables 13, 14, and 15). A number of moose were also taken in late August during the state Tier II and federal subsistence seasons in Unit 25D West. A few moose were reported taken in the 1–10 December open season, but hunting was almost exclusively by local residents during this period, and the number of moose killed was probably greater than reported. The CATG harvest study indicated that local residents harvested moose throughout the year, with the fewest being taken in spring and early summer and the most in late summer and fall (CATG, unpublished data).

<u>Transport Methods</u>. Aircraft were the most common transport mode in Unit 25A, being used by >50% of the successful hunters. Horses and boats were used in 2–28% of the remaining hunts (Table 16). Boats were used by about 75% of successful hunters in Units 25B and 25D East, with airplanes used in about 10% of successful hunts (Tables 17 and 18). Snowmachines were used in taking a small percentage of the moose killed in Units 25B and 25D, but the use of snowmachines and boats was probably underrepresented because relatively few harvest reports were submitted by local hunters.

HABITAT

Assessment and Enhancement

Empirical observations and habitat surveys indicate that the upper Yukon River valley provides excellent moose habitat. Moose populations appear to be well below habitat carrying capacity. As in previous years, moose in Unit 25D appeared to be in excellent nutritional condition. Survey personnel often remark on the relatively large size and rounded contours of both adult and calf moose, noting that most calves were as large or larger than those observed in some other areas during late winter.

Habitat surveys indicate that moose browsing intensity is low in both riparian and upland sites and that a large amount of good to high quality forage is available. The occurrence of broomed browse plants is low compared to the Tanana Flats and other areas with high moose densities and/or more limited range (CT Seaton and C Fleener, unpublished data). Feltleaf willow (*Salix alaxensis*) provides high quality food for moose, and is the most common shrub in riparian habitats. The limited occurrence of moose browsing is reflected in growth form, with extensive stands of 6–50 foot tall feltleaf willows that show little or no evidence of branching due to browsing. Plants only 6–8 feet tall exhibited a mature growth form, also indicating the low intensity of browsing. The mature growth form is rarely observed in young feltleaf willows along the Tanana and Koyukuk Rivers, where moose are more abundant (K Kielland, personal communication).

Other common trees and shrubs, most of which are potential forage species for moose, include sandbar willow (*S. interior*), little tree willow (*S. arbusculoides*), pacific willow (*S. lasiandra*), blueberry willow (*S. nova-anglii/monticola*), diamond leaf willow (*S. pulchra*), fire willow (*S. scouleriana*), bebb willow (*S. bebbiana*), barren ground willow (*S. brachycarpa*), red osier dogwood (*Cornus stolonifera*), balsam poplar (*Populus balsamifera*), and aspen (*P. tremuloides*). The upper Yukon area has the shortest fire cycle in Alaska; extensive fires have created and maintained large areas of good habitat for moose. The low snow accumulation typical of the area is another factor making the Yukon Flats excellent habitat for moose.

CONCLUSIONS AND RECOMMENDATIONS

Recent population surveys indicate that moose numbers continue to be low and have declined in some parts of Unit 25D, although productivity and recruitment are higher than in some other areas in the Interior. Modest progress was made towards achieving management objectives in some areas, and the Yukon Flats Moose Management planning effort is resulting in improvements in population and harvest management. Objectives for Unit 25A were generally met, and the harvest of moose in the remainder of the unit was generally sufficient to satisfy local subsistence needs, as well as provide a moderate amount of hunting for other Alaskans and some nonresidents. Declining moose numbers may result in lower harvests in the future. Revised management goals and objectives for the next reporting period follow. They incorporate goals and objectives developed by the Yukon Flats Moose Management Planning Committee.

MANAGEMENT GOALS

Unit 25 Overall

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

Unit 25A

- Provide an opportunity to hunt under aesthetically pleasing conditions and provide for subsistence use.

Units 25B and 25D

- Provide for subsistence use and for the greatest opportunity to harvest moose.
- Protect, maintain, and enhance the Yukon Flats moose population and habitat, maintain traditional lifestyles and provide opportunities for use of the moose resource.
- Increase the harvestable surplus of bull moose in key hunting areas near local communities by reducing mortality from bear and wolf predation.

MANAGEMENT OBJECTIVES

Unit 25 Overall

- Double the size of the moose population in key hunting areas and, if possible within the entire planning area, in the next 10 years. A secondary objective is to increase the number of moose in Unit 25D from 4000 moose to 8000 by 2012.

- Maintain a minimum of 40 bulls per 100 cows as observed in fall surveys.

- Improve moose harvest reporting to attain 90% or greater reporting compliance during the next 3 years.

- Minimize cow moose harvest while the population is rebuilding, recognizing that some cows will probably be taken for ceremonial purposes when bull moose are in poor condition.

ACTIVITIES

- Continue efforts to communicate with and educate local residents about moose management and the effects of cow moose harvest.

- Work with natural resource offices in local communities to obtain and exchange information on moose populations and management issues.

- Develop cooperative management programs involving state, federal, and tribal management organizations to help improve local harvest monitoring and reporting.

- Monitor moose population status through annual surveys.

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Table 1 Units 25A and 25B moose observed during early winter aerial composition counts, 1987–1992 (data source: F Mauer, Arctic NWR)

Area/ Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
Unit 25A								
1987[a]	63	9	33	25	17	124	149	
1989[b]	75	18	29	52	14	315	367	1.01
1991[c]	55		26	8	16	41	49	
1991[b]	91	13	31	44	14	270	314	0.87
1992[d]				8	15	44	52	
2000[b]	81	21	32	25	14	139	180	
Unit 25B[e]								
1987	119	6	10	6	5	105	111	

[a] Upper Sheenjek River only.
[b] Includes upper Sheenjek and Coleen Rivers.
[c] Observed during moose stratification flights in lower Sheenjek, Coleen, and East Fork Chandalar Rivers.
[d] March 1993 survey in East Fork of Chandalar River drainage around Arctic Village.
[e] The only early winter composition count in this area during regulatory years 1986–2002.

Table 2 Summary of moose population estimates in Unit 25D East, 1995–2001, and 25D West, 1992–2001

Survey year and type	Survey area (mi^2)	Strata size (mi^2)			Area searched (mi^2)			Total search area	No. of moose estimated by strata and total, and density (moose/mi^2)			Total estimate @ 90% CI	Average density moose/mi^2	No. of sample units counted
		L	M	H	L	M	H		L	M	H			
Eastern 25D														
1995 Regression Analysis	1534	--	--	--	--	--	--	386	--	--	--	704±33%	0.46	28
1997 Regression Analysis	1534	--	--	--	--	--	--	346	--	--	--	625±36%	0.40	27
1999 GSPE[a]	2936	1828	--	1108	175	--	366	541	229/0.13	--	596/0.54	829±20%	0.28	102
2000 GSPE	2936	1639		1297	218		375	594	368/0.22		359/0.28	726±25%	0.25	112
2001 GSPE	2936	1324		1612	186		419	605	52/0.03		487/0.37	514±27%	0.18	115
1999 GSPE	1550	--	--	--	--	--	--	--	--	--	--	516±21%	0.33	
2000 GSPE	1550											385±26%	0.24	
2001 GSPE	1550											305±32%	0.20	
Western 25D														
1992 Stratified Random	4544	3682	515	348	266	379	343	988	77/0.02	220/0.43	228/0.66	619±21%	0.14	76
1992 Stratified Random[b]	1532	1040	308	184	46	247	184	476	92/0.09	143/0.47	154/0.84	455±33%	0.30	37
1996 Regression Analysis	1532	476	516	539	120	122	124	366	--	--	--	666±21%	0.44	27
March 1999 Geo	2269	1714	--	554	253	--	264	517	318/0.19	--	422/0.76	735±17%	0.32	96
1999 GSPE	2269	1444	--	825	156	--	345	501	295/0.20	--	567/0.69	862±19%	0.38	93
2000 GSPE	2269	1281		987	124		371	495	124/0.10		553/0.56	670±24%	0.30	
2001 GSPE	2269	1374		865	205		334	539	161/0.12		506/0.56	668±24%	0.29	100
1999 GSPE	1774											707±19%	0.40	
2000 GSPE	1774											555±24%	0.31	
2001 GSPE	1774	1020		755	156		280	437	104/0.10		428/0.57	543±25%	0.31	

[a] 1999 surveys used smaller sample units, and 2 rather than 3 strata.

[b] Based on sample units counted in the 1992 survey and which later comprised the 1996 survey area.

Table 3 Estimated moose population composition based on 1995, 1997, 1999 and 2000 fall population surveys in Unit 25D East, and results of fall 1992, 1996, 1999 and 2000 surveys in Unit 25D West

Survey period and area (mi^2)	Total bulls	Total cows	Total calves	Total adults	Total moose (90% CI)	Bulls: 100 Cows	Yrlg Bulls: 100 Cows	Calves: 100 Cows	% Bulls	% Cows	% Calves	Moose per mi^2
Eastern 25D												
Fall 1995 (1534)	199	369	136	568	704±33%	54	8	37	28	52	19	0.46
Fall 1997 (1534)	208	372	45	580	625±36%	56	16	12	33	60	7	0.40
Fall 1999 (2936)	218	381	223	599	829±20%	57	24	59	26	46	27	0.28
Fall 2000 (2936)	252	319	156	571	726±25%	79	19	49	35	44	21	0.25
Fall 2001 (2936)	208	217	93	225	514±27%	95	17	43	40	42	18	0.18
Fall 1999 (1550)	141	246	123	387	516±21%	57	24	50	28	48	24	0.33
Fall 2000 (1550)	135	169	81	304	385±26%	79	19	49	35	44	21	0.24
Fall 2001 (1550)	123	130	54	253	305±32%	95	20	42	40	43	18	0.20
Western 25D												
Fall 1992 (4544)	224	317	78	541	619±21	71	12	25	36	51	13	0.14
Fall 1992 (1531)	134	252	69	386	455±33%	53	9	28	30	55	15	0.30
Fall 1996 (1531)	184	340	142	524	666±21%	54	10	42	28	51	21	0.44
March 1999 (2296)	--	--	64	671	735±17%	--	--	--	--		8.7	0.31
Fall 1999 (2269)	165	529	168	694	862±19%	31	6	31	19	61	20	0.38
Fall 2000 (2269)	247	346	75	593	670±24%	71	12	22	37	52	11	0.30
Fall 2001 (2269)	193	375	100	568	668±24%	52		27	29	56	15	0.29

Table 4 Moose observed in Unit 25D East during early winter moose composition surveys, 1986–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
1986	84	13	34	26	15	144	170	0.7
1987	81	18	27	29	13	196	225	0.9
1988[a]								
1989	63	9	41	59	20	235	294	1.0
1990[b]	64	5	32	7	16	36	43	0.7
1991[c]	66	9	26	25	13	168	193	0.7
1992[a]								
1993	38	8	40	37	22	128	165	1.0
1994	68	20	25	24	12	160	184	0.6
1995[d]	50	7	30	39	16	193	232	0.46
1996[e]	54	6	43	16	22	57	73	--
1997[d]	61	18	13	14	8	169	183	0.40
1998[a]								
1999[d]	65	24	45	47	21.5	172	219	0.28
2000[d]	77	19	45	31	20.3	122	153	0.25
2001	103	20	39	26	16	134	160	0.18

[a] No survey.
[b] Poor survey conditions, partial count.
[c] Part of the Graveyard trend area was not completed.
[d] Based on composition observed in population survey, except that estimated density is shown.
[e] Based on limited composition survey in Graveyard and Mardow trend count areas.

Table 5 Unit 25D West moose observed during early winter aerial moose composition counts, 1986–2001

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed	Moose/mi^2
1986	78	23	27	20	13	132	152	0.42
1987	71	8	25	13	13	87	100	0.57
1988	84	18	29	13	14	83	96	0.55
1989[a]								
1990[b]	44	12	29	4	15	23	27	
1991[c]	98	8	31	15	13	97	112	0.47
1991[d]	146	8	46	6	16	32	38	0.22
1991[e]	81	8	25	9	12	65	74	1.15
1992[f]	71	12	25	48	13	345	393	0.12
1992[g]	70	11	19	5	10	46	51	0.47
1993[h]	51	14	30	17	16	86	103	0.50
1994[i]	115	23	45	9	14	56	65	0.63
1995[a]								
1996[j]	54	11	42	57	17	273	330	0.44
1997[a]				26	10		248	
1998[k]								
1999[j]	32	6	35	56	21	213	269	0.50
2000	64	7	24	28	13	192	220	0.44
2001	45	9	32	49	18	223	272	0.51

[a] No survey.
[b] Poor survey conditions, only Meadow Creek area surveyed.
[c] Includes both low and high elevation surveys.
[d] Includes only low elevation count areas (Meadow Creek and Birch Creek).
[e] Mt Schwatka area only.
[f] Data from Unit 25D West census.
[g] Data from Meadow Creek and Mud Lakes trend areas within census area.
[h] Data from Meadow Creek and Mud Lakes trend areas. Mt Schwatka area not surveyed.
[i] Mud Lakes area not surveyed.
[j] Based on composition observed in early winter population survey.
[k] Composition observed in March 1999 population survey.

Table 6 Unit 25A reported moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory Year	Reported[a] harvest M	F	Unk	Total
1986–1987	47	0	0	47
1987–1988	41	0	0	41
1988–1989	39	0	0	39
1989–1990	25	0	0	25
1990–1991	56	0	0	56
1991–1992	47	0	0	47
1992–1993	17	0	0	17
1993–1994	27	0	0	27
1994–1995	24	0	0	24
1995–1996	37	0	0	37
1996–1997	39	0	0	39
1997–1998	31	0	0	31
1998–1999	47	0	0	47
1999–2000	25	0	0	25
2000–2001	31	0	0	31

[a] Source: moose harvest reports.

Table 7 Unit 25B reported moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory year	Reported[a] harvest M	F	Unk	Total
1986–1987	27	0	0	27
1987–1988	26	0	0	26
1988–1999	28	0	0	28
1989–1990	24	0	0	24
1990–1991	47	0	0	47
1991–1992	32	0	0	32
1992–1993	18	0	0	18
1993–1994	43	0	0	43
1994–1995	33	0	0	33
1995–1996	32	0	0	32
1996–1997	20	0	0	20
1997–1998	21	0	0	21
1998–1999	31	0	0	31
1999–2000	36	0	1	37
2000–2001	37	0	0	37

[a] Source: moose harvest reports.

Table 8 Unit 25D East reported moose harvest, regulatory years 1986–1987 through 2000–2001

Regulatory	Reported[a]			
year	M	F	Unk	Total
1986–1987	39	0	0	39
1987–1988	47	0	0	47
1988–1999	32	0	0	32
1989–1990	38	0	0	38
1990–1991	52	0	1	53
1991–1992	29	0	0	29
1992–1993	19	0	0	19
1993–1994	27	1	0	28
1994–1995	27	0	0	27
1995–1996	23	0	0	23
1996–1997	14	0	0	14
1997–1998	19	0	0	19
1998–1999	23	0	0	23
1999–2000	16	0	0	16
2000–2001	18	0	0	18

[a] Source: moose harvest reports.

Table 9 Unit 25D West moose harvest for permit hunt 940 and federal subsistence permits, regulatory years 1989–1990 through 2000–2001

Regulatory year	Permits issued	Did not hunt (%)		Unsuccessful hunters (%)		Successful hunters (%)		Bulls (%)		Cows (%)		Unk (%)		Tier II harvest	Federal permit harvest
1989–1990	50	1	(2)	8	(16)	7	(14)	7	(100)	0	(0)	0	(0)	7	
1990–1991	60	9	(15)	3	(5)	4	(7)	4	(100)	0	(0)	0	(0)	4	11
1991–1992	57	44	(77)	13	(23)	6	(11)	6	(100)	0	(0)	0	(0)	6	8
1992–1993	95	67	(71)	21	(22)	5	(5)	5	(100)	0	(0)	0	(0)	5	4
1993–1994	125	54	(43)	40	(32)	10	(8)	10	(100)	0	(0)	0	(0)	10	0
1994–1995	120	63	(53)	30	(25)	10	(8)	10	(100)	0	(0)	0	(0)	10	2
1995–1996	90	44	(49)	27	(30)	16	(18)	16	(100)	0	(0)	0	(0)	16	1
1996–1997	91	32	(35)	31	(34)	10	(11)	10	(100)	0	(0)	0	(0)	10	7
1997–1998	36	23	(64)	11	(31)	2	(18)	2	(100)	0	(0)	0	(0)	2	13
1998–1999	40	22	(55)	11	(28)	7	(18)	7	(100)	0	(0)	0	(0)	7	20
1999–2000	93	55	(59)	25	(27)	13	(14)	13	(100)	0	(0)	0	(0)	13	17
2000–2001	75	41	(55)	21	(28)	9	(12)	7	(78)	0	(0)	2	(22)	9	7

Table 10 Unit 25A moose hunter residency and success, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Successful					Unsuccessful					
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Hunters
1986–1987	4	22	6	5	37 (60)	2	13	10	0	25 (40)	62
1987–1988	4	16	18	3	41 (61)	4	14	3	5	26 (39)	67
1988–1989	3	19	11	6	39 (59)	2	15	9	3	29 (41)	68
1989–1990	3	12	10	0	25 (52)	4	14	5	0	23 (48)	48
1990–1991	5	27	22	2	56 (72)	1	16	5	0	22 (28)	78
1991–1992	4	21	22	0	47 (57)	0	22	13	0	35 (43)	82
1992–1993	2	7	7	1	17 (35)	5	20	6	0	31 (65)	48
1993–1994	3	13	10	1	27 (51)	0	18	8	0	26 (49)	53
1994–1995	1	14	8	1	24 (55)	2	13	5	0	20 (46)	44
1995–1996	6	11	20	0	37 (62)	2	11	10	0	23 (38)	60
1996–1997	1	6	32	0	39 (58)	2	16	9	1	28 (42)	67
1997–1998	3	13	13	2	31 (61)	0	11	9	0	20 (39)	51
1998–1999	4	17	24	2	47 (64)	0	20	7	0	27 (36)	74
1999–2000	3	4	17	0	24 (45)	3	19	7	0	29 (55)	53
2000–2001	1	15	15	0	31 (37)	0	31	21	0	52 (63)	83

[a] Source: moose harvest reports.
[b] Resident of Unit 25.

Table 11 Unit 25B moose hunter residency and success, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Successful					Unsuccessful					
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Hunters
1986–1987	9	10	3	5	27 (47)	6	18	2	5	31 (54)	58
1987–1988	9	10	1	6	26 (53)	5	9	6	3	23 (47)	49
1988–1989	9	9	8	2	28 (50)	2	20	6	0	28 (50)	56
1989–1990	7	16	1	0	24 (40)	9	24	1	2	36 (60)	60
1990–1991	9	31	5	2	47 (57)	9	25	2	0	36 (43)	83
1991–1992	9	17	4	2	32 (46)	12	22	4	0	38 (54)	70
1992–1993	6	9	2	1	18 (19)	7	61	4	3	75 (81)	93
1993–1994	13	24	6	0	43 (52)	4	29	5	1	39 (48)	82
1994–1995	6	19	5	3	33 (34)	5	39	14	6	64 (66)	97
1995–1996	6	24	2	0	32 (40)	2	37	9	1	49 (60)	81
1996–1997	6	10	3	1	20 (29)	5	36	7	1	49 (71)	69
1997–1998	7	11	3	0	21 (34)	4	29	8	0	41 (66)	62
1998–1999	10	18	3	0	31 (53)	3	20	2	2	27 (47)	58
1999–2000	7	29	1	0	37 (41)	8	40	5	0	53 (59)	90
2000–2001	5	25	4	0	34 (48)	1	34	2	0	37 (52)	71

[a] Source: moose harvest reports.

[b] Resident of Unit 25.

Table 12 Unit 25D East moose hunter residency and success, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Successful					Unsuccessful					Hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1986–1987	23	10	1	5	39 (42)	29	22	1	1	53 (58)	92
1987–1988	24	16	6	1	47 (53)	22	13	3	3	41 (47)	88
1988–1989	18	5	4	5	32 (47)	19	8	4	5	36 (53)	68
1989–1990	24	11	2	1	38 (44)	24	20	5	0	49 (56)	87
1990–1991	35	17	0	1	53 (46)	31	26	4	1	62 (54)	115
1991–1992	17	11	1	0	29 (32)	31	31	0	0	62 (68)	91
1992–1993	10	8	1	0	19 (23)	31	31	3	0	65 (77)	84
1993–1995	14	10	3	1	28 (36)	22	24	0	3	49 (64)	77
1994–1996	16	9	0	2	27 (30)	29	31	3	0	63 (70)	90
1995–1996	17	5	1	0	23 (29)	13	35	7	1	56 (71)	79
1996–1997	7	6	1	0	14 (23)	18	25	4	1	48 (77)	62
1997–1998	13	11	2	0	26 (27)	15	50	5	0	70 (73)	96
1998–1999	13	9	1	0	23 (31)	22	24	5	0	51 (69)	74
1999–2000	5	11	0	0	16 (24)	21	25	4	0	50 (76)	66
2000–2001	3	8	1	6	18 (25)	6	38	9	0	53 (75)	72

[a] Source: moose harvest reports.
[b] Resident of Unit 25.

Table 13 Unit 25A reported moose harvest chronology[a] percent by month/day, regulatory years 1986–1987 through 2000–2001

Regulatory	Harvest chronology percent by month/day						
year	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5[b]	Unk	*n*
1986–1987	32	43	13	11		2	47
1987–1988	12	34	34	17		2	41
1988–1989	10	54	31	3		3	39
1989–1990	20	36	40	4		0	25
1990–1991	21	54	20	4		2	56
1991–1992	19	43	32	2		4	47
1992–1993	12	41	35	12			17
1993–1994	30	48	19	4		0	27
1994–1995	44	52	4	0		0	24
1995–1996	35	38	16	8		3	37
1996–1997	33	23	35	8		0	39
1997–1998	3	23	39	26		9	31
1998–1999	28	36	30	2		4	47
1999–2000	12	48	28	4		8	25
2000–2001	16	48	29	6		0	31

[a] Source: moose harvest reports.
[b] No open season.

Table 14 Unit 25B reported moose harvest chronology[a] percent by month/day, regulatory years 1986–1987 through 2000–2001

Regulatory	Harvest chronology percent by month/day							
year	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
1986–1987	7	22	52	7	–[b]	0	11	27
1987–1988	8	19	39	19	4[b]	8	4	26
1988–1989	4	41	44	4	–[b]	4	4	27
1989–1990	8	21	42	13	–[b]	17	0	24
1990–1991	11	28	34	13	2	11	2	47
1991–1992	3	41	38	13	0	3	3	32
1992–1993	11	44	17	0	0	28	0	18
1993–1994	12	33	35	12	0	7	2	43
1994–1995	3	38	44	13	0	3	0	33
1995–1996	28	38	25	3	0	6	0	32
1996–1997	25	35	15	5	0	10	10	20
1997–1998	5	5	29	29	19	10	5	21
1998–1999	10	32	39	10	0	6	3	31
1999–2000	8	32	27	11	0	0	22	37
2000–2001	27	11	35	16	0	8	3	37

[a] Source: moose harvest reports.
[b] No open season.

Table 15 Unit 25D East reported moose harvest chronology[a] percent by month/day, regulatory years 1986–1987 through 2000–2001

Regulatory	Harvest chronology percent by month/day							
year	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
1986–1987	0	56	31	3	–[b]	8	3	39
1987–1988	0	20	53	13	–[b]	7	7	45
1988–1989	0	47	31	3	3	13	3	32
1989–1990	0	45	24	11	3	13	3	38
1990–1991	8	37	40	2	2	6	6	52
1991–1992	17	55	24	3	0	0	0	29
1992–1993	0	42	53	5	0	0	0	19
1993–1994	18	32	29	0	4	11	7	28
1994–1995	8	54	27	8	0	0	0	27
1995–1996	13	43	35	0	0	4	4	23
1996–1997	7	50	29	0	0	0	14	14
1997–1998	0	5	47	37	11	0	0	19
1998–1999	17	57	22	4	0	0	0	23
1999–2000	6	50	31	13	0	0	0	16
2000–2001	5	56	33	0	0	0	5	18

[a] Source: moose harvest reports.
[b] No open season.

Table 16 Unit 25A moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1986–1987	72	17	8	0	0	0	0	2	47
1987–1988	61	12	17	0	0	0	2	7	41
1988–1989	61	17	20	0	0	0	5	5	41
1989–1990	56	16	24	0	0	0	4	0	25
1990–1991	61	11	27	0	0	0	0	2	56
1991–1992	77	15	9	0	0	0	0	0	47
1992–1993	76	6	12	0	0	0	0	6	17
1993–1994	56	26	15	0	0	0	4	0	27
1994–1995	75	4	13	0	0	0	9	0	24
1995–1996	62	16	16	0	0	0	3	3	37
1996–1997	69	28	2	0	0	0	0	0	39
1997–1998	65	6	26	0	0	0	3	0	31
1998–1999	68	15	17	0	0	0	0	0	47
1999–2000	64	20	16	0	0	0	0	0	25
2000–2001	77	6	16	0	0	0	0	0	31

[a] Source: moose harvest reports.

Table 17 Unit 25B moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1986–1987	30	0	63	0	0	0	0	7	27
1987–1988	27	0	65	0	4	0	0	4	26
1988–1989	29	0	61	0	4	0	0	7	28
1989–1990	21	0	75	0	0	0	0	4	24
1990–1991	23	0	68	0	6	2	0	0	47
1991–1992	9	0	78	0	0	0	0	12	32
1992–1993	22	6	61	0	11	0	0	0	18
1993–1994	12	2	77	2	2	2	0	2	43
1994–1995	22	0	73	0	0	0	0	6	33
1995–1996	9	3	75	3	3	0	0	6	32
1996–1997	15	5	75	0	0	0	0	5	20
1997–1998	14	5	71	0	0	0	10	0	21
1998–1999	13	3	81	3	0	0	0	0	31
1999–2000	8	3	73	5	3	0	3	5	37
2000–2001	11	3	81	0	3	0	0	3	37

[a] Source: moose harvest reports.

Table 18 Unit 25D East moose harvest percent by transport method, regulatory years 1986–1987 through 2000–2001[a]

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1986–1987	13	0	67	0	5	0	3	13	39
1987–1988	17	0	66	0	6	0	2	8	47
1988–1989	28	0	47	0	16	0	0	9	32
1989–1990	26	0	51	0	13	0	3	8	39
1990–1991	26	0	64	2	2	0	0	6	53
1991–1992	21	0	72	0	0	7	0	0	29
1992–1993	42	0	53	0	0	5	0	0	19
1993–1994	14	0	75	0	4	0	0	7	28
1994–1995	8	0	78	4	0	0	0	11	27
1995–1996	26	0	61	0	0	0	4	9	23
1996–1997	21	0	71	0	0	0	0	7	14
1997–1998	11	0	84	5	0	0	0	0	19
1998–1999	13	0	74	4	0	4	4	0	23
1999–2000	25	0	63	0	0	6	6	0	16
2000–2001	17	0	78	0	5	0	0	0	18

[a] Source: moose harvest reports.

MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT : 26A (56,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Western North Slope

BACKGROUND

Archaeological evidence indicates moose have been present on the North Slope either sporadically or at low densities for many years. Since about 1940, moose populations have increased in size and have become well established in Unit 26A. Nearly all moose are confined to riparian habitat along river corridors during winter. During summer, many moose move into small tributaries and hills surrounding riparian habitat, and some disperse as far as the foothills of the Brooks Range and across the coastal plain. The largest winter concentrations of moose are found in the inland portions of the Colville River drainage.

Since 1970, late-winter surveys have been conducted annually to assess population status and short yearling recruitment. Complete surveys of all major drainages in Unit 26A were completed in 1970, 1977, 1984, 1991, and 1995. The population increased steadily from a count of 1219 moose in 1970 to 1535 in 1991, then declined to 757 in 1995 (Trent, 1989; Carroll, 1998).

Census and trend counts indicated that the population declined by 75% between 1992 and 1996. Adult mortality was high and fall surveys indicated poor calf survival during 1993 (4% calves), 1994 (2% calves), and 1995 (0%). The decline appeared to be a combination of malnourishment, disease, mineral deficiency, predation, weather factors, and competition with snowshoe hares (Carroll, 1998). Samples were collected from hunter-killed moose and those that were found dead in 1995 and 1996. In addition, we captured, examined, sampled, and radiocollared 45 female and 5 male moose in 1996 and 1997. Analysis indicated that nearly all of the moose tested to be marginally deficient in copper. Several cows captured in 1996 and 1997 tested positive for antibodies to the bacteria *Brucella suis Biovar 4* (8 of 43) and *Leptospira interrogans serovar pomona* (6 of 30). Both diseases cause abortions and weak calves. Relatively high moose populations in the 1980s and early 1990s may have led to over-browsing. Snowshoe hares moved into the area in the early 1990s and irrupted, placing further stress on the browse plants. Wolf and grizzly bear numbers were at relatively high levels during the time of the decline

The population began to recover in 1996. Radiotracking surveys indicated that the adult and calf survival rates increased substantially. Short yearling counts indicated recruitment of 23% during

1997, 26% in 1998, and 17% in 1999. The trend area count increased from 152 moose in 1996 to at least 210 moose in 1999 (Carroll, 2000)

Hunters have used aircraft to hunt moose since the early 1970s (Trent 1989) Most local hunters travel by boat along the Colville River to hunt moose. The mean reported harvest from 1985 to 1993 was 59 moose per year, with a high of 67 in 1991. The harvest decreased to 40 during 1994–1995 and 14 in 1995–96 as the moose population declined and regulations became more restrictive. Hunters harvested 0 moose in 1996, 2 in 1997, 5in 1998, and 2 moose in 1999.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Allow for the recovery of the Unit 26A moose population and maintain a population of over 1000 moose, with a bull: cow ratio of over 30:100.

- Maintain a moose population capable of satisfying subsistence and general hunt needs.

MANAGEMENT OBJECTIVES:

- Conduct a unitwide spring census every 5 years and a spring trend area count to assess population trend and recruitment on subsequent years.

- Conduct a yearly fall aerial sex and age composition survey of the Colville River population.

- Conduct radiotelemetry surveys to examine calf production and survival, distribution, and mortality rates each summer, fall, and spring.

- Monitor predator populations and other mortality factors through field observations and public contacts.

- Examine dead moose to look for causes of death, disease, mineral deficiencies, and contaminants.

- Develop updated population objectives in cooperation with the public and other agencies.

METHODS

We used a Cessna 185 and a Piper PA–18 aircraft to survey trend count areas along the Colville, Chandler, and Anaktuvuk Rivers during 6–9 November 1999, 4–7 April 2000, 5–6 April 2001, and 24–26 October 2001 (after the report period). For all surveys we flew over suitable riparian habitat and attempted to locate all the moose in the survey areas. We determined sex and age composition and estimated the antler size of bulls during the fall surveys and short yearling recruitment and total number of moose during spring surveys.

Surveys to locate and observe radiocollared moose were flown in conjunction with the above mentioned fall and spring surveys. In addition we conducted calving success surveys each year during the first week of June. We obtained GPS locations for all moose that were observed during radiotracking surveys and noted whether the females had 0, 1, or 2 calves.

We compiled harvest data from harvest reports submitted by hunters. In addition we gathered harvest data by contacting hunters in Nuiqsut.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

Census results of 1219, 1258, 1447, and 1535 moose in 1970, 1977, 1984, and 1991, respectively, indicate the population was stable and slowly increasing for at least 20 years. A 1995 census indicated a 51% decline in the population between 1991 and 1995 (Table 1). Trend counts indicated that the population continued to decline until 1996 to about 25% of the 1991 population; then, numbers increased from 1997 through 1999 (Table 2).

The population continued to increase in 2000 and 2001 as indicated by trend counts of 325 and 333 moose, respectively. (Table 2). The large increase in number of moose counted in 2000 could have been partially due to deep snow, which pushed the moose into river bottoms more than usual, making them easier to count. The number of moose counted in the trend count area appears to be increasing faster than in the upper part of the drainage.

The increase in population resulted from low adult mortality and high calf survival, probably due to some combination of the following factors: recovery of vegetation after overbrowsing, reduction of bacterial diseases prevalent in the population, reduced predation, weather factors and reduced hunting pressure.

We used radiocollared moose to determine how many moose were missed by observers during the spring count in 1999. We found that we had failed to see between 12% and 18% of the collared moose in the original count (Carroll, 2000). The number missed probably varies from year to year, depending on conditions.

Population Composition

The percentage of short yearlings counted in spring surveys was very low between 1994 and 1996 (3%, 2%, and <1%). However it increased dramatically in 1997, 1998, and 1999 when 23%, 26%, and 17%, were observed. The trend continued in 2000 and 2001 when 25% short yearlings were counted each year. (Table 2).

During the fall 1999 composition surveys we observed 209 moose in the following classes: 51 bulls (49 bulls:100 cows), 104 cows, and 54 calves (52 calves:100 cows). It appeared that, due to late fall conditions, many bulls had not moved into the count area in 1999. We were unable to conduct fall surveys in 2000. In 2001 (after the reporting period) we observed 368 moose, including 132 bulls (74 bulls:100 cows), 179 cows, and 57 calves (32 calves:100 cows). These counts continued the trend we have seen since 1996 of marked increase in summer calf survival compared to 1993 – 1995 (Table 3).

With improved calf survival, the percentage of bulls in the younger age groups gradually increased, and there is now good representation in all bull antler size groups as shown here:

The estimated antler widths of bulls were:

Inches	<30	30–39	40–49	50–59	60+
1996	0%	0%	38%	45%	17%
1997	4%	8%	16%	48%	24%
1998	13%	22%	14%	31%	20%
1999	18%	16%	12%	28%	26%
2001	13%	18%	17%	32%	20%

Distribution and Movements

Bull moose are widely dispersed during the summer months, ranging from the northern foothills of the Brooks Range Mountains to the arctic coast. Most cow moose move out of the river bottoms, but stay near riparian habitat during summer months, while some range onto the coastal plain. During the fall, as snow cover accumulates, moose move back into to the riparian corridors of the large river systems, primarily the Colville River drainage. By late winter most moose can be found in the riparian corridors. During late April, when snow cover begins to disappear in the foothills, moose begin to move away from the riparian corridors. During late May and early June most parturient cows move away from the river bottoms to calve.

During 1996 and 1997 we radiotracked the collared moose several times and obtained the following distribution information:

- 13 June 1996. 25 of 35 collared moose had moved away from the river bottoms into small tributaries or hills surrounding the major rivers. Eighteen of 20 cows seen with calves had moved away from the major rivers before calving. Most pregnant cows stayed on the major rivers until a few days before parturition and then moved away from the river bottoms to give birth. Three cows moved from the Anaktuvuk River to the Tuluga River to give birth. The mean distance that moose had moved away from the river bottoms was 8 miles and ranged from less than a mile to 18 miles. Three of 5 bulls moved away from the river bottoms with 12 miles being the maximum distance traveled.
- 28 July 1996. 16 of the cows were in the riparian corridors and 18 had dispersed away from the river bottoms. Most of the cows were within 8 miles of the rivers, but one cow and calf were 107 miles north and another cow/calf pair was 36 miles north of the Colville River. One bull was located 2 miles from the riparian corridor and 2 were found in the foothills of the Brooks Range. Two bulls were not found and we assumed they moved out of the survey area.
- 5–8 November 1996. 20 cow moose were sighted on the river bottoms and 14 were found on tributaries and hills around the rivers. Three bulls were found in the riparian corridor, 1 was adjacent to the corridor, and 1 was not found in the survey area.

- 1-2 April 1997. 28 cow moose were in the riparian habitat of the river bottoms and 4 moose in the areas adjacent to the rivers. Two bulls were dead, 2 were in the riparian corridor, and one was not found.

MORTALITY

Harvest

Season and Bag Limit.

1999–2000 and 2000–2001 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 26A: that portion in the Colville River drainage downstream from the Anaktuvuk River		
RESIDENT HUNTERS:		
One bull**	Harvest	1 Aug–31 Aug
NONRESIDENT HUNTERS		No open season
Remainder of Unit 26A		
ALL HUNTERS		No open season

**Hunters may not hunt moose during August using aircraft for transportation or for carrying meat.

Board of Game Actions and Emergency Orders. The Board of Game continued with the regulation passed in 1996 which closed Unit 26A to moose hunting except for a portion of the Colville River downstream from the mouth of the Anaktuvuk River. The portion of Unit 26A open to hunting had a bag limit of one bull from 1 Aug–31 Aug and no aircraft use was allowed for moose hunting.

Hunter Harvest. Hunter harvest reports indicate 2 bull moose were harvested during fall of 1999, 0 in 2000, and 4 in 2001 (after the report period). The low harvests were primarily a result of restrictive regulations (Table 4). Antler size was not reported for most of the harvested moose (Table 5).

Permit Hunts. There were no permit hunts for moose in Unit 26A during the reporting period.

Hunter Residency and Success. All successful hunters and most unsuccessful hunters were local residents. The total number of hunters was low because they were limited to a small section of the former hunting area, and success rates were low because moose numbers in the open area were low (Table 6).

Harvest Chronology. All reported hunting took place during August due to the regulations (Table 7).

Transport Methods. All hunters used boats for transportation (Table 8).

Other Mortality

The Unit 26A moose population declined by approximately 75% between 1991 and 1996. The population declined due to a combination of natural mortality factors including: overpopulation, competition with snowshoe hares, copper deficiency, the bacterial diseases brucellosis and leptospirosis, weather, insect harassment, and predation from bears and wolves.

The mortality rate has been low for both adults and calves since 1996. Among the radiocollared moose the mortality rate was 5.7% for 1996–1997, 2.1% for 1997–1998, 0% for 1998–1999, and 11.9% for 1999–2000 for an average of about 4.5% mortality per year. Calf survival has also increased substantially. The percentage of short yearlings counted during spring surveys increased from an average of 2% from 1994 through 1996 to 23% from 1997 through 2001.

Mortality due to predation has probably decreased substantially during recent years. We conducted wolf surveys in the study area and found that wolf density declined from 4.1 wolves/1000 km^2 in 1994 to 1.6 wolves per 1000 km^2 in 1998. There is no indication that bear numbers have decreased, but is possible that some "specialist" bears that preyed on moose calves during the summer may have died or left the area.

The fact that we have not observed dead moose that appear to have died of starvation indicates that the vegetation may have recovered from the overbrowsing that probably took place when the population was at peak numbers during the late 1980s and early 1990s.

The mortality caused by brucellosis and leptospirosis may be greatly reduced due to the diseases having run their course. The moose that were exposed and were susceptible to the diseases died or did not produce calves that survived. The moose that were resistant to the diseases have survived and are reproducing.

CONCLUSIONS AND RECOMMENDATIONS

After several years of declining population numbers, the Unit 26A moose population began to increase in 1997. As a result of low adult mortality and high calf survival the number counted in the trend count area has increased from 152 in 1996 to 333 in the spring of 2001, an increase of 17 % per year. The recruitment rate for short yearlings has averaged 23% and the adult mortality rate among collared cows has averaged about 4.5% for the last 5 years.

The population increase may have been due to several factors. Vegetation may have recovered from being overbrowsed by moose when the population was at high numbers in the 1980s and early 1990s, allowing for better survival of adults and calves. The bacterial diseases that were prevalent in the population may have run their course. Some "specialist" bears that preyed on moose calves during the summer may have died or left the area. Wolf density in the area is much lower than it was during the decline, so there is less wolf predation. Weather factors have been more favorable during recent years. In addition, some moose may have immigrated into Unit 26A from areas to the south or east.

In response to the severe population decline, we changed the management goal in 1996 from maintaining the population to rebuilding the population. The Board of Game passed regulations that eliminated hunting pressure for most of the area in 1996. While hunting was not the major cause of the decline, it was a contributing factor and one that could be changed to help rebuild the population. The population has increased consistently for 5 years, so we can propose increasing the season length and hunt area for bulls. Restrictions will be necessary that will allow for an increase in harvest, but allow for the continuing recovery of the population.

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Table 1 Number of adult and calf moose from Unit 26A censuses, 1970–1995

Year	Adults	Calves	Total	% Calves
1970	911	308	1219	25
1977	991	267	1258	21
1984	1145	302	1447	21
1991	1231	304	1535	20
1995	746	11	757	1

Table 2 Unit 26A moose trend counts: Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, and Colville River between the mouths of Anaktuvuk and Killik rivers, 1970, 1974–1981, and 1983–2001

Year	Total moose	Adults	Short Yearlings	Short Yearling (%)
1970	750	523	227	30
1974	544	458	86	16
1975	556	386	170	31
1976	650	494	156	24
1977	802	632	170	21
1978	767	623	144	19
1979	644	536	108	17
1980	841	676	165	20
1981	639	594	45	7
1983[a]	315	268	47	15
1984	756	590	166	22
1985	757	613	144	19
1986	866	678	188	22
1987	700	627	73	10
1988	684	602	82	12
1989	699	630	69	11
1990	618	543	74	12
1991	647	516	176	21
1992	510	416	133	18
1993	504	424	85	15
1994	407	396	11	3
1995	307	302	5	2
1996	152	151	1	<1
1997	188	145	43	23
1998	206	153	53	26
1999	210	174	36	17
2000	325	245	80	25
2001	333	251	82	25

[a] Partial counts due to incomplete snow cover and wide dispersal of moose.

Table 3 Unit 26A fall aerial moose composition counts 1983–2001

Year	Bulls:100 Cows	Calves:100 Cows	Calves (%)	Adults	Total moose
1983	54	38	20	150	188
1986	47	18	11	302	339
1987	39	21	13	101	104
1990	33	45	25	277	371
1991	40	39	22	254	325
1992	36	41	23	190	248
1993	36	6	4	381	397
1994	35	3	2	287	293
1995[a]	70	0	0	34	34
1996	60	44	22	126	161
1997	46	40	22	80	102
1998	64	35	18	131	159
1999	49	52	26	155	209
2001	74	32	16	311	368

[a] Partial counts due to incomplete snow cover and wide dispersal of moose.

Table 4 Unit 26A moose harvest, 1985–2001

	Reported hunter harvest		
Regulatory year	Male	Female	Total
1985–1986	50	15	65
1986–1987	46	6	52
1987–1988	49	13	62
1988–1989	51	6	57
1989–1990	41	3	44
1990–1991	60	4	64
1991–1992	59	8	67
1992–1993	52	8	60
1993–1994	53	8	61
1994–1995	36	4	40
1995–1996	14	0	14
1996–1997	0	0	0
1997–1998	2	0	2
1998–1999	5	0	5
1999–2000	2	0	2
2000–2001	0	0	0
2001–2002	4	0	4

Table 5 Percent antler width categories (inches) among moose harvested in Unit 26A, 1983–2001

Regulatory year	Unknown	<20	20–29	30–39	40–49	50–59	60+	*N*
1983–1984	0	0	4	35	15	35	12	26
1984–1985	0	3	5	18	33	30	13	40
1985–1986	0	0	7	11	18	47	19	45
1986–1987	0	0	7	18	29	42	4	45
1987–1988	0	0	0	20	24	47	9	45
1988–1989	0	2	2	0	27	55	14	49
1989–1990	0	0	3	14	14	51	18	39
1990–1991	0	0	4	15	10	59	12	57
1991–1992	16	0	3	3	13	49	16	56
1992–1993	13	0	2	5	7	48	25	52
1993–1994	15	3	2	5	11	49	15	53
1994–1995	10	1	2	8	9	62	8	40
1995–1996	7	0	7	14	7	50	15	14
1996–1997	0	0	0	0	0	0	0	0
1997–1998	0	1	0	0	1	0	0	2
1998–1999	0	1	1	1	1	0	1	5
1999–2000	0	1	0	1	0	0	0	2
2000–2001	0	0	0	0	0	0	0	0
2001–2002	3	1	0	0	0	0	0	4

Table 6 Moose hunter residency and success, Unit 26A, 1987–2001

Regulatory year	Successful hunters						Total hunters				
	Local res[a]	Non-local res[b]	Nonres[c]	Unk[d]	Total	(%)	Local res[a]	Non-local res[b]	Nonres[c]	Unk[d]	Total
1985–1986	–	–	–	–	65	66	29	45	24	0	98
1986–1987	–	–	–	–	52	65	29	33	18	0	80
1987–1988	–	–	–	–	62	61	40	20	39	0	99
1988–1989	–	–	–	–	57	69	12	30	37	5	84
1989–1990	9	13	21	1	44	66	10	23	33	2	68
1990–1991	8	19	35	2	64	65	13	40	43	3	99
1991–1992	9	37	29	1	67	66	13	51	37	1	102
1992–1993	12	16	29	3	60	57	25	35	41	4	105
1993–1994	7	22	29	3	61	79	11	30	32	4	77
1994–1995	8	7	24	1	40	74	11	14	29	0	54
1995–1996	4	3	6	1	14	33	13	12	15	3	43
1996–1997	0	0	0	0	0	0	4	2	0	0	6
1997–1998	2	0	0	0	2	10	20	0	0	0	20
1998–1999	5	0	0	0	5	25	18	2	0	0	20
1999–2000	2	0	0	0	2	14	12	2	0	0	14
2000–2001	0	0	0	0	0	0	UN[e]	UN	UN	UN	UN
2001–2002	4	0	0	0	4	UN	UN	UN	UN	UN	UN

[a] Local resident hunters are residents of the North Slope Borough.
[b] Nonlocal resident hunters are residents of the State of Alaska, but not residing in the North Slope Borough.
[c] Nonresident hunters.
[d] Unknown residency.
[e] Unknown harvest.

Table 7 Percent chronology of moose harvest, Unit 26A, 1987–2001

Regulatory year	Harvest periods						
	Aug	1–7 Sep	8–14 Sep	15–21 Sep	22–31 Sep	Oct–Dec	*N*
1987–1988	9	36	35	6	4	10	62
1988–1989	9	45	34	6	3	0	57
1989–1990	17	48	18	16	0	2	44
1990–1991	4	44	39	6	5	2	64
1991–1992	10	55	22	10	0	3	67
1992–1993	9	58	20	3	8	2	60
1993–1994	7	62	23	3	3	2	61
1994–1995	3	50	19	18	5	5	40
1995–1996	29	7	50	7	0	7	14
1996–1997*	–	–	–	–	–	–	0
1997–1998*	100	–	–	–	–	–	2
1998–1999*	100	–	–	–	–	–	5
1999–2000*	100	–	–	–	–	–	2
2000–2001*	–	–	–	–	–	–	–
2001–2002*	100	–	–	–	–	–	–

*Season only open in August

Table 8 Percent transport methods for moose harvest in Unit 26A, 1987–2001

	Percent method of transportation					
Regulatory year	Airplane	Boat	3 or 4 wheeler	Snowmachine	ORV	*N*
1987–1988	80	15	2	1	2	59
1988–1989	81	18	1	–	–	53
1989–1990	84	14	2	–	–	40
1990–1991	62	28	3	2	3	61
1991–1992	85	7	3	3	2	67
1992–1993	85	13	0	2	0	60
1993–1994	83	17	0	0	0	61
1994–1995	78	18	0	2	2	40
1995–1996	50	43	7	0	0	14
1996–1997	–	–	–	–	–	0
1997–1998	–	100	–	–	–	2
1998–1999	–	100	–	–	–	5
1999–2000	–	100	–	–	–	2
2000–2001	–	–	–	–	–	–
2001–2002	–	100	–	–	–	–

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MOOSE MANAGEMENT REPORT

From: 1 July 1999
To: 30 June 2001

LOCATION

GAME MANAGEMENT UNIT: Units 26B and 26C (26,000 mi^2)

GEOGRAPHIC DESCRIPTION: North Slope of the Brooks Range and Arctic Coastal Plain east of the Itkillik River

BACKGROUND

Moose were scarce in Arctic Alaska prior to the early 1950s, when populations expanded and reached high densities in the limited riparian habitat of major drainages (LeResche et al. 1974). Predation, as well as hunting, probably contributed to the historical scarcity of moose. The reduction in wolf numbers by federal control programs during the late 1940s and early 1950s was likely important in allowing moose populations to increase and become established in most of the riparian shrub habitat on the North Slope. Aerial wolf hunting during the decade following statehood also limited wolf populations.

This area represents the northern limit of moose range in North America. Thus, habitat severely limits the potential size of moose populations, and the concentrated nature of moose distribution and open habitat creates the potential for excessive harvests in accessible areas. During the early 1990s, concentration of hunting pressure along these drainages caused concern among guides, outfitters, hunters, and Alaska Department of Fish and Game (ADF&G) and Arctic National Wildlife Refuge staff. Moose hunting regulations became increasingly restrictive during the past decade and a precipitous decline in numbers of moose led to a season closure in 1996.

Kaktovik and Nuiqsut are the only subsistence communities in the area, and residents took 2–6 moose annually prior to the season closure in 1996. Subsistence harvest was small because moose are scarce near Kaktovik and because most hunting by Nuiqsut residents occurred in the Colville River drainage in adjacent Unit 26A.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Maintain viable populations of moose in their historic range throughout the region.

- Provide a sustained opportunity to harvest moose.

- Provide opportunity for viewing and photographing moose.

MANAGEMENT OBJECTIVES

- In Unit 26B East, allow the moose population to increase to at least 200 moose, with at least 15% calves in spring surveys, before reopening the hunting season.

- In Unit 26B West, allow the moose population to increase to at least 75 moose, with at least 15% calves in spring surveys, before reopening the hunting season.

- Once a hunting season has been reopened, maintain a posthunting sex ratio in Units 26B and 26C of 35 bulls:100 cows.

METHODS

The limited and relatively open nature of winter moose habitat on the North Slope makes a total count in trend count areas, rather than random sampling, the most effective population survey method. Moose are limited almost entirely to riparian shrub habitat during winter. Historically, surveys were conducted in Unit 26B East (east of the east bank of the Sagavanirktok, including the Canning River) and in Unit 26C along the Kongakut and Firth Rivers and Mancha Creek. The west bank of the Canning River is the boundary between Units 26B and 26C. However, Unit 26B East survey data includes moose counted in the Canning River portion of Unit 26C. Surveys in Unit 26B West (west of the east bank of the Sagavanirktok) have also been conducted since 1970. Standard surveys began in 1996 and historical data were reanalyzed to allow a comparison with recent data. Moose inhabit different terrain in Unit 26B East and Unit 26B West. Unit 26B East moose are found primarily in the northern foothills of the Brooks Range while in Unit 26B West moose are found along major drainages on the coastal plain.

The US Fish and Wildlife Service conducted moose composition surveys of riparian willow habitat in Unit 26B East (Martin and Garner 1984; Weiler and Liedberg 1987; Mauer and Akaran 1994; Mauer 1995, 1997). Surveys were done during the end of October, early November, April, or May using Piper PA-18 aircraft flown at 70–90 mph, and/or a Cessna 185 flown at 95–120 mph, at altitudes of 300–600 feet above ground level. The following drainages were surveyed as weather permitted: Accomplishment Creek, Lupine River, Saviukviayak River, Flood Creek, Ivishak River, Gilead Creek, Echooka River, Shaviovik River, Juniper/Fin Creek, Kavik River, and Canning River. Aerial observers circled each moose and, during fall surveys, classified moose as calves, cows, yearling bulls, medium bulls (≤50 inch antlers), or large bulls (>50 inch antlers). Medium and large bulls were combined in this report. Spring surveys were completed in 1999, 2000, and 2001 because low snowfall and poor weather precluded fall surveys. The Alaska Department of Fish and Game conducted the survey in spring 2002 and moose were classified as short yearlings and adult bulls and cows. Because the 2002 survey was conducted in early May, we were able to obtain a minimum estimate of bull:cow and calf:cow ratios.

We conducted spring moose surveys in Unit 26B West in April 1997 and during 1999–2002, using the methods described previously. Surveys were conducted along riparian willow habitat on the Sagavanirktok River from Happy Valley to Sagwon Bluffs and on the Toolik and Kuparuk Rivers starting at approximately latitude 68°52'W to the White Hills. In addition, parts of the Itkillik River have been surveyed periodically since 1981 but because of incomplete surveys during 1996–2002, these data are treated separately.

We conducted habitat reconnaissance in Unit 26B East during the last week of April 1994, in cooperation with the US Fish and Wildlife Service and University of Alaska. Availability, condition, and species composition of moose browse were evaluated along parts of Accomplishment Creek, Section Creek, and the upper Lupine River.

The hunting season has been closed since fall 1996. Prior to the closure, harvest and hunting pressure were monitored using harvest reports submitted by hunters. Reminder letters were sent to hunters who did not report after the fall season. Population surveys, total harvest, residency and success, chronology, and transportation data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY99 = 1 Jul 1999–30 Jun 2000). Informal visits and interviews with hunters and guides also provided insight into population status and moose management issues.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

A complete moose population survey has not been conducted in Units 26B and 26C, but the nature of terrain and sparse, low vegetation makes it possible for trend surveys to account for a large percentage of the moose in areas supporting major concentrations.

In Unit 26B East, the highest numbers of moose observed were 621 in fall 1986 and 629 in fall 1988 (Table 1). Beginning in fall 1990, the number of moose observed declined markedly to 381 moose and continued to decline to 141 moose by fall 1996. The lowest number of 97 moose observed in fall 1997 should be viewed as an underestimate because 25% of the Canning River was not surveyed. Since 1997, surveys have been conducted in the spring and the population appears to have stabilized at about 160 moose (Table 1). During recent surveys the highest concentrations of moose were found along the Echooka, Ivishak, Kavik, and Canning Rivers. When moose numbers were higher, concentrations also were found along Juniper, Fin, and Gilead Creeks.

Based on earlier surveys in Unit 26B West, it appears that moose numbers increased from approximately 100 moose to 165 moose during 1977 through 1984. The surveys conducted in 1984 and 1989 are comparable to standard surveys that began in spring 1996 (Table 2). Moose numbers appeared to be relatively stable during the mid-to-late 1980s at approximately 150 moose (Table 2). Information from harvest data, hunting guides, and bush pilots indicated that the moose population in this area declined during the early 1990s, just as it did in Units 26A and 26C. A survey was not conducted until spring 1996 when 53 moose were observed. Surveys conducted during 1999–2000 indicated a stable population of 50 moose with an increase to 70 moose observed in 2001 and 67 in 2002 (Table 2). This followed the same trend observed in Unit 26B East, where it appeared that the population was relatively stable during RY95–RY01. Most of the moose observed in Unit 26B West were found in the Kuparuk drainage.

Spring surveys conducted along the Itkillik River from the mid 1980s to the mid 1990s indicated moose numbers were stable at about 45 moose (ADF&G files). Although moose did not appear to decline in the early 1990s, as observed elsewhere, we observed only 27 moose in 1999 and 9 in 2002. Either no surveys or incomplete surveys were conducted in 1996, 1997, 1998, and 2001.

The decline in moose numbers in the early 1990s appeared to be widespread on the eastern North Slope, as well as in Unit 26A (Carroll 1998). Calf survival was very low during 1993–1996 (Tables 1 and 2; Carroll 1998) and during summer 1995, carcasses of adult moose were found along the Colville River and its tributaries in Unit 26A (Carroll, ADF&G, personal communication). Necropsies revealed that wolves and bears had not killed these moose. Disease may have been involved because in 1996 and 1997, the bacterial diseases brucellosis and leptospirosis were found in 8 of 43 and 6 of 43 (respectively) live moose that were captured and radiocollared. In addition, a marginal copper deficiency was reported in many of the live and dead moose sampled. Thus, it is possible that disease increased vulnerability to poor environmental conditions during the early 1990s. Winters were long in 1993–1994 and 1994–1995, subjecting moose to shorter growing seasons. Also, in summer 1995 there were numerous reports of intense harassment of moose by mosquitoes (however, there is no documentation that moose are negatively impacted by mosquitoes). Disease may have also increased vulnerability to predation. Wolves and grizzly bears were common in the region, particularly in the mountains and northern foothills of the Brooks Range, and incidental observations by biologists, hunters, and pilots suggested that wolf numbers increased during the early 1990s. There was some postulation that range deterioration may have been involved. During the late 1980s, moose were at the highest densities observed on the North Slope. At the same time the moose were declining, there was a population explosion of snowshoe hares in some drainages in eastern Unit 26A (G Carroll, ADF&G, personal communication). This may have created some competition by affecting the quality of browse. However, habitat reconnaissance east of the Dalton Highway in Unit 26B in April 1994 indicated forage was not in critically short supply even though browsing intensity on favored vegetation was relatively heavy. Species composition consisted mostly of *Salix alaxensis* and *S. pulchra,* with the former predominating. Some current annual growth remained; therefore some moose browse was still available. Quality of browse was not determined, but *Salix alaxensis* is among the highest quality browse species and the one often favored by moose in Alaska. We assume disease, predation, weather, insect harassment, and range deterioration may all have been involved.

In eastern Unit 26C, sizable concentrations of moose were surveyed during fall 1990 and 1992 in the Kongakut and Firth Rivers and Mancha Creek. However, no surveys have been completed recently and the status of these moose populations is unknown. A large proportion of the moose in these areas are migratory, moving south and east to the Old Crow Flats in Canada during spring and summer (Mauer 1998).

Population Composition

In Unit 26B East survival of calves to fall was relatively high (12–14%) from 1988–1991 except in 1989 (5%). No surveys were conducted during RY92 and RY93 and by fall 1994, when the number of moose observed had declined dramatically, survival of calves to fall was very low (4%, Table 1). Low calf survival also occurred in 1995 (5%).

Because no surveys were conducted during the 2 years prior to fall 1994, we do not know precisely when calf survival declined. However, a similar pattern was observed during spring surveys in 1994 in Unit 26A, where numbers of observed moose and survival of short yearlings declined sharply (G Carroll, ADF&G, personal communication). Data from Unit 26A indicate that poor calf survival in Unit 26B began sometime between fall 1993 and spring 1994.

Survival of calves to fall improved in 1996 (11%) and 1997 (14%, Table 1). Fall surveys were not conducted during 1998 and 1999, but 13% short yearlings were observed during spring surveys in 1999 and 8% short yearlings were observed in 2000 (Table 1). Short yearlings were not classified in 2001 but we observed 13% short yearlings in 2002 (Table 1). The lowest value of 8% for short yearlings in spring 2000 may have been partly a result of problems with survey methods. Some short yearlings may have been misidentified as adults because observers did not circle and closely examine each moose.

In Unit 26B East bull:cow ratios were below the management objective of 50:100 during fall 1994; but ranged from 61 to 69 during fall 1995–1997 (Table 1). Although bull:cow ratios were high during this time, the population was declining. This suggested that adult cow mortality was higher than adult bull mortality, at least during RY95. However, the season was closed to hunting in fall 1996 and high bull:cow ratios in fall 1996 and 1997 probably resulted from the closed season. We observed a high bull:cow ratio of 72:100 during the 2002 spring survey. This is likely somewhat conservative because we misclassified those young bulls lacking early antler development as cows.

In Unit 26B West (excluding the Itkillik drainage) percent short yearlings was very low in spring 1996 (2%). It increased to 23% in 2000, was again low in 2001 (7%), and was relatively high in 2002 (16%; Table 2). In 2002, percent short yearlings in Unit 26B West was slightly higher than in Unit 26B East (16% and 13%, respectively). It is possible that predation by wolves and/or grizzly bears may be higher on the east side because it is more mountainous and therefore better habitat for bears and wolves.

During the 2002 spring survey we observed a bull:cow ratio of 34:100. As was suggested for Unit 26B East, it is possible the bull:cow ratio was higher because we probably misclassified some young bulls as cows. However, the bull:cow ratio was substantially lower than that observed in Unit 26B East. Although we have no data on movements, it is likely that some bulls leave Unit 26B West after the rut and winter in the foothills in Unit 26B East. Data from the 1984 spring survey indicated a bull:cow ratio of 30:100 (ADF&G files), similar to that observed in 2002, although harvest would have influenced the composition observed in 1984.

Distribution and Movements

Moose were generally associated with narrow strips of shrub communities along drainages, except in summer when some dispersal occurred. Historically, the greatest concentrations occurred along the Canning, Kavik, Ivishak, Toolik, Kuparuk, Itkillik, and Kongakut Rivers and Juniper and Fin Creeks. Few moose have been observed on the Itkillik River and no surveys have been conducted on the Kongakut River in recent years. Moose movements have not been intensively studied, but casual observations indicate there may be seasonal movements within or between North Slope drainages. Telemetry studies show that some moose winter in the upper Kongakut River and migrate south and east to summer on the Old Crow Flats in Canada (Mauer 1998).

MORTALITY

Harvest

Season and Bag Limit. There was no open season for moose in Units 26B and 26C during RY96–RY99.

Alaska Board of Game Actions and Emergency Orders. The following is a review of previous regulations and regulatory changes. During RY90–RY94 the season for Units 26B and 26C was 5–15 September for both residents and nonresidents, with a bag limit of 1 bull. A 50-inch minimum antler size requirement was in effect for nonresidents and also for anyone hunting within the Dalton Highway Corridor Management Area (DHCMA; see below). During RY90–RY92 the definition of a 50-inch moose was an antler width ≥ 50" or 3 or more brow tines on one side. In RY93 the definition was changed for moose north of the Alaska Range to a bull with antlers at least 50 inches or 4 or more brow tines on one side. An additional season of 1 November–31 December, with a bag limit of 1 bull with antlers at least 50 inches or 4 or more brow tines on one side, was open to residents during RY90–RY94.

In RY95 the season remained the same for Unit 26B and the Canning River drainage, part of which is in Unit 26C. The season for residents and nonresidents in Unit 26C East of the Canning River drainage was 5–15 September with a bag limit of 1 bull. The previous antler restriction for nonresidents was inadvertently eliminated due to an error in a proposal that was submitted to the Board of Game in 1994. The winter season for residents was changed to 1–31 December.

State regulations governed moose hunting along the Dalton Highway in Unit 26B through RY95. The DHCMA extends 5 miles from each side of the Dalton Highway from the Yukon River to the Prudhoe Bay Closed Area. The DHCMA was closed to hunting with firearms. However, big game, small game, and fur animals could be taken by bow and arrow. Hunters had to possess a valid International Bow Hunter Education card. In addition, no motorized vehicles, except aircraft, boats and licensed highway vehicles could be used to transport game or hunters.

The season was closed during RY96 because of a decline in moose numbers and has remained closed through RY00. During their March 2000 meeting, the board determined that a harvest of 60–80 moose was necessary to satisfy subsistence needs in Unit 26.

There has not been an open season on federal lands in Units 26B and 26C in federal regulations since RY96. However, federal subsistence hunting regulations applied to federal lands during RY90–RY95 (RY90 was the first year of federal implementation). In RY90 any rural resident was eligible to hunt, even if they did not live near the resource. Since then, only residents of the corridor and nearby villages (Anaktuvuk Pass, Wiseman, Nuiqsut, and Kaktovik) have been eligible. In RY92–RY93, federal regulations allowed the use of firearms for hunting on federal land within the DHCMA by qualified rural subsistence hunters.

During the March 2002 meeting the Board of Game considered a number of proposals related to bow hunting and the use of motorized vehicles in the DHCMA, some of which may affect moose hunting when it is reopened. The board established the North Slope Closed Area, which is closed to big game hunting. The area includes the portion of Unit 26B within ¼ mile of the Dalton Highway from Atigun Pass north to the Prudhoe Bay Closed Area. The board also established a requirement that hunters using the DHCMA mark arrows with their bow hunter education certification number, extended the restrictions on the use of motorized vehicles in the DHCMA to apply to the Prudhoe Bay Closed Area, and limited the use of licensed highway vehicles in the DHCMA to publicly maintained roads.

Hunter Harvest. The reported moose harvest in Unit 26B was relatively stable during the early 1990s, ranging from 24–37, except in RY92 when harvest was 45 (Table 3). In RY95 harvest declined to 16 animals. The number of hunters increased markedly from 49 in RY91 to 90 in RY92. The number of moose hunters remained high during the following 3 years (63–90), but harvest declined (range = 16–37) to previous levels, probably reflecting the declining moose population.

In Unit 26C the harvest was 3–6 and the number of hunters was 5–12 during RY90–RY95 (Table 4). Compared with Unit 26B, fewer hunters reported hunting in Unit 26C, probably because of a lack of airstrips near moose habitat in Unit 26C and the small number of moose in the area during fall. Most of the hunting in Unit 26C occurred in the Canning River drainage.

Hunter Residency and Success. During RY86–RY96, Alaska residents living outside the area comprised all but a few of the resident hunters in Units 26B and 26C (Table 5). Hunter success declined to below 50% beginning in RY93, likely due to the declining moose population. Nonresidents reported a higher success rate than Alaska residents, probably because many nonresidents benefited from guide/outfitter services.

Harvest Chronology. During RY86–RY96 most moose harvested in Units 26B and 26C were taken during the first 2 weeks of September (Table 6). The concentration of hunting activity in early autumn was likely due to early onset of winter in the region.

Transport Methods. During RY86–RY96, aircraft was the predominant transportation method for hunters; being used by over 70% of the successful moose hunters (Table 7).

Natural Mortality

No intensive studies of moose mortality have been done in the eastern Arctic. The decline in the early 1990s was probably due to a combination of natural mortality factors including the bacterial diseases brucellosis and leptospirosis, copper deficiency, weather, insect harassment, competition with snowshoe hares, and predation from bears and wolves.

There is some evidence that recent mortality rates for adult female moose have been low. In Unit 26A along the Colville River, the mortality rate for radiocollared moose was 5.7% for 1996–1997, 2.1% for 1997–1998, 0% for 1998–1999, and 11.9% for 1999–2000.

CONCLUSIONS AND RECOMMENDATIONS

The moose population in Units 26B and 26C declined dramatically during the early 1990s, but has been fairly stable, and may have increased slightly, since RY95 (Tables 1 and 2). A combination of factors including disease, weather, habitat limitations, insect harassment, and increased predation by wolves and grizzly bears were possibly responsible for the decline. There is some indication that percent short yearlings may be stable in Unit 26B East, although it is difficult to determine the trend because no survey data are available for 2001. Also, there is a possibility that the proportion of short yearlings was underestimated in 2000. Percent short yearlings in Unit 26B West appears to have improved, although we observed a low value in 2001. Similar trends in moose numbers and composition in the early 1990s and a subsequent slow recovery have also been observed in Unit 26A.

We met our first goal of maintaining viable populations of moose in their historic range throughout the region, in part by continuing to keep the hunting season closed until the moose population recovers and our management objectives are met. We did not meet our second goal of providing an opportunity to harvest moose because moose numbers were too low. Moose were available for viewing and photographing, our third goal.

We are approaching our population objective of at least 200 moose in Unit 26B East and 75 moose in Unit 26B West. We are also approaching our objective of $\geq$15% calves in April or May surveys When these objectives are met, we will propose to open the hunting season. Our third objective is to maintain a posthunting sex ratio of 35 bulls:100 cows for Units 26B and 26C. Spring 2002 surveys indicated that bull:cow ratios were higher than our objective.

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Table 1 Unit 26B East (east of Dalton Highway, including Canning River) aerial moose composition counts, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Season	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed
1986–1987[b]	Fall	57	NA	29	87	15	477	564
1987–1988[c]								
1988–1989	Fall	59	30	21	75	12	554	629
1989–1990	Fall	54	13	9	32	5	568	600
1990–1991[d]	Fall	59	7	26	63	14	383	446
1991–1992[d]	Fall	47	9	21	66	15	452	518
1992–1993[c]								
1993–1994[c]								
1994–1995	Fall	39	8	5	14	4	367	381
1995–1996	Fall	66	11	8	7	5	138	145
1996–1997	Fall	61	5	22	16	11	125	141
1997–1998	Fall	69	4	30	14	14	83	97
1998–1999	Spring				20	13	129	149
1999–2000[e]	Spring				14	8	151	165
2000–2001	Spring							146
2001–2002[f]	Spring	72	na	28	22	13	148	170

[a] Data source for 1988–1989 through 2000–2001: F Mauer, US Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.
[b] Modified from Weiler and Leidberg 1987.
[c] No survey.
[d] Incomplete survey. Approximately 27% and 19% of total area was not surveyed in fall 1990 and fall 1991, respectively.
[e] Moose were not circled and examined closely, so some calves may have been identified as cows.
[f] Data collected by ADF&G.

Table 2 Unit 26B West (Kuparuk and Toolik Rivers and Sagavanirktok River from Happy Valley to Sagwon Bluffs) spring aerial moose surveys, regulatory years 1983–1984 through 2001–2002

Regulatory year	Short yearlings	Percent short yearlings	Adults	Moose observed
1983–1984	32	19	133	165
1984–1985 through 1987–1988[a]				
1988–1989[a]	18	12	131	149
1989–1990 through 1994–1995[a]				
1995–1996	1	2	52	53
1996–1997 through 1997–1998[a]				
1998–1999	6	11	50	56
1999–2000	10	23	34	44
2000–2001	5	7	65	70
2001–2002[b]	11	16	56	67

[a] No survey.
[b] The Sagavanirktok River was not surveyed.

Table 3 Unit 26B reported moose harvest and accidental death, regulatory years 1988–1989 through 2001–2002

Regulatory	Reported harvest				
year	M (%)	F (%)	Unk	Total	Hunters
1988–1989	33 (100)	0 (0)	0	33	49
1989–1990	24 (100)	0 (0)	1	25	47
1990–1991	24 (100)	0 (0)	0	24	45
1991–1992	28 (100)	0 (0)	0	28	49
1992–1993	45 (100)	0 (0)	0	45	90
1993–1994	30 (100)	0 (0)	0	30	84
1994–1995	37 (100)	0 (0)	0	37	85
1995–1996	16 (100)	0 (0)	0	16	63
1996–1997 through 2001–2002[a]					

[a] No open season.

Table 4 Unit 26C reported moose harvest and accidental death, regulatory years 1988–1989 through 2001–2002

Regulatory	Reported harvest				
year	M (%)	F (%)	Unk	Total	Hunters
1988–1989	10 (100)	0 (0)	0	10	18
1989–1990	1 (100)	0 (0)	0	1	11
1990–1991	3 (100)	0 (0)	0	3	8
1991–1992	6 (100)	0 (0)	0	6	11
1992–1993	4 (100)	0 (0)	0	4	5
1993–1994	4 (100)	0 (0)	0	4	7
1994–1995	6 (100)	0 (0)	0	6	12
1995–1996	4 (100)	0 (0)	0	4	8
1996–1997 through 2001–2002[a]					

[a] No open season.

Table 5 Units 26B and 26C moose hunter residency and success, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1988–1989	0	13	26	4	43 (64)	0	14	6	4	24 (36)	67
1989–1990	0	11	15	0	26 (45)	0	24	7	1	32 (55)	58
1990–1991	0	7	18	2	27 (51)	0	21	5	0	26 (49)	53
1991–1992	1	11	19	3	34 (57)	1	13	10	2	26 (43)	60
1992–1993	0	23	25	1	49 (52)	0	43	2	1	46 (48)	95
1993–1994	2	23	8	1	34 (37)	1	44	11	1	57 (63)	91
1994–1995	0	24	19	0	43 (44)	2	34	15	3	54 (56)	97
1995–1996	0	3	17	0	20 (28)	2	34	17	0	51 (72)	71
1996–1997 through 2001–2002[c]											

[a] Source: moose harvest reports.
[b] Residents of Units 26B or 26C.
[c] No open season.

Table 6 Units 26B and 26C moose harvest chronology percent by time periods, regulatory years 1988–1989 through 2001–2002[a]

Regulatory	Harvest chronology percent by time periods								
year	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Oct	Nov	Dec	*n*
1988–1989	42	25	22	11					36
1989–1990	27	31	31	4	4				26
1990–1991	37	52	4					2	27
1991–1992	53	41						6	34
1992–1993	63	37							49
1993–1994	50	44	3					3	34
1994–1995	54	44	3					2	41
1995–1996	37	53	10						19
1996–1997 through 2001–2002[b]									

[a] Source: moose harvest reports.
[b] No open season.

Table 7 Units 26B and 26C moose harvest percent by transport method, regulatory years 1988–1989 through 2001–2002[a]

Regulatory year	Harvest percent by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
1988–1989	83	2	5	0	2	0	7		41
1989–1990	96	0	4	0	0	0	0		26
1990–1991	75	4	21	0	0	0	0		24
1991–1992	76	0	15	0	6	0	0	3	34
1992–1993	84	0	8	0	0	0	8	0	49
1993–1994	71	0	21	0	3	0	6	0	34
1994–1995	74	0	19	0	2	0	5	2	43
1995–1996	90	0	0	0	0	0	10	0	20
1996–1997 through 2001–2002[b]									

[a] Source: moose harvest reports.
[b] No open season.

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge and attitudes for responsible hunting.

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