Moose
Management Report
of survey-inventory activities
1 July 2005–30 June 2007

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

Photo by Don Young, ADF&G

Funded through
Federal Aid in Wildlife Restoration
Grants W-33-4 and W-33-5

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

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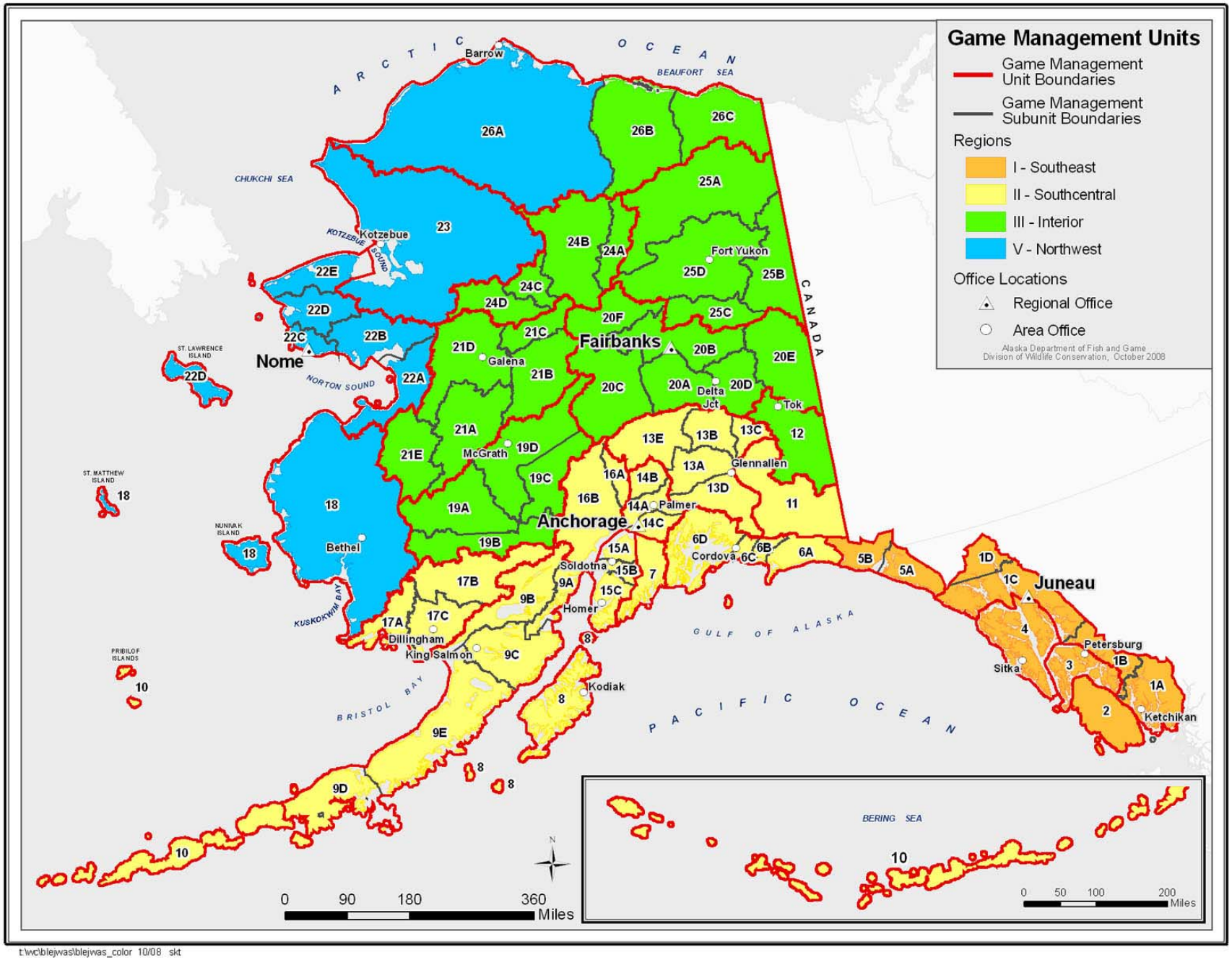

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNITS: 1A (5300 mi^2) and 2 (3600 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, and, in 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. Consequently, population estimates are based on a combination of aerial survey counts and track distribution after a recent snowfall. 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. Moose are occasionally reported from other parts of Unit 1A, including the lower mainland, Revillagigedo Island, Cleveland Peninsula, and from Prince of Wales Island in Unit 2. Moose are occasionally observed in Unit 2, but currently there is no open moose hunting season in this unit. Moose apparently have no problem swimming more than 6 miles across Clarence Strait to reach the Prince of Wales archipelago.

MANAGEMENT DIRECTION

Management Objectives

- Maintain a posthunting population of 50 moose, and an annual harvest of at least 3 bulls.
- Provide maximum opportunity to participate in hunting moose.
- Provide opportunities for nonconsumptive uses.

METHODS

Moose surveys are flown each winter (December–February) when weather and snow conditions become favorable. Hunter reports required as part of the registration hunt provide important information regarding hunter effort, timing, mode of transport, and success.

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, Unit 1A 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 young moose calves. We expect this moose herd will decline in the near future as recent Federal Subsistence regulations allow hunters to remove bulls along the Unuk River drainage well in advance of the breeding season.

A recent decline in hunter observations of moose in Unit 2 suggests very little dispersal of moose from surrounding areas to this archipelago. No population data are available for Unit 2, but numbers are estimated to be extremely low and widely scattered.

Population Composition

Current population estimates for the Unuk River within the Alaska portion of the drainage are between 35–50 moose. Efforts are made each year to complete aerial survey counts after a fresh snowfall with calm wind conditions. However, thick timber canopy cover along most of the river and frequent inclement weather make accurate counts during aerial surveys difficult.

Distribution and Movements

Moose are not restricted from moving between Canada and the U.S. 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 drainage. Some of the best habitat along the river occurs at the upper reaches of the river on the U.S. side and in Canada, and likely supports a significant number of moose outside of Unit 1A. It is also likely those moose move back and forth across the border.

We have had fewer moose sightings outside the Unuk River drainage during this report period. This correlates with several moderately severe winters during this same period that presumably reduced moose numbers and reduced dispersal of animals to new habitats.

MORTALITY

Harvest

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

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

Hunter Harvest. The Unit 1A long-term harvest is 3 bulls. During the past 2 years 4 and 3 moose were harvested respectively under both state and Federal regulations (Table 1). One bull each year was harvested during the early federal season. Hunters who receive federal registration permits report to the U.S. Fish and Wildlife Service rather than ADF&G. Nearly half of the hunters who regularly hunt this moose population qualify for Federal Subsistence and hunt under federal permits, and consequently we receive no report of their hunting effort and thus lose a large portion of important management information. We also have a new group of nonlocal resident hunters from Prince of Wales and Wrangell that are federally qualified and recently started hunting this area after the new early federal season was established.

Permit Hunts. During fall 2005, 41 individuals obtained Unit 1A moose registration permits and 17 hunted (Table 1). During the 2006 season only 16 hunters registered and all of them reported hunting. Hunters participating in the state registration hunt reported 79 days hunted during 2005 and 35 days hunted in 2006. Six federal permit hunters reported an additional 20 days during 2006; federal hunt effort information was not available for the 2005 season.

Hunter Residency and Success. Unit 1A moose hunters continue to be primarily from Ketchikan, Metlakatla, and more recently Prince of Wales Island. Ninety-six percent of the successful hunters during the past 3 years were residents of Ketchikan. On average 10% of the hunters who spend time afield are successful. The 2006 season was very different in that fewer hunters registered to hunt (16) and 20% of those that did were successful (Table 2).

Harvest Chronology. Most Unit 1A moose are harvested during the early (45%) and late (29%) portions of the season (Table 3). A few bulls have been harvested during the early Federal subsistence season which starts on September 6 just 10 days ahead of the State season.

Transport Methods. Most hunters use boats to access the Unuk River (80%) followed by airplanes (13%; Table 4). Currently there are no roads in this hunt area and no suitable places to use off-road vehicles.

OTHER MORTALITY

The extent of wolf, black bear, and brown bear mortality on adult and calf moose in Unit 1A is unknown, but predators likely play a key role in limiting this moose population. Deep and persistent snow in this area is also likely a limiting factor in distribution and expansion of this small semi-isolated moose herd.

CONCLUSIONS AND RECOMMENDATIONS

Access to this hunt area is difficult and consequently it attracts only a few hunters. Historically most moose hunters are from Ketchikan. However, recently there have been more hunters from small towns outside Ketchikan attracted to a new Federal Subsistence moose season. Most of the local residents either own cabins along the lower end of the Unuk River, or have access to one of

them. 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, although the Federal season is making it difficult to account for all the hunting activity. We will continue to gather information about this moose population and continue to document Unit 2 moose sightings. We recommend Unit 2 remain closed to moose hunting. We do not recommend any changes to the Unit 1A moose hunting regulations at this time.

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TABLE 1 Unit 1A moose harvest data by permit hunt for regulatory years 1993 through 2006

Hunt	Year	Permits issued	Did not hunt	Unsuccessful hunters	Successful hunters	Harvest				Total harvest
						Males	(%)	Females	(%)	
RM022	1993	62	17	42	3	3	(100)	0	(0)	3
	1994	81[a]	33	41	6	6	(100)	0	(0)	6
	1995	78	33	43	2	2	(67)	1[b]	(33)	3
	1996	63	27	32	4	4	(100)	0	(0)	4
	1997	59	27	28	4	4	(100)	0	(0)	4
	1998	53	24	26	3	3	(100)	0	(0)	3
	1999	34	14	19	1	1	(100)	0	(0)	1
	2000	51	24	26	1	1	(100)	0	(0)	1
	2001	25	0	22	3	3	(100)	0	(0)	3
	2002	21	0	19	2	2	(100)	0	(0)	2
	2003	10	0	8	2[c]	2	(100)	0	(0)	2[c]
	2004	24	0	21	3[d]	3	(100)	0	(0)	3[d]
	2005	41	24	24	3[e]	3	(100)	0	(0)	3[e]
	2006	16	0	14	2[e]	2	(100)	0	(0)	2[e]
	Average	44	16	26	3	3	(100)	0	(0)	3

[a] 1 permit not returned
[b] Illegal cow kill
[c] 3 additional bulls were harvested under Federal Regulations
[d] 2 additional bulls were harvested under Federal Regulations
[e] 1 additional bull harvested under Federal Regulations

TABLE 2 Unit 1A moose hunter residency and success for regulatory years 1993 through 2006

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	4	(9)	36	6	1	43	(91)	47
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
2001	3	0	0	3	(12)	22	0	0	22	(88)	25
2002	2	0	0	2	(10)	19	0	0	19	(90)	21
2003	2	0	0	2	(20)	8	0	0	8	(80)	10
2004	2	1	0	3	(12)	21	0	0	21	(88)	24
2005	3	0	0	3[b]	(7)	36	2	0	38	(93)	41
2006	2	0	0	2[b]	(20)	8	0	0	8	(80)	10
Average	2	<1	0	3	(10)	25	2	<1	27	(89)	30

[a] Local resident hunters reside in Unit 1A.
[b] One additional bull harvested during early Federal season

TABLE 3 Unit 1A moose harvest chronology for regulatory years 1993 through 2006

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
2001	3	(100)	0	(0)	0	(0)	0	(0)	3
2002	0	(0)	1	(50)	0	(0)	1	(50)	2
2003	0	(0)	1	(50)	1	(50)	0	(0)	2
2004	1	(33)	0	(0)	1	(33)	1	(33)	3
2005	1	(33)	0	(0)	1	(33)	1	(33)	3[a]
2006	0	(0)	1	(50)	0	(0)	1	(50)	3[a]
Average	1	(39)	<1	(11)	<1	(15)	1	(26)	3

[a] One additional bull harvested during early Federal season

TABLE 4 Unit 1A moose harvest percent by transport method for regulatory years 1993 through 2006

Year	Harvest percent by transport method										
	Airplane	(%)	Boat	(%)	Highway vehicle	(%)	Off-road vehicle	(%)	Unk	(%)	*n*
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
2001	0	(0)	3	(100)	0	(0)	0	(0)	0	(0)	3
2002	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
2003	0	(0)	2	(100)	0	(0)	0	(0)	0	(0)	2
2004	0	(0)	3	(100)	0	(0)	0	(0)	0	(0)	3
2005	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0
2006	1	(33)	2	(67)	0	(0)	0	(0)	0	(0)	3
Average	<1	(13)	2	(80)	0	(0)	0	(0)	0	(0)	3

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 1B (3000 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 migrated 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. Moose also occur around Virginia Lake, Mill Creek, and Aaron Creek with a few moose occupying suitable habitat adjacent to Bradfield Canal. LeConte Glacier and Bay divide Unit 1B into northern and southern sections for moose management purposes.

The Thomas Bay moose population is isolated from populations in Canada by the Coast Mountains. For the most part, these moose occupy an area that was heavily logged from the late 1950s through the early 1970s. The Thomas Bay moose population now appears to be in decline and will likely continue to decline as conifer regeneration 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, when it started to decline. The decline continued for several years before eventually culminating in an emergency season closure in 1994.

HUMAN USE HISTORY

Moose are indigenous but recently established in Unit 1B. Since the mid-20th century, isolated populations of moose on the U.S. 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 15 September through 15 October with a 1-bull limit. From 1972 to 1974, however, the harvest of antlerless moose was also 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 three or more brow tines on at least one antler.

From 1959 to 1981 the Thomas Bay season was bulls-only and typically 31 days long, 15 September through 15 October. 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 1 through 15 October. 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 three or more brow tines on at least one antler. Since 1995 the season has been 15 September through 15 October.

Action by the Board of Game effective 1 July 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 three brow tines on at least one antler.

Speculation has long existed that the current antler restrictions, which were developed for the *gigas* subspecies of moose found elsewhere in Alaska, are overly restrictive when applied to the smaller a*ndersonii* subspecies inhabiting the Central Panhandle. In fall 2004 the BOG adopted a department sponsored proposal to implement drawing permit hunts allowing the taking of a limited number of “any-bull” moose in Unit 1B. The current registration moose hunt (RM038) is managed under a selective harvest strategy that allows the taking of only those bulls that meet the spike-fork-3-brow tine or 50-inches antler criteria. Data collected from bulls harvested during the any-bull drawing permit hunts will be used to evaluate the age structure and antler characteristics of that segment of the bull population currently protected under the existing antler restrictions. Such information will prove useful for evaluating the effectiveness of the current antler restrictions, and may provide information necessary to make informed changes to the existing antler regulations.

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, during the 1980s it was 39 and during the 1990s it was 18. The 1971 and 1972 harvests included 18 and 22 cows, respectively. In 1994 the state 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; however, 3 moose were taken on the Stikine under federal permits. In 1995 (the first year antler restrictions were implemented on the Stikine River) the last week of the season was closed by emergency order due to the high percentage of illegal moose taken. Since the implementation of antler restrictions in 1995 the Stikine moose population and harvest have steadily increased.

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 in the 1990s the annual harvest of bulls was 21. A scarcity of calves prompted closure of the season in 1982 and 1983. In recent years, the harvest at Thomas Bay has been declining, averaging just 12 moose annually between 2000 to 2004.

Historical Harvest Locations

The vast majority of moose harvested in the subunit are taken either from in the Stikine River drainage or in the vicinity of 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	2005	2006
Post-hunt numbers	300	N/A	N/A
Annual hunter kill	30	21	35
Number of hunters	250	163	171
Hunter-days of effort	1,750	1,407	1082
Hunter success	12%	13%	20%

Thomas Bay

	Plan Objective	2005	2006
Post-hunt numbers	200	N/A	N/A
Annual hunter kill	20	13	13
Number of hunters	160	108	84
Hunter-days of effort	675	621	599
Hunter success	12%	12%	15%

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 were 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). Since that time the Stikine River population has increased significantly and now appears to be stable at moderate to high density.

The Thomas Bay population was estimated at 180 moose in the late 1970s (ADF&G files, Petersburg). In recent years however, the dense, closed-canopy forests resulting from natural regeneration of second growth stands has reduced available understory browse vegetation. Based on anecdotal reports, observed habitat utilization and harvest records the current population is now believed to be much smaller.

Population Composition

Table 1 shows the results of all Stikine River valley surveys since 1991. Dense coniferous forest, variable snowfall, and inclement weather make adequate surveys difficult. Except in rare instances when early snowfall facilitates aerial surveys prior to antler-drop, no attempt is generally made to differentiate between bulls and cows, but adults and calves are differentiated during late winter aerial surveys.

Early snowfall in 2005 provided the only recent opportunity to obtain sex and age composition data for the Stikine River moose. An aerial survey conducted in early December of that year revealed 199 moose in the Alaska portion of the Stikine River valley. This represents the highest moose count on the river going back to at least 1960. A total of 15 large bulls, 17 small bulls, 106 cows, and 61 calves were observed for a bull-to-cow ratio of 30:100, and a calf-to-cow ratio of 58:100 with a 30% twinning rate.

Information on the number of moose observed by hunters on registration hunt reports provides some of the limited information on population composition in the subunit. Because this data is based on anecdotal information provided by hunters there exists a high likelihood of replicate sights, therefore it should be interpreted with caution. In 2005 a total of 2272 hunters reported observing a total of 1943 moose in Unit 1B, including 652 bulls, 867 cows, and 424 calves, for a bull-to-cow ratio of 75:100, and a calf-to-cow ratio of 49:100. In 2006, 255 hunters reported observing a total of 1587moose, including 611 bulls, 659 cows, and 317 calves, for a bull-to-cow ratio of 93:100, and a calf-to-cow ratio of 48:100.

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. Although Unit 1B moose range extends south of the Stikine River, densities become very low approaching the Bradfield Canal area.

MORTALITY

Harvest

Season and Bag Limit	Resident and nonresident hunters
Unit 1B	15 Sep–15 Oct
1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on 1 side by registration permit only	
or	
1 bull by drawing permit only	15 Sep–15 Oct

Game Board Actions and Emergency Orders. In fall 2006, the Board of Game adopted a Region-wide regulation stating that a broken, damaged or altered antler does not satisfy the spike-fork requirement in antler restricted moose hunts. This regulation resulted from a steadily increasing number of bulls being checked-in annually that met the specified point requirements only as a result of broken or damaged antlers, and growing concern that antlers were being intentionally modified.

Prior to 2006, state law contained a positive customary and traditional use fining for moose in Stikine River drainages and specifying that a harvest of 40 moose annually were necessary to meet subsistence needs. In fall 2006, the Board expanded the customary and traditional use finding from just the Stikine drainages to include all of Units 1B and 3. As a result, the 40 moose necessary for subsistence now applies to all of Units 1B and 3. Because bulls taken during the any-bull drawing hunts are considered a part of the amount necessary for subsistence, nonresidents have been excluded from future participation in the DM033 and DM035 any-bull drawing hunts.

One emergency order was issued regarding Unit 1B moose during the report period. In fall 2006 an emergency order resulted in the early closure of the RM038 moose hunting season within the Stikine River drainages effective at 11:59 PM on October 6. By October 5, 2006 the reported harvest of bull moose in these drainages had reached 31 animals. This represents the highest moose harvest on the river since 1990. In addition, a growing problem of noncompliance with the existing antler regulations resulted in an unacceptably high harvest of bull moose that were intended to be protected by existing regulations.Hunter Harvest. In 2005 the unit-wide harvest for both registration and drawing permit hunts was 33 moose, including 3 illegal. In 2006 the unit-wide harvest was 48 moose, including 3 illegal. In 2005, 163 hunters harvested 21 moose on the Stikine portion of Unit 1B. In 2006, 171 hunters harvested 35 moose in the Stikine River drainage (Table 2). In 2005, 108 hunters harvested 13 moose in the general vicinity of Thomas Bay, including 1 from Farragut Bay and 1 from Cape Fanshaw (Table 3). In 2006, 84 hunters harvested 13 moose in the Thomas Bay vicinity, including 3 from Farragut Bay. One additional moose was harvested at Port Houghton in southern Unit 1C which is within the RM038 hunt boundaries.

In fall 2004 the BOG adopted a department sponsored proposal to implement drawing permit hunts allowing the taking of a limited number of "any-bull" moose in Unit 1B. In 2005, a total of 5 any-bull drawing permits (DM035) were issued for the area north of LeConte Bay and glacier. All 5 permittees hunted, and all were successful. A total of 7 any-bull drawing permits (DM033) were also issued for the area north of LeConte Bay and glacier. Six of 7 permittee's hunted, and all were successful. In 2006, 7 drawing permits each were issued for DM033 and DM035. All of those who received DM033 permits hunted, and 6 of 7 were successful. All 7 of the DM038 permittees hunted, and all were successful (Table 4)

Hunter Residency and Success. The majority of Unit 1B moose hunters are local residents and participation by non-local residents and nonresidents is typically low. In 2005, local residents of Wrangell and Petersburg represented 83% of successful hunters on the Stikine River, with non-local hunters representing 17%. In 2006, local residents of Wrangell and Petersburg represented 93% of successful hunters on the Stikine River, with non-local and nonresident hunters each represented 4% (Table 5). The overall success rate for Stikine River moose hunters was 12% in 2003 and 16% in 2004.

Petersburg residents continued to dominate the Thomas Bay and Farragut Bay moose hunts (Table 6). During this report period, 100% of those who hunted moose successfully in the vicinity of Thomas Bay and Farragut Bay were Petersburg residents. The overall success rate for Thomas Bay and Farragut Bay moose hunters was 11 and 15%, respectively, in 2005 and 2006.

Harvest Chronology. Harvest chronology for Unit 1B moose varies from year to year. In general, most bulls are killed during the first half of the season and the success rate typically declines as the season progresses (Table 7). In 2005, the largest percentage of the annual harvest in the Thomas Bay Area occurred during the third week of the season, followed by the first and second weeks each with an equal percentage of the harvest. The largest percentage of the annual harvest on the Stikine River occurred during the first and fourth weeks of the season, respectively. In 2006 the largest percentage of the annual harvest at Thomas Bay occurred during the third and second weeks of the season, respectively. The largest percentage of the annual harvest on the Stikine occurred during the first and third weeks of the season. 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.

Harvest in particular WAA's. During the report period, moose harvest was reported in 7 Unit 1B WAA's. In both 2005 and 2006 the highest percentage of the annual harvest occurred in WAA # 1708 on the Stikine River and in WAA # 1605 at Thomas Bay, respectively.

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

Transport Methods. With the exception of one Stikine hunter who reported using an airplane in 2006, during the report period all successful Unit 1B hunters reported using boats to reach the areas they hunted (Table 8). Motorized land vehicles are prohibited for moose hunting in the Thomas Bay hunt and the Stikine Wilderness. In the Thomas Bay area, however, motorized land vehicles may be used for other moose hunt related activities such as establishing camps, checking boats, and retrieving harvested moose, which results in this regulation being difficult to enforce and frequently abused.

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 year's wolves and bears are responsible for low calf survival on the Stikine River. At Thomas Bay, wolves are thought to be responsible for the majority of moose predation. Poaching of moose undoubtedly occurs in Unit 1B, however, the extent to which remains unknown.

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 April 2003 the area biologist accompanied Region I research staff to Thomas Bay and the Stikine River to conduct preliminary assessments of browse utilization. A visual assessment of browse conditions at Thomas Bay revealed excessively high utilization rates, indicating that at the time moose may have been at or above carrying capacity. Browse utilization on the Stikine River appeared to be less intense indicating that at the time moose were probably below carrying capacity along the river corridor.

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 2 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. Anecdotal reports from hunters and observations by staff indicate that moose have recently increased utilization of these thinned second-growth units as browse production increases and residual thinning slash begins to settle and decompose.

NON-REGULATORY 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 additional habitat manipulation procedures.

For genetic or environmental reasons moose in this subunit 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 subunit rarely achieve 50-inch antler spreads, and in Thomas Bay in particular the population appears to contain a surplus of sub-legal bulls in excess of that needed to ensure timely breeding of cows. The any-bull drawing permit hunts authorized by the BOG in 2004 should facilitate the removal of surplus bulls and provide information on the age structure and antler characteristics of that segment of the bull population protected under the existing antler restrictions. Such information may prove useful for evaluating the effectiveness of the current antler restrictions, and provide information necessary for modifying the current selective harvest strategy.

CONCLUSIONS AND RECOMMENDATIONS

During this report period, only the Stikine management objectives for hunter success, and the 2006 annual hunter kill were met. In 2005 the success rate of 13% slightly exceeded the management objective of 12%, and at 20% in 2006 greatly exceeded the management objective. Although the total number of hunters was similar to the previous report period, actual days of effort decreased. The harvest of 21 moose in 2005 and 35 moose in 2006 was below and above, respectively, the management objective of 30 moose. We believe the Stikine moose population was at low levels during the late 1990s and early 2000's, but now appears to have increased and stabilized at moderate to high density.

During this report period, only the Thomas Bay management objectives for hunter success were met. The number of hunters declined significantly in 2006, and that trend will likely continue as moose populations decline in response to habitat changes. Hunter-days of effort decreased in 2005 and then again in 2006 reflecting similar declines in the number of hunters. The success rate of 12% in 2005, and 15% in 2006, equaled and exceeded, respectively, the management objective, and were bolstered in part by the high success rate enjoyed by DM035 permit holders. The Thomas Bay moose population currently appears to be in decline and is thought to be at or above carrying capacity.

The Thomas Bay moose harvest began to decline in 2000 and in recent years has remained stable at low levels. Hunters continue to report seeing plenty of bulls in the area; however, few of those qualify as legal under the current antler restrictions. The majority of bulls historically harvested in the area have been younger bulls with spike or forked antlers. It now appears that post-logging habitat changes have reduced carrying capacity resulted in low recruitment, and causing moose to disperse to other areas. As the harvest declines in Thomas Bay, many traditional Thomas Bay hunters appear to be seeking out other more productive areas in Unit's 1B and 3 to hunt moose.

After a sharp decline which began in 1989, and culminated in the 1994 emergency closure of the Stikine moose hunting season, the moose population and harvest has rebounded in recent years. . Although bolstered by the harvest of 7 animals taken by any-bull permit holders, the harvest of 35 bulls, including 27 antler restricted bulls in 2006 is above the long-term average annual harvest of 29 moose during the period 1952 to 1990. An aerial moose survey in December 2006 documented 199 moose on the US-side of the international boundary, which is the highest count going back as far as 1960. The relatively sudden appearance of moose in high numbers on the US-side of the international boundary implies that there is considerable trans-boundary movement of moose between US and Canada.

In fall 2006 an emergency order resulted in the closure of the RM038 moose hunting season within the Stikine River drainages effective on October 7. By October 5, 2006 the reported harvest of bull moose in these drainages had reached 31 animals. This represents the highest moose harvest on the river since 1990. In addition, a growing problem of noncompliance with the existing antler regulations resulted in an unacceptably high harvest of bull moose that were intended to be protected by existing regulations. A relatively high percentage of the antlers checked in from the Stikine River in 2006 appeared to have been intentionally modified further contributing to the decision to close the season early by emergency order.

In fall 2006, the Board of Game adopted a new Region-wide regulation stating that a broken, damaged or altered antler does not satisfy the spike-fork requirement in antler restricted moose hunts. This regulation resulted from a steadily increasing number of bulls being checked-in annually that met the specified point requirements only as a result of broken or damaged antlers, and growing concern that antlers were being intentionally modified.

We recommend that Units 1B and 3, and the extreme southern portion of Unit 1C continue to be managed by a common registration permit hunt, and that 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 may be justified in the future. The implementation of any-bull drawing permit hunts while allowing a limited harvest of surplus bulls, is providing data useful for evaluating the age structure and antler characteristics of the currently protected segment of the bull population. Such information should prove useful for evaluating the effectiveness of the current antler restrictions, and may provide the information necessary to make informed changes to the existing antler restrictions.

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TABLE 1 Unit 1B Stikine area aerial moose surveys, regulatory years 1995 through 2006

Yr month/day	Adults	Calves	(%)	Unidentified	Total moose	Moose/hour
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 [a]	9	2	(18)	0	11	8
6/11	11	7	(39)	0	18	9
2001						
2/7 [a]	3	2	(40)	3	8	8
2002						
3/14 [a, f]	71	5	(7)	0	76	31
6/16 [a]	21	8	(28)	0	29	19
2003						
3/31 [a, f]	33	6	(15)	0	39	13
2004						
2/15 [a, f]	103	32	(24)	0	135	47
2005						
12/06[a]	138	61	(31)	0	199	60
2006						
3/29[a, f]	124	22	(15)	0	146	54

[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
[f] Some older calves may have been classified as adults

TABLE 2 Unit 1B (Stikine) moose harvest by permit hunts, regulatory years 1995 through 2006

Year	Hunter harvest reported						
	M	(%)	F	(%)	Illegal	Unk	Total
1995[a]	10	(100)	0	(0)	1	0	11
1996	18	(100)	0	(0)	0	0	18
1997	17	(100)	0	(0)	0	0	17
1998[b]	22	(100)	0	(0)	2	0	24
1999	20	(100)	0	(0)	0	0	20
2000	12	(100)	0	(0)	2	0	14
2001	18	(100)	0	(0)	0	0	18
2002	11	(100)	0	(0)	0	0	11
2003	17	(100)	0	(0)	1	0	18
2004	24	(100)	0	(0)	3	0	27
2005[c]	19	(100)	0	(0)	2	0	21
2006[c, d]	32	(100)	0	(0)	3	0	35

[a] Includes 6 moose taken under federal permits

[b] Includes 1 DLP..

[c] Includes RM038 and DM033 harvest.

[d] State season closed by emergency order on October 6.

TABLE 3 Unit 1B (Thomas and Farragut bays) moose harvest by permit hunts, regulatory years 1995–2006

Year	Hunter harvest reported						
	M	(%)	F	(%)	Illegal	Unk.	Total
1995[a]	11	(100)	0	(0)	4	0	15
1996[b, c]	23	(96)	1	(4)	1	0	24
1997	18	(100)	0	(0)	0	0	18
1998	23	(100)	0	(0)	1	0	24
1999	19	(100)	0	(0)	1	0	20
2000	6	(100)	0	(0)	0	0	6
2001	14	(100)	0	(0)	1	0	15
2002	14	(100)	0	(0)	1	0	15
2003	9	(100)	0	(0)	2	0	11
2004	11	(100)	0	(0)	4	0	15
2005[d]	12	(100)	0	(0)	1	0	13
2006[d]	13	(100)	0	(0)	0	0	13

[a] Includes one moose harvested in Port Houghton.

[b] Includes DLP.

[c] Addition of all harvest does not equal total because female was also illegal.

[d] Includes RM038 and DM038 harvest

TABLE 4 Unit 1B moose harvest data by drawing hunt number, regulatory years 2005 through 2006

Hunt Nr	Regulatory Year	Permits issued	% did not hunt	Percent successful hunters	Percent unsuccessful hunters	Bulls	(%)	Cows	(%)	Unk	Illegal/ unreported	Total harvest
DM033 Unit 1B south	2005	5	0	100	0	5	(100)	0	(0)	0	0	5
	2006	7	0	86	14	6	(100)	0	(0)	0	0	6
DM035 Unit 1B north	2005	7	14	100	0	6	(100)	0	(0)	0	0	6
	2006	7	0	100	0	7	(0)	0	(0)	0	0	7
Total all hunts	2005	12	8	100	0	11	(100)	0	(0)	0	0	11
	2006	14	0	93	7	14	(100)	0	(0)	0	0	14

TABLE 5 Unit 1B (Stikine) moose hunter residency and success by permit hunt, regulatory years 1995 through 2006

	Successful						Unsuccessful						
Year	Local[a] resident	Nonlocal resident	Non-resident	Unk.	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Unk.	Total	(%)	Total hunters
1995[b]	10	0	0	0	10	(5)	185	9	0	0	194	(95)	204
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
2001	18	0	0	0	18	(11)	133	14	3	0	150	(89)	168
2002	11	0	0	0	11	(8)	126	7	1	0	134	(92)	145
2003	15	3	0	0	18	(12)	128	6	0	0	134	(88)	152
2004	25	1	1	0	27	(16)	124	15	0	0	139	(84)	166
2005	21	0	0	0	21	(13)	129	11	2	0	142	(87)	163
2006	35	0	0	0	35	(20)	133	2	1	0	136	(80)	171

[a] Residents of Petersburg and Wrangell.

[b] Includes federal permits.

TABLE 6 Unit 1B (Thomas and Farragut bays) moose hunter residency and success by permit hunt, regulatory years 1995 through 2006

Year	Successful					Unsuccessful					
	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
1995	14	1	0	15	(11)	108	8	0	116	(89)	131
1996	22	2	0	24	(20)	86	10	1	97	(80)	121
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[b]	19	1	0	20	(19)	79	8	0	87	(81)	107
2000	6	0	0	6	(6)	91	5	2	98	(94)	104
2001[c]	15	0	0	15	(13)	92	5	1	98	(87)	113
2002	15	0	0	15	(13)	90	8	0	98	(87)	113
2003	11	0	0	11	(9)	106	3	1	110	(91)	121
2004	15	0	0	15	(14)	81	11	1	93	(86)	108
2005	13	0	0	13	(12)	89	7	0	96	(88)	108
2006	12	1	0	13	(15)	65	5	0	70	(85)	84

[a] Residents of Petersburg and Wrangell.

[b] Includes 2 illegal kills.

[c] Includes illegal kill.

TABLE 7 Unit 1B moose harvest chronology, regulatory years 1995–2004

Area	Year	15–21 Sept.	22–28 Sept.	29 Sept.–5 Oct.	6–15 Oct.
Thomas Bay					
	1997	5	4	6	3
	1998	9	6	5	4
	1999	5	4	7	4
	2000	3	2	1	0
	2001	3	2	2	8
	2002	7	1	4	3
	2003	4	1	3	3
	2004	7	1	7	0
	2005	3	3	7	0
	2006	2	4	6	1
Stikine					
	1997	7	3	3	4
	1998	12	5	3	4
	1999	6	3	4	7
	2000	3	1	5	5
	2001[b]	6	2	2	7
	2002	6	1	2	2
	2003	2	3	7	6
	2004	10	5	2	10
	2005	10	2	3	6
	2006[a]	21	3	9	2

[a] State season closed emergency order on October 6.
[b] Excludes one unknown.

TABLE 8 Unit 1B successful moose hunter transport methods by area, regulatory years 1997–2006

Area	Year	Airplane	Boat	Highway vehicle	3- or 4-wheeler	Horse	Other	Total
Thomas Bay								
	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
	2001	0	15	0	0	0	0	15
	2002	0	14	0	0	0	1	15
	2003	0	11	0	0	0	0	11
	2004	1	13	0	0	0	1	15
	2005	0	13	0	0	0	0	13
	2006	0	13	0	0	0	0	13
Stikine								
	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
	2001	1	17	0	0	0	0	18
	2002	0	11	0	0	0	0	11
	2003	0	18	0	0	0	0	18
	2004	0	27	0	0	0	0	27
	2005	0	21	0	0	0	0	21
	2006	1	34	0	0	0	0	35

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 P.O. BOX 115526
JUNEAU, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 1C (7600 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 3 of the 4 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 ecological makeup), then presumably they first occurred in the lower part of the river near the turn of the century. Based on communications with Canadian biologists who occasionally conduct aerial surveys in the upper Taku, it appears likely that moose from Alaska migrate into Canada during winter. This explains the low winter aerial survey numbers we see on the Alaska side of the border.

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 did not occur naturally, however, it is one of the most popular herds to hunt in the Juneau area. Fifteen calves from the Anchorage area were released in Berners Bay in 1958, and a supplemental release of 6 more calves occurred 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 the Alaska Department of Fish and Game (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 to manage this moose herd, 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 to within the carrying capacity of the habitat. The use of a habitat capability model as well as moose browse surveys in the early 1980s helped shape the present management strategy of keeping the posthunt 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 1970s. During the past few years, the southern end of the Chilkat Range near Homeshore and Pt. Couverdon has seen a spike in harvest, likely a reflection of an increase in moose numbers along with the adoption of all-terrain vehicle (ATV) hunting practices on the logging road system in that area. Because of thick timber stands throughout this area, it is difficult to gather reliable aerial survey data, so 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 1958. It is likely moose migrated to this area via the Excursion River drainage. Thirty years passed before the first moose was harvested at Gustavus in 1988, indicating that the populating of this area by moose was a gradual process. During the 1990s this population experienced a pattern of eruptive growth, and soon became the largest moose population in the subunit (1C), accounting for a higher annual harvest than the rest of the moose populations in the subunit combined. As the moose population at Gustavus grew, concerns by ADF&G biologists about habitat over-utilization began to mount. Habitat studies were initiated by ADF&G in 1999. In 2000, ADF&G submitted a proposal to the Board of Game (BOG) to initiate an antlerless moose hunt at Gustavus to curb the population growth. Further studies included additional habitat evaluation, and radiocollaring and monitoring of female moose. Data from these studies and the examination of harvested female moose are directing the management efforts at Gustavus.

MANAGEMENT DIRECTION

For management purposes, we have separated the moose in Unit 1C into four distinct populations, with separate management objectives for each. In addition, a management goal was added and the management objectives were changed to reflect the difficult nature of acquiring reliable population composition and size data.

MANAGEMENT GOALS

- For all Unit 1C moose populations: use management strategies that allow for long-term sustainability of the populations.

MANAGEMENT OBJECTIVES

- Taku drainage: Annually compare hunter effort and success as well as age data from harvested moose to gain insight into the status of this moose population. Maintain an annual harvest of at least 10 bull moose. Gather aerial survey data on both the Alaska and the Canada portion of the Taku River, through ADF&G surveys and through correspondence with Canadian biologists.
- Berners Bay: Maintain a posthunting survey count of 80-90 moose, and a bull:cow ratio of at least 25:100.
- Chilkat Range: Annually compare hunter effort and success as well as age data from harvested moose to gain insight into the status of this moose population.
- Gustavus Forelands: Continue to gather research and management data associated with pregnancy, twinning, rump fat, and body condition to guide our management strategy at Gustavus. Maintain a bull: cow ratio of at least 25:100.

METHODS

Aerial surveys were conducted during both years of the report period at Berners Bay and the Gustavus Forelands, but surveys were not conducted along the Chilkat Mountains or in the Taku River drainage. Two registration permit hunts (RM046 and RM049) and 5 drawing permit hunts (DM041, DM042, DM043, DM044, and DM045) were used to manage moose hunting effort in Unit 1C. In regulatory year (RY) 2005, we divided the DM043 hunt area into 3 zones, and created 2 additional draw permit areas listed as DM044 and DM045 (a regulatory year runs from 1 July through 30 June; e.g., RY 2005 = 1 July 2005 through 30 June 2006). Division of the hunts was done to disperse the moose hunting pressure away from the few easily accessible areas hunters were targeting. Berners Bay moose were managed under a bull-only drawing hunt (DM041) during 2005, and a bull and cow drawing hunt (DM041 and DM042) in 2006. The remainder of Unit 1C (excluding that area south of Pt. Hobart and Gustavus) was managed under the RM046 registration permit hunt for bull moose. Gustavus was managed under the newly adopted RM049 registration permit hunt and 3 draw permits for antlerless moose (DM043, DM044, DM045). Since 1995, the area south of Pt. Hobart has been included in the antler-restriction hunt conducted in Units 1B and 3 (RM038), and information about all moose taken there has been included in the management reports covering those areas. A condition of all drawing and registration hunts required successful hunters to bring in incisors from harvested moose for aging. Additional data were collected from the cow moose carcasses from the DM043, DM044, and DM045 hunts. These data included: rump fat measurements, kidneys and associated fat, a liver sample, and the reproductive tract. 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.

Research studies: Beginning in 2002, a research project was initiated at Gustavus to help guide the management of this herd. Data were collected related to moose browse availability and utilization, sightability during aerial surveys, and population parameters such as survival,

pregnancy, and twinning. In 2006 a second moose research project was initiated in Berners Bay with many of the same objectives and goals as the Gustavus project.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Taku River: We have very little information regarding the number of moose in the Taku River drainage. We did not conduct any aerial surveys of this drainage during this report period, and the last survey conducted in the Taku River was in winter 2000, when 37 moose were counted (Table 1). Although this number seems extremely low, it is comparable to historical surveys of the Alaska portion of the Taku River. Correspondence with Canadian biologists suggests that most Taku River moose migrate up the Taku River drainage during early winter, and overwinter in Canada. Harvest records of hunter effort and take and anecdotal information from hunters indicate that the number of moose in the Taku River drainage appears to be stable.

Berners Bay: Aerial surveys conducted in Berners Bay in 2005 and 2006 enumerated 100 and 75 moose, respectively. The lower number of moose seen during 2006 is probably more of a factor of moose sightability on that day than it is of a decline in moose numbers. These survey numbers are close to our management objective of 80–90 moose counted posthunt. The Berners Bay moose population appears to be near the estimated carrying capacity of between 120 and 150 animals. This number is being maintained with selective harvests, which also help to provide for a healthy bull to cow ratio (Table 1).

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. However, we have seen a large increase in moose harvested at the southern end of the Chilkat Range, suggesting moose are doing well in that area. Based on harvest records and anecdotal information from hunters, the number of moose in the Chilkat Range appears to be stable in the Endicott River and St. James Bay areas, and increasing near Homeshore and Pt. Couverdon.

Gustavus Forelands: Aerial surveys conducted at Gustavus during 2005 and 2006 enumerated 295 and 329 moose respectively. These are both well below our highest count of 404 moose during 2003, and an indication that our harvest strategy of decreasing the number of moose at Gustavus appears to be working (Table 1). We used radiocollared moose to estimate a sightability of 70% during the surveys (we are able to see about 70% of the animals present), so our estimated population is still above 400 animals.

Population Composition

We were able to conduct a composition survey of the Berners Bay moose population during both years of this report period (Table 1), and at Gustavus during 2006. This was fortunate, as typically in Southeast Alaska good survey conditions generally do not exist until January, at which time antler drop has commenced and differentiating male and female moose is not possible. For additional insight into the makeup of our moose populations, we collected lower jaws from each harvested moose from successful hunters, providing us with the age structure of the harvest (Tables 2 & 3).

Taku River: We did not conduct any aerial surveys of the Taku River during this report period and therefore were unable to collect composition data. However, we can get some insight into the population structure of the harvested bull moose using age at harvest. The mean age of harvested moose was 3.4 years during 2005, and 1.9 years during 2006. During the report period 50% of the 30 bulls taken were yearling animals. This harvest of young bulls indicates a population with good recruitment, yet leaves some concern for a lack of older bulls. Only 4 of the 30 bulls were over 2.5 years of age.

Berners Bay: The two aerial surveys we conducted allowed us to gather reliable composition data for this population. We observed bull to cow ratios of 21 and 18 bulls:100 cows, and 18 and 16 calves:100 cows during 2005 and 2006 respectively. The bull:100 cow ratios are lower than our objective of 25, but still considered healthy. The calf:100 cow ratios are similar to what we have observed in the past.

Mean age at harvest of bull moose in Berners Bay was 3.3 years, slightly higher than the 2.6 years observed during the previous report period. Two (25%) of the 8 bull moose aged during 2005–2006 were yearlings, a number similar to those in the previous 10 years.

Chilkat Range: No aerial surveys were conducted in this area during the report period.

The mean age of harvested moose during this report period was 3.9 years, similar to the previous report period, and higher than that for any other Unit 1C moose population. The Chilkat Range has little access for hunters throughout most of the area, and few large open areas where hunters can find moose. This probably is responsible for the older mean age of harvested bulls, as bull moose can advance to older age classes in this area because hunters can not easily locate them.

Gustavus Forelands: We conducted aerial surveys in each of the 2 years of the report period, but were able to gather bull composition data in 2006 only. The bull:100 cow ratio was 23:100, very nearly the objective of 25:100. The calf:100 cow ratio was 14:100, with the percent calves only 10–11%. This calf percent is significantly lower than in previous years. Based on the research being conducted at Gustavus, we suspect the lower calf percentages are at least partly due to increased predation on calves by bears and wolves.

The mean age at harvest was 2.7 and 3.3 years, both higher than any of the previous 8 years. This higher age structure was reflected by fewer yearlings in the harvest. During the report period, approximately 20% of the harvest was yearling bulls, compared to 40–55% during the previous 8 years. This decline in yearling bulls is a carryover of the poor calf survival we are seeing compared to past years. Although the antlerless hunt is partly responsible for fewer calves and thus fewer yearling bulls, the disappearance of calves shortly after birth on through the summer is a major factor as well.

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 1(C), Berners Bay Drainages:	15 Sep–15 Oct (General hunt only)
1 moose by drawing permit only; up to 30 permits may be issued	
Unit 1(C), that portion south of Point Hobart, including all Port Houghton drainages:	15 Sep–15 Oct (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	
Unit 1(C), that portion west of Excursion Inlet and north of Icy Passage:	
1 moose per regulatory year, only as follows:	
1 bull by registration permit only or	15 Sep–15 Oct (General hunt only)
1 antlerless moose by drawing permit only; up to 100 permits may be issued	15 Nov–30 Nov (General hunt only)
Remainder of Unit 1(C) 1 bull by registration permit only	15 Sep–15 Oct (General hunt only)

Game Board Actions and Emergency Orders. There were no Board of Game actions affecting moose hunting in Unit 1C during this report period. However, emergency orders were issued to close the bull moose hunting seasons at Gustavus during both years of the report period. In 2005, the season was closed after 7 days, and in 2006 the season was closed after 8 days.

Hunter Harvest.

Taku River: The annual harvest of moose during this report period averaged 15 moose, with 14 being taken in 2005 and 16 in 2006. This is similar to the mean annual harvest of 15 moose during 1997–2004 (Table 3).

Berners Bay: During this report period permits were limited to 8 bull permits only during 2005, while 6 bull permits and 2 cow permits were issued in 2006. The resulting harvests and hunter success rates were 5 bulls harvested by 8 hunters (62% success) during 2005, and 5 bulls bulls harvested by 6 hunters (83% success) during 2006. Additionally, in 2006, 2 hunters had antlerless permits, and each harvested a cow moose for 100% success (Table 5).

Chilkat Range: The mean annual harvest during this report period was 23 moose, the highest ever recorded. Seventeen moose were taken in 2005, and 28 in 2004. This compares with an annual average take of 17 during 1997–2004 (Table 5).

Gustavus: During this report period, the bull moose hunt at Gustavus was being managed under a guideline harvest of 45 bulls in 2005, and 40 bulls in 2006. The antlerless moose drawing permit allowance was 90 in 2005 and 23 in 2006. In 2005, 47 bulls were taken in just 7 days and the hunt was closed by emergency order. In 2006, we closed the hunt at noon each day, and 37 bulls were taken in 8 days before an emergency order was issued to close the season.

In 2005 we issued 90 antlerless permits, and 69 cow moose were harvested.. This high number of antlerless permits was considered necessary to lower the number of moose on the winter range near Gustavus, where the moose density was 10–15 moose/mile^2. In 2006 we issued only 23 antlerless permits but only 12 of the permittees were successful due to extremely difficult hunting conditions caused by deep snow (Table 3).

<u>Permit Hunts</u>. In Unit 1C, moose hunts are managed under two types of permits; drawing and registration. The drawing permits in Berners Bay are used to manage both bull moose (DM041) and antlerless moose (DM042). At Gustavus we used three drawing permits (DM043, DM044 and DM045) to manage the antlerless hunt, and a single registration permit (RM049) to manage the bull moose hunt.

The Berners Bay bull moose drawing hunt (DM041) attracted 609 and 524 applications during 2005 and 2006, respectively, while 355 people applied for the two DM042 permits that were available in 2006. Although there were only 8 permits issued during each of these two years, the close proximity of Berners Bay to Juneau and the historically high hunter success rate explain the popularity of this hunt. The relatively new drawing permit hunts for antlerless moose at Gustavus (DM043, 044, 045) attracted 2286 applications (90 permits) and 1601 applications (23 permits) during 2005 and 2006, respectively. With the limited options in Southeast Alaska for hunting moose, these draw hunts will always be popular.

Under the Unit 1C bull moose registration permit (RM046) a total of 313 permits were issued in 2005, followed by 337 in 2006. For RM049 at Gustavus, 212 permits were issued for 2005, and 197 for 2006. Although we can not determine the destination within Unit 1C of the permittees at the time they acquire their permit (for RM046), the resulting reporting data (Table 4) indicates (41%) hunted the Taku River, while (59%) hunted the Chilkat Mountains.

Gustavus attracted the most hunters, with 150 (43% of 1C moose hunters) in 2005, and 159 (44% of Unit 1C moose hunters) in 2006. As in most hunts, not all the permittees actually participated in a hunt. Combining both years of the report period, approximately 76% of the permittees hunted.

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 204 of 252 harvested moose, other Alaska residents took 44, and nonresidents took 4. 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. However, the recent adoption of the antlerless drawing moose hunts at Gustavus has led to hunters from areas throughout Southeast Alaska participating in this particular hunt. The reason being, of course, that with a drawing permit in hand, a moose is practically guaranteed. Nonresidents eager to take moose focus on areas with larger moose populations and a better chance of getting a trophy animal. Twenty-three percent of hunters pursuing bull moose in Unit 1C were successful during the report period. Hunters at Gustavus continued to experience higher success rates during this report period, averaging 27% for bull moose, and 83% for the antlerless draw hunt. Taku River hunters on the other hand averaged only 18%, and Chilkat Range hunters 19%.

Harvest Chronology. Similar to recent years, the 2005 and 2006 bull-moose harvest was heavily weighted toward the early part of the season (mid to late September). This is partly because nearly all hunters participate on opening day, and hunt less as the season goes on. Also, the guideline harvest for the Gustavus hunt was reached after only two and seven days of hunting during 2005 and 2006 respectively. The pace of the hunts in the Chilkat Range and the Taku River are much slower than Gustavus, but even those areas experience the majority of their respective harvests within the first two weeks of the season.

The chronology of the antlerless harvest differs substantially from the bull harvest in that the antlerless season at Gustavus doesn't begin until the second week of November. Even then, a majority of the animals are killed during the first 2 or 3 days of the hunt.

Transport Methods. The type of transport used by successful hunters varies, reflecting difficulties in the logistics of access.

Taku: In the Taku hunt 93% and 94% of successful hunters during 2005 and 2006 respectively used boats for access (Table 7). Most hunters used boats equipped with jet units to access the upper reaches of the river, then based out of private cabins near the Canadian border.

Berners Bay: In Berners Bay all successful hunters used boats for access (Table 7), and airboats are almost exclusively the boat of choice. Few if any hunters have their own airboats; rather, they make arrangements with one of several local airboaters who then takes them into Berners for their hunt.

Chilkat Range: Hunters in the Chilkat Range used both airplanes and boats for access. During the report period, airplanes and boats were used by 33% and 44% of the hunters, respectively (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. Off-road-vehicle (ORV) use in the Couverdon area is gaining in popularity due to the increase in moose numbers and the recent discovery that ORV hunting is effective on the logging roads throughout that area. This method of access was used by 13% of successful hunters.

Gustavus Forelands: Successful Gustavus Forelands hunters use a variety of access methods. During the report period an average of 62% used highway vehicles, 15% walked, 16% used boats, 2% used all-terrain vehicles, and 5% used airplanes for access. It is almost certain that the people who listed airplane as their mode of access actually flew into Gustavus on a commercial airline, then drove to a residence where they hunted with a vehicle or on foot. Hunters who listed walking as their mode of access are residents of Gustavus who walk out their back doors to hunt. ATV access for hunting moose at Gustavus is restricted to "constructed road surfaces" only, thus the limited use of that access type.

Other Mortality. The winter of 2006 was the most severe (based on snowfall) ever recorded in Juneau, and likely was similar in other areas. Both Berners Bay and Gustavus experienced deep snows that resulted in mortality rates of approximately 20% of radiocollared cow moose in each of these populations. Although we did not have bull moose or calves radiocollared, it is likely the mortality on both of these segments of these populations was even greater than that experienced by cows. Predation by bears and wolves has always been a factor in the 1C moose populations, but has become most noticeable at Gustavus. During the report period, research data indicate that predation on calves has increased considerably since just a few years ago. This source of mortality that affects recruitment and, ultimately, a harvestable surplus for hunters is likely going to play a key role in moose management at Gustavus in future years.

Habitat. We initiated a moose browse monitoring project at Gustavus in 1999 that is ongoing. The aim of this project is to monitor willow utilization by moose on the Gustavus Forelands. Data to date indicate that the moose are utilizing a very high proportion of available willow browse; that is likely leading to the poor nutritional condition of many of the moose in this population. Data generated by this study are being used to guide management of the Gustavus moose population. We also began browse availability and utilization studies in Berners Bay during the report period, and will use these data to help guide our management policies in that area.

CONCLUSIONS AND RECOMMENDATIONS

Taku: Without being able to conduct functional aerial surveys in the Taku River area, it is hard for us to get a sense of the status of this moose population. However, in the absence of survey data, the age of harvested animals, the annual harvest, and the catch per unit effort by hunters all suggest that this population of moose is at least stable. The continued harvest of nearly 50% yearling bulls indicates that this population is relatively healthy, but the lack of many older age class animals suggests that we may be harvesting nearly all available bulls on a yearly basis. In discussions with Canadian biologists, they indicate that very few moose are taken on the Taku River in Canada; their most recent composition survey (2000), in association with the Tulsequah mine project, estimated 256 moose in the Taku River drainage, with 98 bulls:100 cows, and 23 calves:100cows (Rick Marshall pers. Comm.). This gives us some comfort that our harvest is not having a detrimental affect on this herd. Attempts need to be made in future years to acquire survey data in the upper Taku River by working with Canadian biologists.

Berners Bay: The moose population in Berners Bay appeared to be responding to the bull-only hunts of the past three years, based on increasing aerial survey counts through 2005. In 2006 we

had a lower count, but assumed it was related more to sightability than a real decline in moose numbers. The winter of 2006–07 proved to be the most extreme ever experienced in Juneau (based on snow depth), and Berners Bay experienced an even more severe winter. Snow accumulation began in early November, and depths in excess of 6–7 feet persisted into late spring. Moose were limited in their ability to access forage, and likely the energetic expenditure of moving through the snow was extreme. While conducting moose research activities in Berners Bay, we documented a mortality rate of 20% of the collared cow moose. It is likely the mortality of bulls and calves exceeded this level. The long-term ramifications of this extreme winter may be felt for years to come, and likely will result in a limited harvest or absence of any harvest until this population recovers.

Chilkat Range: As with the Taku River moose population, the Chilkat Range moose numbers and composition are not attainable for us through aerial surveys. Therefore we again have to look at the hunter harvest and effort data as a gauge of how this population is doing. The harvest during this report period was the highest ever recorded, largely due to the abundance of moose at Couverdon. The population in this area has recently increased and is fast becoming the second most utilized area, after Gustavus. Hunters have figured out that ATV's can be used on the logging roads to access moose hunting areas, so this area will likely continue to receive intense hunting pressure. Other portions of the Chilkat Range, such as St. James Bay and the upper Endicott River, have been surpassed in hunting effort as well as harvest by Couverdon, but still provide some moose every year. Because of the thick forested areas in the Chilkat Mountains and the inaccessible nature of most of this area, we believe the moose population should remain healthy under the present management strategy. In the absence of population survey data, these data give us a pretty good indication that this moose population is at least stable.

Gustavus Forelands: The recent initiation of a moose research study at Gustavus has provided us with valuable information on moose body condition as well as pregnancy and twinning rates. This along with the carcass evaluation from the antlerless hunts is being used to guide our management at Gustavus. Our concern that the numbers of moose on the Gustavus Forelands is beyond the long-term carrying capacity of the habitat continues, but the past three years of aerial surveys indicates our strategy of harvesting bull and antlerless moose appears to be lowering the moose numbers. Increased predation and lowering recruitment are reasons for concern about the future trajectory of this population. Although we still consider the moose numbers to be in excess of what the habitat can support in the long term, we are reaching a point where harvesting fewer cow moose is prudent given that predation is beginning to replace the need for aggressive moose harvest.

Acquiring additional browse utilization information as well as herd composition data is a priority.

We believe that a continuation of the permit registration system should accommodate current population objectives throughout Unit 1C, and we will continue to collect teeth from harvested moose for age analysis. Areas supporting the most critical winter browse should be analyzed, even if cursorily, to estimate the status of moose populations in relation to carrying capacity. It is hoped that research efforts being conducted at Gustavus and Berners Bay will serve as a template for investigations in other areas and with other populations.

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TABLE 1 Unit 1C aerial moose survey data, regulatory years 1995 through 2006

Year	Bulls	Cows	Calves	Unknown	Total Moose	Count time (hrs)	Bulls per 100 Cows	Calves per 100 Cows	Calves % in herd	Moose per hour
					Berners Bay 1995–2006					
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
2001	---	10	10	46	66	2.0	---	---	15	33
2002	---	4	4	50	58	2.2	---	---	7	26
2003	18	11	13	39	81	2.6	---	---	16	31
2004	7	12	12	55	86	3.3	---	---	14	26
2005	15	72	13	0	100	2.5	21	18	13	40
2006	10	56	9	0	75	3.5	18	16	12	21
					Chilkat Range 1995–2006					
1995					No survey					
1996	---	---	---	20	20	---	---	---	---	
1997					No survey					
1998	6	15	16	35	72	1.1	---	---	22	65
1999					No survey					
2000	---	6	6	113	125	1.7	---	---	---	74
2001-2006					No survey					
					Taku River 1995–2006					
1995–1997					No survey					
1998	---	1	1	3	5	---	---	---	---	---
1999					No survey					
2000	---	5	7	25	37	2.1	---	---	19	18
2001-2006					No survey					
					Gustavus Forelands 1998–2006					
1998	---	48	54	83	185	1.9	---	---	29	97
1999					No survey					
2000	---	45	45	117	207	3.7	---	---	22	57
2001	1	52	62	161	276	2.0	---	---	22	138

TABLE 1 continued

Year	Bulls	Cows	Calves	Unknown	Total Moose	Count time (hrs)	Bulls per 100 Cows	Calves per 100 Cows	Calves % in herd	Moose per hour
					Gustavus Forelands 1998–2006 (continued)					
2002	---	75	82	155	312	2.5	---	---	26	125
2003	37	214	130	23	404	3.3	---	---	32	122
2004	23	41	45	121	230	3.8	---	---	20	60
2005	12	29	32	222	295	4.9			11	60
2006	56	239	34	0	329		23	14	10	

TABLE 2 Unit 1C moose age at harvest, Berners Bay, regulatory years 1997 through 2006

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
									Males										
1997	0	2	1	5	0	0	0	0	0	0	0	0	0	0	0	0	8	100	2.9
1998	0	2	3	0	0	0	0	0	2	0	0	0	0	0	0	0	8	88	3.9
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
2001	0	2	2	1	0	2	1	0	0	0	0	0	0	0	0	0	8	100	3.6
2002	0	2	1	0	1	0	1	0	0	0	0	0	0	0	0	0	5	100	3.3
2003	0	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	8	100	2.1
2004	0	0	3	2	1	0	0	0	0	0	0	0	0	0	0	0	6	100	3.2
2005	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	5	80	2.5
2006	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	5	80	4.0
									Females										
1997	0	1	0	3	2	0	0	0	0	0	1	0	0	0	0	0	7	100	4.5
1998	0	2	3	1	0	0	0	0	0	0	0	0	0	1	0	0	7	100	3.9
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	5.2
2001	0	1	2	0	0	0	1	0	0	0	1	0	0	1	0	0	6	100	6.2
2002	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4	100	2.3
2003								No cow hunt											
2004								No cow hunt											
2005								No cow hunt											
2006	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100	2.5

TABLE 3 Unit 1C moose age at harvest, excluding Berners Bay, regulatory years 1997 through 2006[1]

Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	Age Class 7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% Aged	Mean Age
Chilkat Range																			
1997	0	5	0	3	1	1	0	1	0	1	0	0	0	0	0	0	13	92	3.8
1998	0	10	2	7	1	0	2	2	1	0	0	0	0	0	0	0	28	89	3.4
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	3.9
2001	0	2	2	1	1	2	0	2	0	0	0	0	0	0	0	0	12	83	4.2
2002	0	4	2	0	3	2	0	0	0	1	0	0	0	0	0	0	15	80	3.8
2003	0	6	7	2	0	1	2	0	0	1	0	0	0	2	0	0	22	95	4.2
2004	0	5	3	3	1	0	3	0	1	0	0	0	0	0	0	0	18	89	3.6
2005	0	2	5	2	2	0	0	2	0	2	0	1	0	0	0	0	17	94	4.8
2006	0	8	7	8	3	0	0	0	0	0	0	0	1	1	0	0	28	100	3.5
Gustavus Forelands																			
1997	1	11	9	2	2	0	2	0	0	0	0	0	0	0	0	0	31	87	2.5
1998	2	24	10	5	3	0	0	0	0	0	0	0	0	0	0	0	48	92	2.1
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	2.5
2001	2	18	9	6	4	0	0	1	1	0	0	0	0	0	0	0	46[2]	89	2.6
2002	1	22	13	6	2	0	0	0	1	0	0	0	0	0	0	0	49	92	2.3
2003	3	27	14	4	2	0	0	0	0	0	0	0	0	0	0	0	51	98	2.0
2004	0	23	10	7	0	1	1	0	0	0	0	0	0	0	0	0	43	98	2.3
2005	0	10	23	8	2	3	0	0	0	0	0	0	0	0	0	0	47	98	2.7
2006	0	7	12	6	6	2	1	0	0	0	1	0	0	0	0	0	37	95	3.3

[1] Does not include 3 cow moose taken illegally in Gustavus in 2000.
[2] Includes 1 cow moose shot inadvertently.

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																			
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
2001	0	6	5	5	1	0	0	0	0	0	0	0	0	0	0	1	19	95	3.3
2002	0	10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	15	80	1.8
2003	0	3	3	1	2	1	0	0	0	0	0	0	0	0	0	0	11	91	3.0
2004	0	7	3	3	0	0	1	0	0	0	0	0	0	0	0	0	15	93	2.5
2005	0	5	4	0	0	1	0	0	1	1	0	0	0	0	0	0	14	86	3.4
2006	0	10	5	1	0	0	0	0	0	0	0	0	0	0	0	0	16	100	1.9

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
Gustavus Forelands (Antlerless Harvest)																			
2002	0	1	1	2	1	3	1	0	0	0	0	0	0	0	0	1	10	100	5.4
2003	2	2	6	9	1	2	1	0	1	0	0	0	0	0	1	1	32	88	4.3
2004	2	14	2	8	5	4	4	1	6	1	2	2	0	0	1	0	53	98	4.8
2005	3	3	11	4	3	9	5	5	10	3	6	0	1	1	1	0	69	94	6.1
2006	0	1	3	2	1	0	2	0	0	0	0	1	0	0	0	0	12	83	4.5

TABLE 4 Unit 1C moose hunter effort and success, regulatory years 1997 through 2006

		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-DM041 and DM042					
1997	15	15	42	2.8	0	0	0	15	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
2001	20	14	30	2.1	3	15	5.0	17	45	2.6
2002	15	9	26	2.9	5	28	5.6	14	54	3.9
2003	9	8	24	3.0	0	0	0	8	24	3.0
2004	8	6	9	1.5	2	9	4.5	8	18	2.3
2005	8	5	21	4.2	3	27	9.0	8	48	6.0
2006	8	7	16	2.3	1	15	15.0	8	31	3.9
					Chilkat Range					
1997	489[a]	13	42	3.2	92	370	4.0	105	412	3.9
1998	441[a]	28	85	3.0	58	190	3.3	86	275	3.2
1999	476[a]	11	47	4.3	81	374	4.6	92	421	4.6
2000	455[a]	14	47	3.4	82	326	4.0	96	373	3.9
2001	555[a]	12	56	4.7	61	228	3.7	73	284	3.9
2002	551[a]	15	50	3.3	96	410	4.3	111	460	4.1
2003	516[a]	22	61	2.8	75	244	3.3	97	305	3.1
2004	474[a]	18	49	2.7	80	282	3.5	98	331	3.4
2005	313[a]	17	53	3.1	98	364	3.7	115	417	3.6
2006	337[a]	28	89	3.2	93	355	3.8	121	444	3.7
					Gustavus Forelands					
1997	---	31	125	4.0	73	279	3.8	104	404	3.9
1998	---	48	139	2.9	71	255	3.6	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
2001	---	46	194	4.2	160	748	4.7	206	942	4.6
2002	---	49	176	3.6	130	667	5.1	179	843	4.7
2003	---	52	107	2.1	127	437	3.4	179	544	3.0
2004	---	45	68	1.5	119	292	2.5	164	360	2.2
2005	212	47	47	1.0	103	104	1.0	150	151	1.0
2006	197	37	61	1.6	122	472	3.9	159	533	3.4

Table 4 continues next page

TABLE 4 continued

Year	Permits issued	Successful hunters NR hunters	Successful hunters Total days	Successful hunters Avg. days	Unsuccessful hunters NR hunters	Unsuccessful hunters Total days	Unsuccessful hunters Avg. days	Total hunters NR hunters	Total hunters Total days	Total hunters Avg. days
					Taku River					
1997	---	6	25	4.2	85	365	4.3	91	390	4.3
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
2001	---	19	61	3.2	68	230	3.4	87	291	3.3
2002	---	15	47	3.1	69	268	3.9	84	315	3.8
2003	---	11	28	2.5	73	283	3.9	84	311	3.7
2004	---	15	33	2.2	58	221	3.8	73	254	3.5
2005	---	14	62	4.4	71	294	4.1	85	356	4.2
2006	---	16	50	3.1	66	281	4.3	82	331	4.0
					Gustavus Forelands (Antlerless Harvest)—DM043, DM044, DM045					
2002	10	10	14	1.4	0	0	0	10	14	1.4
2003	35	32	47	1.5	0	0	0	32	47	1.5
2004	60	53	95	1.8	4	18	4.5	57	113	2.0
2005	90	69	163	2.4	11	36	3.3	80	199	2.5
2006	23	12	19	1.6	6	9	1.5	18	28	1.6

[a] 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.

TABLE 5 Unit 1C moose historical harvests, number of hunters, and percent success, regulatory years 1997 through 2006

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% success[b]
			Berners Bay			
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
2001	8	6	0	14	17	82
2002	5	4	0	9	14	64
2003	8	0	0	8	8	100
2004	6	0	0	6	8	75
2005	5	0	0	5	8	63
2006	5	2	0	7	8	88
			Chilkat Range			
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
2001	12	0	0	12	73	16
2002	15	0	0	15	111	14
2003	22	0	0	22	97	23
2004	18	0	0	18	98	18
2005	17	0	0	17	115	15
2006	28	0	0	28	121	23

Table 5 continues next page

TABLE 5 continued

Year	NR males	NR females	NR unknown	Total kill	NR hunters	% Success[b]
			Gustavus Forelands			
1997	30	1[a]	0	31	104	29
1998	47	1[a]	0	48	118	40
1999	41	1[a]	0	42	146	28
2000	46	3[a]	0	49	132	37
2001	45	1[a]	0	46	206	22
2002	49	0	0	49	179	27
2003	51	1[a]	0	52	179	29
2004	43	2[a]	0	45	164	26
2005	47	0	0	47	150	31
2006	37	0	0	37	159	23
			Taku River			
1997	6	0	0	6	91	7
1998	14	0	0	14	61	23
1999	16	0	0	16	65	25
2000	23	0	0	23	69	33
2001	19	0	0	19	87	22
2002	15	0	0	15	84	18
2003	11	0	0	11	84	13
2004	15	0	0	15	73	21
2005	14	0	0	14	85	16
2006	16	0	0	16	82	20
			Gustavus Forelands (Antlerless Harvest)			
2002	0	10	0	10	10	100
2003	1	31	0	32	32	100
2004	1	52	0	53	57	93
2005	3	66	0	69	80	86
2006	0	12	0	12	18	67

[a] Illegal take
b.Includes only legally harvested bull moose

TABLE 6 Unit 1C annual moose kill by community of residence, regulatory years 1997–2006

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
					Berners Bay				
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
2001	14	0	12	1	0	0	0	1	0
2002	9	0	8	0	0	0	1	0	0
2003	8	0	7	0	0	0	0	1	0
2004	6	0	6	0	0	0	0	0	0
2005	5	0	5	0	0	0	0	0	0
2006	7	0	7	0	0	0	0	0	0
					Chilkat Range				
1997	13	0	12	0	0	0	0	1	0
1998	28	1	20	0	0	0	1	6	0
1999	11	0	8	0	0	0	0	2	1
2000	14	1	10	1	0	0	0	1	1
2001	12	0	10	0	0	0	1	1	0
2002	15	0	13	0	0	0	0	2	0
2003	22	0	15	0	0	0	0	7	0
2004	18	1	13	0	0	0	0	3	1
2005	17	1	12	1	0	0	0	3	0
2006	28	2	16	4	0	0	0	5	1
					Gustavus Forelands				
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
2001	46	21	18	2	0	0	1	2	2
2002	49	23	20	2	0	0	0	2	2
2003	52[a]	25	20	4	0	0	1	2	0
2004	45[b]	18	20	4	0	0	0	2	1
2005	47	20	21	3	0	0	0	3	0
2006	37	15	18	1	0	0	1	1	1

[a] One of these moose was an illegal kill
[b] Two of these moose were illegal kills

Table 6 continues next page

TABLE 6 continued

Year	Total kill	Gustavus	Juneau	Sitka	Wrangell	Petersburg	Haines	Other Alaska	Non-resident
					Taku River				
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	23	0	21	1	1	0	0	0	0
2001	19	0	18	0	0	0	0	0	1
2002	15	0	13	2	0	0	0	0	0
2003	11	0	10	1	0	0	0	0	0
2004	15	0	13	1	0	0	1	0	0
2005	14	0	11	2	0	0	0	1	0
2006	16	0	16	0	0	0	0	0	0
					Gustavus Forelands (Cow Harvest)				
2002	10	0	10	0	0	0	0	0	0
2003	32	5	23	1	0	1	1	1	0
2004	53	6	39	3	0	2	1	2	0
2005	69	10	41	4	0	1	3	9	1
2006	12	0	9	1	0	0	0	1	1

TABLE 7 Unit 1C successful moose hunters transport methods, regulatory years 1997–2006

	Airplane		Boat		3 or 4 wheeler		Hwy vehicle		Foot	
Year	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
					Berners Bay					
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	---
2001	0	---	14	(100)	0	---	0	---	0	---
2002	0	---	9	(100)	0	---	0	---	0	---
2003	0	---	8	(100)	0	---	0	---	0	---
2004	0	---	6	(100)	0	---	0	---	0	---
2005	0	---	5	(100)	0	---	0	---	0	---
2006	0	---	7	(100)	0	---	0	---	0	---
					Chilkat Range					
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	---
2001	5	(42)	7	(58)	0	---	0	---	0	---
2002	8	(57)	6	(43)	0	---	0	---	0	---
2003	6	(27)	10	(45)	6	(27)	0	---	0	---
2004	7	(39)	7	(39)	3	(17)	0	---	1	(5)
2005	5	(31)	7	(44)	3	(19)	0	---	1	(6)
2006	10	(35)	12	(43)	3	(11)	3	(11)	0	---
					Gustavus Forelands					
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)
2001	10	(22)	6	(13)	0	---	9	(19)	21	(46)
2002	3	(6)	6	(13)	2	(4)	30	(62)	7	(15)
2003	3	(6)	7	(13)	3	(6)	29	(57)	9	(18)
2004	1	(2)	6	(14)	4	(9)	30	(68)	3	(7)
2005	4	(9)	9	(20)	0	---	24	(51)	9	(20)
2006	1	(3)	4	(11)	2	(5)	27	(73)	3	(8)

TABLE 7 continued

Year	Airplane Total	Airplane (%)	Boat Total	Boat (%)	3 or 4 wheeler Total	3 or 4 wheeler (%)	Hwy vehicle Total	Hwy vehicle (%)	Foot Total	Foot (%)
					Taku River					
1997	0	---	6	(100)	0	---	0	---	0	---
1998	0	---	14	(100)	0	---	0	---	0	---
1999	0	---	17	(100)	0	---	0	---	0	---
2000	2	9	21	(91)	0	---	0	---	0	---
2001	1	(5)	18	(95)	0	---	0	---	0	---
2002	0	---	14	(100)	0	---	0	---	0	---
2003	0	---	11	(100)	0	---	0	---	0	---
2004	0	---	15	(100)	0	---	0	---	0	---
2005	1	(7)	13	(93)	0	---	0	---	0	---
2006	1	(6)	15	(94)	0	---	0	---	0	---
					Gustavus Forelands (Cow Harvest)					
2002	2	(20)	1	(10)	0	---	7	(70)	0	---
2003	5	(16)	3	(9)	2	(6)	22	(69)	0	---
2004	2	(4)	2	(4)	2	(4)	47	(88)	0	---
2005	1	(1)	4	(6)	2	(3)	56	(81)	6	(9)
2006	0	---	2	(17)	1	(8)	8	(67)	1	(8)

TABLE 8 Unit 1C moose hunters commercial services use, regulatory years 1997 through 2006

Year	Unit residents		Other AK residents		Non-residents		Total use		Transport	Non-guided services	Other services
	No	Yes	No	Yes	No	Yes	No	Yes			
					Berners Bay						
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
2001	13	0	2	0	0	0	15	0	0	0	0
2002	13	0	1	0	0	0	14	0	0	0	0
2003	7	0	1	0	0	0	8	0	0	0	0
2004	8	0	0	0	0	0	8	0	0	0	0
2005	8	0	0	0	0	0	8	0	0	0	0
2006	8	0	0	0	0	0	8	0	0	0	0
					Chilkat Range						
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
2001	55	5	11	1	0	0	66	6	5	1	0
2002	72	9	12	0	5	0	89	9	9	0	0
2003	74	0	19	1	3	0	96	1	1	0	0
2004	75	4	12	2	4	1	91	7	7	0	0
2005	77	2	30	1	3	0	110	3	3	0	0
2006	83	7	25	0	6	0	114	7	7	0	0
					Gustavus Forelands						
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
2001	138	8	32	2	19	3	189	13	9	3	3
2002	145	6	17	0	7	0	169	6	5	0	1
2003	152	2	21	0	2	0	175	2	2	0	0
2004	134	4	17	0	7	1	158	5	4	0	1
2005	132	2	13	1	1	0	146	3	2	1	0
2006	138	4	14	2	1	0	153	6	3	0	3

Table 8 continues next page

TABLE 8 continued

Year	Unit residents		Other AK residents		Non-residents		Total use		Transport	Non-guided services	Other services
	No	Yes	No	Yes	No	Yes	No	Yes			
					Taku River						
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	60	1	1	0	0
2000	53	1	3	0	0	0	56	1	0	1	0
2001	75	3	4	0	2	0	81	3	3	0	0
2002	74	3	5	0	0	0	79	3	3	0	0
2003	76	0	6	0	1	0	83	0	0	0	0
2004	64	1	6	0	0	0	70	1	0	1	0
2005	76	0	9	0	0	0	85	0	0	0	0
2006	77	0	5	0	0	0	82	0	0	0	0
					Gustavus Forelands (Cow Harvest)						
2002	7	3	0	0	0	0	7	3	2	0	1
2003	25	3	4	0	0	0	29	3	2	0	1
2004	44	5	6	2	0	0	50	7	4	0	3
2005	54	5	17	3	1	0	72	8	4	0	4
2006	14	0	3	0	1	0	18	0	0	0	0

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, and this has been substantiated by aerial survey efforts conducted by Canadian biologists. . 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, personal communication). 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.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 1D (2700 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 are 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 (ADFG 1990).

Moose migrated to the Chilkat River Valley from drainages in Canada around 1930. Moose numbers peaked in the Chilkat Valley in the mid 1960s, when as many as 700 animals may have been present. By the early 1970s the moose population had sharply declined, possibly because of overuse of the range and overharvest. Survey data collected during the mid 1980s suggested that the herd had declined to 400 animals. More recent surveys suggest that the moose population is around 250 to 350 animals. Some care must be taken in interpreting the survey data because not all areas of the unit were surveyed each year, which undoubtedly accounts for some discrepancy in moose numbers between years.

During the late 1980s and early 1990s, Unit 1D residents expressed concern over the decrease in moose numbers from the highs seen in the 1960s, the subsequent decline in hunting opportunity, and the "stampede" nature of the “any-bull” registration permit hunts with low harvest quotas. To control the unpredictable nature of the hunt, regulations were introduced (a spike-fork/50-inch/3 brow tine requirement) 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 restricted antler hunt for Unit 1D. This hunt allowed more hunter opportunity while affording protection to bulls that did not meet antler requirements. The objective of restricted antler hunts 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 allowing many local hunters the opportunity to pursue 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 at least 200 moose
2. Maintain a post-hunt bull-to-cow ratio of 25:100
3. Reach a harvest of 20–25 moose

METHODS

Chilkat River Valley aerial surveys were conducted in both 2005 and 2006 (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. Survey conditions for both years were considered good based on snow cover, overcast skies, and light winds.

Each year, prior to the moose hunt, we held an informational meeting in Haines to discuss the identification of legal and illegal 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 both years of the report period we maintained a moose check station in Haines and required hunters to check in their harvested moose within 3 days of the kill. Incisors were collected from harvested moose as a condition of the Tier II permit. All permittees were 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 aerial surveys in fall 2005 and 2006. In 2005, 203 moose were counted and in 2006, 188 moose were counted. The number of moose counted during surveys for this report period is comparable to the surveys going back to the early 1980s (Table 1). Based on this number of observed animals, we estimate the moose population in the Chilkat Valley is between 250 and 350 animals.

Population Composition

Survey conditions during the 2005 survey were adequate enough to classify all animals (203 total) seen as bulls, cows or calves. We classified 39 (19 %) of the moose seen on this survey as calves, a slight decrease from the 2004 survey (Table 1), but still considered to be good calf

recruitment. The bull-to-cow ratio was determined to be 39:100 and the calf:cow ratio was 33:100. Survey conditions in 2006 were slightly improved over 2005 and again we were able to classify all animals (188 total) as bulls, cows or calves. We classified 31 (16%) of the moose seen as calves; the bull:cow ratio was 46:100; and the calf:cow ration was 29:100. The high bull:cow ratios during the past two years compared to earlier surveys may be a function of survey timing. Both the 2005 and 2006 surveys were conducted when most of the bulls apparently still retained their antlers, while some of the earlier surveys may have occurred after antler drop had begun. Often in Southeast Alaska, we do not get sufficient snow for conducting surveys until late December or January, long after antlers have begun dropping. Further review of Table 1 illustrates the variable nature of both the number of bulls and calves counted. The number of calves counted in each of the reporting period years was the same or slightly higher than the 10-year mean count of 31 calves. It is more difficult to quantify bull moose because of survey timing. The highest bull:cow ratios in the last ten years were recorded in 2005 & 2006 (Table 1).

Mean age at harvest was 3.1 years during this report period, a decrease from the last report period (2003–2004). The harvest age structure shift is due to a high proportion of yearling bulls taken in 2005 and 2006, 8 and 12, respectively (Table 2).

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 1 side by Tier II subsistence hunting permit only; up to 220 permits may be issued.	15 Sep–30 Sep (Subsistence hunt only)	No open season.

Game Board Actions and Emergency Orders: Two regulations involving the Unit 1D moose hunt were promulgated by the board at its fall 2006 meeting. First, the season length was extended by one week (15 September–7 October). This proposal to lengthen the moose hunting season was put forth by the Alaska Department of Fish and Game (ADF&G, department) to allow additional hunting opportunity. The selective strategy hunt management should easily accommodate this season change, and data from recent surveys support this as the bull:cow ratios are presently above our management objectives.

The second regulation passed makes it illegal to take a spike/fork bull moose if the antler configuration is the result of broken, damaged or altered antlers. This proposal was also submitted by the department in response to concerns about the Unit 1B antler restricted moose hunt, where several bull moose were being harvested annually that had their antlers modified to meet spike/fork antler configuration requirements. Although Unit 1D was not necessarily experiencing these same concerns, it was included in the regulation to maintain consistency in Southeast's antler restricted moose hunts.

Hunter Harvest: During this report period, the mean annual harvest was 23 moose, a slight increase from the last report period. In 2005, 18 bull moose were taken, and in 2006, 27 bull moose were harvested. The 2006 harvest is the highest harvest since 1997. Reasons for this are likely the increased season length, which provided an extra week of hunting opportunity, and a significant increase in the number of yearling bulls that were available (Table 2).

Permit Hunts: All moose hunting in Unit 1D is administered under a Tier II subsistence permit system. Two hundred and fifty permits were available during each year of the report period (Table 3), but only 220 were issued in each of 2005 and 2006. While 250 permits are authorized by the Alaska Board of Game, the department limits the number to 220 to keep the hunting pressure at a level that provides for a sustainable harvest. The number of permit applicants increase in 2006 to 258 applications, up from 232 in RY2005. It is unclear why the number of applicants is increasing.

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 40 of the 45 moose harvested during the report period. Hunter success was 11% and 15% in 2005 and 2006, respectively. Success rates are similar to the previous four years (Table 3). Successful hunters took an average of 4.8 days in 2005 and 2.9 days in 2006 to harvest a bull moose (Table 3). The relatively short amount of time required to kill a bull moose in 2006 was at least partly due to the number of yearling bulls available for harvest. Total hunter days were 1021 in 2005 and 1011 in 2006 (Table 3), similar to the previous two report periods.

Harvest Chronology: During each year of the report period, the Unit 1D moose season remained open for the entire two weeks of the season. Hunters took 44% and 67% of the total harvest in the first four days of the season in 2005 and 2006, respectively. Nine spike/fork bulls (33% of the total harvest) were taken during this period in 2006. This is partly due to the high level of participation during the early part of the season, but also reflects the quick harvest of those bulls that have legal antler formations.

Transport Methods: Most Unit 1D moose hunters use boats or highway vehicles (Table 6). During the 2005 and 2006 hunting seasons, 62% and 52% of successful hunters used boats, respectively. Nearly all of the remaining successful hunters used highway vehicles (17% and 26%, respectively) (Table 6).

Commercial Services: Three hunters reported the use of commercial services during the report period (Table 7), all in 2005. While the number of hunters indicating they used a commercial service is consistent with other report periods, hunters reporting use of commercial services in this and other years may have incorrectly reported (e.g., listing commercial airline to Haines as a transporter). 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:

There is increasing interest in harvesting moose for cultural education and traditional funeral ceremonies. One bull moose was taken in 2006 for cultural education. These types of harvests are important for passing traditional subsistence knowledge from generation to generation. As interest increases, the department will work with interested parties and monitor these harvests to ensure compatibility with current management objectives and harvest strategies (i.e., spike/fork, 50 in. or 3-brow-tine bull moose).

Unit 1D residents have suggested that local brown bear and wolf populations continue to increase, and that bear and wolf predation on moose calves may be partly responsible for low recruitment rates we observe during aerial surveys. Unit 1D brown bear harvest accounts for the majority of mainland Southeast Alaska harvest, averaging 14 bears each year for the period 1996-2005 (range 7–21) (Scott 2007), and has remained stable for the last several report periods. The skull size and age indices we have from these harvested bears do not indicate a change in the bear population. The wolf harvest is low in Unit 1D, averaging 5 wolves per year over the last ten years (range 2–12) (Scott 2006). During this report period 2 and 3 wolves were taken in 2005 and 2006, respectively. Wolf harvest information is inadequate to speculate on the population. Quantifiable data are not available to support the contention that the predator populations are increasing. However, we can and do measure the number of calves seen during our annual surveys. Based on this data, the percentage of calves in the herd during 2005 and 2006 (19% and 16%, respectively), is similar the 10-year average of 17% calves. In some years deep snow may contribute 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), and this is something that should be examined more closely.

The abundance of shrubs for both foraging and cover adjacent to the Haines Highway attracts moose, and 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. Two moose are known to have been hit by vehicles during the report period; one moose each year. When able, these moose are salvaged and distributed to local charities.

No unreported kills were discovered in either year of the report period. It appears that preseason education and a systematic approach for addressing moose that do not meet the antler requirements (enforcement action and meat distribution) has reinforced a positive working relationship with area moose hunters. Sublegal bull harvest does not appear to be a significant problem in Unit 1D although it is inherent with some populations managed under the spike/fork, 3-brow-tine or 50-inch hunts.

Habitat: Nearly all moose habitat in this subunit lies within the Haines State Forest, managed under multiple-use guidelines of the 2002 Haines State Forest Management Plan. 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 areas with less snow accumulation where moose are able to access browse.

Habitat changes within nonforested portions of the area are also of concern, although only anecdotally documented in recent years. 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 postglacial land uplift (isostatic rebound) is causing permanent habitat change. In May 2007, department staff conducted a moose browse survey in three areas of the Unit 1D moose range. These areas included the Kelsall River (Mule Meadows), Tsirku River fan, and along the Haines Highway near Klukwan. Preliminary data suggest that plant availability, distribution and size dictate which species are browsed. However, willow (*salix* spp.) appears to be the preferred browse species. Winter weather is an additional factor to consider when reviewing these data. Due to record snowfall in 2006–2007, moose had to subsist on any available browse once snow depth reached a level that impeded movement. Additional surveys are necessary to detect browsing trends. This year's surveys were intended to provide general browsing information and to identify locations that can be surveyed long term. Browse surveys are scheduled to continue in the next report period.

CONCLUSIONS AND RECOMMENDATIONS

The management objectives at the beginning of this report were adapted from the Strategic Plan for Management of Moose in Region I, Southeast Alaska 1990–94 (ADF&G 1991). Based on existing aerial survey data and the lack of correction or sightability data, we believe it is practical to use a minimum population level of 200 moose, post hunt, as a management objective. The harvest objective of 20–25 bulls was met in 2006 but not in 2005. We met the objective of a 12% hunter success rate in 2006 (15%) but not in 2005 (11%).

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, but predator-prey relationships have not been investigated in the Chilkat River Valley. Winter wolf predation does not appear to be a serious problem, except when moose movements are restricted by extremely deep snow. However, an actively trapping populace likely maintains a check on this source of predation.

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.

Surveys for the last few years suggest that moose numbers in Unit 1D are no longer declining and indicate that the population has remained relatively stable over the past 20 years. It is encouraging to see the number of yearling bulls in the harvest increasing. The increase indicates a successful calf crop and will provide additional calves for herd recruitment. The present regulatory structure supports a moose 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 (Chilkat Valley) moose aerial survey data, regulatory years 1997 –2006[1]

Regulatory year	Total Bulls	Total Cows	Total calves	Unk	Total moose	Count time (hrs)	Bulls per 100F	Calves per 100F	Calves % in herd	Moose per hour
1997	10	37	36	115	198	4.1	---	---	18	48
1998	20	23	25	103	171	5.2	---	---	15	39
1999	---	4	4	67	75	4.9	---	---	---	15
2000	28	30	35	129	222	5.5	18	22	16	56
2001	38	153	30	---	221	5.2	25	20	14	42
2002					No Survey					
2003	29	103	26	---	158	4.4	28	25	17	36
2004	23	45	52	119	239	4.4	---	---	22	55
2005	46	118	39	---	203	5.0	39	33	19	41
2006	49	106	31	2	188	4.4	46	29	16	43

[1] Missing survey data is due to conditions that did not allow for herd composition collection.

TABLE 2 Unit 1D age structure of harvested moose, regulatory years 1997 through 2006

Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	Age Class 7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5	Total kill	% aged	Mean age
1997	0	2	0	3	6	1	1	1	0	1	0	0	0	0	0	0	15	88	4.6
1998	0	4	2	0	7	2	0	1	0	1	2	0	0	0	0	0	19	100	4.8
1999	0	6	2	3	2	3	2	0	2	0	1	0	0	0	0	0	21	100	4.3
2000	0	2	4	1	2	3	3	0	2	0	0	0	0	0	0	0	18	95	4.6
2001	0	8	1	1	3	1	1	1	1	0	0	0	0	0	0	0	17	100	3.5
2002	0	3	2	4	5	1	1	2	2	0	0	0	0	0	0	0	22	91	4.5
2003	0	3	1	3	3	8	0	2	0	0	0	0	0	0	0	0	21	95	4.5
2004	0	4	2	4	3	3	0	3	0	0	0	0	0	0	0	0	19[1]	100	4.1
2005	0	8	1	5	1	2	0	0	0	0	0	0	0	0	0	0	18	94	2.8
2006	0	12	3	3	3	2	2	2	0	0	0	0	0	0	0	0	27	100	3.3

[1] Does not include 1 unsalvaged illegal harvest.

TABLE 3 Unit 1D moose hunter effort and success, regulatory years 1997 through 2006

		Successful hunters			Unsuccessful hunters			Total hunters		
Year	Permits issued	# hunters	Total # days	Avg. # days	# hunters	Total # days	Avg. # days	# hunters	Total # days	Avg. # days
1997	200	17	50	2.9	130	891	6.9	147	941	6.4
1998	200	19	79	4.2	146	976	6.8	165	1055	6.4
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
2001	200	17	68	4.0	137	963	7.0	154	1031	6.7
2002	200	22	78	3.5	135	971	7.2	157	1049	6.7
2003	222	21	80	3.8	140	895	6.4	161	975	6.1
2004	202	19	86	4.5	142	1029	7.2	161	1115	6.9
2005	220	18	87	4.8	148	934	6.3	166	1021	6.2
2006	220	27	77	2.9	150	934	6.2	177	1011	5.7

TABLE 4 Unit 1D annual moose kill by community of residence, regulatory years 1997– 2006

Regulatory year	Total kill	Haines	Skagway	Juneau	Sitka	Other Alaska	Non-resident
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
2001	17[1]	16	0	0	1	0	0
2002	22	21	1	0	0	0	0
2003	21	18	0	3	0	0	0
2004	19[2]	18	1	0	0	0	0
2005	18	15	0	2	0	1	0
2006	27	25	0	1	1	0	0

[1]Includes 1 illegally harvested bull.

[2]Does not include 1 unsalvaged illegal harvest.

TABLE 5 Unit 1D historical moose harvests, number of hunters, and percent success, regulatory years 1997 through 2006

Regulatory year	NR males	NR females	NR unknown	Total kill	NR hunters	Percent success
1997	17	0	0	17	145	12
1998	19	0	0	19	164	12
1999	21	0	0	21	163	13
2000	18	0	0	18	160	11
2001	17	0	0	17	154	11
2002	22	0	0	22	157	14
2003	21	0	0	21	161	13
2004	19[1]	0	0	19	161	12
2005	18	0	0	18	166	11
2006	27	0	0	27	177	15

[1]Does not include 1 unsalvaged illegal harvest.

TABLE 6 Unit 1D transport methods used by successful moose hunters, regulatory years 1997–2006

	Airplane		Boat		ORV		Highway vehicle		Other	
Year	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
1997	0	---	10	(71)	0	---	4	(29)	0	---
1998	1	(6)	11	(65)	2	(12)	3	(17)	0	---
1999	2	(10)	15	(71)	0	(0)	4	(19)	0	(0)
2000	0	(0)	12	(67)	2	(11)	4	(22)	0	(0)
2001	1	(6)	14	(82)	0	---	2	(12)	0	---
2002	2	(10)	12	(57)	2	(10)	5	(23)	0	---
2003	1	(5)	13	(62)	1	(5)	3	(14)	3	(14)
2004	0	(0)	11	(58)	1	(5)	6	(32)	1	(5)
2005	0	---	12	(66)	3	(17)	3	(17)	0	---
2006	2	(7)	14	(52)	3	(11)	7	(26)	1	(4)

TABLE 7 Unit 1D commercial services used by moose hunters, regulatory years 1997–2006[1]

	Unit residents		Other AK residents		Total use		Other
Year	No	Yes	No	Yes	No	Yes	services
1997	76	2	3	0	79	2	0
1998	133	1	6	0	139	1	0
1999	126	2	15	0	141	2	1
2000	132	1	12	1	144	2	1
2001	128	1	8	0	136	1	0
2002	134	0	9	0	143	0	0
2003	136	3	6	1	142	4	0
2004	135	1	10	0	145	1	0
2005	145	2	9	1	154	3	0
2006	169	0	8	0	177	0	0

[1] Commercial service use may not be accurate due to reporting errors

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 3 (3000 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 15 September through 15 October with a 1-bull limit. The season was closed from 1968 until 1990 when the season reopened on Wrangell Island 1–15 October with a 1-bull bag limit, a spike-fork or 50-inch antler restriction, and a harvest ticket requirement. In 1991 the season reopened on Mitkof Island 1–15 October with a 1-bull bag limit, a spike-fork or 50-inch antler restriction, and a harvest ticket requirement. In 1993 the remainder of Unit 3 was opened 1–15 October with a 1-bull bag limit, a spike-fork, 3-brow tine or 50-inch antler restriction, and a registration permit requirement throughout the unit. From 1995 to present the season dates have been 15 September–15 October.

Action by the Board of Game effective 1 July 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 1 side.

Speculation has long existed that the current antler restrictions, which were developed for the *gigas* subspecies of moose found elsewhere in Alaska, are overly restrictive when applied to the smaller a*ndersonii* subspecies inhabiting the Central Panhandle. In fall 2004 the BOG adopted a department sponsored proposal to implement drawing permit hunts allowing the taking of a limited number of "any-bull" moose in Unit 1B. The current registration moose hunt (RM038) is managed under a selective harvest strategy that allows the taking of only those bulls that meet the spike-fork-3-brow tine or 50-inch antler criteria. Data collected from bulls harvested during the any-bull drawing permit hunts will be used to evaluate the age structure and antler characteristics of that segment of the bull population currently protected under the existing antler restrictions. Such information will be useful for evaluating the effectiveness of the current antler restrictions, and may provide information necessary to make informed changes to the existing antler regulations.

Historical harvest patterns

The average annual harvest during the 1990s was 19 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 2000, the average annual harvest was 24 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. Most hunters are in the field early in the season and 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 of 10 and 17 bulls were harvested, respectively. Since 1993, the year all of Unit 3 was opened to moose hunting, most 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 rebuilding Sitka black-tailed deer populations on the Unit 3 islands compounds the complexity of establishing moose management goals. Moose numbers are currently 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 include a crude estimate of the population size, limited knowledge of habitat utilization and moose movements, and anecdotal information from people in the field.

The Alaska Department of Fish and Game (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 5 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	2005	2006
Post hunt numbers	400	N/A	N/A
Annual hunter kill	40	59	43
Number of hunters	470	528	491
Hunter-days of effort	2300	3127	2916
Hunter success	10%	11%	9%

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 submit 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

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-inch, 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 proactive 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 ADF&G wildlife biologists over a period of many years continue to suggest an expanding population. Densities seem to be the greatest on Mitkof and northwestern 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. Because this data is based on anecdotal information provided by hunters there exists a high likelihood of replicate sightings, therefore it should be interpreted with caution. In 2005 a total of 303 hunters reported observing 941 moose, including 316 bulls, 328 cows, and 297 calves, for a bull-to-cow ratio of 96:100 and a calf-to-cow ratio of 90:100. In 2006, 257 hunters reported observing 1465 moose, including 484 bulls, 643 cows, and 338 calves, for a bull-to-cow ratio of 75:100 and a calf-to-cow ratio of 53:100.

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 Zarembo, and Kuiu islands.

MORTALITY

Harvest

Season and Bag Limit	Nonresident and resident hunters
Unit 3	15 Sep–15 Oct
1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on 1 side by registration permit only	
or	
1 bull by drawing permit only	15 Sep–15 Oct

Game Board Actions and Emergency Orders. In fall 2006, the Board of Game adopted a Region-wide regulation stating that a broken, damaged or altered antler does not satisfy the spike-fork requirement in antler restricted moose hunts. This regulation resulted from a steadily increasing number of bulls being checked-in annually that met the specified point requirements only as a result of broken or damaged antlers, and from growing concern about possible intentional modification of antlers.

In the Petersburg Management Area prior to 2002 state subsistence law included a positive customary and traditional use determination for moose only in the Stikine River drainages of Unit 1B. The amount reasonably necessary to meet subsistence needs was set at 40 moose annually. In 2002, the customary and traditional use determination for moose was expanded to include not only the Stikine River drainages, but all of Units 1B and 3. In fall 2006, the Board of Game determined that moose taken in these units during the any-bull drawing permit hunts were considered part of the amount necessary to meet subsistence needs. As a result, to ensure that enough moose were available for harvest to meet subsistence needs, nonresidents were excluded from participation in any-bull drawing hunts in Units 1B and 3.

No emergency orders were issued regarding Unit 3 moose during the report period.

Hunter Harvest.

In 2005, 528 hunters harvested 59 moose in Unit 3 (Table 1). Aided to some extent by 9 bulls taken under any-bull drawing permits, the harvest of 59 moose in 2005 was the highest ever for Unit 3. In 2006, 491 permittees harvested 43 moose.

In fall 2004 the BOG adopted a proposal sponsored by ADF&G to implement drawing hunts, allowing the taking of a limited number of "any-bull" moose in Unit 3. In 2005, a total of 5 any-bull permits (DM047) were issued for Mitkof Island, all permittees hunted, and all were successful. A total of 5 any-bull permits (DM048) were issued for Kupreanof Island, all permittees hunted, 4 of whom were successful. In 2006, 5 any-bull permits were issued for Mitkof, all permittees hunted, 2 of whom were successful. Five any-bull permits were issued for Kupreanof, 4 permittees hunted, 3 of whom were successful (Table 2).

Hunter Residency and Success. The overwhelming majority of those who participate in the Unit 3 moose hunt are local residents of Petersburg, Kake, and Wrangell (Table 3). Local residents, therefore, typically represent the largest group of successful hunters. The overall success rate for all residency groups combined was 11% in 2005, and 9% in 2006, both of which were above the 10-year average of 7%. In 2005 the 10 moose taken by nonlocal residents was the most on record for this residency group. Just 2 and 1 nonresident hunters participated in the Unit 3 moose hunt in 2005 and 2006, respectively, and all were successful. The successful nonresident hunter in 2006 possessed an any-bull drawing permit which greatly enhanced the chance of success.

Harvest Chronology. Harvest chronology for Unit 3 moose varies from year to year. In general, most bulls are killed during the first half of the season and the success rate typically declines as the season progresses. In 2005 most of the annual harvest occurred during the second week and first week of the season, respectively. In 2006 most of the annual harvest occurred during the third and fourth weeks of the season (Table 4).

Harvest in particular WAA's. During the report period hunters reported harvesting moose in 12 Unit 3 WAA's. In both 2005 and 2006 the largest percentages of the annual harvest occurred in WAA # 5132 on northwest Kupreanof Island and in WAA # 2007 on Mitkof Island, respectively.

Guided hunter harvest. Currently, no guided moose hunts are offered in the unit.

Transport Methods. During both years of the report period, most successful Unit 3 moose hunters used highway vehicles to access their hunting areas; a smaller number used boats (Table 5).

Other Mortality

Wolves are common throughout Unit 3 and predation by wolves on adult and calf moose has been well documented. Substantial predation of moose calves by black bears has been documented in other areas and probably occurs in Unit 3 as well. Poaching of moose undoubtedly occurs in Unit 3; however, the extent to which this occurs remains unknown.

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 the long term. Recent increases in moose distribution and abundance in Unit 3 are likely linked to timber harvest. Early succession 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, pre-commercial 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.

NON-REGULATORY MANAGEMENT PROBLEMS/NEEDS

The long-term effects of clearcut logging will probably 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 more sublegal bulls than are needed to ensure timely breeding of cows. The any-bull drawing permit hunts recently authorized by the BOG should facilitate the removal of surplus bulls and provide information on the age structure and antler characteristics

of that segment of the bull population protected under the existing antler restrictions. Such information may prove useful for evaluating the effectiveness of the current antler restrictions, and may provide information necessary for modifying the current selective harvest strategy.

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 for moose and deer is of concern to biologists and hunters.

In 2005 and 2006 the Unit 3 moose hunt exceeded all management objectives with the exception of the 2006 success rate. The success rates of 11% and 9% in 2005 and 2006, respectively, were up from the previous report period, but remained slightly below the management objective of 10% in 2006. The increased success rates during the report period are attributable in part to the relatively high success rate enjoyed by any-bull drawing permit holders. Although moose density varies from island to island, the Unit 3 moose population appears to be expanding. In both 2005 and 2006 the moose harvest from the Unit 3 islands exceeded that of the Unit 1B mainland.

In fall 2006, the Board of Game adopted a new regionwide regulation stating that a broken, damaged or altered antler does not satisfy the spike-fork requirement in antler restricted moose hunts. This regulation resulted from a steadily increasing number of bulls being checked-in annually that only met the specified point requirements as a result of broken or damaged antlers, and growing concern about the likelihood that antlers were being intentionally modified.

We recommend that Units 1B and 3, and the extreme southern portion of Unit 1C continue to be managed by a common registration permit hunt, and that the season dates remain from September 15 through October 15 with a bag limit of 1 bull with spike/fork or 50-inch antlers or at least 3 brow tines on 1 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 may be justified. The implementation of any-bull drawing permit hunts, while allowing a limited harvest of surplus bulls, is providing data that will be used to evaluate the age structure and antler characteristics of the currently protected segment of the bull population. Such information should prove useful for evaluating the effectiveness of the current antler restrictions, and may provide the information necessary to make informed changes to those restrictions.

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TABLE 1 Unit 3 moose harvest, regulatory years 1997 through 2006

Year	Hunter harvest reported							
	M	(%)	F	(%)	Unk.	Total	Illegal	Total
1997	20	(100)	0	(0)	0	20	2	22
1998	40	(100)	0	(0)	0	40	2	42
1999[a]	24	(100)	0	(0)	0	24	2	26
2000	30	(100)	0	(0)	0	30	1	31
2001[a]	22	(100)	0	(0)	0	22	1	23
2002	25	(100)	0	(0)	0	25	1	26
2003	39	(100)	0	(0)	0	39	2	41
2004	40	(100)	0	(0)	0	40	1	41
2005[b, c]	58	(98)	0	(2)	0	58	1	59
2006[c]	41	(100)	0	(0)	0	41	2	43

[a] Includes one DLP
[b] Numbers do not equal total because the cow was also illegal
[c] Includes DM047 and DM048 harvest

TABLE 2 Unit 3 moose harvest data by drawing hunt number, regulatory years 2005 through 2006

Hunt Nr	Regulatory Year	Permits issued	Percent did not hunt	Percent successful hunters	Percent unsuccessful hunters	Bulls	(%)	Cows	(%)	Unk.	Illegal/ unreported	Total harvest
DM047 Mitkof Is.	2005[a]	5	0	100	0	4	(80)	1	(20)	0	1	5
	2006	5	0	40	60	2	(100)	0	(0)	0	0	2
DM048 Kupreanof Is.	2005	5	0	80	20	4	(100)	0	(0)	0	0	4
	2006	5	20	75	25	3	(100)	0	(0)	0	0	3
Total all hunts	2005	10	0	90	10	8	(89)	1	(11)	0	1	9
	2006	10	10	56	44	5	(100)	0	(0)	0	0	5

[a] Numbers do not equal total because the cow was also illegal

TABLE 3 Unit 3 moose hunter residency and success, regulatory years 1997–2006

	Successful					Unsuccessful					
Year	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Local[a] resident	Nonlocal resident	Non-resident	Total	(%)	Total hunters
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
2001	20	3	0	23	(5)	404	31	1	436	(95)	459
2002	25	1	0	26	(6)	393	0	0	431	(94)	457
2003	38	3	0	41	(8)	421	48	2	471	(92)	512
2004	39	2	0	41	(8)	431	28	0	459	(92)	500
2005	47	10	2	59	(11)	445	24	0	469	(89)	528
2006	38	4	1	43	(9)	410	38	0	448	(91)	491

[a] Residents of Kake, Petersburg, and Wrangell

TABLE 4 Unit 3 moose harvest chronology in, regulatory years 1997–2006

Year	15–21 Sep	22–28 Sep	29 Sep–5 Oct	6–15 Oct	Total
1997	4	7	5	6	22
1998	14	13	7	8	42
1999	7	5	5	9	26
2000	11	7	5	8	31
2001	11	2	3	7	23
2002	6	6	5	9	26
2003	13	6	7	15	41
2004	10	12	6	13	41
2005	19	21	8	11	59
2006	6	7	11	19	43

TABLE 5 Unit 3 successful moose hunter transport methods, regulatory years 1997–2006

Year	Airplane	Boat	Highway vehicle	3/4 wheeler	Horse	Unknown	Total
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
2001	0	5	18	0	0	0	23
2002	0	7	19	0	0	0	26
2003	0	11	29	1	0	0	41
2004	0	11	30	0	0	0	41
2005	1	8	46	4	0	0	59
2006	3	10	28	2	0	0	43

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 5 (5800 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 in the late 1920s or early 1930s. Range expansion to the west followed slowly, with animals not documented on the Malaspina Forelands west of Yakutat Bay until 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 a population estimate exceeding 2000 animals. The population began declining toward a more realistic carrying capacity (thought to be substantially lower than 2000) in the mid 1960s. During this period, aggressive harvest strategies, including cow hunts, were employed to lower the moose numbers and prevent degradation of moose habitat. Poor reproductive success and severe winters in 1970 and 1972 depressed moose numbers further and resulted in the Unit 5A moose-hunting season being closed from 1974 to 1977. After the hunting closures in the mid 1970s, the Yakutat Forelands moose population slowly increased to its present level of 600–800 animals. The population appears to have reached a threshold that is at the carrying capacity of the area. Predation appears to be a more significant limiting factor than habitat quality for this population.

The Nunatak Bench area was closed to hunting after rising water levels from the Hubbard Glacier ice dam flooded much of the moose habitat there in summer 1986. Following retreat of the Hubbard Glacier and 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.

Since 1978 Unit 5 moose hunting under state regulation has been managed under a registration permit system. In 1991 a federal subsistence season was instituted that ran concurrently with the state season. 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 a week earlier than the state season (8 October vs.15 October). Although the concurrent seasons had been managed under the state's registration permit system, the new "early hunt" was administered under a separate federal registration permit issued by the U.S. Forest Service (USFS) and the National Park Service and prohibited

hunting on federal public lands except by Yakutat residents from 8–21 October. However, there is a block of 9 townships of nonfederal land near Yakutat where non-federally qualified subsistence users can legally hunt during the first week of the state season that begins 15 October. Just prior to the 2004 hunting season, the Alaska Department of Fish and Game (ADF&G, department) worked with the USFS to craft a joint state and federal permit that now serves as the only permit needed to hunt the Yakutat Forelands. Development of this joint permit made it possible for the department to track all hunting effort and obtain necessary data for management of moose in this area.

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 (RY 2005– RY 2006)	**Plan objective**
Unit 5A Yakutat Forelands		
Post-hunt moose numbers (estimated)	600–800	1000
Annual hunter kill (average)	35	70
Number of hunters (annual average)	142	250
Hunter-days of effort (annual average)	559	1025
Hunter success (annual average)	25%	28%
Unit 5A Nunatak Bench		
Post-hunt moose numbers (estimated)	15	50
Annual hunter kill (average)	0	5
Number of hunters (annual average)	1.5	10
Hunter-days of effort (annual average)	2.5	60
Hunter success (annual average)	0%	50%
Unit 5B Malaspina Forelands		
Post-hunt moose numbers (estimated)	200	250
Annual hunter kill (average)	1	25
Number of hunters (annual average)	14	50
Hunter-days of effort (annual average)	104	200
Hunter success (annual average)	8%	50%

METHODS

Aerial surveys were conducted in portions of Unit 5A and 5B during both years of the report period (Table 1). All surveys were flown with a Cessna 185 or 206 aircraft because better-suited survey aircraft are not available in Yakutat.

Two state and one joint state/federal registration permit hunts were used to manage moose hunting effort in Unit 5: RM062 (Unit 5B), RM059 (Unit 5A-Nunatak Bench), and RM061 (Unit 5A-Yakutat Forelands-joint state/federal permit). The USFS helps manage the RM061 hunt by issuing a federal emergency order (EO) concurrently with the state EO, to close the season when guideline harvest levels are reached. The department issues all permits and collects all permits reports as well as analyzes all hunt data, and is responsible for issuing emergency orders to close the state portion of the season. Successful hunters must provide the lower jaw from the animal taken and complete a hunt report to the department no later than 15 days after the hunt closes.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Portions of the Yakutat and the Malaspina forelands consist of heavy coniferous forests that make it difficult to detect moose. Until recent years, the department assumed moose sightability across the forelands to be about 50% (Smith and Franzman 1979). However a moose study conducted on the Yakutat Forelands during 2000–2004 by the United States Forest Service (USFS) and ADF&G yielded a moose sightability model that has given us a sightability correction factor for most available habitats. In general, moose sightability is estimated to be about 70% across the entire survey area—when surveys are done, about 70 percent of the moose present are actually seen and counted. Although this model was developed in Unit 5A on the Yakutat Forelands, we use it to provide us with insight into our survey results in Unit 5B as well. Nunatak Bench lacks coniferous stands, so sightability is much higher in this area. However, due to the dense alder thickets a solid snow base is essential to provide for a reliable survey in this area.

Several factors affect our ability to conduct comprehensive moose surveys in the Yakutat area on an annual basis. Variable snow coverage, strong drainage winds, and inclement weather all play a role in dictating when and where we can conduct surveys in a reliable manner. Additionally, the availability of survey aircraft in Yakutat often limits when we can survey. Because of this, our moose survey and coverage can vary considerably on a year to year basis (Table 1). The Yakutat Forelands in Unit 5A are generally surveyed annually, although in some years we attempt only to acquire a sample of several hundred moose for composition purposes. We try to survey Nunatak Bench each year to assure we do not overharvest this small herd. In recent years, the population has declined dramatically due to the flooding of their prime habitat by rising water levels of Russell Fiord. The damming of Russell Fiord by the Hubbard Glacier has led to water levels rising more than 60 feet in this area on two occasions during the past 20 years. In Unit 5B, our survey schedule is less consistent because of the lower hunting pressure this area receives, and thus there is a lesser need to monitor this population on a year-to-year basis.

Because of inconsistent early snowfall year to year, the timing of aerial surveys often occurs after antler drop, resulting in unreliable composition data. Therefore, in the tables accompanying this report, the composition data is often absent. The total number of moose is annotated on survey reports with the general breakdown of adult moose and calves.

Unit 5(A) Yakutat Forelands: During the first year of this report period, we counted 632 moose in this area. This is by far the highest count in the past 10 years (Table 1) and exceeds any count since the late 1960s. Good snow conditions and the adoption of a more thorough systematic survey design are likely the main reasons for this higher count. Until recent years, the survey strategy was to focus effort on the open areas where moose were concentrated, especially during the postrut period. However, due to poor snow conditions or late arriving snow, often the moose were dispersed by the time surveys were flown (January or February), and this methodology therefore missed large portions of the moose population. More recently we developed a methodology where we fly transects one-quarter mile apart across the entire forelands, thereby accounting for moose that otherwise might have been missed. Although we still omit the heavy coniferous forests from our surveys, we thoroughly cover all other habitats. During this report period we conducted a thorough survey during 2005, but limited our survey to a subset of the population in 2006 to achieve herd composition. With the varying survey intensities displayed in Table 1, probably the best measure to focus on across time is the number of moose observed per hour of flight time.

Unit 5(A) Nunatak Bench: Aerial surveys of the Nunatak Bench area were completed during both years of the report period. In RY 2005 and RY 2006 we counted 14 and 11 moose respectively. The moose herd at Nunatak Bench continues to suffer from the effects of a 65-foot rise in water level at the site during summer 2002. As happened in 1986, the Hubbard Glacier advancement created a dam that resulted in a rise in the water level in this area that consequently led to a depressed moose population (Table 1).

Unit 5(B) Malaspina Forelands: The Unit 5B moose population appears to be doing okay based on the most recent aerial survey conducted during RY 2006 (Table 1). This survey enumerated 167 moose with a sighting rate of 35 moose per hour of survey time. Although the sighting rate isn't as high as that recorded in some years, the count of 167 moose is the most animals recorded in the past 20 years. As with Unit 5A, our more intensive survey methodology in recent years is probably most responsible for this high moose count.

Population Composition

Unit 5A, Yakutat Forelands: During this report period, the 2005 aerial survey did not provide us with reliable composition. The timing of the survey was after antlers began dropping, so detecting bull moose was not possible in all cases. Therefore, our survey data consisted of cows, calves, bulls, and adult moose of unknown sex (Table 1). Several of the bull moose we counted had only one antler, and likely there were others that had lost both antlers. The minimal bull:100 cow ratio was 8:100, with a minimum calf:100 cow ratio of 14:100. The percent calves was 11%.

In addition to survey composition data, we try to gain insight into population through the age structure of the harvested bull moose. Since 1997 the mean age at harvest of Unit 5A Yakutat Forelands moose has ranged from a low of 2.7 years in 1997 to a high of 4.4 years in 2002 (Table 2). Mean age at harvest during this report period was 3.1 years. The number of 1.5 and 2.5 year old bulls in the harvest was 23 and 20 during 2005 and 2006 respectively, representing

the highest percentage of these young age classes since 1998. Although the overall harvest during the report period was relatively low compared to previous years (Table 2), the presence of these younger age classes provides some confidence that these age classes are well represented in the population.

Nunatak Bench: At Nunatak Bench, only the 2006 count allowed for a reliable composition assessment, revealing a bull:cow ratio of 38:100, but the sample size was very small (Table 1). Only 2 calves were seen in 2005, and none were seen in 2006. The low moose harvest at Nunatak Bench has not allowed us to gather any meaningful age distribution information.

Malaspina Forelands: 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 3.0 and 7.5 years since 1997. The mean age of 7.5 during RY 2006 is the highest recorded (Table 2). This erratic age structure is probably related more to sample size than any real population change. However, the older age class moose are probably more prevalent in Unit 5B because of the limited access and lower hunting pressure this area receives in comparison to the Yakutat Forelands.

MORTALITY

Harvest

Season and bag limits	Resident and nonresident hunters
Unit 5A, except Nunatak Bench	15 Oct–15 Nov
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	15 Nov–15 Feb
1 moose by registration permit only; up to 5 moose may be taken	
Unit 5B	15 Sep–15 Dec
1 bull by registration permit only; up to 25 bulls may be taken	

Game Board Actions and Emergency Orders. There were no Board of Game actions concerning Unit 5 moose hunting during the report period. However an emergency order (EO) was issued to close the moose season at Nunatak Bench in 2006.

Hunter Harvest. The annual harvest of moose in Unit 5A (Yakutat Forelands) ranged from 33 to 61 during 1997–2006, with a mean of 42. However, the mean annual harvest over the past 2 report periods (35 moose/year) has been substantially lower than that recorded during 1997–1992 (Table 3). The reasons for this decline in harvest are puzzling, especially in light of our recent aerial survey data that indicate the Unit 5A moose numbers are healthy, with no reason to suspect the population has changed dramatically in recent years. With our paucity of reliable bull:cow ratio data over time, we don't know whether the bull proportion of the herd has changed over time. This seems like the most likely scenario that would lead to the decline in harvest. So, although the moose numbers appear to relatively high, our bull:cow ratios based on our surveys appear to be lower than optimal (Table 1).

No moose were harvested at Nunatak Bench during the report period. The 2005 season ran the entire 3-month season with only 3 hunters participating, but none were successful. In 2006 the season was closed by emergency order prior to the season to prevent any harvest (Table 3).

The harvest in Unit 5B also declined precipitously during this report period. In 2005 no moose were taken, and in 2006 only 2 were harvested. Data in Table 5 indicate that hunter effort was lower during this report period, but there was enough hunter activity to expect a higher harvest than we recorded. Over the two years of the report period, 28 hunters spent 208 days afield in search of a moose (Table 5). Given that any bull is legal in this area, this suggests that few bulls were seen, since only 2 were harvested. Two factors may have contributed to the low harvest. First, most hunters targeting Unit 5B hunt out of the same place, that being a government cabin near Esker Stream. There could be habitat or predator changes occurring that make that area less desirable for moose. This is somewhat substantiated by hunters reporting that they are seeing very few moose, and lots of brown bears. Second, the commercial guide who usually operated on the west end of Unit 5B relinquished most of his operation, and only 1 moose was taken in that area, while in previous years 3–5 animals were taken by guided hunters (Table 4).

Permit Hunts. Permits issued for the Yakutat Forelands hunt (RM061) in 2005 and 2006 totaled 197 and 174 respectively. The number of permittees who actually hunted was lower, with 158 and 127 hunters during 2005 and 2006 respectively.

The hunting effort at Nunatak Bench hunt (RM059) was limited during this report period. In 2005 only 3 of 13 permittees hunted and in 2006 the season was closed prior to any permits being issued (Table 3).

The Unit 5B hunt (RM062) received significantly less hunting pressure during this report period, 28 hunters, compared to 46 hunters during the previous period and 50 hunters during RY 2002–RY 2003.

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 state permit hunts. Adoption of the joint state/federal permit during RY 2004 made it easier for ADF&G to keep track of the reporting process for RM061.

Hunter Residency and Success. 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. Yakutat hunters took 46 of 70 bulls (66%) harvested

in 5A during the report period. 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 nonlocal hunters in areas farther from Yakutat (especially east of the Dangerous River) and in those areas accessible only by airplane. Nonlocal Alaskans residents hunting but not living in Unit 5, took 21 moose (30%) during the report period. Nonresidents took only 3 moose during the report period, similar to the mean of 3.7 moose harvested per two-year period for the past 4 report periods (Table 4). Since 1997 the overall success of Unit 5A hunters has ranged from 22 to 31 percent (Table 3). Hunter success was 23% in 2005 and 26% in 2006.

Hunting effort at Nunatak Bench is usually dominated by Yakutat residents. The remote location of this area and difficult access mean that locals who have the equipment and local knowledge to successfully hunt are the ones who use this area. During the report period effort was minimal, with only 3 people hunting in 2005 (all Yakutat residents), and none in 2006 due to the season being closed prior to any hunting taking place. No moose were harvested (Table 4).

The Malaspina Forelands hunt is less dominated by local use because it is less convenient to hunt, and inclement weather often deters local hunters from short excursions to this area. Local residents did not take either of the 2 moose that were harvested during this report period. One successful hunter was a nonlocal Alaska resident, the other was a nonresident. During 2005 hunter success was 0% and in 2006 it was 15% (Table 3).

Harvest Chronology. Most of the Unit 5A harvest on the Yakutat Forelands took place during the first three weeks of the 5A season, when areas adjacent to Yakutat and easily accessible by boat or highway vehicle are open. The federal season opens on 8 October, while the state season opens a week later on 15 October. However, up until 22 October only federally qualified subsistence hunters can hunt on federal land in Unit 5A.

In Unit 5B, the 2 moose that were taken were harvested in late September, 3 weeks into the season. Generally hunters wait until late September before pursuing moose in this area.

Transport Methods. Transport methods used in the Yakutat Forelands were similar to the previous report period (Table 6). The use of aircraft dropped only slightly, from 20% during 2003–2004 to 17% in 2005–2006. The use of boats was 33%, just above the 32% from the previous report period, while 3- and 4-wheeler use increased from 23% to 31%. Highway vehicles made up most of the remainder transportation access, with 19% of the hunters using this method. Three and 4-wheelers are probably underrepresented because some hunters reporting highway vehicles or “other” probably used off-road vehicles as well. Many unsuccessful hunters also use these machines for access. 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, all-terrain vehicles (ATVs), or highway vehicles, while most nonresident hunters charter aircraft for access. The use of aircraft generally increases later in the season as nonlocal hunters begin hunting in portions of the unit that don’t have roads.

Commercial Services. Commercial services were used by 13% of Unit 5 moose hunters during the report period (Table 7). Nonlocal hunters were more likely to use commercial services, usually for transport to the field. Commercial services were used by a higher percentage of Unit 5B hunters (68%) than Unit 5A hunters. This undoubtedly reflects the fact that the Malaspina Forelands are more difficult to access.

Other Mortality.

The winter of 2006–07 was the most severe on record in many parts of Southeast Alaska, including Yakutat. Heavy snowfall that persisted late into the spring probably resulted in above average winter mortality for moose in Unit 5.

CONCLUSIONS AND RECOMMENDATIONS

None of the management objectives for Unit 5 moose hunts were met during this report period. The most glaring shortfalls have been in the harvests, which were well below the objectives. This is not easily explained given that the populations of the Malaspina and Yakutat forelands are near management objectives, and traditionally have supported a higher moose harvest. The high number of 1.5 and 2.5 year old bulls in the harvest during the report period suggests that recruitment was good during those years, so hopefully that will translate into higher moose harvests in the future. The Nunatak moose population will probably take a few more years before it will be strong enough to allow a moose hunt.

Complete fall sex and age composition counts of all Unit 5 moose herds need to be conducted, if possible, during the next report period. Reliable survey data will allow us to both better interpret the decline in moose harvest and make necessary adjustments to our management strategies.

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TABLE 1 Unit 5 aerial survey data, regulatory years 1995 through 2006[1]

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					
1995	14	71	78	303	466	8.5	NA	NA	17	55
1996	10	68	8	0	86	1.9	15	12	9	45
1997						No survey				
1998	7	17	17	333	374	6.7	NA	NA	NA	56
1999						No survey				
2000	1	10	11	343	365	9.1	NA	NA	NA	40
2001	26	32	33	183	274	6.7	NA	NA	12	41
2002	28	146	21	0	195		19	14	11	NA
2003	11	46	48	262	367	10.3	NA	NA	13	36
2004						No survey				
2005	41	71	75	445	632	12.1	NA	NA	12	52
2006[2]	10	119	11	0	140	3.4	9	11	8	42
					5A Nunatak Bench					
1995	5	6	6	16	33	0.3	NA	NA	18	110
1996–1998						No survey				
1999	NA	NA	NA	33	33	0.4	NA	NA	NA	83
2000	NA	1	1	52	54	0.8	NA	NA	NA	68
2001	8	4	3	20	35	0.5	23	9	13	70
2002						No survey				
2003	1	1	1	22	25	0.4	NA	NA	NA	63
2004						No survey				
2005	1	2	2	9	14	.5	NA	NA	14	28
2006	3	8	0	0	11	1.4	38	0	0	8
					5B Malaspina Forelands					
1995	4	10	11	84	109	1.75	NA	NA	10	62
1996–1998						No surveys				
1999	NA	NA	NA	38	38	0.8	NA	NA	NA	48
2000	NA	2	3	108	113	2.2	NA	NA	NA	51
2001	22	8	9	52	91	2.0	24	15	10	46

2002						No survey				
2003	20	19	20	94	153	4.2	NA	NA	NA	37
2004						No survey				
2005	6	8	9	43	66		NA	NA	14	NA
2006	0	21	21	125	167	4.8	NA	NA	13	35

[1]Due to survey timing, poor snow conditions, extreme winds, and less than ideal survey aircraft, herd composition data is not often not reliable and is noted as (NA=data not available).

[2] Composition survey of west side of Dangerous River-under poor survey conditions.

TABLE 2 Unit 5 age structure of harvested moose, regulatory years 1997 through 2006

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	Total kill	% Aged	Mean Age
								Age	Class										
									Yakutat Forelands										
1997	1	22	18	8	4	3	1	0	2	0	1	0	0	1	0	0	61	100	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
2001	1	11	4	5	5	2	4	1	2	0	0	0	0	1	0	0	38	95	3.9
2002	0	12	5	6	4	2	3	4	2	0	1	1	1	0	0	0	45	91	4.4
2003	0	11	4	7	2	1	1	0	0	0	0	0	1	0	0	0	30	90	3.2
2004	1	12	12	6	3	2	0	3	1	0	0	0	0	0	0	0	40	100	3.1
2005	0	14	9	5	2	0	2	3	0	0	0	0	0	0	0	0	37	95	3.0
2006	0	9	11	4	2	1	1	0	1	0	0	0	1	0	0	0	33	91	3.2
									5A Nunatak Bench										
2000	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	100	5.0
2001	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	50	3.5
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	---
2003	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	3	100	6.5
2004	0	0	0	1	0	0	0	1	2	0	0	0	0	0	0	0	4	100	7.0
2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	---	---
2006	Season Closed by Emergency Order																0	---	---
									5B Malaspina Forelands										
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
2001	0	4	0	2	1	1	0	0	1	0	0	0	0	0	0	0	9	100	3.5
2002	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	67	3.0
2003	0	0	1	0	3	2	0	2	0	0	0	0	0	0	0	0	9	89	5.3
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	---
2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	---	---
2006	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	100	7.5

TABLE 3 Unit 5 historical harvests, hunters, and success, regulatory years 1997–2006

Year	Nr MM	Nr FF	Nr unk.	Total kill	Nr hunters	Percent success
			5A Yakutat Forelands			
1997	59	1	1	61	194	31
1998	54	1	0	55	195	28
1999	41	1	0	42	114	37
2000	37	0	0	37	146	25
2001	37	1	0	38	152	25
2002	43	1	1	45	187	24
2003	30	0	0	30	137	22
2004	40	0	0	40	172	23
2005	37	0	0	37	158	23
2006	33	0	0	33	127	26
			5A Nunatak Bench			
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
2001	2	0	0	2	2	100
2002	0	1	0	1	3	33
2003	2	1	0	3	8	38
2004	2	2	0	4	5	80
2005	0	0	0	0	3	0
2006			Season Closed by Emergency Order			
			5B Malaspina Forelands			
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
2001	9	0	0	9	26	35
2002	3	0	0	3	24	13
2003	9	0	0	9	28	32
2004	2	0	0	2	18	11
2005	0	0	0	0	15	0
2006	2	0	0	2	13	15

Includes moose harvested under federal ceremonial permit

TABLE 4 Unit 5 annual moose kill by community of residence, regulatory years 1997 through 2006

Year	Total kill	Yakutat	Juneau	Ketchikan	Sitka	Pelican	Hoonah	Petersburg	Haines	Wrangell	Other AK	Non-resident
						5A Yakutat Forelands						
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
2001	38	25	8	0	0	0	0	0	0	0	2	3
2002	45	34	6	0	1	0	0	0	2	0	1	1
2003	30	20	7	0	2	0	0	0	0	0	1	0
2004	40	30	5	0	2	0	0	0	0	0	1	2
2005	37	23	7	0	3	0	0	0	0	0	2	2
2006	33	23	6	0	0	0	0	0	0	0	3	1
						5A Nunatak Bench						
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
2001	2	2	0	0	0	0	0	0	0	0	0	0
2002	1	1	0	0	0	0	0	0	0	0	0	0
2003	3	3	0	0	0	0	0	0	0	0	0	0
2004	4	4	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006						Season Closed by Emergency Order						
						5B Malaspina Forelands						
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
2001	9	1	4	0	0	0	0	0	0	0	0	4
2002	3	2	0	0	0	0	0	0	0	0	0	1
2003	9	3	1	0	0	0	0	0	0	0	0	5
2004	2	1	0	0	0	0	0	0	0	0	0	1
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006	2	0	0	0	0	0	0	0	0	0	1	1

TABLE 5 Unit 5 hunter effort and success, regulatory years 1997 through 2006[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						
1997	300	59	154	2.6	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	3.9	114	383	3.6
2000	173	37	92	2.5	108	626	6.0	146	718	5.0
2001	198	38	130	3.4	126	604	4.8	164	734	4.5
2002	221	45	137	3.0	171	788	4.6	216	925	4.3
2003	171	30	78	2.6	107	586	5.5	137	664	4.8
2004	211	40	121	3.0	132	744	5.6	172	865	5.0
2005	197	37	145	3.9	121	470	3.9	158	615	3.9
2006	174	33	74	2.2	94	428	4.6	127	502	4.0
				5A Nunatak Bench						
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	2.8	5	14	3.5
2000	14	3	6	2.0	4	8	2.0	7	14	2.0
2001	9	2	5	2.5	0	0	0	2	5	2.5
2002	9	1	2	2.0	2	4	2.0	3	6	2.0
2003	14	3	3	1.0	5	6	1.2	8	9	1.1
2004	13	4	6	1.5	1	2	2.0	5	8	1.6
2005	13	0	0	0	3	5	1.7	3	5	1.7
2006				Season Closed by Emergency Order						
				5B Malaspina Forelands						
1997	48	13	44	3.4	16	62	3.9	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	5.0	12	61	5.5
2000	46	11	54	4.9	15	71	4.7	26	125	5.0
2001	45	9	31	3.4	17	118	6.9	26	149	5.7
2002	36	3	6	2.0	21	113	5.4	24	119	5.0
2003	53	9	37	4.1	19	93	4.9	28	130	4.6
2004	44	2	20	10	16	87	5.4	18	107	5.9
2005	30	0	0	0	15	95	6.3	15	95	6.3
2006	26	2	13	6.5	11	100	9.1	13	113	8.7

[1] Includes data from both federal and state moose permits. 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 1997 through 2006[1]

Year	Airplane		Boat		3 or 4 wheeler		ORV		Highway vehicle		Foot	
	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)	Total	(%)
5A Yakutat Forelands												
1997	17	(44)	6	(16)	4	(11)	0	---	11	(29)	0	---
1998	16	(29)	15	(28)	8	(15)	0	---	15	(28)	0	---
1999	8	(28)	10	(43)	3	9	1	3	6	(17)	0	---
2000	12	(34)	11	(31)	8	23	0	---	4	(12)	0	---
2001	11	(32)	14	(41)	1	(3)	0	---	8	(24)	0	---
2002	10	(23)	17	(39)	9	(20)	1	(2)	7	(16)	0	---
2003	6	(22)	7	(26)	7	(26)	1	(4)	6	(22)	0	---
2004	7	(18)	15	(38)	8	(20)	1	(2)	9	(22)	0	---
2005	6	(16)	9	(24)	14	(38)	0	---	8	(22)	0	---
2006	6	(18)	14	(43)	8	(24)	0	---	5	(15)	0	---
5A Nunatak Bench												
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	---
2001	0	---	2	(100)	0	---	0	---	0	---	0	---
2002	0	---	1	(100)	0	---	0	---	0	---	0	---
2003	0	---	3	(100)	0	---	0	---	0	---	0	---
2004	0	---	4	(100)	0	---	0	---	0	---	0	---
2005	0	---	0	---	0	---	0	---	0	---	0	---
2006	Season Closed by Emergency Order											
5B Malaspina Forelands												
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	---
2001	6	(75)	0	---	2	(25)	0	---	0	---	0	---
2002	2	(67)	0	---	0	---	1	(33)	0	---	0	---
2003	1	(11)	5	(56)	3	(33)	0	---	0	---	0	---
2004	0	---	1	(50)	1	(50)	0	---	0	---	0	---
2005	0	---	0	---	0	---	0	---	0	---	0	---
2006	0	---	0	---	2	(100)	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 1997 through 2006[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						
1997	67	5	21	13	4	7	92	25	22	1	2
1998	101	1	18	17	7	5	126	23	18	3	2
1999	59	2	16	11	3	7	78	20	15	2	3
2000[2]	90	3	10	15	3	3	103	23	18	2	3
2001	82	2	23	16	1	4	106	22	19	2	1
2002	130	3	33	12	2	1	165	16	15	1	0
2003	101	3	26	14	0	0	127	17	16	0	1
2004	117	2	26	21	2	5	145	28	25	1	2
2005	111	5	17	19	1	3	129	27	25	2	0
2006	98	0	17	10	0	1	115	11	10	1	0
					5A Nunatak Bench						
1997	2	0	0	0	0	0	3	0	0	0	0
1998	3	0	0	0	0	0	3	0	0	0	0
1999	2	0	4	0	0	0	6	0	0	0	0
2000	3	0	3	0	0	0	6	0	0	0	0
2001	2	0	0	0	0	0	2	0	0	0	0
2002	3	0	0	0	0	0	3	0	0	0	0
2003	6	0	2	0	0	0	8	0	0	0	0
2004	5	0	0	0	0	0	5	0	0	0	0
2005	3	0	0	0	0	0	3	0	0	0	0
2006					Season Closed by Emergency Order						
					5B Malaspina Forelands						
1997	8	1	0	4	2	8	10	13	5	8	0
1998	2	3	2	7	1	9	5	19	10	9	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
2001	1	2	1	9	0	13	2	24	12	12	0
2002	6	2	4	7	0	5	10	14	9	5	0
2003	11	2	1	4	1	9	13	15	6	8	1
2004	2	0	1	7	1	7	4	14	9	5	0
2005	1	0	4	0	1	9	6	9	9	9	0
2006	2	0	1	1	0	9	3	10	1	9	0

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

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

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 the Matanuska-Susitna area (Burris and McKnight 1973). During 1949–1958, Cordova residents successfully raised 24 captive moose calves and released them on the western Copper River Delta in Subunit 6C. This small population grew rapidly and expanded eastward into Subunit 6B by the early 1960s. Eastward expansion continued into Subunit 6A to the Bering River area by the late 1960s and to Cape Yakataga by the mid 1970s. The population reached a record high of approximately 1600 in 1988 (Griese 1990), then declined to about 1200 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 in Unit 6D, numbering about 40 animals total.

Hunting of the introduced population in 6C began with 25 bulls harvested in 1960. Harvest began in 6B during 1965 and 6A during 1971. Moose in 6A were divided into two populations (east and west of Suckling Hills) during 1977 and have been managed separately since then. Hunters harvested more than 4300 moose during 1965–2004 in Subunits 6A, 6B and 6C. In contrast, total kill of the endemic moose population in 6D during the same period was approximately 55 moose. The harvest quota for cow moose in Subunit 6C was moved into federal subsistence hunting during 2000–01, as was 75% of the bull harvest quota during 2002–03.

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). Nowlin (1995) revised objectives in 1994 using new information about carrying capacity of the winter ranges (MacCracken 1992) and refined estimates of population size.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

Our goals in Subunit 6A East are to take large moose and to provide for optimum harvest. For the remainder of Unit 6 the goals are to provide for optimum harvest and to provide for the greatest opportunity to hunt.

POSTHUNT MANAGEMENT OBJECTIVES

Our management objective for Subunit 6A East is to maintain a population of 300–350 moose and a minimum bull:cow ratio of 30:100. Our objectives for Subunit 6A West and 6B are to maintain populations of 300–350 moose and minimum bull:cow ratios of 15:100 in each unit. In 6C our objective for this report period was to increase the population to 400 moose by the year 2006 and maintain a minimum bull:cow ratio of 15:100.

METHODS

We conducted aerial surveys to determine population size, sex and age composition of moose in Units 6A–6C, and twinning rates of cows in Unit 6C. We flew surveys in Piper Super Cub (PA-18) and Bellanca Scout aircraft. We conducted modified Gasaway surveys (Gasaway et. al. 1986) when snow conditions and weather windows allowed, or single-day composition counts when survey conditions were limited.

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

I summarized survey and harvest data by subunit, except for 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.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

We conducted modified Gasaway surveys in Units 6A West and 6C (Table 1) during the reporting period. Surveys in Units 6A West and 6C were flown in January after most bulls had cast antlers. We flew composition counts in Unit 6B and 6C (both in December after antler cast began), and in 6A West during late January. We flew seven twinning surveys 25 May–20 June 2007 in Unit 6C. Best results were obtained during overcast mornings when moose were actively feeding, which occurred on 2 surveys.

Population Size

Survey results indicated moose populations were stable in Units 6A and 6B, and increasing in Unit 6C. The posthunt moose population in Unit 6 during the reporting period was approximately 1365 moose, including 280 in 6A East, 275 in 6A West, 200 in 6B, 560 in 6C, and 50 in 6D. The population in Unit 6C increased substantially from 2001 when the last Gasaway survey was flown (Table 1), and continued to increase to 560 moose despite a higher cow harvest in 2006.

Population Composition

Bull:cow ratios were obtained for Units 6B, 6A West, and 6C during the reporting period (Table 1), although they are minimum estimates because of antler cast. The proportion of calves was normal in the units surveyed. Spring surveys in Unit 6C indicated a twinning rate of 65% for cows with calves at heel.

MORTALITY

Harvest

Season and Bag Limit. In Subunit 6A East, the bag limit for all hunters was 1 moose. The bull moose season during this reporting period was 1 September–30 November. Nonresident hunters were restricted to bulls with 50-inch antlers or antlers with 3 or more brow tines on at least 1 side. Resident hunters were restricted to spike, fork or 50-inch antlers.

In Subunit 6A West, the season for all hunters was 1 September–30 November, with a bag limit of 1 moose. Altogether, resident harvest quota was up to 20 bulls by registration permit, and nonresident quota was up to 5 bulls by drawing permit.

The season in Subunit 6B was 1 September–30 November for resident hunters only with a bag limit of 1 moose. We authorized a harvest of 20–25 bulls by registration permit. No motorized vehicles were allowed for transportation 15 August–5 September, with the exception of highway vehicles on the maintained surface of the Copper River Highway. Also, moose could not be taken until after 3 a.m. following the day on which an airboat was used for transportation. All airboats were required to display an Alaska Department of Fish and Game identification number.

In Subunit 6C the state season was 1 September–31 October for resident hunters only, with a bag limit of 1 moose by drawing permit and quota of 9 bulls (Table 3). Federal subsistence permits included 27 bulls in each year of the reporting period, and antlerless quotas of 5 in regulatory year (RY) 2005, and 40 in RY 2006 (a regulatory year runs from 1 July to 30 June; e.g., RY 2005 = 1 July 2004–30 June 2005). The subsistence hunt was administered by the U.S. Forest Service, Cordova Ranger District.

The general season in Subunit 6D for all hunters was 1–30 September, and the bag limit was 1 bull by harvest ticket.

Reported moose harvest for Unit 6 was 102 in RY 2005 and 135 in RY 2006 (Table 2), which was the highest harvest in 14 years. Composition of the harvest in Unit 6 was 92% in RY 2006 and 72% males in RY 2006.

Board of Game Actions and Emergency Orders. We issued emergency orders to close the registration permit hunts for bull moose in 6B (16 September, both years). These were normal management actions. The Board of Game reauthorized all antlerless moose hunts during the reporting period.

Permit Hunts. During this reporting period, Subunit 6A West had 1 registration and 1 drawing permit hunt, 6B had 1 registration hunt, and 6C had 1 state drawing hunt. Also in 6C there were 1 federal subsistence hunt (with a harvest of 5 cows each year and harvests of 16 bulls in RY 2003 and 28 bulls in RY 2004) and 1 potlatch bull permit each year (Table 3).

Hunter Residency and Success. More than 75% of moose hunters in Unit 6 were local residents during the reporting period (Table 4). This was an increase over past years because most of the increasing quota in Unit 6C has gone to Federal subsistence users (Cordova residents only). Resident-only seasons and difficult access on the Copper River Delta discouraged nonlocal hunters from participating in other hunts. This has been the pattern for the last 5 years.

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). Unit 6C has good road access from Cordova, allowing both highway vehicle and airboat access to moose. This pattern of use has not changed over the past 5 years.

Other Mortality

Predation by brown bears and wolves was the primary cause of calf and adult (nonhunter) mortality. Brown bears and wolves were observed chasing and feeding on calves and adult moose throughout the moose range of Unit 6 (Carnes 2004; MacCracken et al. 1997; personal observation). Estimates of moose kill rates for wolves in Unit 6, which were comparatively low (Carnes 2004), indicated that approximately one-quarter of the moose population in Units 6A and 6B could potentially be killed by wolves each year. Occasional deep snow and severe weather can contribute to mortality. Calf survival declined by 8% in Unit 6C during a 2-month period between composition counts and Gasaway surveys in 2005 (Table 1).

Wolves were maintained at low density in Unit 6C by hunting and trapping. Posthunt wolf population size was generally 6 or fewer in 2 small packs, which had relatively little impact on the moose population. Therefore, moose in 6C were subject to primarily seasonal predation by brown bears, rather than the dual predators (bears and wolves) present throughout the rest of Unit 6. This has allowed calf production in Unit 6C to escape every 2–3 years (Table 1). Calf production in other subunits, where both predators are abundant, has not exceeded 15% in 18–20 years. The moose population in Unit 6C has been increasing under higher bull and antlerless harvest quotas, whereas in Units 6A and 6B populations are below management objectives and antlerless harvest has been eliminated.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations have been below management objectives in Units 6A West, 6A East, and 6B for 16, 6, and 11 years, respectively, because of wolf and brown bear predation. In contrast, the population objective in Unit 6C of 400 moose was surpassed by 160; increases in cow and bull harvests are underway to reduce the herd and maintain it near 400 moose. I recommend extending the spring brown bear season in Units 6A–C by 1 week to reduce brown bear predation. Options to reduce wolf predation are limited. Trapper access into 6A and 6B is quite difficult because of remoteness, generally poor snow and ice conditions, and frequent winter storms. Land ownership is primarily federal, where same-day airborne hunting could not occur. I recommend extending the wolf season to close coincident with the brown bear season (May 31) to allow spring bear hunters the opportunity to take wolves in Units 6A and 6B.

Adequate snow and weather windows are becoming increasingly rare along the coast during early winter. Therefore, as budgets allow I will attempt to fly more single-day composition counts before antler cast, in addition to later-season Gasaway surveys to obtain population estimates. These dual surveys have the additional benefit of monitoring calf survival between early and mid winter.

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TABLE 1 Unit 6 moose estimated population composition and size, 1992–2006

Unit	Regulatory Year	Survey date (m/d/y)	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
	2001–02		-	15	265	285	220–360	218
6A West	1995–96	01/15/96	-	14	271	316	272–361	221
	1999–00	11/28/99	-	13	348	412	181–643	382
	2001–02	02/20/02	-	13	260	297	236–358	253
	2003–04[a]	11/16/03	19	13	132	-	-	161
	2005–06	12/04/05	18	15	143	275	238–311	206
	2005–06[a]	01/31/06	-	10	163	-	-	187
6B	1994–95	11/16/94	22	10	266	296	244–347	182
	1996–97	12/14/96	-	6	289	308	249–367	167
	1998–99	01/21/99	-	9	266	320	243–396	286
	2000–01[a]	02/02/01	-	11	159	-	-	178
	2001–02	02/21/02	-	13	144	198	176–219	168
	2003–04[a]	11/25/03	57	6	111	-	-	124
	2005–06[a]	12/02/05	45	15	103	-	-	129
6C	1996–97		-	17	214	259	232–287	216
	1998–99	12/08/98	-	25	221	334	293–375	293
	2000–01	02/08/01	-	10	278	354	307–402	308
	2001–02	02/06/02	-	20	272	341	318–365	326
	2003–04[a]	11/13/03	63	6	114	-	-	146
	2005–06[a]	12/01/05	30	18	163	-	-	240
	2005–06	02/01/06	-	10	425	488	423–533	409
	2006–07	01/18/07	-	20	273	560	453–667	361

[a] Composition count

TABLE 2 Unit 6 moose harvest and accidental death, 2000–2005

		Hunter harvest									
	Regulatory	Reported					Estimated			Accidental	
Unit	year	M	(%)	F	(%)	Total[a]	Unreported	Illegal	Total	death	Total
6A East	2002–03	13	(100)	0	(0)	13	1	0	1	0	14
	2003–04	17	(100)	0	(0)	17	1	0	1	0	18
	2004–05	26	(100)	0	(0)	26	1	0	1	0	27
	2005–06	12	(100)	0	()	12	1	0	1	0	13
	2006–07	21	(100)	0	()	21	1	0	1	0	22
6A West	2002–03	14	(78)	4	(22)	18	1	1	2	0	20
	2003–04	18	(86)	3	(14)	21	1	1	2	0	23
	2004–05	15	(88)	2	(12)	17	1	1	2	0	19
	2005–06	25	(86)	4	(14)	29	1	1	2	0	31
	2006–07	12	(100)	0	()	12	1	1	2	0	14
6A TOTAL	2002–03	27	(87)	4	(13)	31	2	1	3	0	34
	2003–04	35	(92)	3	(8)	38	2	1	3	0	41
	2004–05	41	(95)	2	(5)	43	2	1	3	0	46
	2005–06	37	(90)	4	(10)	41	2	1	3	0	44
	2006–07	33	(100)	0	()	33	2	1	3	0	36
6B	2002–03	15	(100)	0	(0)	15	0	0	0	0	15
	2003–04	16	(94)	1	(6)	17	0	1	1	0	18
	2004–05	30	(100)	0	(0)	30	0	1	1	0	31
	2005–06	20	(100)	0	()	20	0	0	0	0	20
	2006–07	25	(100)	0	()	25	0	1	1	0	26

TABLE 2 continued

Unit	Regulatory year	Hunter harvest Reported M	(%)	F	(%)	Total[a]	Estimated Unreported	Illegal	Total	Accidental death	Total
6C	2002–03	21	(81)	5	(19)	26	0	0	0	0	26
	2003–04	21	(81)	5	(19)	26	0	0	0	1	27
	2004–05	35	(88)	5	(13)	40	0	0	0	3	43
	2005–06	35	(90)	4	(10)	39	0	1	1	1	41
	2006–07	32	(46)	38	(54)	70	0	1	1	0	71
6D	2002–03	2	(100)	0	(0)	2	0	1	1	0	3
	2003–04	3	(100)	0	(0)	3	0	1	1	0	4
	2004–05	3	(100)	0	(0)	3	0	1	1	0	4
	2005–06	2	(100)	0	()	2	0	1	1	0	3
	2006–07	7	(100)	0	()	7	0	1	1	0	8
Unit 6	2002–03	65	(88)	9	(12)	74	2	2	4	0	78
TOTAL	2003–04	75	(89)	9	(11)	84	2	3	5	1	90
	2004–05	109	(94)	7	(6)	116	2	3	5	3	124
	2005–06	94	(92)	8	(8)	102	2	3	5	1	108
	2006–07	97	(72)	38	(28)	135	2	4	6	0	141

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

TABLE 3 Unit 6 moose harvest data by permit hunt, 2000–2005

Unit/hunt nr	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6A/RM160[a]	2002–03	Bull	68	63	48	52	13	(100)	0	(0)	13
	2003–04	Bull	68	51	55	45	15	(100)	0	(0)	15
	2004–05	Bull	62	69	47	53	10	(100)	0	(0)	10
	2005–06	Bull	72	47	39	61	23	(100)	0	()	23
	2006–07	Bull	61	69	47	53	10	(100)	0	()	10
6A/DM160[b]	2002–03	Bull	5	40	67	33	1	(100)	0	(0)	1
	2003–04	Bull	5	0	40	60	3	(100)	0	(0)	3
	2004–05	Bull	5	0	40	100	5	(100)	0	(0)	5
	2005–06	Bull	5	60	50	100	2	(100)	0	()	2
	2006–07	Bull	5	60	0	100	2	(100)	0	()	2
6A/DM162	2002–03	Antlerles	5	20	0	100	0	(0)	4	(100)	4
	2003–04	Antlerles	5	0	40	60	0	(0)	3	(100)	3
	2004–05	Antlerles	5	40	33	67	0	(0)	2	(100)	2
	2005–06	Antlerles	5	20	0	100	0	()	4	(100)	4
	2006–07	No Hunt	0				0		0		0
6B/RM164	2002–03	Bull	138	36	81	15	15	(100)	0	(0)	15
	2003–04	Bull	154	36	85	17	16	(94)	1	(6)	17
	2004–05	Bull	166	28	75	25	30	(100)	0	(0)	30
	2005–06	Bull	159	27	77	17	20	(100)	0	()	20
	2006–07	Bull	192	35	80	20	25	(100)	0	()	25

TABLE 3 continued

Unit/hunt nr	Regulatory year	Legal moose	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	(%)	Cows	(%)	Total reported harvest
6C/DM167	2002–03	Bull	5	0	0	100	5	(100)	0	(0)	5
	2003–04	Bull	5	0	0	100	5	(100)	0	(0)	5
	2004–05	Bull	9	11	0	100	8	(100)	0	(0)	8
	2005–06	Bull	9	0	0	100	9	(100)	0	()	9
	2006–07	Bull	9	0	0	100	9	(100)	0	()	9
6C/ Fed subst.[b]	2002–03	Both sexes	21	0	0	100	16	(76)	5	(24)	21
	2003–04	Both sexes	21	0	0	100	16	(76)	5	(24)	21
	2004–05	Both sexes	33	0	3	97	27	(84)	5	(16)	32
	2005–06	Both sexes	32	3	3	97	26	(87)	4	(13)	30
	2006–07	Both sexes	66	0	2	95	23	(38)	38	(62)	61

[a] RM prefix was a registration hunt, DM prefix a drawing hunt.
[b] Federal subsistence hunts, including bull, antlerless, and potlatch bull.

TABLE 4 Unit 6 moose hunter residency and success, 2000–2005

		Successful					Unsuccessful					
Unit	Regulator year	Local resident [a]	Nonlocal resident	Nonresident	Total	(%)	Local resident	Nonlocal resident	Nonresident	Total	(%)	Total hunter
6A East	2002–03	0	0	13	13	(27)	6	6	22	35[b]	(73)	48
	2003–04	1	2	13	17	(55)	3	3	8	14	(45)	31
	2004–05	1	3	22	26	(58)	0	4	15	19	(42)	45
	2005–06	1	2	9	12	(39)	0	3	16	19	(61)	31
	2006–07	5	1	14	21	(55)	4	4	9	17	(45)	38
6A West	2002–03	15	2	1	18	(58)	11	0	2	13	(42)	31
	2003–04	13	5	3	21	(49)	13	7	2	22	(51)	43
	2004–05	12	0	5	17	(100)	0	0	0	0	(0)	17
	2005–06	22	5	2	29	(64)	10	5	1	16	(36)	45
	2006–07	7	3	2	12	(57)	3	6	0	9	(43)	21
6A TOTAL	2002–03	15	2	14	31	(39)	17	6	24	48[b]	(61)	79
	2003–04	14	7	16	38	(51)	16	10	10	36	(49)	74
	2004–05	13	3	27	43	(69)	0	4	15	19	(31)	62
	2005–06	23	7	11	41	(54)	10	8	17	35	(46)	76
	2006–07	12	4	16	33	(56)	7	10	9	26	(44)	59
6B [c]	2002–03	13	2	0	15	(17)	68	5	0	73	(83)	88
	2003–04	14	3	0	17	(17)	76	6	0	82	(83)	99
	2004–05	28	2	0	30	(25)	83	7	0	90	(75)	120
	2005–06	18	2	0	20	(13)	109	21	0	130	(87)	150
	2006–07	23	2	0	25	(20)	88	11	0	99	(80)	124

TABLE 4 continued

Unit	Regulatory year	Successful Local resident [a]	Successful Nonlocal resident	Successful Nonresident	Successful Total	Successful (%) [b]	Unsuccessful Local resident	Unsuccessful Nonlocal resident	Unsuccessful Nonresident	Unsuccessful Total	Unsuccessful (%)	Total hunter
6C [c]	2002–03	26	0	--	26	(100)	0	0	--	0	(0)	26
	2003–04	25	1	--	26	(100)	0	0	--	0	(0)	26
	2004–05	39	1	--	40	(100)	0	0	--	0	(0)	40
	2005–06	35	4	--	39	(98)	1	0	--	1	(3)	40
	2006–07	67	3	--	70	(97)	2	0	--	2	(3)	72
6D	2002–03	1	0	0	2	(8)	21	2	1	24	(92)	26
	2003–04	3	0	0	3	(12)	17	4	1	22	(88)	25
	2004–05	3	0	0	3	(9)	22	7	2	31	(91)	34
	2005–06	2	0	0	2	(7)	20	7	1	28	(93)	30
	2006–07	5	0	2	7	(18)	26	4	2	32	(82)	39
Unit 6 TOTAL	2002–03	55	4	14	74	(34)	106	13	25	145	(66)	219
	2003–04	56	11	16	84	(38)	109	20	11	140	(63)	224
	2004–05	83	6	27	116	(45)	105	18	17	140	(55)	256
	2005–06	78	13	11	102	(34)	140	36	18	194	(66)	296
	2006–07	107	9	18	135	(46)	123	25	11	159	(54)	294

[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, 2000–2005

Unit	Regulatory year	Harvest periods 8/20–8/31	9/1–9/15	9/16–9/30	10/1–10/15	10/16–10/31	11/1–11/30	12/1–12/31	n [a]
6A East	2002–03	0	31	8	31	31	0	0	13
	2003–04	0	41	24	29	6	0	0	17
	2004–05	0	38	27	23	12	0	0	26
	2005–06	0	25	33	33	0	8	0	12
	2006–07	0	29	33	24	14	0	0	21
6A West	2002–03	0	44	50	0	6	0	0	18
	2003–04	0	62	33	5	0	0	0	21
	2004–05	0	18	12	6	65	0	0	17
	2005–06	0	21	10	31	38	0	0	29
	2006–07	0	33	0	0	17	50	0	12
6A TOTAL	2002–03	0	39	32	13	16	0	0	31
	2003–04	0	53	29	16	3	0	0	38
	2004–05	0	30	21	16	33	0	0	43
	2005–06	0	22	17	32	27	2	0	41
	2006–07	0	30	21	15	15	18	0	33

TABLE 5 continued

Unit	Regulatory year	Harvest periods 8/20–8/31	9/1–9/15	9/16–9/30	10/1–10/15	10/16–10/31	11/1–11/30	12/1–12/31	n [a]
6B	2002–03	0	100	0	0	0	0	0	15
	2003–04	0	100	0	0	0	0	0	17
	2004–05	0	100	0	0	0	0	0	30
	2005–06	0	95	5	0	0	0	0	20
	2006–07	0	80	20	0	0	0	0	25
6C	2002–03	0	52	20	16	12	0	0	25
	2003–04	0	50	12	19	12	8	0	26
	2004–05	0	53	20	13	8	5	1	40
	2005–06	0	62	8	18	8	5	0	39
	2006–07	0	30	25	16	14	9	6	69
6D	2002–03	0	0	0	0	0	0	0	2
	2003–04	0	0	100	0	0	0	0	3
	2004–05	0	0	100	0	0	0	0	3
	2005–06	0	100	0	0	0	0	0	2
	2006–07	0	67	33	0	0	0	0	6
Unit 6 TOTAL	2002–03	0	55	23	11	11	0	0	73
	2003–04	0	60	20	13	5	2	0	84
	2004–05	0	55	17	10	15	2	1	116
	2005–06	0	53	11	20	14	3	0	102
	2006–07	0	41	23	12	11	9	3	133

[a] Totals may include harvest of unknown date of kill.

TABLE 6 Unit 6 moose harvest percent by transport method, 2000–2005

Unit	Regulatory year	Airplane	Boat	3- or 4-wheeler	ORV	Highway Vehicle	n [a]
6A East	2002–03	100	0	0	0	0	13
	2003–04	88	6	0	0	6	17
	2004–05	85	8	4	4	0	26
	2005–06	58	25	8	0	8	12
	2006–07	65	10	15	10	0	21
6A West	2002–03	28	72	0	0	0	18
	2003–04	53	47	0	0	0	21
	2004–05	59	41	0	0	0	17
	2005–06	21	79	0	0	0	29
	2006–07	55	45	0	0	0	12
6A TOTAL	2002–03	58	42	0	0	0	31
	2003–04	71	26	0	0	3	38
	2004–05	74	21	2	2	0	43
	2005–06	32	63	2	0	2	41
	2006–07	61	23	10	6	0	33

TABLE 6 continued

Unit	Regulatory year	Airplane	Boat	3- or 4-wheeler	ORV	Highway Vehicle	n [a]
6B	2002–03	20	73	0	0	7	15
	2003–04	0	45	0	0	55	17
	2004–05	8	67	8	0	17	30
	2005–06	6	63	6	0	25	20
	2006–07	10	52	0	5	33	25
6C	2002–03	0	39	4	4	52	26
	2003–04	0	32	16	0	52	26
	2004–05	0	39	0	0	61	40
	2005–06	0	58	5	3	34	39
	2006–07	0	47	0	6	47	70
6D	2002–03	0	0	0	0	0	2
	2003–04	0	33	33	0	33	3
	2004–05	0	0	0	0	100	3
	2005–06	0	50	0	0	50	3
	2006–07	0	0	17	0	83	6
Unit 6 TOTAL	2002–03	30	46	1	1	21	74
	2003–04	31	31	7	0	30	84
	2004–05	32	37	3	1	27	116
	2005–06	15	61	4	1	19	101
	2006–07	17	40	3	6	35	135

[a] Totals may include harvest of using unknown transportation.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 7 (3520 mi^2)

GEOGRAPHIC DESCRIPTION: Eastern Kenai Peninsula

BACKGROUND

Federal public lands cover approximately 78% of Unit 7, 50% managed by the U.S. Forest Service–Chugach National Forest, 22% by the National Park Service–Kenai Fjords National Park, and 5% by the U.S. Fish and Wildlife Service–Kenai National Wildlife Refuge. The moose population in Unit 7 is at a low density relative to other units on the Kenai Peninsula. Severe winters with deep snow are normal for this region and probably contribute to a high mortality rate for moose in this area. Less than 10% of the moose harvest on the Kenai Peninsula over the past 20 years has come from Unit 7. Very little moose monitoring or research has been done by the Alaska Department of Fish and Game (ADF&G) in this unit since the 1970s and early 1980s due to budget constraints. However, moose survey and research collaborations between ADF&G and the U.S. Forest Service (USFS) are slated in the unit for 2006–2008.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVE

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

METHODS

Composition surveys are flown in traditional count areas as funding allows. Harvest data come from hunter information taken from harvest tickets. This report reflects updated data, so the information in the tables may differ slightly from past reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

A comprehensive moose survey has never been conducted in Unit 7. Limited composition surveys, combined with harvest reports, suggest the moose population has remained relatively stable during the past decade. The actual number of moose counted during composition counts is

not rigorously comparable between years, because survey intensity, locations, and conditions are inconsistent. We perform composition counts in order to get an adequate sample of moose to calculate ratios of bulls:cows and calves:cows. Composition counts conducted in 8 count areas in December of 2005 showed 23 bulls:100 cows and 11 calves:100 cows (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The traditional hunting periods for moose in Unit 7 has been in August and September for more than 30 years. The general season in Unit 7 has been 20 August–20 September since 1993. Since 1987, the bag limit has been one bull with a spike or fork on at least one antler, or 50-inch antlers, or antlers with three or more brow tines on at least one side. These antler restrictions have greatly increased the bull:cow ratios in many areas and contributes to the long-term sustainability of the moose population in Unit 7.

The average reported harvest from 2003 through 2006 in Unit 7 was 32 moose (Table 2).

Board of Game Action and Emergency Orders. During the March 2005 meeting, the board changed the season for the permit hunt DM522 from 20 October–20 November to 10 October–10 November.

Permit Hunts. Information for permit hunts DM210 and DM211, which encompass both Unit 7 and Unit 14C, are provided in the Unit 14C management report. Permit hunt DM522, which encompasses portions of Units 7 and 15A, tallied 2–3 bulls harvested each year (Table 3).

Hunter Residency and Success. About half of the general season hunters were residents of Unit 7 (Table 4). The success rate averaged 10% over the past four seasons (Table 4).

Harvest Chronology. Moose were harvested throughout the season, but in somewhat larger proportions at the start and end of the season (Table 5). The chronology of the harvest depends on weather conditions and other factors unrelated to moose abundance.

Transport Methods. Highway vehicles are the main transportation method used by successful hunters in Unit 7 (Table 6).

Other Mortality

Highway vehicles killed an average of 27 moose per year during the past 4 years in Unit 7 (Table 2). The effect of wolf and bear predation on moose and the degree of illegal poaching is unknown. The level of mortality for moose during severe winters is probably high and a significant limiting factor.

HABITAT

Assessment/Enhancement

No significant fires or other habitat alterations are known to have occurred in the unit during the reporting period.

CONCLUSIONS AND RECOMMENDATIONS

The ADF&G and the USFS have started a collaborative moose project slated to start in 2006 and continue for at least 2 years. The project entails conducting fall composition counts through a large portion of the unit, which will provide the most comprehensive assessment of the bull:cow and calf:cow ratios in the unit since the early 1980s. The project also involves fitting 20–40 moose with GPS-telemetry collars to gain information on moose movements, habitat use, adult and calf survival, and reproduction limitations in the unit. A summary of these findings will be included in the next moose management report.

New Federal Subsistence regulations have been adopted for Cooper Landing residents in Units 7, 15A, and 15B. This new Federal season will start in 2008. Due to conservation concerns, ADF&G was opposed to these Federal Subsistence regulations. Neither the Federal Regional Advisory Council nor the Federal Subsistence Board saw any conservation concerns with the new Federal hunting seasons. Future management reports will report the results and possible impacts of these Federal hunts.

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MCDONOUGH, T. 2008. Unit 7 moose management report. Pages 110–115 *in* P. Harper, editor. Moose management report of survey and inventory activities 1 July 2005–30 June 2007. Alaska Department of Fish and Game. Project 1.0. Juneau.

TABLE 1 Unit 7 moose aerial composition counts and estimated population size, 2003–06

Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
2003–04	24	27	18	249	304	700–1000
2004–05	No Surveys Conducted					700–1000
2005–06	23	11	8	422	465	700–1000
2006–07	No Surveys Conducted					700–1000

TABLE 2 Unit 7 reported general season moose harvest and accidental death, 2003–2006

Regulatory	Reported Hunter Harvest				Accidental death			Total Reported
Year	Bull	Cow	Unk	Total	Road	Train	Total	Mortality
2003–04	29	0	0	29	24		24	53
2004–05	32	0	0	32	30		30	62
2005–06	38	0	0	38	30		30	68
2006–07	30	0	0	30	25		25	55

TABLE 3 Unit 7 harvest for drawing permit hunts, 2003–2006

Hunt Nr	Regulatory Year	Permits Issued	Permittees that hunted	Percent success	Harvest			
					Bulls	Cows	Unk.	Total
DM522[a]	2003–04	25	14	21	3	0	0	3
	2004–05	25	18	17	3	0	0	3
	2005–06	25	18	17	3	0	0	3
	2006–07	25	21	10	2	0	0	2

[a] Includes area within Units 15A and 7.

TABLE 4 Unit 7 residency and success of moose hunters for the general season, 2003–2006

Regulatory Year	Successful				Unsuccessful				Total Hunters
	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b] (%)	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b]	
2003–04	14	13	2	29 (9)	147	147	9	304	333
2004–05	13	14	4	32 (9)	157	126	21	310	342
2005–06	19	16	3	38 (11)	141	143	11	295	333
2006–07	18	10	2	30 (9)	127	143	25	299	329

[a] Local = residents of Unit 7.

[b] Includes unspecified residency.

TABLE 5 Unit 7 moose general season harvest chronology (percent of harvest), 2003–2006

Regulatory Year	Harvest Periods 8/20–8/25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unknown	Harvest
2003–04	28	3	7	7	14	38	3	29
2004–05	16	6	9	6	28	31	3	32
2005–06	5	5	5	8	29	45	3	38
2006–07	23	0	17	13	13	33	0	30

TABLE 6 Unit 7 general season transport methods for successful moose hunters (percent of harvest), 2003–2006

Regulatory Year	Percent of Harvest 3/4 wheel-ATV	Airplane	Boat	Highway Vehicle	Horse/ Dogteam	ORV	Unknown	Harvest
2003–04	0	14	14	59	10	0	3	29
2004–05	0	13	9	59	13	6	0	32
2005–06	5	24	11	34	16	3	8	38
2006–07	7	13	10	50	13	0	7	30

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

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 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 later (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 considered 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, and 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.

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 state’s intensive management law.

METHODS

We scheduled fall sex and age composition 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 indicate populations in most of Unit 9 have been relatively stable over the past 28 years. Moose densities remained very low in Units 9A, 9B, 9D, and the southern portion of 9E.

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 2500 moose. The area of Unit 9C outside of Katmai National Park had approximately 800 moose. There were approximately 2000 moose in Unit 9B. Units 9A and 9D probably contained about 300 and 600 moose, respectively.

Population Composition

Poor weather conditions and inadequate snow cover frequently limit moose surveys in Unit 9. This has led to most trend areas being surveyed infrequently. Moose movements are also thought to add variability to survey results. New techniques to compensate for these limitations are being considered for future moose surveys in Unit 9.

Trend surveys were conducted during the fall of 2005 and 2007. Lack of snow cover during the November of 2006 prevented the completion of surveys in all subunits.

Bull:cow ratios in Unit 9B trend areas are generally lower than ratios reported during the 80s and 90s. Moose distribution and changes in harvest likely explain much of the change. Ratios are particularly low when the Nakeen trend area, which has had an average of 20 bulls:100 cows during the past 25 years (range 8–32), is included in the analysis. Bull:cow ratios in Unit 9B averaged 34 bulls:100 cows when the Nakeen trend area was excluded from the analysis. Surveys in 2007 indicate an adequate number of bulls exist on the landscape (Table 1). Calf ratios were above the 25-year average for this subunit in 2003 and slightly below average in 2005 (25-year average = 21.5 calves:100 cows, Table 1).

Bull:cow ratios in Unit 9C appear relatively stable in spite of the low ratio reported in 2003 and a possible increase in 2007 (Table 2). The survey conducted in 2007 incorporated a variation in sampling technique that may have influenced the ratio estimate, but a large number of yearling bulls were also observed which altered the ratio and also suggests that 2006 was a good year for moose calf recruitment. The calf:cow ratios in Unit 9C were extremely low between 1999 and 2003, but showed improvement in 2005 and 2007. This pattern of erratic calf ratios is normal for Unit 9.

Surveys in Unit 9E were not conducted on a sufficient scale to estimate the composition of moose on a subunit scale during this survey period. Bull:cow ratios are generally above management objectives in Unit 9E, but were abnormally low in 2005 (Table 3). The calf ratio observed in 2005 is among the highest reported in Unit 9E during the past 25 years. Taking sample size and historic variation into consideration, the population in Unit 9E appears stable. Harvests are not having a negative influence on bull:cow ratios.

While conducting line transect surveys for bears in Unit 9D during May and June of 2002, 86 moose were observed, of which 17 were calves. Because the data were collected during the moose calving season and the survey was not designed to assess moose populations, no useful comparisons can be derived from the number of calves observed. The observed sex composition was 87 bulls:100 cows, which indicates that the population is not heavily hunted.

MORTALITY

Harvest

Seasons and Bag Limit. In Unit 9A resident and nonresident hunters could hunt 1–15 September, and the bag limit was 1 bull. In Unit 9B nonresidents could hunt 5–15 September with a bag limit of 1 bull with ≥50-inch antlers or ≥4 brow tines; resident hunters could hunt 1–15 September and 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 20 August–15 September and 1 December–15 January.

The nonresident season dates in Unit 9C were the same as for Unit 9B; however, the nonresident bag limit was 1 bull with ≥50-inch antlers or ≥3 brow tines. The resident fall season has remained the same as 9B, but the resident winter season dates in Unit 9C were different in the Naknek River drainage and the remainder of 9C. Within the Naknek drainage any bull could be taken during the state hunting season of 1–31 December, while the remainder of 9C was open 15 December–15 January with the same bag limit. Within the southern portion of the Naknek drainage, the federal subsistence season was open 20 August–15 September under a registration permit (RM233). In December federal lands were open only to local rural residents, and a subsistence registration permit (RM232) was required to take antlerless moose.

The nonresident season in Unit 9E was 10–20 September, and the bag limit was 1 bull with an antler spread of ≥50 inches or ≥3 brow tines on at least 1 antler. The state season for resident hunters in Unit 9E was 10–20 September and 1 December–20 January. The bag limit in Unit 9E was 1 bull; however, moose taken 10–20 September must have a spike or 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 open 20 August–20 September and 1 December–20 January with a bag limit of 1 bull.

Unit 9D was open only to residents 15 December–20 January with a bag limit of 1 bull. Federal subsistence permits were issued with the same season dates and had a quota of 10 bulls from both the state and federal hunts.

Board of Game Actions and Emergency Orders. No changes were made to the moose hunting regulations in Unit 9 during this reporting period.

Federal Subsistence Board Actions. During the 2006 meeting the Federal Subsistence Board was successfully petitioned to reduce the bag limit by eliminating the cow harvest during the winter hunt on Becharof National Wildlife Refuge lands in 9C. During the 2007 meeting the Federal Subsistence Board extended the moose season in Unit 9E from 1–20 December to 1 December–30 January.

Hunter Harvest. Reported moose harvests have averaged 165 moose annually since 2000 (Table 4). Household surveys of several communities done by ADF&G's Subsistence Division and unconfirmed reports indicate that many moose are harvested that are not reported by hunters. Much of the unreported harvest occurs during closed seasons and a significant proportion of the animals taken are cow moose.

Permit Hunts. Federal subsistence registration permits are required for the early fall season hunt (FM233) and the December moose hunt (FM232) within the Becharof National Wildlife Refuge in 9C. Participation in these hunts is generally low.

Hunter Residency and Success. The number of moose hunters in Unit 9 peaked in 1987 at 694 hunters. Participation in the moose hunt dropped to an average of 561 hunters during the 1990's and has continued to decline in recent years (Table 5). While there have been fluctuations in the proportion of hunters from the 3 residency categories (local resident, nonlocal resident, and nonresident), the decline in the number of hunters was not attributed to any 1 group.

Since 1988 the success rates have been relatively stable for all 3 residency groups. Nonresidents typically had a higher success rate (average = 52% from 2000 to 2006, range = 48–57%) than either residents of Unit 9 (average = 28% from 2000 to 2006, range = 19–33%) or other Alaska residents (average = 29% from 2000 to 2006, range = 26–36%) because virtually all of them flew out to hunt, and many employed guides.

Harvest Chronology. Since 2000, approximately 89% of the reported moose harvest has occurred in September (Table 6). Reported harvest levels during the winter season have remained low and ranged from 7 to 15% of the total harvest, but the total winter harvests exceed reported values according to many sources.

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

Other Mortality

Moose calf production and condition appear to have improved since the 1960s and 1970s, but calf recruitment has remained low. Bear predation of neonatal moose appears to remain the primary cause. 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.

CONCLUSIONS AND RECOMMENDATIONS

Compared to other units statewide, harvests in Unit 9 have remained relatively stable for the past 28 years, despite major changes to moose regulations. Reduced harvests since 2000 reflect

changes in the number of moose hunters in Unit 9 and coincided with reduced opportunity to hunt caribou in portions of Unit 9. Changes in the number of moose taken have resulted from decreased effort and do not indicate differences in the moose population.

The average annual harvest reported since 2000 (165 moose) was within sustainable levels. An unknown number of unreported moose are taken each year, many of which are cows. In spite of this concern, the moose population appears stable in most of Unit 9, based on harvest statistics and trend data. Fortunately, illegal harvests can only affect a portion of the Unit 9 population because of the limited access imposed by poor winter travel conditions during recent years.

Tension between user groups over who should have access to moose in Unit 9 has increased with the decline of caribou populations throughout the unit. Recent proposals to change moose regulations typically ask for exclusion of select user groups to supposedly protect the moose population and they are often accompanied by proposals that create additional opportunity for other user groups that would be detrimental to the moose population. It is reasonable to assume that this tension surrounding moose and the sense of entitlement among some users is contributing to a disregard for regulations that were established to conserve the moose population. Illegal harvest activities pose the greatest threat to moose in areas that are easily accessed.

Brown bear predation on neonate moose and illegal harvests in select areas are the major limiting factors preventing an increase in moose densities in Unit 9. However, altering bear to 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 maintaining a high density bear population in Unit 9, and any drastic reduction in bear numbers would probably be opposed by a large segment of the public. Concern about the detrimental effects of illegal harvests is addressed regularly during public meetings and through law enforcement efforts, but a cessation of these practices will not occur without community support and involvement to deter these behaviors.

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TABLE 1 Moose composition counts in Unit 9B, 2000–2007

Year	Males: 100 cows	Yearling males: 100 cows	Calves: 100 females	Calf %	Adults	Total moose	Moose/hour
2003	14	3	26	19	74	91	30
2004	-	-	-	-	-	-	-
2005	23	5.5	19	13	158	182	20
2006	-	-	-	-	-	-	-
2007	40	4	2	2	103	106	27

TABLE 2 Moose composition counts in Unit 9C, 2000–2007

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose/hour
2000	33	2	7	5	290	306	52
2001	30	3	9	7	271	290	42
2002	-	-	-	-	-	-	-
2003[a]	23	3	5	4	91	96	25
2004	-	-	-	-	-	-	-
2005	34	9	19	12	440	504	36
2006	-	-	-	-	-	-	-
2007	40	8	20	13	236	270	34

[a] Includes some surveys by FWS.

TABLE 3 Moose composition counts in Unit 9E, 2000–2007

Year	Males: 100 females	Yearling males: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose/hour
2001	48	12	11	7	305	328	34
2002[a]	74	27	20	11	87	97	47
2003[a]	46	10	10	6	131	140	18
2004	-	-	-	-	-	-	-
2005[a]	25	5	22	15	81	95	19

[a] Includes some surveys by FWS.

TABLE 4 Annual moose harvest in Unit 9, 2000–2006

	Reported				Estimated	
Year	Male	Female	Unknown	Total	Unreported	Total
2000	176	2	2	180	100	280
2001	167	8	0	175	100	275
2002	171	6	2	179	100	279
2003	177	0	0	177	100	277
2004	158	3	0	161	100	261
2005	158	0	2	160	100	260
2006	124	1	0	125	100	225

TABLE 5 Moose hunter residency and success in Unit 9, 2000–2006

	Successful					Unsuccessful				
Year	Local resident	Nonlocal resident	Nonresident	Unk.	Total[a]	Local resident	Nonlocal resident	Nonresident	Unk.	Total[a]
2000	37	29	113	1	180	110	71	105	2	288
2001	33	51	89	2	175	100	93	67	0	260
2002	39	39	100	1	179	79	111	84	5	279
2003	41	32	102	2	177	88	92	91	2	273
2004	34	29	95	3	161	94	80	82	2	258
2005	43	32	84	1	160	87	73	92	3	255
2006	28	24	73	0	125	118	67	84	0	269

[a] Includes unknown residency.

TABLE 6 Reported moose harvest chronology (percent) in Unit 9, 2000–2006

Year	August 20–31	September 1–5	September 6–10	September 11–15	September 16–20	December 1–15	December 16–31	January 1–20	Other
2000	> 1	9	22	43	18	0	3	3	1
2001	> 1	7	26	41	14	3	7	1	1
2002	0	7	21	39	15	13	3	0	2
2003	>1	7	25	41	14	5	4	2	1
2004	0	9	21	46	14	6	3	1	>1
2005	0	11	20	38	19	3	4	4	1
2006	0	11	15	35	24	3	4	5	3

TABLE 7 Successful moose hunter transport methods (percent) in Unit 9, 2000–2006

Year	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unspecified
2000	62	0	26	7	2	< 1	< 1	3
2001	59	0	24	6	7	0	2	2
2002	65	0	28	3	0	1	2	1
2003	57	0	21	7	10	1	2	2
2004	59	0	25	4	**3**	3	2	4
2005	61	0	26	8	2	0	3	1
2006	61	0	23	5	8	0	1	2

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 11 (12,784 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. It increased during the 1950s and reached a peak in the early 1960s. When moose were most abundant, between 85 and 120 moose per hour were observed 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 during the early 1980s and probably peaked again in 1987 when 55 moose per hour were observed. Moose numbers declined in the 1990s because of severe winters and increased wolf predation.

Moose harvests in Unit 11 averaged 164 (range = 123–242) per year from 1963 until 1974. Either-sex bag limits were in effect until 1974, and cows made up as much as 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 harvesting of cows was prohibited. Between 1975 and 1989, fall seasons remained 1–20 September and harvests averaged 45 (range = 21–58) bulls per year by an average of 186 hunters. In 1990 the moose season was shortened in response to deep snow conditions and to bring it into alignment with adjacent Unit 13. In 1993, the current 20 August–20 September state season and bag limit were established. Harvests averaged 34 (range = 22–42) bulls by 131 hunters during the 1990s. In 2000 a federal subsistence season was opened and harvests increased.

Most of Unit 11 was included in Wrangell–Saint Elias National Monument in December 1978. In 1980 monument status was changed to park and preserve status with passage of the Alaska National Interest Lands Conservation Act. State hunting regulations still apply on private and preserve lands within Unit 11, though “hard park” lands–those within park, rather than preserve, boundaries–are much more closely managed by the National Park Service (NPS).

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 is usually conducted every year during the late fall to determine sex and age composition and population trends in a count area along the western slopes of Mount Drum. Because of a lack of snow, fall counts were not completed in 2002 and 2005. The survey was not flown in 2004 and 2007 due to budget constraints. Harvests and hunting pressure were monitored through a harvest ticket reporting system. 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. Weather conditions have been unfavorable for burning in recent years, and wildfires affected little or no habitat this reporting period.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

The average number of moose observed in Count Area (CA) 11 (212 mi^2; the western slopes of Mount Drum) from 1994 to 1996 was 132 moose (0.46 moose/mi^2) with a count rate of 29 per hour. The 3-year average between 1999 and 2001 was 106 moose (0.37 moose/mi^2) at 24 per hour, down 20% from the previous period. The 2003 and 2006 counts of 138 moose and 149 moose respectively (0.5 moose/mi^2), at a rate of 30–32 per hour, suggest moose numbers may have increased slightly over the last 5 years.

Population Size

An accurate population estimate is not available for all of Unit 11 because a complete unitwide census has never been conducted. Density estimates are available from three partial surveys conducted over the years. During a winter stratification survey in 1986, density estimates varied from 0.1–0.4 moose/mi^2 and resulted in an extrapolated population estimate of approximately 2500 moose (over 5200 mi^2 of moose habitat). A fall 1993 census conducted by NPS biologists resulted in a density of 0.58 moose/mi^2 with a unitwide extrapolated estimate of 3000 moose (Bill Route, NPS, personal communication). The most recent density data were collected in fall 2007 and moose density was estimated at 0.5 moose/mi^2 over a 3170 mi^2 area of GMU 11

(Mason Reid, NPS, personal communication). Extrapolation of moose density in the study area to the entire unit would result in a population estimate of approximately 2600 moose.

Population Composition

The bull:cow ratio in CA11 was 115:100 in 2003 and 92:100 in 2006 (Table 1). Bull:cow ratios have been between 92 and 157 bulls:100 cows since 1997. The bull:cow ratio in the 1997 NPS survey area was 52:100 with the area around the Nabesna road having the lowest number of bulls (Mason Reid, NPS, personal communication). The bull:cow ratio greatly exceeds the current management goal of maintaining no less than 30 total bulls:100 cows, and 15 adult bulls:100 cows.

The 2006 calf:cow ratio in CA-11 of 48:100 is the highest observed since 1979. CA11 calf:cow ratios normally range between 9 and 25 calves:100 cows. An unusually high ratio could be due to movement and/or increased production and survival over a small area. Reid reported calf:cow ratios of 19:100 for the NPS census in 2007, a figure more in line with values usually observed in CA11.

Distribution and Movement

Data from past fall composition and winter stratification surveys, field observations, and reports from the public indicate 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 feet. Migrations to lower elevations begin with snowfall, but usually are not complete 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 Limits. The state general season is 20 August–20 September, with a bag limit of 1 bull with spike-fork antlers, or 50-inch antlers or antlers with 3 or more brow tines on at least 1 side. The federal subsistence season has the same dates with a bag limit of 1 bull.

Board of Game Actions and Emergency Orders. The Board of Game took no actions affecting Unit 11 moose hunting this reporting period.

Hunter Harvest. The combined federal and state harvest for the 2006–07 season was 40 bull moose (Table 2). The reported bull moose harvest averaged 46 (range = 39–55) a year 2000–2005. The 2006 harvest is within this range and no trends are evident.

Hunter Residency and Success. Table 3 gives residency breakdowns for successful and unsuccessful moose hunters in the state general hunt. Local residents accounted for 32% (n=7) of the total moose taken in Unit 11 during 2006, while nonresidents took 36% (n=8). The

remainder (n=7) went to nonlocal Alaska residents. Though success rates appear to have fallen over the past decade for area residents in the state harvest ticket database, most of the moose harvested by area residents are now reported through the federal permit system established by the NPS in 2000. Local residents took 63% of the combined state and federal harvests.

The overall hunter success rate in 2006 was 23% for the state general hunt, similar to the 5-year average of 25% in 2001–2005. Success rates for federal subsistence hunters have been lower, averaging 14% (range = 8–20), (Table 4). Successful state hunters averaged 6.2 (range = 5–6.9) days in the field to kill a moose during this reporting period, while unsuccessful hunters averaged 7.3 (range = 6.9–7.7) days in the field. No trend was evident in this effort data.

Harvest Chronology. Chronology data indicate most moose are taken late in the season in Unit 11 (Table 5). Bull moose are more vulnerable then, because their movements increase at the onset of rut in mid September, which also coincides with leaf fall.

Transportation Methods. Unit 11 moose hunters use mostly aircraft, 3-or 4-wheelers, or highway vehicles to reach hunting areas (Table 6). No trends were observed in the transportation data for this reporting period. NPS regulations restrict transportation methods in Unit 11, limiting hunting opportunities throughout the unit. Aircraft cannot be used for hunter transportation in portions of the unit designated as park. Except for federal subsistence hunting, all off-road vehicle use for hunting is restricted to existing trails by permit only. Federal subsistence hunters do not need a permit to use 3-or 4-wheelers or ORVs and are not limited to existing trails; thus, their use in the state hunt may be declining because more locals are hunting from these vehicles under the more liberal federal subsistence bag limits and transportation regulations.

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 and reports by hunters and trappers of suspected wolf predation indicate that wolves are important predators of moose in the unit. Brown bear predation is less apparent because it occurs during early summer, and detection is difficult. The low calf:cow ratios observed during fall counts suggest early calf mortality similar to that observed in areas with documented high brown bear predation on neonatal moose calves. The Unit 11 moose population will probably remain at low densities as long as predation continues to limit recruitment. This suppression can occur over long periods when alternative prey such as sheep and caribou are available (Gasaway et al. 1983), as they are in Unit 11.

HABITAT

Assessment

Fires occurred throughout much of Unit 11 prior to the mid 1940s, when the Bureau of Land Management (BLM) began suppressing fires. The benefits of those fires, increased browse, were reached in the 1960s, and moose numbers were high over much of the unit. Only 1 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 fires have either received initial fire suppression, 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.

During the 1990s, limited commercial clearcut logging occurred in the lower Chitina River Valley on privately owned lands. The willow regrowth in some of these cuts has been substantial. However, much of it remains underused by moose, because predation remains the most limiting factor for moose within Unit 11.

Enhancement

Habitat manipulation to benefit moose is not currently an option in Unit 11 because most of the area 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. Should a fire ignite under the right conditions, substantial moose habitat could be regenerated.

CONCLUSIONS AND RECOMMENDATIONS

An increase in the number of moose counted, the moose per hour figures, and the moose per mi^2 figures lead to the conclusion that moose numbers in the western portion of Unit 11 may have increased slightly between 2001 and 2006. Recent winters have been milder and snow depths not deep enough to result in additional mortality. Predation remains the limiting factor for moose in GMU 11. Given the relatively high numbers of brown bears and wolves in Unit 11, the moose population will probably remain at a low density for an extended period of time. Annual fluctuations may occur when predation rates respond to changing winter severity.

Moose hunting patterns have not changed considerably in Unit 11 during this reporting period for either the state general hunt or the federal subsistence hunt. The number of hunters has increased since 2000 for all hunts combined, but much of this is due to the establishment of a separate NPS federal subsistence moose permit for the federal subsistence hunt that same year. Additionally, as new communities are added to the federally qualified list by the Federal Subsistence Board, more hunters are drawn to the unit in search of moose. The liberal bag limit of any bull and unlimited ORV use in the federal subsistence hunt draw considerably more interest than the state general hunt, which has antler restrictions.

Unit 11 has the potential to support more moose. The population objective of maintaining moose at existing densities (0.3 to 0.5 moose/mi^2) should be reconsidered and perhaps increased. To do this, we need to explore options available to managers to enhance the moose population consistent with NPS regulations. I recommend reviewing the control and enforcement of moose harvest in Unit 11. Dual management creates numerous enforcement and reporting problems, such as illegally taken moose on state or private land being reported as federal subsistence moose.

LITERATURE CITED

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TABLE 1 Unit 11 (CA-11) fall aerial moose composition counts, 2000–2007

Year	Bulls: 100 females	Yearling bulls: 100 females	Calves: 100 females	Calf %	Adults	Total moose	Moose /hour	Density moose/mi ^{2}
2000	157	3	24	9	95	104	23	0.4
2001	94	4	9	4	89	93	19	0.3
2002	No data	--	--	--	--	--	--	--
2003	115	7	15	7	129	138	30	0.5
2004	No data	--	--	--	--	--	--	--
2005	No data	--	--	--	--	--	--	--
2006	92	11	48	20	119	149	32	0.5
2007	No data							

TABLE 2 Unit 11 Moose harvest [a] and accidental death, 2000–2007

Regulatory Year	Reported M	Reported F	Reported Total [b]	Unreported	Estimated Illegal	Total	Total
2000–01	45	0	46	5	5	10	56
2001–02	41	1	43	5	5	10	53
2002–03	51	0	52	5	5	10	62
2003–04 [c]	39	0	39	5	5	10	49
2004–05 [c]	55	0	56	5	5	10	66
2005–06	48	0	48	5	5	10	58
2006–07	40	0	40	5	5	10	50

[a] Includes state harvest tickets and federal registration permit hunts and is corrected for double reporting.
[b] Includes unknown sex.
[c] Double reporting data not available, and harvest not corrected for double reporting.

TABLE 3 Unit 11 Moose hunter residency and success for general state harvest ticket hunt only, 2000–2007

	Successful				Unsuccessful			
Regulatory Year	Local resident	Nonlocal resident	Non Resident	Total [a]	Local resident	Nonlocal resident	Non-resident	Total [a]
2000–01	13	8	4	30	36	39	4	80
2001–02	8	12	8	31	49	34	3	88
2002–03	10	13	8	33	50	30	8	88
2003–04	8	7	14	29	34	45	12	95
2004–05	6	10	13	30	34	34	11	79
2005–06	8	5	6	19	34	36	15	85
2006–07	7	7	8	22	27	38	4	72

[a] Includes unspecified residency.

TABLE 4 Unit 11 Federal subsistence permit hunt, 2000–2007

Hunt	Regulatory year	Permits issued	Percent[a] did not hunt	Number (%) unsuccessful hunters	Number (%) successful hunters	Bulls	Cows	Unknown	Harvest
RM 714	2000–01	161	16	97 (80)	24 (20)	23	0	1	24
	2001–02	183	22	113 (88)	16 (12)	14	1	1	16
	2002–03	191	27	108 (84)	21 (16)	20	0	1	21
	2003–04	245	22	141 (94)	9 (6)	9	0	0	9
	2004–05	263	30	127 (83)	26 (17)	26	0	0	26
	2005–06	231	27	123 (84)	24 (16)	24	0	0	24
	2006–07	254	30	150 (89)	18 (11)	18	0	0	18

[a] Percent of all permittees returning reports.

TABLE 5 Unit 11 Moose harvest (%) chronology by seasonal weeks for general state harvest ticket hunt only, 2000–2007

Regulatory Year	Season Dates	*Week of Season* 1st	2nd	3rd	4th	5th
2000–01	20 Aug–20 Sep	7	3	10	27	53
2001–02	20 Aug–20 Sep	7	7	7	30	50
2002–03	20 Aug–20 Sep	13	0	23	29	35
2003–04	20 Aug–20 Sep	11	11	18	36	25
2004–05	20 Aug–20 Sep	3	3	21	34	38
2005–06	20 Aug–20 Sep	11	16	16	26	32
2006–07	20 Aug–20 Sep	0	14	27	23	36

TABLE 6 Unit 11 Successful moose hunter transport methods (%) for general state harvest ticket hunt only, 2000–2007

Regulatory Year	Airplane	Horse	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown
2000–01	47	0	0	27	0	7	17	3
2001–02	55	0	3	26	0	6	10	0
2002–03	36	3	15	24	0	6	12	3
2003–04	60	3	3	17	0	10	7	0
2004–05	50	7	0	13	0	13	13	3
2005–06	42	5	0	32	0	5	16	0
2006–07	41	9	0	36	0	0	14	0

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

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

GEOGRAPHIC DESCRIPTION: Upper Tanana and White River drainages

BACKGROUND

Following federal predator 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. Between the mid 1970s and early 1980s, the Unit 12 moose density was estimated between 0.2 and 0.4 moose/mi^2 (ADF&G, unpublished data, Tok).

In response to the declining moose populations, wolf control programs were conducted in adjacent Units 20D (1980), 20E (1981–1983), and in northern Unit 12 (1981–1983). Beginning in regulatory year (RY) 1982 (RY = 1 July through 30 June, e.g., RY82 = 1 Jul 1982–30 Jun 1983), attempts were made to reduce the grizzly bear population by liberalizing grizzly bear hunting regulations. Small-scale moose habitat enhancement programs were conducted during the late 1980s and 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).

Based on data collected during October–November aerial composition surveys and area-specific population estimation surveys from 1989 through 2004, the moose population in Unit 12 remained relatively stable from 1989 to 1993; grew slightly during 1994–1997, possibly due to increased calf survival; and remained stable during 1998–2004. During the growth phase of 1994–1997, the most apparent increase occurred in northwestern Unit 12 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, 0.6 moose/mi^2 by 1994, and about 1.0 moose/mi^2 in 1997.

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

Unit 12 has traditionally 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 come 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. As moose numbers declined in the early 1970s, season length was shortened and cow seasons were eliminated by 1975, and the Nabesna Road moose season was closed entirely from 1975 through 1981. Between 1986 and 1991, the Little Tok River drainage was closed to moose hunting because of low recruitment and a declining bull:cow ratio. Restrictive season length and bag limits have continued since 1991.

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

During 2000–2003, in cooperation with Tetlin National Wildlife Refuge (Tetlin NWR) staff, we estimated moose population size and composition using the geospatial population estimator method (GSPE; Ver Hoef 2001, DeLong 2006, Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique, in all of Unit 12 excluding those portions of the Nabesna, Chisana, and White River drainages within Wrangell–St. Elias National Park and Preserve.

In fall 2004, Tetlin NWR staff conducted a moose population estimation survey in a 2954-mi^2 area encompassing the Tetlin NWR and adjacent state and private lands. During fall 2005 and 2006, Alaska Department of Fish and Game (ADF&G) staff conducted a GSPE moose

population estimation survey in a 2845-mi^2 area on state and private lands in northern and western Unit 12. No other surveys were conducted during RY05–RY06. The average search intensity for the 2004 Tetlin and 2005 ADF&G surveys was approximately 4.0 min/mi^2. Given this low search intensity we do not have an appropriate sightability correction factor to estimate total moose in the survey areas (R. Boertje, ADF&G, unpublished data, Fairbanks). Therefore, population estimates provide numbers of observable moose with a cost-efficient, low-intensity search.

HARVEST

Harvest was estimated using harvest reports. To increase the reporting rate, reminder letters were sent to hunters who did not initially report. Information obtained from the reports was used to determine total harvest, hunter residency, success rates, harvest chronology, and transportation used. Harvest data were summarized by regulatory year. Estimates of moose legally harvested outside the hunting season for ceremonial potlatches were obtained by interviewing residents and public safety officers of villages where potlatches took place.

HABITAT

Enhancement

We continued work with the Department of Natural Resources–Division of Forestry on a cooperative wildlife habitat logging plan for the lower Tok River drainage to increase deciduous browse and cover for wildlife and to provide nursery structure for planted spruce seedlings. The *Robertson River Prescribed Burn Plan* (Paragi et al., ADF&G/DNR 2002 unpublished Robertson River burn plan, Fairbanks) was completed in 2002and may be implemented when conditions and funding allow.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In RY03 we estimated the observable Unit 12 moose population at 2900–5100 moose (±22%, 90% CI), with a search intensity of approximately 4.0–5.0 min/mi^2. Total estimated number of moose was 3600–6400 using a conservative sightability correction factor of 1.25. This is an estimated density of 0.6–1.1 moose/mi^2 of suitable moose habitat (6000 mi^2).

During RY04–RY06, a unitwide population survey was not conducted. However, results from the 2004 Tetlin survey (Collins et al. 2005) and the 2005 and 2006 ADF&G surveys of northwestern Unit 12 (Table 1) indicated a stable trend. Therefore, it is likely the unitwide trend was stable during RY04–RY06.

Localized moose harvest likely caused declines in moose numbers near villages and communities in Unit 12. Poaching and legal harvest for funeral and ceremonial potlatches likely had the greatest effect, because cow moose were often harvested.

Research has shown that predation by both wolves and bears was the primary factor maintaining the area moose populations at low densities (0.2–1.1 moose/mi^2, Gasaway et al. 1992; FWS–Tetlin NWR, unpublished data, Tok).

Population Composition

Moose composition surveys were conducted in portions of Unit 12 in the fall during 1988–2006 (Table 2). During 2005 and 2006, bull:cow ratios were 22:100 and 37:100, respectively, in western and northern Unit 12. The bull:cow ratio within a 731-mi^2 portion of the upper Tok River drainage, excluding most of the Little Tok River drainage, was estimated at 22 bulls:100 cows in 2005. In RY06 the bull:cow ratio in this area was estimated at 24 bulls:100 cows after an antler restriction was implemented for resident hunters and bulls with spike or forked antlers (spike–fork) were eliminated from the nonresident bag limit. Calf survival to 5 months was 30–41 calves:100 cows and yearling bull survival was 7–11:100 cows (Table 2) during 2005 and 2006.

Distribution and Movements

Moose occur throughout Unit 12 below an elevation of about 4500 feet. There are about 6000 mi^2 (15,540 km^2) of suitable moose habitat in the unit. There are both migratory and nonmigratory segments of the population, and moose that rut in the Tok River area appear to move the greatest distances. Many cows migrate south of the Alaska Range for calving, return to the Tok River for the rut, 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).

During RY99–RY06, 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 legal harvest potlatches contributed to the decline of these resident moose.

MORTALITY

Harvest

Season and Bag Limit. Seasons and bag limits in Unit 12 are summarized in Table 3.

Alaska Board of Game Actions and Emergency Orders. In spring 2000 the Alaska Board of Game identified the moose population in Unit 12 as important for high levels of human consumptive use under the Intensive Management (IM) law (AS 16.05.255[e]–[g]). This designation means the board must consider intensive management when regulatory action to significantly reduce harvest becomes necessary. The board set the Unit 12 IM population objective at 4000–6000 moose and IM harvest objective at 250–350 moose. Reducing harvest could become necessary if the population is depleted or has reduced productivity.

Since the mid 1970s, communities in and adjacent to Units 12 and 20E have expressed concern about chronically low moose densities due to predation by wolves and bears. These communities proposed various predator control programs to increase moose numbers. During the spring 2004 Board of Game meeting, the Upper Tanana–Fortymile Fish and Game Advisory Committee and the public provided testimony to explain the problem and made proposals to increase the moose

population. The board subsequently requested that ADF&G prepare a draft wolf and brown bear predation control implementation plan.

At the request of the board, ADF&G developed the Upper Yukon–Tanana Predator Control Plan (UYTPCP) to increase moose survival in portions of Units 12 and Unit 20E. At their November 2004 meeting, the board approved the UYTPCP, which allowed the department to conduct a wolf and brown bear population reduction or regulation program for up to 5 years, beginning 1 January 2005 in the Upper Yukon–Tanana predator control area in Units 12 and 20E. Wolf control was approved for a 6600-mi^2 area in southern Unit 20E and the portion of Unit 12 north of the Alaska Highway and west of the Taylor Highway. Grizzly bear control was approved for a 2700-mi^2 portion of southern Unit 20E to reduce predation on moose calves.

During the May portion of the spring 2006 Board of Game meeting, the Upper Yukon–Tanana predator control area was enlarged to 18,750 mi^2 to include most of the Fortymile caribou herd's annual range, largely to benefit the caribou herd. The board authorized wolf control in the entire predator control area, and expanded the Unit 12 portion of the predator control area to include the portion of Unit 12 north of the Alaska Highway and east of the Taylor Highway. Brown bear control was limited to a 4050-mi^2 portion of southern Unit 20E to reduce predation on moose calves.

The board implemented antler restrictions (spike–fork, 50-inch antlers, or antlers with 4 or more brow tines) for residents and eliminated spike–fork bulls from the nonresident bag limit in the entire Tok River drainage upstream from the Tok Cutoff bridge. These changes were implemented due to concerns about declining bull numbers and the low bull:cow ratio (22 bulls:100 cows), which signaled a potential of falling below the management objective of 20 bulls:100 cows.

Harvest by Hunters. Reported harvest in Unit 12 was 134 bulls and 2 moose of unknown sex in RY05 and 118 bulls in RY06 (Table 4). The harvest during the previous 5 years was similar, averaging 122 bulls annually (range 101–137).

Total unitwide harvest represented ≤4% of the estimated prehunt population in recent years and had little impact on the unitwide population dynamics. During RY05–RY06 the annual out-of-season take was estimated at 25–40 moose, mostly cows. Most out-of-season take occurred near communities and along the road system.

Hunter Residency and Success. During RY05–RY06, an average of 584 hunters (range 574–594) reported hunting moose in Unit 12 (Table 5). Hunter numbers increased from the previous 5-year average of 536 hunters (9% increase). Participation by local and nonlocal Alaska residents and nonresidents all added to this increase. In RY05 the success rate in Unit 12 was 24%, which was higher than the previous 5-year average of 22%. In RY06 the success rate dropped to 20%, likely due in part to the new antler restrictions in the upper Tok River drainage.

During RY05–RY06, local residents accounted for an average of 51% of moose hunters, nonlocal residents averaged 38%, and nonresidents 11%. The number of local and nonresident hunters has remained relatively constant since RY94, but the number of nonlocal hunters has increased. Local hunters took 39% and 41% respectively of the reported harvested bulls during

RY05–RY06, nonlocals took 38% and 36%, and nonresidents took 22% in both years (Table 5). Harvest by nonlocal Alaska residents increased during RY99–RY06 compared to RY93–RY98 due to a 39% increase in the number of nonlocal Alaska residents who hunted in Unit 12.

Harvest Chronology. Beginning in RY01 the hunting season in most of Unit 12 was split into 2 periods: 24–28 August and 8–17 September. This attempt to maintain harvest within sustainable levels eliminated the large influx of hunters during Labor Day weekend, but retained overall season length (15 days). During the first 5 days of the season in RY01–RY06 (24–28 Aug) harvest was reduced 41% ($\bar{x}$ = 11 bulls) compared to RY93–RY00 (1–5 Sep, $\bar{x}$ = 27 bulls) (Table 6). High harvest was regained during the 10-day September season beginning in RY03 when the number of hunters increased. However, the unitwide harvest has remained within sustainable levels.

Transport Methods. During RY05–RY06, the type of transportation used most by successful hunters was 4-wheelers (ATV, $\bar{x}$ = 37%), followed by airplane ($\bar{x}$ = 19%), boat ($\bar{x}$ = 15%), highway vehicle ($\bar{x}$ = 14%), other ORV ($\bar{x}$ = 8%), and horse ($\bar{x}$ = 7%, Table 7). During RY90–RY00, an average of 19% of successful hunters used ATVs and 24% used highway vehicles, compared to 34% and 15% respectively during RY01–RY06. This represents a 79% increase in ATV use by successful hunters and a 37% decrease in use of highway vehicles. Use of all other transportation types by successful hunters remained relatively constant.

Other Mortality

Predation by wolves and grizzly bears has likely been the greatest source of mortality for moose in Unit 12 and has likely been the major factor keeping the population at a low density since the mid 1970s. In contrast to most other areas that contain sympatric moose, wolf, and grizzly bear populations, wolves may be the primary predator on moose calves on the Northway–Tetlin Flats, based on a sample of 10 radiocollared newborn calves during the late 1980s (ADF&G, unpublished data; FWS–Tetlin NWR, 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 bears were likely more significant predators in these areas.

HABITAT

Assessment

Nearly 30 years of wildfire suppression allowed for vast areas of potentially good moose habitat to become dominated by spruce forests lacking abundant moose browse. We have conducted browse surveys periodically since the 1970s and found that in most years, use of preferred browse species is low relative 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 RY05–RY06, habitat was not limiting the moose population in Unit 12, but medium- to large-scale creation of early seral species could result in a higher moose population, as evidenced by moose population increases in the 1969 Ladue burn in eastern Unit 20E (Gardner 2000), the 1990 Tok burn, and the Teslin burn in Yukon, Canada (Boertje et

al. 1995). Boertje et al. (1995) hypothesized that seral stages reduce predation efficiency in a variety of ways.

Considering the population status and trends of wolves and grizzly bears in Unit 12, the moose population is likely to remain at low densities for an extended period. However, it appears that concentrated public wolf trapping and bear harvest could cause local populations of moose to increase, especially in areas that received habitat enhancement. The likely mechanism is improved calf, yearling, and adult survival (Gasaway et al. 1983, 1992). A slight increase in the moose population in Unit 12 north of the Alaska Highway may have occurred after recent wolf control efforts. However, additional population data are needed to evaluate moose and wolf numbers.

Enhancement

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

In 1990 a wildfire burned approximately 97,000 acres of primarily decadent black spruce muskeg in the Tetlin Hills and adjacent to Tok. Quality moose browse species recolonized much of this area and, in response, the moose population increased rapidly (0.19 moose/mi^2 in 1989 to 1.0 moose/mi^2 by 1997). Excellent moose winter browse is expected to persist for the next 10–15 years.

Local residents observed the increase in moose in the area burned by the 1990 Tok wildfire. As a result, local residents are receptive to using fire or other habitat enhancement techniques to benefit moose, as evidenced by public support of the planned prescribed burns in the Robertson River and near Tanacross village. No prescribed burns were conducted during RY05–RY06.

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 3–10 feet tall; <1% were above 10 feet and unavailable for moose. We documented continual use of this area during winter by 10–30 moose and observed increased use as calving habitat.

Since 1998 we have been working in cooperation with the Department of Natural Resources–Division of Forestry to determine suitable timber harvest sites within a proposed 1000-acre timber sale area in the Tok River valley. Potential areas to be harvested 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 to promote willow and aspen regeneration following timber harvest on these sites. Harvested areas will be 80–200 acres in size. No mechanical treatment projects were conducted during RY05–RY06.

NONREGULATORY MANAGEMENT PROBLEMS OR 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 needs to be reduced. The department has tried to address this problem with local villages during village council meetings and Traditional Knowledge workshops but limited corrective steps have been taken. Potlatches are culturally important and should be maintained; however, restrictions on harvest should be implemented, especially in portions of Unit 12 where the moose densities are very low. In summer 2004 we worked with village residents, the Tanana Chiefs Conference, and ADF&G–Subsistence Division staff to design management of potlatch moose harvest that better protects the moose population while meeting the villages' needs. These efforts will continue.

CONCLUSIONS AND RECOMMENDATIONS

During RY05–RY06, moose were far less numerous in Unit 12 than in the 1960s. Population surveys in fall 2005 and 2006 indicate the unitwide population is likely stable at 3600–6400 moose (0.6–1.1 moose/mi^2 of suitable moose habitat), which met the IM population objective. Moose numbers in portions of the unit, especially near roads, were very low (<0.2 moose/mi^2), which primarily affected subsistence hunters and nonconsumptive users. Every year travelers on the Alaska Highway comment on the lack of wildlife in the upper Tanana Valley. Habitat was not limiting, but predation and out-of-season take in certain areas maintained the moose population at low density.

During RY05–RY06 the Unit 12 moose management objective of maintaining a posthunting sex ratio of at least 40 bulls:100 cows east of the Nabesna River and 20 bulls:100 cows in the remainder of the unit was met. However, the bull:cow ratio in the more accessible areas of the unit declined to 20–25:100 due to moderate harvest rates and low yearling bull recruitment. In the upper Little Tok River drainage, an antler restriction regulation was adopted in RY96 to protect the bull:cow ratio but allow maximum hunter opportunity. This area was expanded in RY06 to include a larger portion of the upper Tok River drainage for similar reasons. Harvest may need to be restricted in a similar manner in other areas with high harvest rates to maintain an adequate bull:cow ratio to meet management objectives.

During RY01–RY06 the most significant change in harvest patterns was the increase in the portion of the harvest by hunters who used 4-wheelers (34%) compared to RY90–RY00 (19%). Since RY01, harvest has averaged 123 moose (range 101–137). This harvest rate is within sustainable levels, based on a 3–4% harvest rate, with bulls-only harvest. This harvest also meets the amount necessary for subsistence. However, continued harvest of cows is likely not sustainable. Additional efforts need to be made to track overall cow harvest within the unit.

A total of 136 and 118 moose were reported harvested during RY05 and RY06 respectively, which did not meet the IM harvest objective of 250–450 moose. Recruitment of young moose into the population was not high enough in accessible areas of Unit 12 to achieve the IM harvest objective. To meet this harvest objective, recruitment along the road and trail systems must be improved. Modeling data indicate IM harvest objectives could be met in these portions of the unit if intensive habitat management is coupled with elevated wolf and bear harvest.

Population trends were monitored. Additional habitat enhancement programs were planned and should be implemented during the next 2 years. Hunting seasons and bag limits allowed maximum hunting opportunity and met subsistence needs. We continue to work with local villages to manage moose harvest and reduce harvest of cows for potlatch ceremonies. Moose viewing opportunities were shared with visitors and local residents.

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TABLE 1 Unit 12 Northwest population estimate using the geospatial population estimator, 2000–2006

Year	Area surveyed	Survey size (mi^2)	Number of sample units surveyed	Population estimate (±90% CI)	Population estimate with SCF[a]
2000	Northwest Unit 12	2846	60	2575 (±23%)	3219
2001	Northwest Unit 12	2865	79	2204 (±15%)	2755
2003	Northwest Unit 12	2845	69	3064 (±35%)	3830
2005	Northwest Unit 12	2845	48	2129 (±15%)	2661
2006	Northwest Unit 12	2702	89	2317 (±18%)	2896

[a] Sightability correction factor of 1.25 used in estimate.

TABLE 2 Unit 12 aerial moose composition counts, fall 1988–2006

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Moose observed	Adults observed	Calves observed	Percent calves	Moose/hr
1988	64	18	33	1133	943	189	17	40
1989[a]	50	13	30	1317	1094	223	17	44
1990	47	12	25	1256	1071	185	15	40
1991	49	12	24	1472	1264	200	14	44
1992	45	10	26	1071	906	165	15	32
1993[b]	26	7	36	850	662	187	22	57
1994[c]	38	16	39	414	327	87	21	
1994[d]	97	13	25	421	374	47	11	44
1995[d]	82	12	26	526	461	65	12	51
1996	39	9	32	1258	1022	236	19	57
1997[c]	36	11	41	596	458	138	23	
1997[d]	87	22	31	512	439	73	14	39
1998[e]	65	14	34	277	229	48	17	
1998[f]	38	7	29	150	124	26	17	54
1999[b]	22	8	17	823	721	102	12	65
2000[g,h]	40	9	18	630	558	72	11	
2000[h,i]	84	10	34	268	229	39	15	
2001[g,h]	40	11	27	672	566	106	16	
2001[h,i]	64	18	33	466	400	66	14	
2002[g,h]	42	12	15	350	305	45	13	
2003[g,h]	25	7	32	575	464	111	19	
2003[h,i]	89	15	33	564	475	89	15	
2004[h,i]	70	16	48	437	351	89	22	
2005[g,h]	22	11	30	384	315	69	20	
2006[g,h]	37	7	41	873	688	185	21	

[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 stratification" 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. Survey conducted by Alaska Department of Fish and Game.; [h] Ratios and percentages determined using weighted contributions from high and low sample areas. Actual counts of cows, calves, and bulls were not used in estimates.
[i] Survey area includes federal and private lands in eastern and southern Unit 12. Survey conducted by Fish and Wildlife Service–Tetlin National Wildlife Refuge.

TABLE 3 Unit 12 moose hunting seasons and bag limits, regulatory years 2005–2006 and 2006–2007

Regulatory year	Area	Season		Bag limit[a]
2005–2006	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:	24–28 Aug 8–17 Sep	1 bull with spike–fork antlers or 50 inch antlers or antlers with 4 or more brow tines on at least one side.
		NONRESIDENT:	8–17 Sep	1 bull with spike–fork antlers 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Unit 12, east of the Nabesna River and south of the winter trail running southeast from Pickerel Lake to the Canadian Border.	RESIDENT:	1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
		NONRESIDENT:	1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Remainder of Unit 12.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull. Or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
2006–2007	Unit 12, that portion in the Tok River drainage upstream from the Tok Cutoff Bridge, including the Little Tok River drainage.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull with spike–fork antlers or 50-inch antlers or antlers with 4 or more brow tines on at least one side.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Unit 12, east of the Nabesna River and south of the winter trail running southeast from Pickerel Lake to the Canadian Border.	RESIDENT:	1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
		NONRESIDENT:	1–30 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Remainder of Unit 12.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull. Or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.

[a] Fifty-inch antlers defined as having a spread of at least 50 inches or at least 4 brow tines on at least one side.

TABLE 4 Unit 12 moose harvest and accidental death, regulatory years 1990–1991 through 2006–2007

Regulatory year	Harvest by hunters							Accidental death		Total
	Reported				Estimated					
	M (%)	F (%)	Unk	Total	Unreported	Illegal	Total	Road	Total	
1990–1991	94 (100)	0 (0)	4	98	15–20	30–40	45–60	4–5	4–5	147–163
1991–1992	109 (100)	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 (100)	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 (100)	0 (0)	2	101	20–50	3–10	23–60	3–5	3–5	127–166
2002–2003	124 (100)	0 (0)	0	124	20–50	3–10	23–60	3–5	3–5	150–189
2003–2004	132 (99)	1 (1)	1	134	20–50	3–10	23–60	3–5	3–5	160–199
2004–2005	137 (100)	0 (0)	0	137	20–50	3–10	23–60	3–5	3–5	163–202
2005–2006	134 (99)	0 (0)	2	136	20–30	5–10	25–40	3–5	3–5	164–181
2006–2007	118 (100)	0 (0)	0	118	20–30	5–10	25–40	3–5	3–5	146–163

TABLE 5 Unit 12 moose hunter residency and success, regulatory years 1990–1991 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1990–1991	45	26	17	10	98 (23)	186	131	15	0	332 (77)	430
1991–1992	48	49	13	0	110 (27)	160	132	9	4	305 (73)	415
1992–1993	23	35	12	1	71 (15)	222	164	13	9	408 (85)	479
1993–1994	38	33	18	2	91 (24)	186	90	12	1	289 (76)	380
1994–1995	43	28	17	0	88 (19)	240	118	15	1	374 (81)	462
1995–1996	55	34	26	3	118 (24)	249	113	16	0	378 (76)	496
1996–1997	62	41	20	1	124 (24)	251	119	14	0	384 (75)	508
1997–1998	43	29	30	0	102 (21)	245	125	14	0	384 (79)	486
1998–1999	68	46	35	0	149 (29)	232	110	19	0	361 (71)	510
1999–2000	69	41	29	0	139 (25)	240	155	23	0	418 (75)	557
2000–2001	49	41	21	1	112 (21)	241	144	23	1	409 (79)	521
2001–2002	49	27	22	3	101 (19)	242	155	20	2	419 (81)	520
2002–2003	53	43	26	2	124 (23)	212	170	25	0	407 (77)	531
2003–2004	54	44	36	0	134 (24)	230	164	35	4	433 (76)	567
2004–2005	49	53	34	1	137 (25)	204	167	30	0	401 (75)	538
2005–2006	53	51	30	2	136 (24)	234	167	35	2	438 (76)	574
2006–2007	48	42	26	2	118 (20)	255	178	40	3	476 (80)	594

[a] Residents of Units 12, 20E, and eastern 20D are considered local residents. Local residents live mainly at Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

TABLE 6 Unit 12 moose harvest chronology by month/day, regulatory years 1990–1991 through 2006–2007

Regulatory year	Harvest chronology by month/day (%)						
	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 (20)	41 (43)	28 (30)	4 (4)	3 (3)	98 (100)
1991–1992		34 (32)	45 (42)	22 (20)	4 (5)	1 (1)	110 (100)
1992–1993		25 (35)	31 (44)	6 (9)	4 (6)	4 (6)	71 (100)
1993–1994		29 (33)	40 (45)	16 (18)	4 (4)	0 (0)	91 (100)
1994–1995		25 (30)	26 (31)	25 (30)	3 (4)	4 (5)	88 (100)
1995–1996	2 (2)	33 (29)	52 (45)	17 (15)	5 (4)	6 (5)	118[b] (100)
1996–1997	1 (1)	39 (32)	44 (36)	27 (23)	7 (7)	1 (1)	124[b] (100)
1997–1998	1 (1)	30 (30)	38 (38)	19 (20)	10 (10)	1 (1)	102 (100)
1998–1999	2 (2)	41 (28)	65 (45)	30 (21)	5 (3)	1 (1)	149 (100)
1999–2000	11 (9)	37 (28)	54 (40)	23 (18)	3 (3)	2 (2)	139 (100)
2000–2001	4 (4)	32 (30)	48 (44)	16 (15)	6 (5)	2 (2)	112 (100)
2001–2002	9 (10)	0 (0)	41 (43)	34 (35)	6 (7)	4 (5)	101 (100)
2002–2003	13 (11)	0 (0)	64 (52)	45 (37)	0 (0)	0 (0)	124 (100)
2003–2004	12 (9)	2 (2)	63 (47)	40 (31)	12 (9)	2 (2)	134 (100)
2004–2005	7 (5)	3 (2)	68 (50)	43 (32)	10 (8)	4 (3)	135 (100)
2005–2006	12 (9)	0 (0)	58 (45)	43 (34)	7 (6)	7 (6)	127 (100)
2006–2007	15 (13)	2 (2)	60 (52)	31 (27)	4 (3)	4 (3)	118 (100)

[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.

TABLE 7 Unit 12 moose harvest percent by transport method, regulatory years 1990–1991 through 2006–2007

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
2002–2003	18	9	15	31	0	10	16	2	124
2003–2004	12	13	16	31	0	10	16	1	134
2004–2005	15	11	15	36	0	7	15	1	137
2005–2006	13	10	13	36	0	7	19	1	136
2006–2007	24	3	16	37	0	9	9	1	118

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 13 (23,368 mi^2)

GEOGRAPHIC DESCRIPTION: Nelchina and Upper Susitna River

BACKGROUND

Moose densities in Game Management Unit (GMU) 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, reaching 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. Moose numbers declined by an estimated 47%, reaching a low in 2001. Since implementation of active wolf management in GMU 13 in 2003, moose numbers have started to rebound.

Historically, GMU 13 has been an important area for moose hunting in Alaska. Annual harvests were large, averaging more than 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, harvests were reduced by eliminating both the cow hunt and winter season in 1972 and reducing fall bull seasons to 20 days in 1975. 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 bull harvest dropped 34% from the previous season. From 1981 through 1988 the population increased, as did the harvest, which peaked in 1988 at 1259 moose. Since 1990, the harvest regulations have been through several changes in response to severe winters, increased predation, and low bull:cow ratios. During the 1990s the harvest declined, and reached a low of 468 moose reported taken in 2001. The moose harvest and population have steadily increased since then.

[1] This unit report also includes data collected after the end of the reporting period at the discretion of the reporting biologist.

MANAGEMENT DIRECTION

POPULATION OBJECTIVE

Increase the unit moose population to 20,000–25,000 moose with a minimum of:

- 25–30 calves:100 cows
- 25 total bulls:100 cows
- 10 yearling bulls:100 cows in the fall.

HUMAN USE OBJECTIVE

Increase the yearly moose harvest of bulls and cows to a combined total of 1200–2000 animals. Provide for a subsistence harvest of 600 moose per year.

METHODS

We conducted aerial surveys during the fall to learn sex and age composition and population trends in large count areas distributed throughout the unit. Additional surveys, using techniques developed by Gasaway (1986) and Ver Hoef (2001), have been conducted periodically in different portions of the unit to obtain detailed population estimates.

Surveys were flown during calving season to determine percent twins, and harvests were monitored by requiring permit and harvest ticket reports from all hunters. Modeling of the moose population has been used to help explain past trends as well as predict future trends.

Moose habitat improvement work has centered on monitoring the effects of controlled burns. The Alaska Department of Natural Resources (DNR) and the federal Bureau of Land Management (BLM) ignited a controlled burn in the Alphabet Hills in 2003; approximately 5000 acres burned. The fire was ignited again in August of 2004, and total acreage burned increased to 41,000 acres. A donation from the Safari Club International allowed us to establish browse plots during the summer of 2005 within the burn to evaluate vegetation regrowth. An additional moose count area was also established during the fall of 2005 within the burn to help evaluate the response by moose.

On a smaller scale, a 50-acre mechanical browse-crushing project was carried out during the spring of 2006 to improve survival in a critical overwintering area along the lower Chistochina River. The project was funded by the Alaska Soil and Water Conservation District, Alaska Department of Fish and Game (ADF&G), and Cheesh'na Tribal Council. Staff from ADF&G will monitor vegetation regrowth and the overall benefit to moose. The project will also be used as an educational tool within the Copper River valley to promote healthy moose habitat and additional projects to further benefit moose through habitat manipulation.

In addition to general habitat projects, staff evaluated and responded to several 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 in established trend count areas during the fall each year (Table 1). The number of moose counted in trend areas increased by 30% (average = 5% annually) from 2001–2007. going from 3466 to 4517 moose (includes an estimated 183 moose for count area 15). The moose per hour figure went up 32% between 2001 and 2006 (37 to 49 moose/hour). The moose per hour observed in 2007 declined since more flying time than usual was required because of less than ideal count conditions. The increase in moose numbers is attributed to good productivity, mild winters, and lower wolf predation due to predator management.

Population Size

GMU 13 covers nearly 24,000 mi^2 over 5 subunits. Though it is not possible to survey the entire area, up to 115 hours are flown annually in established moose count areas covering nearly 3600 mi^2. Density estimates from fall 2007 counts ranged from a low of 0.8 moose/mi^2 in Subunit 13E to a high of 1.8 moose/mi^2 in Count Area 10 within Subunit 13C. On average 1.3 moose/mi^2 were observed within the continuous trend count areas during 2007 (Table 2), up 30% from the 1.0 moose/mi^2 average between 2000 and 2002, when moose numbers bottomed out.

The GMU 13 moose population will be considered below the population objective until fall trend count figures increase to the levels observed during the late 1980s.

Population Composition

Population composition data collected during fall sex and age composition counts from 2001 through 2007 are presented in Table 1. The GMU 13 bull:cow ratio for the continuous count areas steadily increased from 23 bulls:100 cows in 2001 to 32 bulls:100 cows in 2007. The bull:cow ratio now exceeds management goals for the unit as a whole. The lowest bull:cow ratios are in 13A and 13E (Table 2). An analysis of the bull:cow ratio by age class indicates an increase of 7 yearling bulls:100 cows from 2001 to 2007 (Table 1). The recent increase in yearling bulls has been due in part to improved calf production and survival due to mild winters, as well as increased overwinter survival of calves due to a reduction in wolves. The current yearling bull ratios meet the management objective of 10 yearling bulls:100 cows in 13B and 13C, though still fall short in the remaining subunits (Table 2).

Fall calf:cow ratios in the continuous count areas were 23:100 in 2006 and 22:100 in 2007 (Table 1). Between 1978 and 1988 when moose numbers were increasing in GMU 13, calf production and survival were high, with calf:cow ratios of 22–31:100 in the fall. The calf:cow ratio in 2000 was the lowest annual estimate ever observed in GMU 13, 11:100. Although calf:cow ratios have shown improvent over the last 4 years and are the best observed since the early 1990s, they are still below the management objective of 25–30:100. The recent improvement in calf ratios coincides with wolf reductions under the GMU 13 predator management program.

Productivity

Productivity estimates are only available for portions of GMU 13 and cannot be directly

extrapolated to the remainder of the unit. Research by Ballard et al. (1991) showed pregnancy rates of 72–88% between 1977 and 1985 across 13A and 13B. The lower rates were attributed to misdiagnosis and a disproportionate number of older cows in the sample population. Research in 13A since the early 1990s has addressed pregnancy and twinning rates. The radiocollared moose in the study area were subjected to ultrasound pregnancy exams during November of 1994, 1995, and 1997. Results showed average pregnancy rates near 88%, which were maintained until spring in 2 of the 3 years (Testa 1997). The pregnancy rate for November 2007 was likewise 88% (Dale, pers. comm.).

The fall in utero twinning rate was 26% (n=43) for radiocollared cows in 13A tested by ultrasound in 1994 and 1995 (Testa and Adams 1998). The twinning rate at birth for collared cows in 13A, based on calf observations, has averaged 21% (range = 9–40) between 1994 and 2007. Twinning rates are obtained in other subunits by flying aerial surveys from late May to early June, just past the peak of parturition, and tend to be higher than in 13A, averaging 27% (range = 11–51) between 1992 and 2006. Preliminary data from radiocollared neonates in 13A in 2006 showed that approximately 18% of calves died by May 31 (Dale, pers. comm.), indicating twinning rates collected from traditional early June surveys are likely biased low. For Interior Alaska moose populations, twinning rates of ≥20% indicate average to above average productivity.

Distribution and Movements

Data from fall surveys are represented for the individual subunits in Table 2. Moose were most abundant along the southern slopes of the Alaska Range in 13B and 13C and in the eastern Talkeetna Mountains in western 13A. Subunit 13D and the Lake Louise Flats (eastern 13A) continue to have the lowest densities unitwide. Historically, moose numbers in western 13A, 13B, and 13C have fluctuated more than the lower density areas of eastern 13A and 13D.

Fall rutting and postrutting concentrations are in subalpine habitats. The distribution of wintering moose depends largely on snow depth and, to a lesser degree, wolf distribution. Moose generally move down to lower elevations as snow depth increases. Earlier movement may occur if wolf densities are reduced in the lower riparian areas, such as observed in 2007. Known wintering concentration areas include the southern Alphabet Hills, the upper Susitna River, the eastern foothills of the Talkeetna Mountains, the Tolsona Creek burn, and the Copper River floodplain.

MORTALITY

Season and Bag Limit. Season dates were 1–20 September for the general moose hunt under state regulations. The bag limit was 1 bull with a spike/fork antler on 1 side, or 4 brow tines on 1 side, or a spread of 50 inches or more. A Tier II subsistence permit hunt was established in 1995, and 150 Tier II permits were issued annually during this reporting period. Tier II moose permits were limited to 1 per household. The Tier II hunting season during this report period was 15–31 August. A federal subsistence registration hunt has been in place in Unit 13 since 1990 for residents of Units 13, 12, and 20, with a bag limit of any bull and season dates of 1 August–20 September in federal subsistence areas only.

Board of Game Actions and Emergency Orders. In 1999 the board shortened the general moose season in Unit 13 by establishing a 1–20 September season (eliminating 10 days in late August)

and changed the Tier II season dates from 1–19 August to 15–31 August. 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, changes that have been in effect since 2002.

In March 2000, the Board of Game also passed a wolf control implementation plan for portions of GMU 13. In the fall of 2003, land and shoot was implemented as a part of that plan. In March 2005, the plan was expanded to 13C. During the March 2007 board meeting, moose salvage requirements were changed to require the meat be left on the bone of the ribs and all quarters. In addition, Tier II moose hunters were also required to salvage the heart and liver. Also for the Tier II hunt, the use of aircraft or any off-road vehicle over 1500 pounds was prohibited; and permit holders were given the ability to transfer their permits to resident family members within 2nd degree of kindred. In January 2008 at the statewide board meeting, the aircraft and off-road vehicle use restrictions for the Tier II hunt were lifted.

Harvest

Total Harvest. The 2006 Unit 13 reported harvest was 691 moose from all hunts (Table 3). The lowest harvest in 40 years was 468 moose reported 5 years earlier in 2001. Hunting pressure peaked in 1996 with 6135 reported hunters, then dropped 44% to a recent low of 3462 in 2002. Pressure has steadily increased since then, with 4137 hunters in 2006.

General Hunt. Harvest reports from 2006 showed 593 moose taken by 3501 hunters during the general state hunt (Table 4). This is the highest harvest in 6 years and an increase of 28% from the 2002 low of 466 general season moose taken.

Permit Hunts. The BLM implemented a subsistence moose hunt on federal land in 1990. Registration permits are issued to residents of GMU 13 (FM 313), as well as residents of those communities in adjacent units (FM 314) that have customary and traditional use determinations in GMU 13. Federal harvests during this two-year reporting period averaged 50 bulls a year (Table 5). This is a very popular hunt for GMU 13 and Delta Junction residents with more than a thousand permits issued in most years. The amount of federal land open for this hunt is extremely limited, accounting for <2% of the moose habitat in GMU 13. The fact that the federal harvest accounts for up to 8–10% of the yearly unitwide moose harvest leads to the speculation that a number of moose claimed under the federal hunt may actually be taken on state lands. With season dates of 1 August–20 September, federal hunters are out 1 month earlier than state general season hunters. While success is low early in the season, enforcement is quite limited.

A state subsistence moose hunt (TM300) for any bull was initiated in 1995, with 150 permits allocated under the Tier II permitting system. The harvest in 2006 was 51 bulls (Table 5). This hunt became increasingly important to permit holders when moose numbers began to decline in the late 1990s. In 2002 the harvest jumped 56%, or 19 bulls. Of the total unit moose harvest, this subsistence harvest has gone from 3% in 1995 to approximately 8% in 2007. Because of the any-bull bag limit, antler composition data from this harvest shows a smaller average size of harvested bulls than those taken under the general hunt (38 inches vs. 53 inches in 2006). Due to the variation in size and limited number of moose harvested in this hunt, this harvest has little influence on age composition of bulls remaining after the subsistence season. The general hunt begins the day after the subsistence hunt closes.

Illegal Harvests. Unreported and illegal harvest estimates of 50 moose are considered high because of our antler restriction regulations of spike-fork/50-inch (Table 3). 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, we believe numerous sub-50-inch bulls are harvested because few hunters can reliably tell a 50-inch bull from a bull in the high 40-inch category. This assumption is based on a number of years of field experience monitoring this hunt, as well as Alaska Wildlife Trooper case reports. Many of the illegal bulls taken are initially misidentified as legal by the hunter. Some illegal bulls that are taken and transported home without detection are likely reported as legal kills or not reported at all.

Hunter Residency and Success. Local residents (residents of GMU 13) have accounted for 9–13% of the moose harvested under the general season during the past 5 years, according to harvest report data (Table 4). Historically, nonresidents averaged 10% of the unitwide moose harvest until the nonresident season was closed in 2002.

The success rate for moose hunters in the Unit 13 general hunt was 17% in 2006, up from 13% in 2001 (Table 4). Other hunter success rates in 2006 were 40% for the Tier II subsistence permit hunt and 9% for the federal subsistence hunt (Table 5). Hunting effort has remained steady in the general hunt during this reporting period, averaging 7.4 (range = 7.1–7.7) days per hunter for successful hunters and 7.6 days (range = 7.2–8.0) for unsuccessful hunters. Moose hunting effort peaked in 1995 when nearly 550 general season hunters spent an average of 10.2 days hunting, (total of 55,938 days afield). Hunting effort declined by 62% by 2002, when approximately 2660 hunters spent an average of 8.0 days hunting (a total of 21,169 days). In 2006, approximately 3500 general season hunters spent an average of 7.2 days hunting (a total of 24,615 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 60% of the harvest every year since 2001. This harvest pattern is predictable because moose are more vulnerable later in September. Leaf fall starts occurring at this time, bull movements increase, and onset of the rut increases the effectiveness of calling.

Transport Methods. During this reporting period and every year since 1993, 4-wheelers have been the most important method of transportation (Table 7). It is obvious that GMU 13 is an important 4-wheeler and off-road vehicle (ORV) area for moose hunters. In 2006 those using either 4-wheelers or ORVs were the largest group of hunters and accounted for 71% of the total moose harvest.

Other Mortality

Brown bears are abundant in GMU 13 and are important predators of neonatal moose calves. Research in the 1970s indicated brown bears kill up to 50% of the calves within the first 6 weeks of life (Ballard et al. 1981). Although brown bears kill adult moose, the rate is much lower than for calves. A substantial reduction in bear numbers (1979 bears removed from the Upper Susitna) has been shown to increase calf survival significantly in this unit (Ballard et al. 1987). Based on this research, liberalized hunting regulations have been in effect for brown bears in GMU 13 since the mid 1990s in an attempt to substantially reduce the population and increase calf survival unitwide. Regardless, ongoing research continues to show high neonatal losses due to bears (Dale, pers. comm.).

Wolf numbers in GMU 13 started increasing in 1990. The fall 1999 and 2000 unitwide estimates exceeded 500 wolves (>12 wolves/1000km^2) and were the highest in more than 25 years. Snow depths in 1999 and again in 2000 were also considered severe. Based on unitwide wolf population and moose estimates, the fall 2000 moose-to-wolf ratio was estimated at about 31:1. Considering that wolves in GMU 13 continue to prey on moose even when caribou are present (Ballard et al. 1987), this extremely low ratio was expected to keep the moose population in a steady decline. Following implementation of a wolf control plan in 2000 the wolf harvest started increasing, and the wolf population declined. Our spring wolf estimates both in 2006 and 2007 were approximately 160 wolves (4.0 wolves/1000 km^2), meeting spring wolf management objectives.

Winter snow conditions are monitored by measuring snow depths at 17 established snow courses throughout the area. A winter severity index is then developed for the unit. The historical winter severity index for GMU 13 includes data back to 1963. The winter severity index for the period covered by this report shows that the winter of 2004–05 was classified as severe and had the deepest snow in over 15 years; record snow depths were recorded in 13E. Overall, the last 2 winters during this reporting period were classified as mild, though in 2006, 13A and 13B had snow pack that approached severe conditions for moose. Observations of winter mortality in GMU 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 snow accumulation is about 30 inches. As the snowpack increases, yearlings, then adult bulls, and finally adult cows die, regardless of moose densities. Deep snow also influences survival of neonatal calves the following spring. If cows are in poor condition at parturition, neonatal survival declines, resulting in lower calf:cow ratios the following fall. In addition to killing moose, deep snow often makes it easier for wolves to take moose, further reducing overwinter survival.

HABITAT

Assessment

GMU 13 has numerous areas where habitat improvement could produce more favorable browse conditions for moose. Due to the size and remoteness of much of the unit, fire is considered the only option for extensive habitat improvement. Wildfires occurred throughout much of GMU 13 before 1950, when fire suppression activities began. Since then, negligible acreage has burned. Current fire suppression policies in the Copper Basin Fire Management Plan (Alaska Interagency Fire Management Plan 1987) set aside large portions of the unit as Limited Suppression (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. This has likely reduced the moose carrying capacity over extensive portions of GMU 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.

Ongoing research continues to evaluate browse quality and use by moose in western portions of 13A. All indications are that browse availability is high, and use rates are sustainable (Collins 2001).

The use of prescribed fires to replace wildfire as a method of improving moose habitat has had very limited application in GMU 13. The climate in GMU 13 typically prevents the use of prescribed fire, except in the driest years. Also, scattered cabins and private land ownership in GMU 13 have increased over the years and increase the liability associated with the use of prescribed fire. In spite of problems associated with controlled burns, work with BLM and DNR has been ongoing, and a prescribed fire was completed in 2004. The Alphabet Hills controlled burn was ignited in August 2004 and approximately 41,000 acres burned. The area burned was around Kelly Lake on the south slopes of the Alphabet Hills in subunit 13B. This area was also lit in 1984 and 2003, but in both instances the fires did not carry because moistures were too high and the weather changed abruptly. Plans call for another ignition attempt in years with favorable burn weather.

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 its use to small but important concentration areas near the road system where access for heavy equipment is available. One such small site near Paxson was crushed in 1993, and initial regeneration of willows was good. Additional sites for mechanical treatment have been identified along the Copper River in subunit 13C where moose winter during deep snow years. A small 50-acre site just east of Chistochina in 13C was treated in March of 2006. Another 80-acre site was treated in March 2008 in the same vicinity. Vegetation re-growth will be monitored over the next several years.

CONCLUSIONS AND RECOMMENDATIONS

Moose numbers have increased in GMU 13 since 2001. Comparison of the number of moose counted between 2001 and 2007 indicates there has been an increase in all sex and age categories of moose. Overall, moose count numbers are up approximately 30%, with the largest increases in subunits 13C and 13B.

The increase in moose observed since 2001 is attributed primarily to increased survival due to reduced predation. Active wolf management that brought the wolf population down from record highs was the single most important factor. Also contributing to the increased survival was the occurrence of relatively mild winters since 2000. Mild winters also help increase productivity, as cows in better physical condition have higher calving rates.

Calf-to-cow ratios during this reporting period are well above those observed in the late 1990s when moose were rapidly declining, but are still below the management objective. Neonatal calf mortality due to brown bear predation continues to be significant. Liberal sport hunting regulations since 1994 have resulted in an increase in brown bear harvests, but no effect on neonatal calf mortality has been detected. Even if brown bear numbers declined, the importance of neonatal calf mortality remained high because overall moose numbers dropped appreciably. A multi-year brown bear study is in progress to evaluate the impact of increased bear harvests on the bear population and should provide insights as to why high calf mortality is still a major factor in GMU 13.

The bull:cow ratio the last 2 years of this reporting period meets or exceeds the overall management objective for the unit. Much of the increase in the bull:cow ratio is attributed to higher overwinter calf survival and increased recruitment of yearlings. While yearling cows are also being recruited, they are not yet adequately replacing the large number of older cows dying off and overall cow numbers have not kept up.

Harvests and hunting pressure in GMU 13 increased during this reporting period; however, both harvests and hunting effort are well below the level observed in the late 1980s when GMU 13 was one of the top moose hunting units in the state. Whether GMU 13 can again meet harvest objectives is yet to be determined. Certainly the unit has the capability of producing more moose for harvest than we are currently taking. Habitat issues may influence harvest rates once we approach higher levels. The lack of substantial fires over the past 50 years has resulted in lower browse quality. Even though the elevation of GMU 13 moose habitat is some of the highest in the state, productivity data suggest GMU 13 moose reproductive performance figures remain average for moose statewide.

We recommend increasing bull harvests in those portions of GMU 13A, B and C where moose numbers have increased the most. 13A west. A drawing permit system for any bull should be implemented to increase the harvest of bulls. These permit hunts should be for small specific areas, and the permit harvests limited by strict harvest objectives for each area.

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TABLE 1 Unit 13 fall aerial moose composition counts in continuous count areas 3, 5, 6, 10, 13, 14, 15, and 16, 2001–2007

Year	Bulls: 100 cows	Yearling bulls: 100 cows	Calves: 100 cows	Calves %	Adults observed	Total moose observed	Moose /hour	Density moose/mi^2 (observed range)
2001	23	3	15	11	3086	3466	37	1.0 (0.6–1.4)
2002 [a]	24	6	22	15	2918	3428	36	1.0 (0.5–1.2)
2003	24	8	18	12	3707	4230	47	1.2 (0.5–1.7)
2004	28	6	22	15	3215	3768	40	1.1 (0.5–1.5)
2005	27	7	18	13	3500	4009	45	1.1 (0.4–1.4)
2006	30	8	23	15	3416	4028	49	1.1 (0.5–1.5)
2007 [b]	32	10	22	14	3875	4517	40	1.3 (0.5–1.8)

[a] Count areas 3 and 6 were not flown in 2002, data was estimated.
[b] Count area 15 was not flown in 2007, data was estimated.

TABLE 2 Unit 13 fall 2007 aerial moose composition counts by subunit in continuous count areas 3, 5, 6, 10, 13, 14, 15[a], and 16

Unit	Bulls: 100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves %	Total moose observed	Moose /hour	Density moose mi^2
13A	23	9	27	18	1256	49	1.3
13B	35	12	20	13	2265	40	1.5
13C	36	15	21	14	463	54	1.5
13D	66	7	15	8	183	25	0.5
13E	24	5	16	11	346	37	0.8

[a]13D not counted in 2007, data was estimated.

TABLE 3 Unit 13 moose harvest [a] and accidental death, 2002–2007

Regulatory	Reported				Estimated			Accidental			Grand
year	M	F	U	Total[b]	Unreported	Illegal	Total	Road	Train[c]	Total	total
2002–03	571	0	3	574	25	25	50	50	5	55	679
2003–04	625	1	1	627	25	25	50	50	12	62	739
2004–05	609	0	7	616	25	25	50	50	43	93	759
2005–06	566	0	4	570	25	25	50	50	25	75	695
2006–07	684	0	7	691	25	25	50	50	25	75	816

[a] Includes permit hunt harvest, harvest tickets and federal subsistence hunts.
[b] Includes unknown sex.
[c] 13E – the Alaska Railroad – an average after 2004-05.

TABLE 4 Unit 13 moose hunter residency and success for general harvest ticket hunt only, 2002–2007

	Successful				Unsuccessful				
Regulatory year	Local [a] resident	Nonlocal resident	Non-resident	Total [b]	Local [a] resident	Nonlocal resident	Non-resident	Total [b]	Total hunters
2002–03	54	407	2	466	315	1898	11	2239	2705
2003–04	64	432	1	504	337	1943	4	2305	2809
2004–05	48	458	1	510	317	2075	10	2413	2923
2005–06	44	430	1	478	336	2268	7	2626	3104
2006–07	53	533	5	593	384	2476	20	2908	3501

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

TABLE 5 Unit 13 moose harvest data for permit hunts, 2002–2007

Hunt Number	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unknown	Harvest
State Tier II	2002–03	150	8	58	42	54	0	--	54
TM300	2003–04	150	12	52	48	62	0	--	62
	2004–05	134	10	51	49	55	0	1	56
	2005–06	150	13	68	32	41	0	0	41
	2006–07	150	13	60	40	51	0	0	51
Federal	2002–03	1103	36	91	9	54	0	0	54
Subsistence	2003–04	1075	32	89	11	60	1	0	61
BLM	2004–05	1062	38	91	9	49	0	1	50
FM313/314	2005–06	938	39	91	9	51	0	0	51
	2006–07	1077	52	91	9	47	0	0	47

TABLE 6 Unit 13 moose harvest chronology percent by week for general harvest ticket hunt, 2002–2007

Regulatory year	Season dates	Week of harvest [a] 1st	2nd	3rd	4th	*n*
2002–03	1 Sep–20 Sep	8	26	34	32	466
2003–04	1 Sep–20 Sep	7	24	33	36	504
2004–05	1 Sep–20 Sep	6	24	41	28	510
2005–06	1 Sep–20 Sep	5	27	34	34	478
2006–07	1 Sep–20 Sep	7	24	36	33	593

[a] Weeks end 1 September, 8 September, 15 September, and 22 September.

TABLE 7 Unit 13 moose harvest percent by transport method for successful general harvest ticket hunters, 2002–2007

Regulatory year	Percent of Harvest Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Airboat	Unknown	*n*
2002–03	9	1	10	46	0	20	12	0	2	466
2003–04	8	2	7	47	0	20	14	1	1	504
2004–05	7	2	5	54	0	18	11	0	1	510
2005–06	6	1	7	54	0	16	13	1	2	478
2006–07	7	1	5	52	0	19	13	1	2	593

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 P.O. BOX 115526
JUNEAU, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

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

GEOGRAPHIC DESCRIPTION: Matanuska Valley

BACKGROUND

Moose in the Matanuska Valley were described as scarce when the area was settled by relocated farmers and others during the 1930s. The Unit's moose population 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. A 37,000-acre fire in the Big Lake area in 1996 and habitat enhancement due to agricultural and development activities allowed the population to increase to more than 6000 animals by the late 1990s.

Annual harvest levels in the first 12 years since statehood (1960–71) ranged from 20 to 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). Following severe winters 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). Harvest during the "any bull" period of 1979–1992 averaged 367 (range 201–530) (Griese 2000).

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). Since 1993, the period with antler restrictions, the general season harvest averaged 354 (range 226 – 498) (Del Frate 2004).

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 agriculture, development and road construction have been responsible for an increase in moose browse. As the area continues to grow, much of the early seral moose habitat will be replaced with homes, roads, and associated industry. During the 1990s, motorists killed an average of 180 moose annually in the Matanuska/Susitna Valley. From 2000 to 2004 the average road kill increased to 194. Road kill

reporting since 2005 has been inconsistent and is believed to be incomplete. The number of moose killed by the railroad seems to reflect snowfall and varies widely from year to year.

Habitat enhancement efforts during the 1990s were aided by fires. 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 man-caused fire occurred in the Big Lake area (Griese and Masteller 1998). Even though the habitat enhancement from this fire substantially enhanced moose forage and habitat in Unit 14A, politically it restricted future prescribed burn opportunities. Since 2001, the Ruffed Grouse Society (RGS), and the State of Alaska's Division of Forestry (DOF) and Department of Fish and Game (ADF&G, the department) have been cooperating on habitat enhancement efforts in the Matanuska Valley Moose Range (MVMR) to benefit both moose and ruffed grouse. Also, ADF&G staff in Palmer have been cooperating regularly with Division of Forestry staff on proposed timber sales in an effort to enhance moose habitat in lieu of prescribed fires.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Maintain and enhance the moose population to provide for high levels of human consumptive use.
- Provide maximum opportunity to participate in hunting moose
- Provide opportunities for nonconsumptive uses.

MANAGEMENT OBJECTIVES

- Maintain a posthunt population of 6000–6500 moose with a sex ratio of 20–25 bulls:100 cows.
- Achieve an annual hunter harvest of 360–750 moose.

METHODS

Geospatial surveys based on Ver Hoef (2001) were conducted between 7 and 12 December, 2003. This generated a population estimate and age and sex statistics, including bull-to-cow ratios, calf-to-cow ratios, and numbers of yearling bulls. During these surveys bulls were categorized as yearlings (spike/fork), medium (<50 inch or 3 brow tines), or large (>50 inch or 3 brow tines).

The harvest was monitored with harvest and permit reports from Unit 14A hunters. All harvest data was reviewed for accuracy and updated if necessary. Some figures may not match those previously reported. The Alaska Railroad Corporation provided numbers of moose killed by trains. MATCOM, which is the primary dispatch for the Alaska State Troopers and Wasilla Police Department, provided numbers of moose killed illegally, by highway vehicles, or in defense of life or property. Previously, this information was provided by the Alaska Department of Public Safety. Age categories (calf, yearling, adult) and sex of moose from road and railroad mortalities were provided by charities receiving the meat.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population increased between the fall survey in 2000 (5552 ± 571, 80% C.I.) and the fall survey in 2001 (6679 ± 453, 80% C.I.) and stabilized in 2003 (6564 ± 748)(Table 1). No surveys were flown in 2004, 2005, or 2006.

Population Composition

We observed 19 bulls:100 cows in the fall of 2001 (Table 1). We observed 21 bulls:100 cows in 2003. We were at or near our objective levels (20–25 bulls:100 cows). Calves were presumed to have high overwinter survival during this report period (Table 2).

MORTALITY

Harvest

Season and Bag Limit. The fall general open season was 20 August–30 September for all resident and nonresident hunters for both years and 10–17 August for archery-only hunters. During this period 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 department issued 50 drawing permits for antlerless moose for the 20 August–30 September period in 2001 and 400 permits for antlerless moose in 2002. In 2003 the season length was reduced to 20 August–25 September, and the number of permits was reduced to 390. The number of permits was further reduced to 280 in 2004. There were 280 permits in 2006.

Board of Game Actions and Emergency Orders. During the spring 2001 Board of Game (BOG) meeting the winter 'spike-fork-only' hunt was eliminated. Also, the department informed the BOG of our intent to issue 50 antlerless moose drawing permits because the population exceeded the upper end of the previous population objective of 5500. The board increased the population objective (from 5000–5500 to 6000–6500) and broadened 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.

At its spring 2007 meetings, the BOG considered proposals to change or modify moose hunting seasons in Units 14A, 14B, and 16A. They decided to reduce the general moose hunting seasons in 14B and 16A due to conservation concerns and as a precondition to consideration of predator control implementation. The Unit 14A general harvest closing date of 30 September was changed to 20 September to be consistent with the new season closing date passed by the BOG for Units 14B and 16A. This was to reduce or eliminate the possibility of general season hunters putting additional pressure on Unit 14A during the last 10 days of the season. Also in 2007, the BOG approved a new youth antlerless moose hunt for the drawing permit area DM412

Hunter Harvest. During the past 10 years the moose harvest has fluctuated from 319 to 745 moose. depending on herd status and the number of permit hunts. The bull moose harvest for the past 5 years has remained relatively consistent, averaging 376 moose (range 328–415).

Permit Hunts. Any-bull permits were discontinued in 2000. The department issued 50 antlerless moose drawing permits for the Matanuska River area (DM409-the only antlerless hunt available) in 2001, resulting in a harvest of 30 moose. In 2002, the department increased the number of total antlerless permits to 400 (harvest of 212) in order to keep the moose population within objectives (Table 4). The permits were reduced in 2003 to 390, resulting in 177 moose taken, and reduced again in 2004 to 280 permits, resulting in 137 moose taken. Similarly in 2006, 136 antlerless moose were harvested for the 280 permits issued.

Hunter Residency and Success. An average of 2950 people hunted in Unit 14A each year during the last 5 years. Local residents of Unit 14 consistently make up the majority of the hunter composition, harvesting 96 to 98 percent of all moose taken in Unit 14A. Hunter success was 13 percent during 4 of the last 5 years (Table 5). Residency composition of hunters changed little from previous years.

Harvest Chronology. More moose are taken during the first week of the general season than any other period (Table 6). Generally, the next highest period of harvest is during the last week or two of the general season, regardless of when that part of the season occurs.

Transport Methods. Elimination of the winter hunt in 2001–02 consequently eliminated use of snowmachines as a transportation method (Table 7). Four-wheelers and highway vehicles together have accounted for a majority of the transportation types used by successful hunters in the past 10 seasons (Table 7). In 1998 the department began tracking harvest by hunters from airboats. Since that time 1 percent or less of the hunters have reported using airboats in GMU 14A. (Table 7).

Accidental and Illegal Mortality

Accidental human-caused moose mortality during the 10-year period 1997–2007 averaged 185 (range 130–252) moose killed by highway vehicles and 16 (range 2–34) by train (Table 3). There appears to be an increasing trend of highway collisions as a result of higher moose numbers and many more vehicles on valley roads. Winter weather only exacerbates the problem.

HABITAT

Enhancement

Every winter from 2001–02 to 2006–07, ADF&G, in cooperation with RGS and DOF, has contracted aspen cutting in the Matanuska Valley Moose Range (MVMR) to produce early successional growth to benefit grouse, moose, and other species. These habitat enhancement efforts resulted in significant aspen regeneration on approximately 400 acres of forest stands in areas heavily used by moose during the winter months. Also, in 2005 ADF&G cooperated with the Alaska Moose Federation on a winter willow crushing project to stimulate the regeneration of willow along upper Wasilla Creek in the MVMR.

CONCLUSIONS AND RECOMMENDATIONS

The harvest objective (360–750) has been met since 2001 (Table 3). The antlerless permits issued since then helped achieve this objective. Harvest of antlerless moose is needed to maintain the population size at objective levels.

We believe effective intensive management and mitigation for increased development and urban expansion in this subunit requires investigation into the distribution and movement of moose. Specifically, studies investigating the annual moose movement patterns into the Pt. MacKenzie agricultural project, the 1996 Big Lake burn, and other areas will reveal the proportion of 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 adjacent units, 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, 1996–2007

Regulatory year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves(%)	Adults Observed	Moose Observed	Moose / mi^2	Estimated Population Size
1996–97 [c]	23	6	42	25	1696	2290	n/a	5500–6500
1997–98 [d]	14	5	30	21	611	774	n/a	5000–6000
1998–99 [e]	17	7	33	22	1191	1509	3	4729±530[b]
1999–00 [e]	19	10	37	24	1021	1317	3.4	5348±721[b]
2000–01 [e]	18	7	37	19	1300	1693	3.5	5552±571[b]
2001–02 [e]	19	8	34	22	1781	2301	4.2	6679±453[b]
2002–03 [a]	--	--	--	--	--	--	--	--
2003–04 [f]	21	9	29	19	1498	1869	4.1	6564+748[b]
2004-05 [a]	--	--	--	--	--	--	--	--
2005-06 [a]	--	--	--	--	--	--	--	--
2006-07 [a]	--	--	--	--	--	--	--	--

[a] No surveys
[b] 80% confidence interval
[c] Combined results of Matanuska River drainage east of Moose Creek and composition surveys in CAs 1–7 &Pt. MacKenzie
[d] Incomplete Modified Becker survey due to antler drop
[e] Modified Becker survey (non-random sampling but duplication of 1991 sampling units)
[f] Ver Hoef Spatial Estimator Survey method

TABLE 2 Unit 14A late winter aerial moose composition surveys, 1990–2007

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 surveys				
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
2002–03	no surveys				
2003–04	4/14	6,8	80	25	31
2004–05	no surveys				
2006–07	no surveys				

[a] Calves = short yearlings

TABLE 3 Unit 14A moose harvest[a] and accidental death, 1996–2007

	Reported				Estimated			Accidental deaths[e]			Grand
Regulatory year	M	F	Unk	Total[b]	Unreported[c]	Illegal[d]	Total	Road	Train	Total	total
1996–97	555	288	8	851	39	50	89	185	17	202	1142
1997–98	489	251	5	745	34	55	89	168	16	184	1018
1998–99	376	208	6	590	26	55	81	134	15	149	820
1999–00	323	0	9	332	23	60	83	181	34	215	630
2000–01	313	1	5	319	22	60	82	133	7	140	541
2001–02	345	31	7	383	24	60	84	252	15	267	734
2002–03	328	215	1	544	23	60	83	130	2	132	759
2003–04	415	177	2	594	29	60	89	247	21	268	951
2004–05	360	135	3	498	25	60	85	209	14	223	806
2005–06	379	160	2	541	27	60	87	200[f]	14	214	842
2006–07	397	131	3	531	28	60	88	200[f]	23	223	842

[a] Includes permit hunt harvest
[b] Includes moose of unknown sex
[c] Derived by taking 7% of the reported harvest of bulls.
[d] Includes moose taken in defense of life or property, enforcement cases and an estimate of out of season take
[e] Road and train kills are minimum numbers
[f] Road kill estimates for 2005-06 and 2006-07 are minimum estimates based on reported numbers which were shown to be incomplete

TABLE 4 Moose harvest data by permit hunts in Unit 14A, 2002–2007

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unk	Total
DM400, 14A, Susitna River, Redshirt Lake[a]										
	2002–03	2479	60	7	39	61	4	30	0	34
	2003–04	2248	50	12	52	48	0	21	0	21
	2004–05	1931	40	15	62	38	0	13	0	13
	2005–06	1460	30	17	60	40	0	10	0	10
	2006–07	1258	30	13	73	27	0	7	0	7
DM401, 14A, Susitna River, Figure Eight Lake[a]										
	2005–06	477	10	0	10	90	1	8	0	9
	2006–07	440	10	20	75	25	1	1	0	2
DM402, 14A, Point Mackenzie										
	2002–03	3216	50	2	39	61	3	27	0	30
	2003–04	3126	50	10	18	82	0	37	0	37
	2004–05	2806	50	6	36	64	0	30	0	30
	2005–06	2985	50	6	26	74	2	33	0	35
	2006–07	2844	50	6	32	68	1	31	0	32

TABLE 4 Moose harvest data by permit hunts in Unit 14A, 2002–2007, continued

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unk	Total
DM403, 14A, Big Lake										
	2002–03	1562	20	5	42	58	0	11	0	11
	2003–04	1563	20	10	28	72	0	13	0	13
	2004–05	1563	20	10	28	72	0	13	0	13
	2005–06	1425	20	5	32	68	0	12	1	13
	2006–07	1521	20	5	37	63	1	11	0	12
DM406, 14A, Bald Mountain Ridge										
	2002–03	2167	50	12	45	55	0	24	0	24
	2003–04	1970	50	10	51	49	0	22	0	22
	2004–05	1963	40	0	62	38	0	15	0	15
	2005–06	1925	40	5	39	61	0	23	0	23
	2006–07	1892	40	12	54	46	0	16	0	16
DM407, 14A, Matanuska River, North[b]										
	2004–05	3430	60	8	36	64	1	34	0	35
	2005–06	2879	60	12	43	57	0	30	0	30
	2006–07	2927	60	10	37	63	2	32	0	34

TABLE 4 Moose harvest data by permit hunts in Unit 14A, 2002–2007, continued

Hunt	Regulatory year	Applicants	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls	Cows	Unk	Total
DM408, 14A, Matanuska River, South[b]										
	2004–05	976	30	10	59	41	0	11	0	11
	2005–06	819	30	13	54	46	0	12	0	12
	2006–07	866	30	13	54	46	1	11	0	12
DM409, 14A, Matanuska River[b]										
	2002–03	4192	150	9	36	64	1	86	0	87
	2003–04	3656	100	7	33	67	2	60	0	62
DM410, 14A, Knik River										
	2002–03	3042	70	11	48	52	1	31	0	32
	2003–04	2290	50	6	49	51	0	24	0	24
	2004–05	2068	40	5	47	53	2	18	0	20
	2005–06	1992	40	8	22	78	0	29	0	29
	2006–07	1954	40	5	45	55	0	21	0	21

[a] DM400 divided into two hunts –DM400, DM401 – in 2005

[b] DM409 split into two hunts – DM407, DM408 – in 2004

TABLE 5 Unit 14A moose hunter residency and success[a], 1997–2007

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident[b]	Nonlocal resident	Nonres.	Unk.	Total (%)	Total hunters
1997–98	441	21	5	5	472 (13)	3174	67	43	17	3301 (87)	3773
1998–99	329	13	11	3	356 (11)	2848	79	30	27	2984 (89)	3340
1999–00	314	8	5	4	331(12)	2440	62	21	28	2551 (88)	2882
2000–01	295	14	7	3	319 (11)	2424	51	38	16	2529 (89)	2848
2001–02	327	13	11	2	353 (13)	2256	46	30	12	2344 (87)	2697
2002–03	306	11	12	0	329(11)	2489	51	46	4	2590 (89)	2919
2003–04	385	16	14	0	415 (13)	2590	63	38	0	2691 (87)	3106
2004–05	329	9	14	0	352 (13)	2295	56	47	0	2398 (87)	2750
2005–06	344	19	13	6	382 (13)	2419	58	42	20	2539 (87)	2921
2006–07	363	14	14	4	395 (13)	2530	53	50	37	2670 (87)	3065

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

TABLE 6 Unit 14A moose harvest chronology [a] 1997–2007 [b]

Regulatory year	August			September					November	December			
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15	Unknown[c]	Total
1997–98 [e]	3	86	22	35	42	61	--	--	111	41	51	20	472
1998–99 [c]	2	68	23	41	39	56	--	--	45	21	45	16	356
1999–00 [d]	6	57	14	32	25	44	53	--	--	36	52	13	332
2000–01 [d]	4	67	20	38	30	43	24	--	--	27	55	11	319
2001–02 [e]	10	61	28	36	43	48	46	68	--	--	--	13	353
2002–03 [e]	6	71	20	32	35	51	45	53	--	--	--	10	323
2003–04 [e]	13	87	34	57	41	67	54	50	--	--	--	14	417
2004–05 [e]	11	73	17	48	36	62	45	53	--	--	--	16	361
2005–06 [e]	9	70	21	43	50	62	57	57	--	--	--	9	378
2006–07 [e]	9	66	23	47	34	75	51	77	2	--	--	14	398

[a] Does not include drawing permit hunts
[b] All information in this table has been updated since last management report.
[c] Open season = 10–17 Aug (Archery only), 20 Aug–20 Sep (Gen.SF/50), 20 Nov–15 Dec (SF)
[d] Open season = 10–17 Aug (Archery only), 20Aug–25 Sep (Gen.SF/50), 5 Dec–15 Dec (SF)
[e] Open season = 10–17 Aug (Archery-only), 20 Aug–30 Sep (Gen.SF/50)

TABLE 7 Unit 14A percent transport methods of successful moose hunters[a], 1997–2007

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Sample size
1997–98	3	3	6	28	18	4	35	3		472
1998–99	4	4	7	35	6	5	33	5	1	356
1999–00	3	2	12	29	7	6	36	3	1	332
2000–01	3	2	9	34	8	4	36	3	1	319
2001–02	5	1	10	37	0	7	36	3	1	353
2002–03	6	3	12	36	0	5	32	5	1	323
2003–04	4	2	11	39	0	6	35	3	0	417
2004–05	7	3	10	38	0	5	30	5	1	361
2005–06	7	3	10	37	0	7	34	3	1	380
2006–07	6	2	9	39	0	6	36	4	0	393

[a] Does not include drawing permit hunts

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

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

GEOGRAPHIC DESCRIPTION: Western Talkeetna Mountains

BACKGROUND

The first comprehensive moose survey in Unit 14B, conducted in fall 1987, estimated moose numbers at 2814 ± 248 (80% CI) (Masteller 1995). Deep snow winters in 1989–90 and 1994–95 caused high mortality reflected in the 1999 survey estimate of 1687 ± 244 (Masteller 1995, 1998). Surveys completed in 2005 showed a further decline to 1412 ± 215 (Peltier 2006)

The moose harvest has decreased since the 1980s. Hunter harvest averaged 259 moose during the 1980s and liberal cow seasons allowed peak harvests to reach 534 in 1984, and 347 moose in 1987 (Griese 1993). With the decline in moose populations the annual harvest during the 1990s dipped to 58 moose and has remained on average at about that level. 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

- Maintain and enhance the moose population to provide for high levels of human consumptive use.
- Provide maximum opportunity to participate in hunting moose

MANAGEMENT OBJECTIVES

- 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

In fall 2005, we conducted a Ver Hoef (2001) geospatial (GSPE) survey. We were not able to complete any other surveys during the reporting period due to limited budgets and poor survey conditions.

The harvest was monitored with harvest reports from Unit 14B hunters. All harvest data was reviewed for accuracy and updated if necessary. Some figures may not match those previously reported. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Alaska Department of Public Safety provided some numbers of moose killed illegally, killed by highway vehicles, or in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population size

Unit 14B was surveyed in the fall of 2005. The resulting moose population estimate in Unit 14B was 1413 ± 215 (80%CI) (Table 1). Lower snow years during the reporting period have possibly curtailed any further decline in the population, although poor recruitment may temper any increase. Higher priorities in Units 14A and 16B will most likely result in Unit 14B not being surveyed in fall 2007 or 2008.

Population Composition

In our November 2005 survey, we observed 30 bulls and 16 calves:100 cows. Calves made up 10.7% of the sampled population. 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 12.3:100 in 1999 and 5.35:100 in 2005.

MORTALITY

Harvest

Season and Bag Limit. The fall general open season was 10–17 August (for archery-only hunters), 20 August–30 September for all resident and nonresident hunters. 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).

Board of Game Actions and Emergency Orders.

At the spring 2005 meeting, the Board of Game (BOG) considered several proposals to change moose hunting and the SF50 system; however, no changes were approved. During the spring 2007 meeting the board reduced the season 5 days to address low population numbers in Units 14B and 16.

Hunter Harvest. Reported harvest has decreased since 92 bulls were taken during 1996–97 (Table 2). The reported harvest since the end of the December season in 2000 has been 57 bulls per year. This is substantially lower than the historic highs reported in the1980s.

Hunter Residency and Success. Local residents of Unit 14 consistently make up the majority of the hunter composition (Table 3). The number of local hunters has been relatively consistent in the past 5 years ranging between 386–426 hunters (Table 3).

Harvest Chronology. The highest proportion of moose was taken during the last 10 days of the season. This trend is more apparent in years were the season length gets closer to the rut. Only 5 animals were harvested during the archery only season (10–17 August) in the past 10 years (Table 4).

Transport Methods. The elimination of the winter hunt in 2001–02 consequently eliminated the use of snowmachines as a transportation method. All-terrain vehicles and highway vehicles have together accounted for a majority of the transportation types used by successful hunters in the past 10 seasons (Table 5).

Other Mortality

Moose killed by train collisions numbered 19 and 6 in 2005–06 and 2006–07, respectively (Table 2). The number of road killed moose reported in Table 2 for this reporting period was estimated as a minimum from the previous 2 years. In 2005 the Alaska Department of Public Safety (DPS) contracted dispatch services to MATCOM, which is the primary dispatch for the Wasilla Police Department. As a result of the new dispatch staff and procedures for handling wildlife related calls we were not able to receive accurate data about the number and location of moose killed in vehicle collisions in the valley during this reporting period.

CONCLUSIONS AND RECOMMENDATIONS

Even before the severe winter of 1999–00, the moose population was below the objective level of 2500–2800. Since the 2005 survey the population may have increased, but is most likely well below management objectives. The average annual harvest by hunters for the last 5 years was 57, below the objective of 100–200. Hunter harvest is unlikely to reach 100 moose unless access opportunities substantially increase, and the moose population increases.

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, 1997–2007

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)
1997–98 [a]	--	--	--	--	--	--	--	--
1998–99 [b]	37.5	9.5	11.1	7.5	407	440	--	--
1999–00 [c]	40.2	12.3	21.3	13.2	616	699	1.6	1687 ± 244
2000–01 [a]	--	--	--	--	--	--	--	--
2001–02 [a]	--	--	--	--	--	--	--	--
2002–03 [a]	--	--	--	--	--	--	--	--
2003–04 [a]	--	--	--	--	--	--	--	--
2004–05 [a]	--	--	--	--	--	--	--	--
2005–06 [d]	29.82	5.35	15.5	10.7	582	646	--	1413 ± 215
2006–07[a]	--	--	--	--	--	--	--	--
2007–08[a]	--	--	--	--	--	--	--	--

[a] No surveys conducted.
[b] High-grade sex and age composition survey conducted 20 November, 1998.
[c] 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.
[d] Data from Ver Hoef GSPE surveys conducted in November 2005

TABLE 2 Unit 14B moose harvest[a] and accidental death, 1997–2007

Regulatory year	Reported				Estimated			Accidental deaths[d]			Grand
	M	F	Unk	Total	Unreported[b]	Illegal[c]	Total	Road	Train	Total	Total
1997–98	72	2	0	74	7	20	27	13	14	27	128
1998–99	78	3	0	81	8	20	28	16	18	34	143
1999–00	65	0	2	67	7	20	27	21	80	101	195
2000–01	48	0	0	48	5	20	25	14	7	21	94
2001–02	66	0	1	67	7	20	27	31	15	46	140
2002–03	67	0	0	67	7	20	27	13	2	15	109
2003–04	56	0	0	56	6	20	26	29	10	39	121
2004–05	56	0	0	56	6	20	26	29	78	107	192
2005–06	47	1	0	48	5	20	25	20[e]	19	39	112
2006–07	57	0	0	57	6	20	26	20[e]	6	26	109

[a] All information in this table has been updated since last management report.
[b] Derived by taking 10% of the total reported kill.
[c] Includes moose taken in defense of life or property.
[d] Road and train are minimum numbers. Road kills do not include unsalvageable animals.
[e] Estimated minimum based on the previous 2 years as data was missing for this period.

TABLE 3 Unit 14B moose hunter residency and success, 1997–2007

	Successful					Unsuccessful					
Regulatory year	Local resident[a]	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident[a]	Nonlocal resident	Nonres.	Unk.	Total	Total hunters
1997–98	67	2	5	0	74 (13)	477	19	9	4	509	583
1998–99	73	4	4	0	81 (14)	465	27	12	4	508	589
1999–00	60	1	4	1	66 (11)	488	19	13	11	531	597
2000–01	47	4	4	1	56 (10)	457	22	15	3	497	553
2001–02	62	2	3	0	67 (16)	331	12	13	3	359	426
2002–03	57	4	6	0	67 (14)	364	13	23	2	402	469
2003–04	54	1	1	0	56 (12)	372	15	17	1	405	461
2004–05	52	1	2	1	56 (13)	355	13	13	6	387	443
2005–06	46	1	1	0	48(11)	345	16	18	3	382	430
2006–07	43	6	8	0	57(13)	343	16	11	4	374	431

[a]Unit 14 residents.

TABLE 4 Unit 14B moose harvest chronology 1997–2007

Regulatory year	August			September					November	December			
	10–17	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15	Unk	Total[d]
1997–98[a]	1	9	3	7	16	13	--	--	3	3	5	3	63
1998–99[a]	2	9	5	7	6	20	--	--	4	4	7	5	69
1999–00[b]	0	6	2	3	5	14	9	--	--	3	7	2	51
2000–01[b]	0	3	0	5	2	15	9	--	--	2	10	2	48
2001–02[c]	0	10	0	4	6	6	15	23	--	--	--	3	67
2002–03[b]	1	7	5	5	7	8	19	14	--	--	--	1	67
2003–04[c]	0	5	2	5	4	12	12	16	--	--	--	--	56
2004–05[c]	0	8	1	6	7	12	9	13	--	--	--	--	56
2005–06	0	3	6	2	5	8	6	16	--	--	--	2	48
2006–07	1	7	3	7	9	12	4	13	--	--	--	--	56

[a] Open season = 10–17 Aug (Archery-only), 20 Aug–20 Sep (Gen.SF/50), 20 Nov–15 Dec (SF-only) (SF/50 – "spike-fork/ 50 inch").
[b] Open season = 10-17 Aug (Archery-only), 10 Aug–25 Sep (Gen.SF/50), Dec 5–15 (SF-only).
[c] Open season = 10–17 Aug (Archery-only), 10 Aug–30 Sep (Gen.SF/50).
[d] Chronology does not include moose taken out of season or during DM 416.

TABLE 5 Unit 14B percent transport methods of successful moose hunters, 1997–2007

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Number moose harvested
1997–98	16	2	10	27	12	12	18	2		49
1998–99	8	2	3	36	15	10	20	5	2	61
1999–00	18	2	0	29	16	10	24	2	0	51
2000–01	8	0	2	27	17	19	23	2	2	48
2001–02	15	1	4	42	0	15	22	0	0	67
2002–03	7	0	7	46	0	9	27	3	0	67
2003–04	5	2	4	52	0	16	20	2	0	56
2004–05	2	0	2	58	0	11	21	7	0	57
2005–06	10	0	8	44	0	17	19	2	0	48
2006–07	11	0	4	53	0	11	16	4	4	57

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 14C (1912 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 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 four 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 three 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 three decades, overabundant moose have reduced the distribution and density of browse species.

Annual harvests have fluctuated dramatically. A record harvest of nearly 500 moose (50% females) occurred in 1965, but 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. Several new permit hunts established during this reporting period have reversed the decline in annual harvests. The 5-year mean harvest that includes this reporting period was 102 moose (30% cows), up from 93 moose in the last report.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

- Maintain a population of 2000 moose.
- Maintain a posthunting sex ratio of no fewer than 25 bulls:100 cows.

METHODS

We conducted aerial surveys annually, except in 2002, in some hunt areas to estimate sex and age composition during fall and early winter (Table 1). Fall surveys were not flown in 2002 because there was inadequate snow cover until late December, after most bulls had shed antlers. In addition, the Fort Richardson/Elmendorf/Upper Ship Creek aerial census was not conducted in 2004 because we were unable to obtain a flight clearance from the Fort Richardson Range Control on days when weather and snow conditions were conducive to an aerial survey, due to military training activities. 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 are adversely affected by snow depths of 70–90 cm (28–36 inches), which impede movement, and depths greater than 90 cm restrict movement to the extent that adequate food intake 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 experienced more severe winters, interspersed with a few milder 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 subunit's moose population. Vehicle collisions and starvation caused most of the known moose mortality. Fall 1996 surveys found the moose population 25–30% below the fall 1994 estimate. With milder winters and a reduction in harvest, the subunit's moose population recovered by fall 1998 to near or above the management objective of 2000 moose. Another severe winter in 1998–99 reduced the population to an estimated 1650 by fall 1999. The population rebounded to an estimated 2200 in fall 2003, which is the highest estimate on record. A census was not conducted on Fort Richardson/Elmendorf/upper Ship Creek in fall 2004; however, by fall 2005 the estimated population was 38% lower than in fall 2003. Based on composition counts in 2004 and a high number of moose (24) reported dead from unknown causes in early 2004, the winter of 2003–04 may have been the worst one on record for moose mortality. The pattern of large population declines following severe winters and slow increases following milder winters is consistent with a population above carrying capacity.

Population Size

We estimated a fall 2006 population of 1600 moose in Subunit 14C, including the Placer and Portage River drainages (Table 1).

Population Composition

The bull:cow ratio in the subunit as a whole has ranged from 43:100 to 57:100 (Table 1) during the past five years. There is no clear trend in bull:cow ratios. The calf:cow ratio ranged from 29:100 to 45:100, and the percentage of calves in the population ranged from 17–24%, about the

same as the previous reporting period. The subunit had 14–22 yearling bulls per 100 cows, also about the same as the previous reporting period.

Distribution and Movements

Moose are year-round 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 6 September–15 November and 15 December–15 January in 2005–06, and 5 September—15 November and 15 December—15 January in 2006–07. The bag limit was 1 moose by drawing permit; however, some hunts specified bull or antlerless only. Hunting was limited to archery only, except in the fall season when muzzleloading rifles were permitted north of Eagle River. We issued 100 archery permits and 25 muzzleloader permits for bulls and antlerless moose in 2005 and 2006. We issued 25 drawing permits for Elmendorf Air Force Base in 2005 and 2006. The bag limit was 1 moose; however, bull, antlerless, or either-sex moose were specified on permits, and the season was 6–30 September in 2005 and 5–30 September in 2006. We issued 4 drawing permits in the Anchorage Management Area in 2005 and 2006. The bag limit was 1 antlerless moose by muzzleloader or shotgun with rear sights and slugs only, and the season was 20 October–30 November in 2005 and 1–30 November in 2006. The open season in the Birchwood Management Area was 6–30 September in 2005 and 5–30 September in 2006. The bag limit was 1 moose by drawing permit; however, bull or antlerless moose were specified on permits. Fifteen bull and antlerless permits were issued in 2005; however, only 10 bull permits were issued in 2006. This hunt has been increasingly difficult to administer, because the area is nearly all private or railroad property where access is restricted, or municipal park where discharge of firearms and bows is prohibited. Much of the private land is under development and the area is becoming less rural and more suburban. The open season in the Eklutna Lake Management Area was 6 September—20 October in 2005 and 5 September—20 October in 2006. The bag limit was 1 bull by archery only. The hunt was administered by registration permit with a quota of 4 bulls. The general season in the remainder of Subunit 14C was 6–30 September in 2005 and 5–30 September in 2006. The bag limit was 1 bull moose with spike-fork/50-inch antlers; however, hunters could take antlerless moose by drawing permit in specified drainages (20 permits were issued in 2005 and 2006). The open season for the Twentymile River area was 20 August—30 September in 2005 and 2006. The bag limit was 1 moose by drawing permit with 20 bull permits issued in 2005 and 2006.

Board of Game Actions and Emergency Orders. The Board of Game 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 were issued because the Division of Parks and Outdoor Recreation continued to prohibit discharge of firearms in these drainages, and the antlerless portion of this hunt was not reauthorized by the board beginning in 2001. The antlerless hunt was reinstituted by the board in March 2005 and, in fall 2005 a moose hunt was conducted in the Anchorage Management Area for the first time in two decades. Allowing too many permittees to

hunt in this area would conflict with other user groups; thus, the number of permits should remain low, perhaps 10 or less, and the bag limit should be antlerless only to focus the limited harvest on cows. Because the hunt is authorized for the Anchorage Management Area, the hunt area boundaries can be expanded or contracted, with the cooperation of major landowners, to meet the hunt objectives. Beginning in 2007, the number of permits was increased to 8, with the first 4 permittees allowed to hunt in upper Campbell Creek drainage and the last 4 permittees allowed to hunt in McHugh Creek drainage.

The Board of Game authorized a new harvest strategy in upper Ship Creek. In the past, most moose harvested in Ship Creek drainage were on Fort Richardson and Elmendorf AFB. However, training, security needs, and other military priorities had capped the number of permits and was limiting the harvest below optimum. Some Ship Creek moose were harvested in upper Ship Creek drainage under an open-season, spike-fork/50-inch strategy, but access was limited to foot, horse, and nonmotorized methods, which limited participation due to limited access points. Up to 40 antlerless permits were issued to increase harvest in upper Ship Creek; however, many of these permittees were not hunting or unsuccessful. The new strategy uses "either-sex" drawing hunts followed by an "any-bull" registration hunt.

All antlerless moose hunts, except DM666, were reauthorized annually from 2003–2006. DM666 was reauthorized annually beginning in 2005.

Moose hunting in the Eklutna Management Area is managed with a registration hunt (RM445) and is closed by emergency order when the quota of bulls is met. An emergency order closed the season effective 27 September 2002, after a third of the quota was reported on 25 September, and it was likely that the quota would be exceeded over the weekend of 28–29 September. An emergency order closed the season effective 2 October 2003 when the quota was met. An emergency order closed the season effective 12 October 2004 when the quota was met. No emergency orders were issued in 2005 and 2006 because the quota was not met.

The Board of Game revised 5 AAC 92.230 (Feeding of game). Effective July 1, 2002, it is illegal to intentionally or negligently leave human food, pet food, or garbage in a manner that attracts moose. Initially the fine was $50, but it was increased to $100 in September 2002 and to $300 in May 2008. During this report period a few moose were increasingly reported getting into dumpsters and other garbage containers. Alaska State Troopers stationed in Anchorage and the Anchorage area biologists have issued several citations for feeding moose each year beginning in 2004–05.

Hunter Harvest. During the 2005–06 and 2006–07 seasons, 103 and 113 moose were harvested, respectively, with a 2-year mean of 74 bulls and 34 cows (Table 2). Approximately 15% of the bulls were taken during the general season. The remaining moose were taken in permit hunts.

Permit Hunts. During the 2005–06 season, we issued 506 permits to hunt moose in Subunit 14C. Of these, 91 hunters (24%) were successful. In 2006–07, 503 permits were issued and 87 hunters (23%) were successful (Table 4).

Drawing permit hunts are very popular. In 2005, 5303 hunters applied for 249 drawing permits (1385 applications were for the 20 bull permits for the Placer/Twentymile hunts). In 2006, 5180 hunters applied for 259 drawing permits (1340 of the applications were for the 20 permits for the

Placer/Twentymile hunts). The number of drawing permits increased substantially (e.g., up from 140 in 2003) during this reporting period. In addition to those receiving drawing permits, 257 bowhunters in 2005 and 249 bowhunters in 2006 registered for a permit for the Eklutna Lake archery hunt. The high number of unsuccessful bowhunters in this hunt reduced the total success rate for permit hunts in Subunit 14C (Table 4).

Hunter Residency and Success. Residents of Subunit 14C accounted for 96% and 85% of the moose harvested in Subunit 14C in 2005–06 and 2006–07, respectively (Table 3). Nonresidents accounted for 4% and 7% of the total harvest in Subunit 14C in 2005–06 and 2006–07, respectively.

Harvest Chronology. In the general-season, spike-fork/50-inch hunts 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). The day after Labor Day was 6 September in 2005 and 5 September in 2006; thus, a smaller proportion of moose were harvested the first week in 2005 (20%) and 2006 (13%) than during the first week in 2003 (29%) when the day after Labor Day was Sept. 2.

Most moose in Subunit 14C are harvested in drawing and registration permit hunts, with separate and overlapping seasons extending from the day after Labor Day to March of the following year. Thus, the chronology of harvest in these hunts is not comparable.

Transport Methods. Approximately two-thirds to three-fourths of all successful hunters used a highway vehicle for transportation to their hunting area (Table 6). Most moose hunt areas in Subunit 14C are in jurisdictions or terrains that limit airplanes, boats, and other motorized vehicles. For example, Chugach State Park allows airplanes to land only at one airstrip (at the head of Eklutna Lake) and restricts four-wheelers to the Eklutna Lakeside Trail and logging roads in Bird Creek drainage. Only electric outboards may be used on boats on Eklutna Lake. With the exception of the Knik, Twentymile, and Placer rivers, which are navigable by airboats and boats with jet units, other streams in Subunit 14C are not navigable by motorboats.

Other Mortality

Moose killed by vehicles and trains accounted for 62% of known, human-caused mortality during the past 5 years (i.e., not counting estimates of unreported or illegal mortality). Vehicles killed at least 239 moose and trains killed 22 moose in 1994–95, a record high because of near-record snow depths that forced many moose into town. On average at least 166 moose were killed in vehicle and train collisions annually over the past 5 years (Table 2). These are conservative figures because not all collisions are reported and some moose, never found, die from injuries. The number of moose killed by vehicles has increased as more roads and houses are built and more vehicles are used for commuting, although other important factors are the population level and snow depths.

An additional 10–20 moose have died from unknown, but not natural, causes each year and most have been salvaged by trappers for use as bait in other units. In recent years, several of these moose have been biopsied. One died in winter from cyanide gas produced during the digestion of what appeared to be Mayday tree (*Prunus padus*) fruits (K. Beckmen, pers. commun.). Thousands of Mayday trees have been planted in Anchorage, and they have become an invasive

species, replacing natural woody vegetation in riparian areas. Other moose in Anchorage have browsed ornamental evergreens, and were found dead hours or a few days later. Evergreens such as Japanese yew (*Taxus* spp.) are known to be highly toxic to herbivores; however, the number of potentially toxic ornamental plants available to moose in Anchorage is unknown. Moose have also been observed regurgitating excessive amounts of liquid after eating ornamental kale (*Brassica*), one of the first plants to become succulent in Anchorage in early spring.

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 died from starvation-related causes in recent winters due to 1) greater than average snowpacks in some years that cover potential browse and require greater expenditure of energy, and 2) overbrowsing in previous winters. In recent years, 4–5 packs of wolves have occupied Subunit 14C, and both black and brown bears kill moose calves in summer, particularly before the salmon return to local creeks.

Moose are often reported dying from unverified, but mostly natural, causes in the Anchorage area. The reports typically peak in late winter and spring, but some of these moose were dead for months and were only found when the snow melted. Causes of these mortalities include starvation, disease, ingesting toxic substances, and accidents such as falling off a cliff or getting a leg caught in the crotch of a tree. The following number of moose were reported dead and salvaged in the Anchorage area ("fall" includes 1 July–31 December, "spring" includes 1 January–30 June): 5 (fall 2002), 9 (spring 2003), 4 (fall 2003), 24 (spring 2004), 3 (fall 2004), 3 (spring 2005), 2 (fall 2005), 3 (spring 2006), 0 (fall 2006), and 4 (spring 2007). These mortalities are not included in the human-caused mortalities in Table 2, although some of the moose may have been injured in vehicle collisions or from eating toxic ornamental plants.

HABITAT

Assessment

Large tracts of subalpine and riparian habitat are protected throughout the 500,000-acre Chugach State Park and Chugach National Forest lands 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 subunit. Increased traffic on existing roads continues to boost Anchorage road kills. Several new roads (e.g., Abbott Loop [now Elmore Road] extension and Dowling extension) bisect natural areas and may result in many moose-vehicle collisions. Low-speed roads and trails associated with development, however, also provide movement corridors, which reduce energy expenditures for moose during years of heavy snowfall. Fences are another growing problem for moose in that they hamper movements and often separate calves from cows.

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. The Chugach National Forest 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 over-winter in the Anchorage Bowl.

CONCLUSIONS AND RECOMMENDATIONS

One of two population objectives was met. The bull:cow ratio exceeded 25:100. However, the fall 2006 population was estimated at 1600 moose, compared to the objective of 2000 moose. The moose population has declined 38% since the last Fort Richardson Gasaway census in fall 2003. The Subunit 14C moose population has exceeded the carrying capacity for several decades, and hunters have been unable to harvest enough moose to reduce the population below the carrying capacity. We are recommending that the population objective be lowered to 1700 moose to reduce winter mortality during normal to severe winters. With several new hunts, including "either-sex" and "any-bull" bag limits, hunters may be able to maintain moose numbers at that level, resulting in a healthier and more productive population. Fewer moose in the Anchorage Bowl and Eagle River areas, in particular fewer winter kills that become bear food in spring, will attract fewer brown bears into neighborhoods and city parks and might ultimately reduce brown bear productivity and population size in the Anchorage area.

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.

Nuisance moose in residential areas remain a significant problem. Over a decade ago, the Alaska Department of Transportation and Public Facilities (DOT&PF) estimated rural moose-vehicle collisions cost an average of $15,150 for vehicle repairs; emergency, medical, and legal services; and lost wages (DOT&PF 1995). Considering inflation, moose-vehicle collisions probably cost Anchorage residents at least $3 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. 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).

With so many moose in the city, public safety is a concern, especially for children. Area biologists and education specialists devote considerable time advising schools and parents on moose safety. Area biologists also assist schools that are unable to chase moose from school grounds. In 2003, Region II education staff and Anchorage area biologists produced a moose-safety poster for children to color. The poster is used in elementary school classes, in conjunction with a teacher's guide. A moose-safety video was produced in 2003–04 by Mirror Lake Middle School students in cooperation with Anchorage area biologists, Region II education staff, the University of Alaska Anchorage, and the Anchorage School District. Copies were distributed to all Anchorage elementary schools. The target audience was all third- through fifth-graders in the Anchorage School District; however, second-graders are also watching the video. Pre- and post-tests show a substantial increase in knowledge of how to avoid moose attacks or injuries in the event of an attack.

The Alaska Legislature enacted a "nuisance moose" law (AS 16.05.052) during its 2004 session. The new law allows private individuals and organizations to capture and translocate "nuisance" moose from urban to rural areas. The department opposed the bill because it would have little or no affect on moose populations held at low numbers by predation or poor habitat, and it could result in spreading disease from high-density urban populations to rural populations. The department also expressed concerns about unqualified people using lethal drugs in urban settings, holding moose calves without adequate facilities and veterinary supervision, and potential cost to the state. The primary source of "nuisance" moose is likely to be Subunit 14C. Since the bill has become law, the department's policy is to hold private parties to the same standards as department staff; to date no individuals or organizations have been authorized to capture, hold, or translocate moose.

Anchorage area Alaska Department of Fish and Game (ADF&G) biologists are often involved in planning efforts that affect moose habitat and mortality, such as roads. From 2005 to 2007, staff participated in planning for a number of transportation infrastructure projects, among them the Abbott Loop (now Elmore Road) extension, East Dowling Road extension, West Dowling Road extension, East 48th Avenue extension, Seward Highway and Alaska Railroad upgrades, and the Knik Arm Crossing, to name a few. Without our input, the Elmore Road extension would have been a fenced barrier to moose movement in Bicentennial Park and adjacent areas. DOT&PF project engineers and environmental staff have been largely unresponsive to requests for adequate moose-crossing structures, although a combined moose/pedestrian underpass will be installed on the East 48th Street (now Martin Luther King, Jr., Parkway) extension.

Similarly, in 2003 the U.S. Army Alaska (USARAK) proposed building a 34-mile-long, 8-foot-high chain link fence along the border of Fort Richardson. This fence would have bisected the Anchorage lowlands from the North Fork of Campbell Creek to the coast north of Eagle River Flats, in effect blocking movement of hundreds of moose between calving, rutting, and winter ranges (Sinnott 2003). Based on our input and public concerns, USARAK subsequently agreed to build only a pipe rail fence with numerous gaps to facilitate wildlife passage, although the Glenn Highway fence was replaced and extended nearly to the Hiland weigh station. During the same period, Elmendorf Air Force Base built several miles of security fence that blocks wildlife movements, without soliciting or heeding advice from ADF&G's area office. Cumulative losses of habitat and restrictions on movement are adversely affecting the moose population in Subunit 14C. Area biologists need to be involved early in planning of roads and long fences and must have information on moose distribution and movement corridors.

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TABLE 1 Subunit 14C fall aerial moose composition counts and estimated population size, 2002–2007

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	2002–03 [b]	--	--	--	--	--	--	
Portage River	2003–04	26	12	62	35	185	43	229
Placer River	2004–05 [c]	61	34	52	24	94	30	120
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	150
Hillside	2002–03 [b]	--	--	--	--	--	--	
	2003–04	27	10	22	13	130	33	160
	2004–05	28	11	40	24	99 [d]	30	120
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	140
Anchorage Bowl (except Hillside)	2002–03 [b]	--	--	--	--	--	--	
	2003–04	--	--	--	--	--	--	300 [e]
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	250 [e]
Fort Richardson	2002–03 [b]	--	--	--	--	--	--	
Elmendorf AFB	2003–04	58	18	40	20	527	39	649
Upper Ship Cr.	2004–05 [f]	--	--	--	--	--	--	
	2005–06	59	16	31	17	395	38	435
	2006–07	45	14	30	17	404	26	452

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 [g]	2002–03 [b]	--	--	--	--	--	--	
	2003–04	--	--	--	--	--	--	170 [e]
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	120 [e]
Peters Creek [h]	2002–03 [b]	--	--	--	--	--	--	
	2003–04	--	--	--	--	--	--	85
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	65 [e]
Eklutna River Thunderbird Cr.	2002–03 [b]	--	--	--	--	--	--	
	2003–04	36	11	14	9	46	--	57
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	45
Bird Creek Indian River [i]	2002–03 [b]	--	--	--	--	--	--	
	2003–04	--	--	--	--	--	--	160 [e]
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	110 [e]

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 [h]	2002–03 [b]	--	--	--	--	--	--	
Knik River	2003–04	--	--	--	--	--	--	220
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	150 [e]
Lake George [j]	2002–03 [b]	--	--	--	--	--	--	
	2003–04	--	--	--	--	--	--	170 [e]
	2004–05	--	--	--	--	--	--	
	2005–06	--	--	--	--	--	--	
	2006–07	--	--	--	--	--	--	140 [e]
Subunit 14C	2002–03 [b]	--	--	--	--	--	--	
Total	2003–04	44	15	40	22	888	38	2200
	2004–05 [f]	43	22	45	24	183	28	
	2005–06	57	16	31	17	395	38	
	2006–07	45	14	30	17	404	26	1600

[a] Estimates based on sightability correction factors (SCF) of 1.23 (2003), 1.10 (2005), and 1.12 (2006), calculated with MOOSPOP for the Fort Richardson/Elmendorf/Upper Ship Creek census area, except estimates in unsurveyed drainages are extrapolated based on trends on the Fort Richardson/Elmendorf/Upper Ship Creek census area; [b] Fall surveys not conducted due to lack of snow; [c] Bear Valley not surveyed due to turbulence; [d] Total includes 10 adult/yearling moose of unknown sex; [e] No recent aerial surveys completed; therefore, estimate is best guess; [f] No aerial survey of Fort Richardson/Elmendorf/Upper Ship Creek census area because of difficulty obtaining flight clearances from Range Control due to military training activities; [g] Eagle River count area last surveyed in 1998; [h] Peters Creek count area and Hunter/Knik count area last surveyed in 2001; [i] Bird/Indian count area last surveyed in 1988; [j] Lake George count area last surveyed in 1997.

TABLE 2 Subunit 14C moose harvest and accidental death, 2002–2007

	Hunter harvest									
	Reported			Estimated			Accidental death [b]			
Regulatory year	M (%)	F (%)	Total[a]	Unreported	Illegal	Total	Road	Train	Total	Total
2002–03	62 (66)	32 (34)	94	10	10	20	143	11	154	268
2003–04	84 (72)	32 (28)	116	10	10	20	188	14	202	338
2004–05	62 (75)	21 (25)	83	10	10	20	167	7	174	277
2005–06	67 (67)	34 (33)	103	10	10	20	138	8	146	269
2006–07	80 (71)	33 (29)	113	10	10	20	147	9	156	289

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

TABLE 3 Subunit 14C moose hunter residency and success, 2002–2007

	Successful				Unsuccessful				
Regulatory year	Local resident	Nonlocal resident	Nonresident	Total[a] (%)	Local resident	Nonlocal resident	Nonresident	Total (%)	Total hunters [a]
2002–03	82 [b]	9	3	94 (21)	316 [b]	20	9	345 (79)	439
2003–04	103 [b]	4	9	116 (24)	340 [b]	10	12	362 (76)	478
2004–05	72 [b]	8	3	83 (18)	353 [b]	18	13	384 (82)	468
2005–06	89 [c]	6	4	99 (20)	376 [c]	13	11	401 (80)	500
2006–07	96 [c]	7	8	113 (21)	389 [c]	10	19	423 (79)	536

[a] Includes hunters with unspecified residency.
[b] Residents of Units 14 and 7 (majority from Subunit 14C). Includes all DM210 hunt area.
[c] Residents of Subunit 14C. Includes only Subunit 14C portion of DM210.

TABLE 4 Subunit 14C moose harvest data by permit hunt, 2002–2007

Hunt no. /Area	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Total harvest [a]
DM210, 211	2002–03	10	40	67	33	100	0	2
Twentymile	2003–04	20	10	50	50	100	0	9
Portage	2004–05	25	28	57	43	89	11	9
Placer	2005–06	20	5	37	63	100	0	12
	2006–07	20	5	58	42	100	0	8
DM422,423	2002–03	25	8	57	43	80	20	10
Fort Richardson	2003–04	25	8	74	26	50	50	6
(muzzleloader)	2004–05	25	12	73	27	83	17	6
	2005–06	25	8	48	52	70	30	12
	2006–07	25	8	74	26	83	17	6
DM424,425,427	2002–03	95	14	61	39	41	59	32
Fort Richardson	2003–04	95	16	53	48	49	51	38
(archery only)	2004–05	100	13	67	33	55	45	29
	2005–06	100	19	60	40	56	44	32
	2006–07	100	17	57	43	53	47	36
DM428,429,430	2002–03	15	13	31	69	56	44	9
Elmendorf AFB	2003–04	20	5	47	53	60	40	10
(archery only)	2004–05	20	10	50	50	67	33	9
	2005–06	25	24	21	79	60	40	15
	2006–07	25	12	45	55	58	42	12

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	2002–03	10	10	67	33	0	100	3
Hunter	2003–04	10	10	67	33	0	100	3
Knik	2004–05	10	30	86	14	0	100	1
(antlerless)	2005–06	10	40	83	17	0	100	1
	2006–07	10	30	57	43	0	100	3
DM442	2002–03	20	15	65	35	0	100	6
Ship	2003–04	20	30	86	14	0	100	2
(antlerless)	2004–05	40	30	93	7	0	100	2
	2005–06	0	--	--	--	--	--	--
	2006–07	0	--	--	--	--	--	--
DM443	2002–03	10	20	62	38	0	100	3
Peters and	2003–04	10	50	80	20	0	100	1
Little Peters	2004–05	10	20	100	0	0	0	0
(antlerless)	2005–06	10	40	67	33	0	100	2
	2006–07	10	20	75	25	50	50	2
DM446, 447	2005–06	40	28	66	34	70	30	10
Ship	2006–07	50	24	61	39	80	20	15
(any moose)								

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 Birchwood (archery only)	2002–03	15	27	82	18	50	50	2
	2003–04	15	13	92	8	100	0	1
	2004–05	15	20	83	17	100	0	2
	2005–06	15	13	100	0	0	0	0
	2006–07	10	30	100	0	0	0	0
DM666 Anchorage (muzzleloader, shotgun only)	2005–06	4	0	0	100	0	100	4
	2006–07	4	0	25	75	0	100	3
RM445 [b] Eklutna (archery only)	2002–03	114	43 [c]	94	6	100	0	4
	2003–04	167	48 [d]	94	6	100	0	5
	2004–05	218	58 [e]	96	4	100	0	4
	2005–06	257	32 [f]	98	2	100	0	3
	2006–07	249	31 [g]	99	1	100	0	2
Totals for all permit hunts	2002–03	314	25	70	30	55	45	71
	2003–04	382	30	72	28	57	43	75
	2004–05	463	36	79	21	66	34	62
	2005–06	506	26	76	24	63	37	91
	2006–07	503	24	77	23	62	38	87

[a] Includes moose with unspecified sex; [b] Registration hunt; [c] Includes 22 permittees who did not report; [d] Includes 33 permittees who did not report; [e] Includes 86 permittees who did not report; [f] Includes 9 permittees who did not report; [g] Includes 2 permittees who did not report.

TABLE 5 Subunit 14C moose harvest [a] chronology, 2002–2007

Regulatory year	Percent of harvest 8/26–9/1	9/2–9/8	9/9–9/15	9/16–9/22	9/23–9/29	9/30–10/6	n
2002–03 [b]	0	9	13	43	35	0	23
2003–04 [c]	2	29	22	22	22	2	41
2004–05 [d]	10	19	24	24	24	0	21
2005–06 [e]	4	20	24	28	20	4	25
2006–07 [f]	0	13	29	29	29	0	14

[a] Does not include permit hunt harvests and Placer and Portage drainages (Unit 7).
[b] Season 9/3–9/30
[c] Season 9/2–9/30
[d] Season 9/7–9/30
[e] Season 9/6–9/30
[f] Season 9/5–9/30

TABLE 6 Subunit 14C moose harvest [a] percent by transport method, 2002–2007

Regulatory year	Percent of harvest Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Off-road vehicle	Highway vehicle	Unknown/ Other	n
2002–03	6	7	4	0	0	0	68	9	94
2003–04	6	9	11	3	0	0	63	7	116
2004–05	2	4	11	6	0	0	76	1	83
2005–06	2	3	9	1	0	1	77	7	99
2006–07	4	6	8	4	0	2	66	11	113

[a] Does not include Placer and Portage drainages (Unit 7)

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 15A (1314 mi^2), 15B (1121 mi^2), and 15C (2441 mi^2)

GEOGRAPHIC DESCRIPTION: Western Kenai Peninsula

BACKGROUND

Unit 15A. Historical records and reports from residents indicate moose were abundant throughout the 1900s in subunit 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-square-mile forest fire in 1947 were 2 factors 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 to 1974 reduced the moose population over the entire Kenai Peninsula. Estimates for subunits 15A and 15B indicate the combined population estimate declined from 7900 in 1971 to 3375 by 1975. Subunit 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 Jay Ver Hoef (Alaska Department of Fish and Game [ADF&G] Fairbanks biometrician) and summarized by Kellie and DeLong (2006). Using Ver Hoef's modified Gasaway census technique we estimated the moose population in Subunit 15A at 2097 (95% confidence interval 1704–2431). Results of a geospatial survey completed in February 2008 will be provided in the management report covering that period (to be published in 2010). The winters of 1998–99 and 1999–2000 were classified as severe for 15A, with snow accumulation up to 40 inches.

From 1947–1969, wildfires that occurred in Unit 15A were within an area with a perimeter of about 388,000 acres. From 1970–2007 fire perimeters have encompassed only 5000 acres. Consequently, less browse associated with successional forest stages has been available to moose, and a gradual decline in moose population size is anticipated. during normal winters.

Increased human presence and the 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 retaining management authority for wildlife on nonfederal lands and for non-subsistence wildlife species on federal lands. The Kenai National Wildlife Refuge is the largest landholder in Subunit 15A and actively participates in a variety of cooperative moose management programs. These include support of the Alaska Department of Fish and Game 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.

Unit 15B. The moose population in Subunit 15B has been relatively stable for the past decade. Censuses conducted in 1990 and 2001 estimated the population at around 1000. Forests within 15B have succumbed to widespread spruce bark beetle (*Dendroctonus rufipennis*) infestations that began in the 1990s. More than 500,000 hectares of spruce forests have been affected (Kenai Peninsula Borough 2006). Since 2001, infestation rates are decreasing as the number of unaffected trees becomes scarce (U.S. Forest Service and Alaska Department of Natural Resources . 2002). Salvage logging efforts are limited because most of the area in 15B is within the Kenai National Wildlife Refuge and has a “wilderness” designation, which limits all commercial activities.

Most of the hunting within 15B is by drawing permit only in 15B East, which is designated as a “trophy” area. During this reporting period (1 July 2005–30 June 2007) the quality (antler size) and quantity of moose harvested has declined, as has hunter satisfaction.

From 2004–2007 fire perimeters have encompassed about 20,400 acres in Unit 15B. These fires should provide areas with improved moose habitat, but the extent of the benefit to the moose population in this unit will not be known for some time.

Unit 15C. Available habitat on the lower peninsula can be limiting in winters with heavy snow accumulations. Important winter habitat includes the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, lower reaches of Fox River and Sheep Creek, and the Homer Bench. Despite several winters of deep snow in the late 1990s, the estimated moose population size increased about 30% between surveys in 1993 and 2002. Community development continues, increasing interactions of human residents and moose.

Widespread spruce bark beetle infestations have also affected this region of the peninsula. Much of the affected forest outside of designated wilderness has been, or is, scheduled for salvage logging. Spruce mortality and salvage logging efforts will affect the quality of moose habitat on a large scale, but the nature of the effect remains uncertain.

As far as moose habitat is considered, Unit 15C has the most potential. Since 2004, the perimeter of wildfires has encompassed over 87,000 acres in this unit. Time will tell how much quality moose habitat is regenerated from theses fires, but relative to Units 15A and 15B, Unit 15C has more potential for large areas of quality moose habitat in the near (10 years) future.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

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

Primary moose management objectives in the SLWMA are to:

- Provide opportunities to 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.

Unit 15B-West

- Maintain a bull-to-cow ratio of 15:100.
- Allow for maximum opportunity to participate in hunting in 15B West.

Unit 15B-East

- Maintain a bull-to-cow ratio of 40:100.
- Provide opportunities to harvest large-antlered bulls under aesthetically pleasing conditions.

Unit 15C

- Maintain a healthy and productive population.
- Maintain a minimum sex ratio range of 15–20 bulls:100 cows.

METHODS

Unit 15A. During years with adequate snowfall, we conducted aerial surveys in November and December in selected trend count areas to ascertain sex and age composition. Recently, weather conditions permitted surveys during 2003, 2005, and 2006.

A population estimate for Subunit 15A was developed from data collected with a geospatial survey (Kellie and Delong 2006) in February 2001 and an additional geospatial survey was conducted in February 2008. Results from the 2008 survey will be presented during the next reporting period.

Unit 15B. Composition surveys are flown in traditional count areas as funding allows. Harvest data is provided by hunter information taken from harvest tickets.

Unit 15C. The only fall composition surveys completed during this reporting period were conducted in November 2005. Censuses were done in 1993 and 2002. Harvest data come from hunter information taken from harvest tickets.

This report reflects updated data in all tables; therefore data may differ slightly from past reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Composition in Unit 15A

The February 2001 estimate for moose wintering in the unit was 2068 (95% CI: 1704–2431). The February 1991 estimate for moose wintering in the unit was 3432 (95% CI: 2921–3943). These data indicate a decline of approximately 40 percent; however, it is believed that most of this decline occurred during the severe winters of 1998–99 and 1999–2000. The winters of 2000–01 through 2002–03 were relatively mild and should have been favorable for moose survival and production.

Composition surveys flown during November and December 2003 and 2005 indicated a relatively stable bull:cow ratio (23:100 and 24:100, respectively) that is above the minimum management objective, but the total number of moose observed and percent calves in the population declined in 2006 (Table 1). Since these are trend counts, we did not apply statistical analyses to the data, but there is an obvious decline in total moose numbers and number of calves in the 15A population.

Population Size and Composition in Unit 15B

A February 2001 census of the 650.4 square miles of suitable moose habitat in Subunit 15B estimated the population at 958 moose (95% CI: 777–1139). This produced a density of about 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. Calves composed 21% of the population, compared to 10% found in the February 1990 census. No survey flights have been conducted since this 2001 census.

Population Size and Composition in Unit 15C

A random-stratified census (Gasaway 1986) was conducted in lowland portions of Subunit 15C (1190 mi^2) during the winter of 1992–93. The population was estimated at 2079 moose (95% CI: 1425–2734). During the winter of 2001–02, a geospatial census (Ver Hoef 2001) conducted over the same area produced an estimate of 2981 moose (95% CI: 2508–3454) (Table 1). A comparison between surveys showed a population increase of about 30%. Both censuses were conducted in late winter, precluding composition counts. There were probably additional moose in the mountainous portion of Subunit 15C, outside the census area, during both censuses.

The actual number of moose seen during composition counts is not comparable from year to year, because survey intensity and conditions are inconsistent. Composition counts are performed in order to get an adequate sample of moose to calculate ratios of bulls to cows and calves to cows. Composition counts conducted in 2005 in two traditional count areas, one around the Caribou Hills and the other south of the Anchor River, showed healthy bull:cow and calf:cow ratios (Table 1). The bull:cow ratio is above the minimum management objective of 15:100.

MORTALITY

Harvest

Season and Bag Limit. The general season for Unit 15A and 15B is 10–17 August (archery only), and 20 August.–20 September. 20. Unit 15C shares the 20 August–20 September dates but does not have an archery-only season. Since 1987, the bag limit has been 1 bull with a spike or fork on at least 1 antler, or 50-inch antlers, or antlers with 3 or more brow tines on at least 1 side (SF50). Harvest statistics are shown in Tables 2 and 3.

From 2003 through 2004, the federal subsistence hunt issued an average of 43 permits each year in Units 15A, 15B, and 15C, with an average yearly harvest of 6 moose each year.

Board of Game Actions. There were no Board of Game actions during the reporting period other than reauthorizing the antlerless moose permit hunts for the Homer area (DM549) and for Skilak Loop (DM524).

During its 2006 meeting the Federal Subsistence Board passed a regulation to liberalize the moose hunting season on federally qualified lands in Units 15B and 15C for federally qualified subsistence users. The additional season dates are 20 October–10 November. The SF50 or 3 brow-tine restrictions still apply to this hunt.

Permit Hunts

Unit 15A. No permits were issued for the SLWMA during this report period. The last survey of the SLWMA, conducted in December 2005, counted 79 moose and 12 bulls:100 cows. By agreement with the Kenai National Wildlife Refuge, a survey of the area must be completed, and a minimum count of 130 moose must be obtained before permits for this area can be issued.

Unit 15B. 15B East is managed as an area where hunters are able to view and harvest large-antlered bulls through a drawing permit system. Permittees reported harvesting 16 bulls in 2005 and 9 in 2006 (Table 3).

Unit 15C. Since 1987 there has been a Tier II subsistence hunt (TM549) for any bull in a portion of Unit 15C southwest of a line from Point Pogibshi to the point of land between Rocky and Windy Bays. One to 3 bulls have been taken during this season in the last 4 years (Table 3).

The antlerless hunt for moose near Homer was initiated in 1995 (DM549). No permits were issued in 2001. In 2002 through 2006, 50 permits were issued each year. The average harvest is 23 moose (Table 3).

Hunter Residency and Success

Unit 15A. Hunter success ranged 12–14% during the last 4 years (Table 4). During all years, local residents (people living in Unit 15) accounted for the vast majority (79–86%) of successful moose hunters.

Unit 15B-West. Hunter success ranged 14–18% during the last 4 years (Table 4). During all years, local residents (people living in Unit 15) accounted for the vast majority (83–95%) of successful moose hunters.

Unit 15C. Hunter success ranged 16–23% during the last 4 years (Table 4). During all years, local residents (people living in Unit 15) accounted for the vast majority (86–87%) of successful moose hunters.

During this reporting period (1 July 2005 – 30 June 2007) 30% of the reported moose harvest came from Unit 15A, 16% from 15B and 54% from Unit 15C.

Transport Methods. Most moose hunters use highway vehicles as their primary method of transportation to access hunting areas in Units 15A and 15B (Table 5). The most popular method used in Unit 15C was the all-terrain vehicle (ATV).

Harvest Chronology. The chronology of the harvest depends on weather conditions and other factors unrelated to moose abundance. The highest proportions of the harvest generally occur at the start and the end of the season (Table 6).

Other Mortality

Unit 15A. Crippling loss by hunters and loss to predation was unknown. In 2003-04, vehicle–wildlife accidents killed 134 moose in 15A, compared to 56 in 2006-07 (Table 2).. Between regulatory years 2003–04 and 2006–07, on average 80 moose were killed each year in wildlife–vehicle accidents in Unit 15A. About 50% of moose killed by vehicles each year are calves.

We began a public awareness program in 1990 in an effort to reduce the number of vehicle-moose collisions (Del Frate and Spraker 1991). Unfortunately, while collisions have declined, this is attributable to relatively mild winters, which allowed moose to forage away from the roadways, and to a lower moose population, rather than the public awareness program. We anticipate that heavier snow winters or increases in the moose population will result in an increase in vehicle-moose populations.

Unit 15B. An average of 59 moose per year have been killed by motor vehicles in Unit 15B during the past 4 years (Table 2). The impact of predation on moose by wolves and bears is unknown. The level of mortality for moose during severe winters is probably high.

Unit 15C. Moose killed in Subunit 15C by motor vehicles averaged 86 annually over the last four years (Table 2). The high number of moose wintering within the Homer Bench continues to be habitat limited during deep snow winters. The level of mortality for these moose during severe winters is probably high.

HABITAT

15A

Assessment

The last significant burn (79,000 acres) in Unit 15A occurred in 1969. Generally, the duration for producing quality moose browse after a burn is 20–25 years, and I believe the area within the 1969 burn has lost its value for producing significant amounts of quality browse. I believe maturation of the habitat, predation, and collisions with automobiles are the leading causes of declines in the Unit 15A moose population.

Enhancement

In May 1991 approximately 7900 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 (FWS) 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 to be left untreated (unburned) as scattered islands for wildlife cover and as a seed source for revegetation.

From 1970–2007, fires have encompassed less than 5000 acres in Unit 15A.

15B

From 1890 (when a wildfire burned most of the unit) to 2003, no significant wildfires occurred in this unit. However, from 2004–2007 fires have encompassed about 20,500 acres. Assessment of moose habitat generated by these fires is still premature because it is still too early in the revegetation period.

15C

Assessment

Reduction of beetle-killed forest stands through salvage logging has been underway for more than a decade. Postlogging site work that encourages hardwood regeneration beneficial for moose habitat has been recommended to local foresters and has been conducted on some sites

with apparent success. If site preparation is done properly, resulting in a healthy regeneration of hardwoods, habitat quality for moose will probably increase greatly. However, if site preparation is not conducted or done inadequately, blue-joint grass (*Calamagrostis canadensis*) will initially crowd out hardwood and spruce seedlings, creating less desirable moose habitat and slowing forest succession.

Enhancement

Mitigation funds stemming from the construction of the Bradley Lake Hydroelectric Project allowed for the creation of Kachemak Moose Habitat Inc., a group focused on improving and protecting moose habitat. This group continues to purchase land and help orchestrate conservation easements to benefit moose habitat on the lower Kenai Peninsula. The Tracey Road fire burned more than 5000 acres northeast of Homer in May of 2005. It is unknown if this fire was hot enough to burn the ground layer and greatly enhance moose habitat. The Fox Creek fire (summer 2005) south of Tustumena Lake encompassed approximately 35,000 acres. Assessments of the potential effects on moose in that area will be provided in the management report for the next report period.

CONCLUSIONS AND RECOMMENDATIONS

Unit 15A. Kris Hundertmark of ADF&G 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 (23:100 in 2003 and 24:100 in 2004).

With the increase in the number of bulls, the opportunity for viewing and photography has increased. Public perception of improved population health and public support for continuation of the SF50 program has also widened.

Unlike other game management units in Alaska, no emergency reduction in moose seasons or bag limit was necessary, even with a decreasing population. The conservative nature of the SF50 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. Currently, the largest impacts on the Kenai Peninsula moose population are declining habitat quality, predation, and deaths caused by collisions with motor vehicles. In the absence of significant events affecting habitat (such as burns encompassing more than 50,000 acres), I expect the downward trend in Unit 15A moose numbers to continue.

Unit 15B. The permit hunts in 15B East are not producing the quality (antler size) or quantity of large bulls that they were in the recent past. As a consequence of these data and new regulations regarding federal subsistence hunts in this area, the number of late season (26 September–15 October) permits was reduced to 10 (down from 50) for the 2008 season. It is my intent not to issue any permits for the late season hunts in 2009.

Harvest levels are well within acceptable guidelines to maintain a minimum bull:cow ratio of 40:100. Summer and winter moose range on the Kenai National Wildlife Refuge in 15B continues to deteriorate due to wilderness lands management policies that favor advanced forest succession. ADF&G and FWS should cooperate on selected habitat enhancement projects (mechanical manipulation and prescribed burns) to improve moose habitat in the unit. Similar to Unit 15A, the habitat in Unit 15B is maturing, excluding the areas that burned during 2004, 2005 and 2007.

Unit 15C. The bull:cow ratio was within the objective range of 15–20 bulls:100 cows. However, these ratios vary dramatically across count areas because of clustered distributions of post-rut aggregations. Adequate bull:cow ratios are desired to minimize the length of the rut and ensure most cows conceive during their first estrous cycle (Schwartz et al. 1994). There are biological uncertainties regarding the movement of moose throughout the subunit. Snow depth appears to dictate movements to the Homer Bench, but we do not know what proportion of moose display this migratory behavior or the source locations for the migrants. Investigations into how movements on the lower peninsula contribute to the fitness of the migrants versus nonmigratory moose, a determination of animal locations across seasons, and other answers could contribute greatly to our knowledge of population dynamics of this population. These answers could help us make management decisions for subpopulations of moose that are affected by severe winters and also clarify the bull:cow ratios in specific areas during the rut.

The expansion of federal subsistence hunting opportunities and the increased effort associated with these new opportunities have severely restricted the potential to allow any additional (regardless of how limited they are) drawing seasons for the general public. If the current trend of federal subsistence activities continues, it will essentially eliminate ADF&G's ability to be creative with its management scheme to offer additional moose hunting opportunities to the general public. The establishment of the 20 October–10 November federal subsistence moose season has already contributed to my decision to reduce permit numbers for drawing hunts on federally qualified lands.

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TABLE 1 Unit 15 aerial composition counts for moose and estimated population size, 2003–06

Unit	Regulatory Year	Bulls: 100 Cows	Calves: 100 Cows	% Calves	Adults	Total Moose Observed	Estimated Population Size
15A	2003–04	23	26	17	628	763	1000–2000
	2004–05	No Surveys Conducted					1000–2000
	2005–06	24	16	11	544	614	1000–2000
	2006–07	11	13	10	226	252	1000–2000
15B	2003–04	No Surveys Conducted					700–1000
	2004–05	No Surveys Conducted					700–1000
	2005–06	No Surveys Conducted					700–1000
	2006–07	No Surveys Conducted					700–1000
15C	2003–04[a]			15	895	1059	2500–3500
	2004–05	No Surveys Conducted					2500–3500
	2005–06	21	27	18	637	780	2500–3500
	2006–07	No Surveys Conducted					2500–3500

[a] Summary of late winter composition counts; sex of adults could not be distinguished.

TABLE 2 Unit 15 Reported general season moose harvest and accidental death, 2003–2006

Unit	Regulatory Year	Reported Hunter Harvest				Accidental death			Total Reported Mortality
		Bull	Cow	Unk	Total	Road	Train	Total	
15A	2003–04	172	1	3	176	134	0	134	310
	2004–05	130	0	1	131	83	0	83	214
	2005–06	118	2	3	123	45	0	45	168
	2006–07	128	1	1	130	56	0	56	186
15B	2003–04	41	1	0	42	67	0	67	109
	2004–05	37	0	0	37	61	0	61	98
	2005–06	47	0	0	47	51	0	51	98
	2006–07	39	1	0	40	56	0	56	96
15C	2003–04	308	3	1	312	105	0	105	417
	2004–05	276	0	2	278	74	0	74	352
	2005–06	274	3	1	278	86	0	86	364
	2006–07	211	1	2	214	79	0	79	293

TABLE 3 Unit 15 harvest data for drawing permit hunts, 2003–2006

	Hunt No.	Regulatory Year	Permits Issued	Permittees that hunted	Percent Success	Harvest			
						Bulls	Cows	Unk.	Total
15A	DM524	2003–04	0						
		2004–05	0						
		2005–06	0						
		2006–07	0						
	DM526	2003–04	0						
		2004–05	0						
		2005–06	0						
		2006–07	0						
15B	DM530-539	2003–04	100	67	22	15	0	0	15
	(combined	2004–05	100	58	28	16	0	0	16
	totals)	2005–06	100	76	21	16	0	0	16
		2006–07	100	67	13	9	0	0	9
15C	DM549	2003–04	50	49	55	0	27	0	27
		2004–05	50	41	56	1	22	0	23
		2005–06	50	46	52	0	24	0	24
		2006–07	50	44	41	1	17	0	18
	TM549	2003–04	4	4	50	2	0	0	2
		2004–05	4	3	33	1	0	0	1
		2005–06	4	4	75	3	0	0	3
		2006–07	4	2	50	1	0	0	1

TABLE 4 Unit 15 residency and success of moose hunters for the general season, 2003–2006

Unit	Regulatory Year	Successful				Unsuccessful				Total Hunters
		Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b] (%)	Local[a] Resident	Nonlocal Resident	Non-Resident	Total[b]	
15A	2003–04	151	13	11	176 (14)	842	170	34	1052	1228
	2004–05	103	17	6	131 (13)	707	159	32	912	1043
	2005–06	102	19	2	123 (12)	763	150	24	940	1063
	2006–07	106	12	8	130 (12)	784	158	24	973	1103
15B	2003–04	40	2	0	42 (14)	203	37	10	251	293
	2004–05	34	0	2	37 (15)	184	18	10	216	253
	2005–06	43	3	1	47 (18)	192	18	3	214	261
	2006–07	33	4	3	40 (14)	213	24	7	244	284
15C	2003–04	267	33	10	312 (23)	906	124	26	1066	1378
	2004–05	241	27	9	278 (22)	871	110	21	1010	1288
	2005–06	240	24	13	278 (21)	905	136	26	1075	1353
	2006–07	186	17	10	214 (16)	901	155	25	1090	1304

[a] Local = residents of Unit 15.

[b] Includes unspecified residency.

TABLE 5 Unit 15 general season transport methods for moose hunters (percent of harvest), 2003–2006

Unit	Regulatory Year	Percent of Harvest							Harvest
		3/4 wheel-ATV	Airplane	Boat	Highway Vehicle	Horse/ Dogteam	ORV	Unknown	
15A	2003–04	15	6	6	61	2	5	5	176
	2004–05	15	5	9	62	2	4	3	131
	2005–06	15	4	7	61	0	4	10	123
	2006–07	13	5	11	63	2	2	4	130
15B	2003–04	14	5	12	52	2	5	10	42
	2004–05	8	3	3	76	3	0	8	37
	2005–06	19	0	6	64	4	0	6	47
	2006–07	10	0	3	70	5	0	13	40
15C	2003–04	45	2	2	33	6	8	4	312
	2004–05	52	2	3	25	7	6	5	278
	2005–06	45	2	6	31	8	5	3	278
	2006–07	43	1	4	33	7	7	5	214

TABLE 6 Unit 15 moose general season harvest chronology (percent of harvest), 2003–2006

Unit	Regulatory Year	Harvest Periods								
		8/10–8/17[a]	8/20–8/25	8/26–8/31	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	Unknown	Harvest
15A	2003–04	15	22	5	4	8	21	18	7	176
	2004–05	17	19	5	8	9	18	21	4	131
	2005–06	13	24	6	7	7	14	21	7	123
	2006–07	22	19	8	8	5	14	21	4	130
15B	2003–04	14	31	10	10	5	14	17	0	42
	2004–05	19	24	8	8	11	14	14	3	37
	2005–06	19	23	2	4	9	11	28	4	47
	2006–07	30	25	5	5	15	3	15	3	40
15C	2003–04	0	33	11	13	10	12	17	4	312
	2004–05	0	27	10	13	12	16	21	3	278
	2005–06	1	26	16	11	10	17	16	4	278
	2006–07	0	37	10	7	10	10	20	5	214

[a] Archery-only season is 10–17 August in 15A and 15B only.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 16A (1850 mi^2)

GEOGRAPHIC DESCRIPTION: West side Susitna River (Kahiltna River to Chulitna River)

BACKGROUND

Historically, the moose population in Unit 16A has fluctuated greatly as a consequence of severe winters; recently it likely has also declined due to predation. 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, which was 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 in the late 1990s and early 2000s.

Unit 16A shares land within Denali National Park and Denali State Park. Access is limited to a few points from the Parks Highway, Petersville Road or Oil Well Road. Boats, 4-wheelers, snowmobiles, and airplanes are used to access more remote portions of the unit. Since Unit 16A was separated from Unit 16B in 1973, historical annual hunter harvest have fluctuated as a result of variable moose densities, availability of cow moose hunts, and improved hunter access (Griese 1996). Harvest numbers have ranged from a high of 309 (1984) to a low of 37 (1990) (Del Frate 2004). The annual harvest has averaged 137 bulls in the past 5 seasons (2002–2006). It's possible that proportionally higher harvests in recent years may have had a negative effect on bull numbers and the resulting bull-to-cow ratio,

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

- Maintain and enhance the moose population to provide for high levels of human consumptive use.
- Provide maximum opportunity to participate in hunting moose.
- Enhance wildlife viewing opportunities within state and national parks.

MANAGEMENT OBJECTIVES

- Attain a 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

A population inventory survey was conducted using the Ver Hoef method (Ver Hoef 2001) 22–28 November 2005. Previous surveys were conducted in 2000 and 1997 (Del Frate 2004). No trend counts or calf surveys were conducted in Unit 16A during this reporting period.

The harvest in Unit 16A was monitored with general season and drawing permit harvest reports from hunters. However the last permit hunt was in 2000. All harvest data were reviewed for accuracy and updated if necessary. Some figures may not match those previously reported. The Alaska Railroad Corporation provided numbers of moose killed by trains, and the Alaska Department of Public Safety and MATCOM, which is the dispatch center for the Alaska Wildlife Troopers and the Wasilla Police Department, provided numbers of moose taken illegally, killed by highway vehicles or shot in defense of life or property.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The population decreased about 55% between the fall surveys in 1997 (3636 ± 614, 80% CI) and 2005 (1619 ± 197, 80% CI) (Table 1). Other GMUs were scheduled for surveys in 2006 but none was conducted due to poor weather conditions and lack of snow.

Population Composition

Recent surveys show that the bull:cow ratios are lower than historic trends but above the minimum objective of 20 per 100 cows. The composition assessed in 2005 included 22 bulls and 19 calves:100 cows, which is down from 33 bulls and 35 calves:100 cows found in 1997 (Table 1).

MORTALITY

Harvest

Season and Bag Limit. The fall general open season was 20 August–30 September for all resident and nonresident hunters for both years, and 10–17 August for archery-only hunters, During this period 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).

Board of Game Actions and Emergency Orders. At the spring meetings in 2007, the board considered proposals to change moose hunting in Unit 16A in order to reduce hunting pressure on bulls and accommodate the implementation of predator control. This resulted in a reduction in the season length with an earlier closing date of 20 September, with the change to take effect in the fall of 2007.

Hunter Harvest. The annual harvest has declined recently, averaging 115 moose over the last 5 years. This is down from the previously reported 5-year average of 151 (Table 2) and below the harvest objective minimum (190). The lower harvest is likely due to lower moose densities. Similarly, the reduced number of bulls seen in the most recent surveys in 16A may be reflecting an overall declining trend in bull numbers (Table 1).

Hunter Residency and Success. The number of moose hunters in Unit 16A averaged 901 during 2005–2006 (Table 3). The majority of hunters are not considered local residents (i.e. residents of Unit 16) (Table 3). Hunter success during the reporting period was 13%. This is lower than the 10-year average of 16%.

Harvest Chronology. One moose was taken in the 10–17 August archery season in 2005. None was taken during the archery season in 2006. During this reporting period, hunters generally waited till the end of the season to hunt in GMU 16A, harvesting more than 70% of the general season moose during the last 2 weeks (Table 4).

Transport Methods. The elimination of the winter hunt in 2001–02 consequently eliminated the use of snowmachines as a transportation method (Table 5). Four-wheelers and boats together have accounted for most of the transportation used by successful hunters in the past 10 seasons. In 1998 the department began tracking harvest by hunters from airboats. Since that time up to 5 percent of the successful hunters have reported using airboats in GMU 16A.

HABITAT

Enhancement

An 18,000-acre area east of the lower end of Kroto Creek (Deshka River) was prepared for a planned prescribed burn in 1994 (W. Collins pers. comm.). During spring and summer 2007, a 10,000-acre wildfire burned over major portions of the same prescription area (G. Holt pers. comm.). This was expected to result in improved habitat and forage for moose. Because of negative public sentiment towards fire after the 1995 Miller's Reach/Big Lake wildfire and the 2007 wildfire that occurred in the prescribed burn area, it is unlikely the planned prescribed burn will take place anytime soon, if at all.

Timber harvest and forest regeneration has produced limited enhancement opportunities during this reporting period. Recent development of a local wood fiber market, chip mill plant, and improved shipping via Port Mackenzie has stimulated interest from others in the forest products industry. The primary chip producer, NPI, Inc., failed to reach agreement with the Matanuska-Susitna Borough regarding port access to ship wood chips to foreign and domestic markets outside. It is unknown if this market will continue to develop along with the additional demand for timber harvest and yield potential for moose habitat improvement opportunities. The Department of Natural Resources, Division of Forestry proposed additional timber sales that would have potential to enhance habitat for moose. While some of this sale activity was curtailed or shutdown due to local sentiment or court order, it is hoped that future proposed sales will occur to allow for habitat and forage enhancement opportunities.

The National Park Service has continued its planning and design efforts to build a new visitor's center located in Denali State Park. This NPS facility will be located in Unit 13E adjacent to the northeast corner of Unit 16A. Construction of the visitor's center and access road may have an impact on moose habitat and movement. More importantly the associated infrastructure, support industry, and visitor traffic associated with this development may affect moose hunting and other consumptive uses in the area.

CONCLUSIONS AND RECOMMENDATIONS

The approximate 33% decline in the moose population between the 1997 and 2000 surveys was likely due to the winter conditions in 1999-00 and an increase in wolf numbers (Masteller 2000). The continued decline since then (33% from 2000 to 2005) probably resulted from the same factors as well as the effects of similar declines in adjacent units 16B and 14B. The harvest decreased in 2004, 2005, and 2006, likely due to the reduced bull numbers and the higher bull harvests that occurred in the early 2000s (Table 4). Hunter effort is expected to continue to increase in Unit 16A due to improved access within the unit and lack of opportunity for general season hunting in Unit 16B. It is unlikely that the moose population will reach the objective levels until the predator population decreases and habitat quality improves. Also, continued mild winters with moderate snow-depths will be necessary to stabilize and recover the moose population in Unit 16A.

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TABLE 1 Unit 16A fall aerial moose composition surveys and censuses, 1997–2007

Regulatory year	Bulls: 100 Cows	Yearling Bulls: 100 Cows	Calves: 100 Cows	Calves(%)	Adults Observed	Moose Observed	Moose / mi^2	Population Size
1997–98 [c]	33	12	35	21	974	1234	2.1	3636 ± 614[b]
1998–99 [a]	--	--	--	--	--	--	--	--
1999–00 [a]	--	--	--	--	--	--	--	--
2000–01 [c]	28	6	22	15	661	787	1.4	2420 ± 528
2001–02 [a]	--	--	--	--	--	--	--	--
2002–03 [a]	--	--	--	--	--	--	--	--
2003–04 [a]	--	--	--	--	--	--	--	--
2004–05 [a]	--	--	--	--	--	--	--	--
2005–06 [d]	22	3	19	14	510	590	1.1	1619 ± 197
2006–07 [a]	--	--	--	--	--	--	--	--

[a] No surveys conducted
[b] 80% C.I.
[c] Becker and Reed (1990) survey methodology
[d] Ver Hoef (2001) survey methodology

TABLE 2 Unit 16A moose harvest and accidental death, 1997–2007

Regulatory year	Reported				Estimated			Accidental deaths[c]			Grand total
	M	F	Unk	Total	Unreported[a]	Illegal[b]	Total	Road	Other	Total	
1997–98	197	0	1	198	14	25	39	14	0	14	251
1998–99	168	0	0	168	12	25	37	12	0	12	217
1999–00	168	0	3	171	12	25	37	14	0	14	222
2000–01	139	0	1	140	10	25	35	20	0	20	195
2001–02	153	0	0	153	11	25	36	15	0	15	204
2002–03	155	0	0	155	11	25	36	12	0	12	203
2003–04	168	0	0	168	12	25	37	17	0	17	222
2004–05	139	0	0	139	10	25	35	15	0	15	189
2005–06	107	2	0	109	8	20	28	10[d]	0	10	147
2006–07	115	0	0	115	8	20	28	10[d]	0	10	153

[a] Derived by taking 7% of the reported harvest

[b] Includes moose taken in defense of life or property

[c] Roadkill is minimum number and does not reflect moose hit and lost or not salvaged

[d] Estimated minimum based on the previous 2 years as data was missing for this period

TABLE 3 Unit 16A moose hunter residency and success, 1997–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident[a]	Nonlocal resident	Nonres.	Unk.	Total	
1997–98	16	114	11	0	141 (18)	54	545	25	3	627	768
1998–99	6	110	2	2	120 (15)	55	573	19	7	654	774
1999–00	14	115	9	4	142 (17)	42	645	18	10	715	857
2000–01	3	107	6	3	119 (12)	55	773	22	5	855	974
2001–02	12	131	10	0	153 (18)	40	649	19	5	713	866
2002–03	7	134	14	0	155 (16)	43	730	29	0	802	957
2003–04	12	144	11	1	168 (19)	48	696	38	0	782	950
2004–05	7	119	10	3	139 (16)	33	646	40	0	719	858
2005–06	4	101	4	0	109 (12)	42	726	49	3	820	929
2006–07	3	100	10	2	115 (13)	40	676	26	15	757	872

[a] Unit 16 residents

TABLE 4 Unit 16A moose harvest chronology[a] 1997–2007

Regulatory year	August		September					November	December		Unknown	Total
	20–26	27–31	1–7	8–14	15–20	21–25	26–30	20–30	1–7	8–15		
1997–98[b]	20	7	11	29	36	--	--	17	4	8	9	141
1998–99[b]	9	5	13	21	40	--	--	11	4	13	4	120
1999–00[c]	11	7	15	21	38	32	--	--	2	16	4	142
2000–01[c]	6	3	5	16	37	29	--	--	7	11	4	119
2001–02[d]	8	3	7	10	34	37	52	--	--	--	2	153
2002–03[d]	17	2	9	11	33	34	44	--	--	--	4	154
2003–04[d]	13	6	10	15	34	34	47	--	--	--	9	168
2004–05[d]	8	4	9	20	35	37	21	--	--	--	5	139
2005–06[d]	5	2	8	11	19	24	36	--	--	--	3	108
2006–07[d]	4	5	6	14	33	24	25	--	--	--	4	115

[a] Does not include harvest from drawing permit hunts
[b] Open season = 20 Aug–20 Sep (SF-50), 20 Nov–15 Dec (SF-only)
[c] Open season = 20 Aug–25 Sep (SF-50), 1–15 Dec (SF-only)
[d] Open season = 10–17 Aug (Archery-only), 20 Aug–30 Sep (SF-50)

TABLE 5 Unit 16A percent transport methods of successful moose hunters[a], 1997–2007

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Total
1997–98	9	0	15	34	16	6	15	4	--	141
1998–99	10	1	19	22	16	7	23	2	2	120
1999–00	7	1	25	39	6	3	17	2	1	142
2000–01	10	0	15	40	5	13	12	0	5	119
2001–02	10	0	25	38	0	8	16	1	3	153
2002–03	10	0	23	33	0	11	16	2	5	154
2003–04	11	0	21	40	0	8	14	1	5	168
2004–05	9	1	15	52	0	6	15	1	0	139
2005–06	12	1	19	47	0	6	13	2	1	109
2006–07	13	1	17	45	0	6	10	3	4	115

[a] Does not include harvest from drawing permit hunts.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 16B (10,405 mi^2)

GEOGRAPHIC DESCRIPTION: West Side of Cook Inlet and Kalgin Island

BACKGROUND

Moose numbered probably in excess of 10,000 animals in Unit 16B during the early 1980s (Griese 1996). Before the severe winter of 1989–90 there probably were 8500–9500 moose (Harkness 1993). 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). Predation on neonatal moose calves by bears most likely influenced recruitment and caused a declining trend (Faro 1989). McDonough (unpublished data) estimated 150–200 wolves in the unit during the winter of 2001–02, up from the 120–140 wolves estimated in the fall 1998 (Masteller 2000). A control program to reduce the number of wolves in the area began in 2004. At that time the population was estimated at 175-180 wolves (Peltier 2006).

From 1962–74, hunting seasons were liberal in Unit 16B (20 August–30 September and 1–30 November 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 general season was closed in both 2001 and 2002 and then again in 2006. Four hundred Tier II permits were issued for 20 August–30 September (SF-50) and the 15 November–28 February (any bull) periods. These Tier II hunt areas were divided into 3 units (TM565, TM567, TM569) (Del Frate 2004).

The Kalgin Island moose population resulted from a translocation of calves during 1957–59. Numbers grew to a density of 7 moose/mi^2 during 1981 (Taylor 1983), but were reduced to approximately 1 moose/mi^2 by 1985. High moose densities severely degraded habitat and the

department adopted restrictive population objectives to maintain moose densities at less than 1 moose/mi^2 while vegetation recovered (Faro 1990). In 1999 the Board of Game adopted an any-moose registration hunt for 20 August–30 September. The board later shortened the season to 20 August–20 September to relieve conflicts between hunters and other occupants of the Island.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Maintain and enhance the moose population to provide for high levels of human consumptive use.

MANAGEMENT OBJECTIVES

Unit 16B (*excluding Kalgin Island*)

- Maintain a moose population of 6500–7500 moose and 20–25 bulls:100 cows.
- Achieve a harvest of 310–600 moose.

Kalgin Island

- Maintain a posthunt population of 20–40 moose with at least 15 bulls:100 cows

METHODS

Because of the unit's size, 16B is divided into 3 zones (North, Middle, and South) for survey purposes. The North area is described as 16B north of the Skwentna River. The Middle area is that area north of the Beluga River and Beluga Lake and south of Skwentna River. The South portion is all of 16B south of Beluga River and Beluga Lake except Kalgin Island. We have conducted various types of surveys (Gasaway et. al. 1986, Becker and Reed 1990, Ver Hoef 2001) of each of these units as funding and priorities allow (Table 1).

Aerial surveys were conducted in 16B Middle and on Kalgin Island in 2005, and another survey of Kalgin Island was conducted in 2006. Poor weather conditions precluded other surveys of the area during the reporting period.

We collected harvest and hunter effort data from registration (Kalgin), general harvest, and Tier II permit reports.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population size

We estimated the 16B Middle population at 1714 ± 343 (80% CI) in fall 2005 (Table 1). This is a reduction from 1836 ± 267 (80% CI) in fall 2001 (Table 1). The last population estimate of 16B north was 898 ± 163 (80% CI) in fall of 2003. Trend counts were completed in 16B south in 2003 and 2004. As a result of the 2004 trend count survey, the population of 16B south was revised upward to 960 animals. Thus the estimated 16B population is estimated to be 3066–4078 moose. The moose population on Kalgin Island was estimated to be 100–120 moose in January of 2006 (Table 1). Poor survey conditions in February of 2007 were probably responsible for the

low survey count of 37 moose on Kalgin Island, as the population was counted at 118 moose in November of 2007.

Population Composition

The 16B Middle composition assessed in 2005 was 29 bulls and 14 calves:100 cows. The 16B North composition assessed in 2003 included 35 bulls and 17 calves:100 cows. The 16B South composition was 23 bulls and 23 calves:100 cows in 2004. Kalgin Island in 2006 had 17 bulls and 47 calves:100 cows. It was not possible to determine the population composition for Kalgin Island during the 2006–2007 year as the surveys were completed so late in the season. (Table 1).

MORTALITY

Harvest

Season and Bag Limit The general resident-only hunting season for 2005–2006 was 1–20 September for residents only (SF/50) (Table 2), or by Tier II (TM 565, TM 567, and TM 569)for any bull from 15 November–28 February. There was no general resident season in 2006–2007. The Tier II season was 1–20 September (SF/50) or 15 November–28 February (any bull). There were 260 Tier II permits issued each year (Table 3). Kalgin Island was open to registration hunting (RM 572) from 20 August—20 September (any moose).

Board of Game Actions and Emergency Orders. The Board of Game approved a predator management plan to reduce the number of wolves in 16B and subsequently increase the moose population. Permitted pilots took 91 wolves in the winter of 2004–05, 23 in 2005–2006, and 32 in 2006–2007. In addition the board created a black bear control program to further reduce predation on moose calves. The effects of these programs on the moose population will not be known for some time. The board made no changes to 16B moose hunting during the reporting period.

Hunter Harvest. The harvest decreased in 2005 and again in 2006 (Table 2). The Tier II harvest increased in 2 out of 3 areas, most likely because of the elimination of general hunting in 16B and the shift in permit numbers (Table 3). The harvest on Kalgin Island was 20 moose each year of the reporting period, down from 54 during each of the previous years (Table 3).

Hunter Residency and Success. The general season was closed to nonresidents during the reporting period and closed to all hunters, other than Tier II hunters, during 2006–2007 (Table 4).

Harvest Chronology. About 52% of the moose taken in the general hunt of 2005–2006 were taken during the last 5 days of the season (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 (Table 6).

Other Mortality

The severe winter of 1999–00 negatively impacted the moose population. In midwinter moose were observed floundering in snow depths exceeding five 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 that the population has yet to recover from the 1999-00 winter. The effects of predation by wolves and bears are suspected 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 of 1998 (Masteller 2000). Recent control efforts have reduced the wolf population in the area. An ongoing study in 16B shows that black and brown bear predation may have as much or more influence on calf recruitment as wolf predation. Black and brown bear surveys were conducted in spring of 2007 and indicated a very high density of bears in the unit. Brown bear season and bag limits have been liberalized and a black bear control program was scheduled to begin in the fall of 2007.

Due to the continued decline in moose numbers throughout Unit 16B, Alaska Department of Fish and Game staff drafted a proposal to close the Federal Subsistence hunt for cow moose. The Federal Subsistence Board approved this proposal in May of 2004.

CONCLUSIONS AND RECOMMENDATIONS

The moose population in Unit 16B was below objective levels for this reporting period. Our estimate of 3066–4078 moose was below the minimum objective of 6500 and below what we believe the habitat could support. Current season and bag limit structure will allow bull:cow ratios to remain above minimum objective levels. If the moose density remains low, we should be cautious and maintain bull:cow ratios at or above the upper end of our objective of 25 bulls:100 cows.

Additional information is needed to better manage moose in Unit 16B. Future efforts should be directed at gaining accurate and precise estimates of wolf populations. 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. Prescribed burns should be considered for habitat enhancement since much of the unit contains mature stands of birch/aspen/spruce forest.

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TABLE 1 Unit 16B fall aerial moose composition counts and estimated subpopulation sizes, 1997–2007

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
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
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
2003–04	Northern[g]	11/24-12/6	35	7	17	9	292	326	--	898±163
	Southern[d]	12/1	46	17	23	14	133	154	--	700-850
	Kalgin Is.[h]	11/25	38	25	89	39	76	125	--	179
2004-05	Southern[d]	12/5-9	23	10	23	16	509	604	--	960
2005–06	Middle[e]	11/26-12/1	29	4	14	13	582	628	--	1714±343
	Kalgin Is.[h]	1/17/06	17	3	47	29	69	97	4.2	100-120
2006–07	Kalgin Is.[h]	2/9/07	--	--	--	30	26	37	1.6	50-70

[b] 80% confidence intervals
[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 moose harvest[a] and accidental death, 1997–2007

Regulatory year	Reported				Estimated			Accidental deaths[e]			Grand
	M	F	Unk	Total[a]	Unreported[b]	Illegal	Total	Road	Other	Total	Total
1997–98	315	15	1	331	20	25	45	1	0	1	377
1998–99	289	7	1	297	20	30	50	0	0	0	347
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	131	22	1	154	10	25	35	0	0	0	189
2002–03	91	16	2	109	10	25	35	0	0	0	144
2003–04	206	25	1	232	15	25	40	0	0	0	272
2004–05	184	34	0	218	15	25	40	0	0	0	258
2005–06	149	10	0	159	15	25	40	0	0	0	199
2006–07	117	11	0	128	15	25	40	0	0	0	168

[a] Includes all reported harvest including Federal Subsistence.
[b] Includes moose taken in defense of life or property

TABLE 3 Unit 16B moose harvest data by permit hunt, 1995–2007

Hunt Number[a]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest			
						Bulls	Cows	Unk	Total
TM565	1997–98	139	30	32	37	50	1	0	51
	1998–99	140	21	39	37	52	0	0	52
	1999–00	140	22	31	41	57	0	0	57
	2000–01	140	16	54	31	43	0	0	43
	2001–02	140	29	41	30	42	0	0	42
	2002–03	141	25	51	24	33	0	0	33
	2003–04	141	27	42	32	43	1	0	44
	2004–05	100	11	45	44	43	1	0	44
	2005–06	141	28	38	34	48	0	0	48
	2006–07	120	14	48	38	46	0	0	46
TM567	1997–98	59	12	38	48	29	0	0	29
	1998–99	60	17	37	42	25	0	0	25
	1999–00	60	13	18	58	34	0	0	34
	2000–01	60	25	37	38	23	0	0	23
	2001–02	160	31	41	28	45	0	1	46
	2002–03	160	37	54	9	14	0	0	14
	2003–04	60	22	40	38	23	0	0	23
	2004–05	60	8	49	43	26	0	0	26
	2005–06	60	25	39	33	20	0	0	20
	2006–07	140	21	49	30	42	0	0	42

TABLE 3 continued

Hunt Number[a]	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Harvest			
						Bulls	Cows	Unk	Total
TM569	1997–98	59	53	24	17	9	1	0	10
	1998–99	60	30	42	25	15	0	0	15
	1999–00	60	35	37	20	12	0	0	12
	2000–01	60	50	42	8	5	0	0	5
	2001–02	100	42	27	31	32	0	0	32
	2002–03	100	26	51	23	21	0	0	21
	2003–04	60	28	50	22	13	0	0	13
	2004–05	60	13	72	15	9	0	0	9
	2005–06	59	36	48	16	9	0	0	9
	2006–07	85	34	46	20	17	0	0	17
DM571/ RM572	1997-98	60			20	1	11	0	12
	1998-99	40			18	0	7	0	7
	1999-00	437	37	42	18	30	50	0	80
	2000–01	355	32	50	18	22	42	0	64
	2001–02	142	30	48	22	10	21	0	31
	2002–03	130	27	43	30	21	16	1	38
	2003-04	202	29	44	28	30	24	0	54
	2004-05	255	28	50	22	22	32	0	54
	2005–06	194	34	56	10	10	10	0	20
	2006–07	143	41	45	14	9	11	0	20

[a]TM = Tier II permit, RM = registration permit, DM= drawing permit

TABLE 4 Unit 16B moose hunter[a] residency and success 1997–2007

	Successful					Unsuccessful					
Regulatory year	Local resident[b]	Nonlocal resident	Nonres.	Unk.	Total (%)	Local resident[b]	Nonlocal resident	Nonres.	Unk.	Total	Total hunters
1997–98	14	163	48	4	229 (32)	25	416	36	2	479	708
1998–99	7	153	37	1	198 (25)	25	497	53	4	579	777
1999–00	7	115	40	6	168 (22)	27	489	62	18	596	764
2000–01	10	129	30	2	171 (22)	20	534	60	4	618	789
2001–02[c]	--	--	--		--	--	--	--	--	--	--
2002–03[c]	--	--	--		--	--	--	--	--	--	--
2003–04	9	88	1	1	99 (24)	20	281	3	5	309	408
2004–05[d]	7	75	0	3	85 (20)	29	300	6	5	340	425
2005–06[d]	3	59	0	0	62(16)	17	293	2	3	315	377
2006–07[c]	--	--	--	--	--	--	--	--	--	--	--

[a] Does not include individuals participating in permit hunts
[b] Unit 16 residents
[c] No general open season
[d] No general non-resident open season

TABLE 5 Unit 16B moose harvest chronology[a] by months of season, 1997–2007

Regulatory year	August		September					Unknown	Total
	20–26	27–31	1–7	8–14	15–20	21–25	26–30		
1997–98[b]	11	12	22	27	63	35	49	9	228
1998–99[b]	14	8	18	30	33	38	50	7	198
1999–00[c]	5	1	10	28	35	37	45	7	168
2000–01[c]	3	5	14	19	55	34	37	4	171
2001–02[d]	--	--	--	--	--	--	--	--	--
2002–03[d]	--	--	--	--	--	--	--	--	--
2003–04[e]	--	--	14	28	47	1	2	6	98
2004–05[e]	1	--	12	22	47	1	1	1	85
2005–06[e]	1	--	7	21	32	1	--	--	62
2006–07[d]	--	--	--	--	--	--	--	--	--

[a] Does not include harvest from permit hunts
[b] Open season = Aug 20–Sep 30 (SF/50); Kalgin Island = Aug 20–Sep 20 (Any bull)
[c] Open season = Aug 20–Sep 30 (SF/50)
[d] No general open season
[e] Open season = Sep 1–20 (SF/50)

TABLE 6 Unit 16B percent transport methods of successful moose hunters[a], 1997–2007

Regulatory year	Airplane	Horse	Boat	3 or 4 wheeler	Snowmachine	ORV	Highway vehicle	Unk.	Airboat	Sample size
1997–98	62	6	19	4	0	2	3		3	229
1998–99	56	7	23	8	0	2	1	2	2	198
1999–00	60	5	19	10	0	2	2	0	2	168
2000–01	65	3	20	7	0	1	2	1	2	171
2001–02[b]	--	--	--	--	--	--	--	--	--	--
2002–03[b]	--	--	--	--	--	--	--	--	--	--
2003–04	56	1	16	14	1	1	5	4	1	98
2004–05	64	0	15	12	0	1	5	4	0	85
2005–06	63	--	19	13	--	--	1	1	1	62
2006–07[b]	--	--	--	--	--	--	--	--	--	--

[a] Does not include harvest from permit hunts
[b] No general open season

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

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 migrating 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 Alaska Department of Fish and Game (ADF&G, 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 three 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 resulted in part from a positive response by unit residents to department education efforts, and from the abundance of an alternative big game resource as the Mulchatna caribou herd grew and extended its range (Van Daele 1995).

Moose are now common along the Nushagak/Mulchatna rivers and all of their major tributaries. They are also common throughout the Wood-Tikchik lakes area. Moose have successfully extended their range westward into the Togiak and Kulukak river drainages of Subunit 17A, where a viable population has become established.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

SUBUNIT 17A

- Manage for a minimum population of 300 moose and a target population of 1100–1750 moose.

SUBUNIT 17B

- Manage for a population of 4900–6000 moose with a human use objective of 200–400 moose. Achieve and maintain a density of 1 moose/mi^2 on habitat considered good moose range.

SUBUNIT 17C

- Manage for a population of 2800–3500 moose with a human use objective of 165–350 moose. Maintain a minimum density of 0.5 moose/mi^2

METHODS

Moose populations in Subunit 17A were monitored in cooperation with personnel from the Togiak National Wildlife Refuge (TNWR). Movements along the border of Subunits 17A and 17C were monitored during a radiotelemetry study from 1989 to 1994. In March 1998, 36 moose were radiocollared in 17A to study movements and population parameters (Aderman, et. al. 1999). Additional moose have been radiocollared in 17A each year since. Late winter aerial surveys of 17A were conducted during this reporting period.

Aerial surveys of trend count areas in Subunits 17B and 17C were 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 1 November–15 December, when moose were thought to be 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 1992–1993 to investigate population trends, but have not been conducted since 1998.

Moose population estimation surveys have been conducted 8 times in portions of Subunits 17B and 17C. A portion of 17C was surveyed in 1983. In 1987 a portion of the upper Mulchatna River area in 17B was surveyed, and in 1995 western 17C and most of 17A were surveyed. In March 1999 and March 2004 population estimation surveys for 17C were completed using a geospatial population estimator (GSPE) model. In March 2001 and March 2006 population estimation surveys for the western portion of 17B (upper Nushagak River drainage) were completed using the GSPE model. In March 2002 a population estimation survey for the eastern porting of Unit 17B (Mulchatna drainage) was completed using the GSPE model. (Kellie and DeLong 2006, and DeLong 2006).

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 the Alaska Bureau of Wildlife Enforcement during the hunting season.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

POPULATION SIZE

Aderman et. al. (1995) estimated there were approximately 100 moose in Subunit 17A and the portion of 17C surveyed in 1995. Each year during late winter, department staff and TNWR staff attempt to survey 17A, east of and including the Matogak River drainage and north of the Nushagak Peninsula. A survey conducted in March 2004 indicated a minimum population of 777 moose in 17A (Aderman and Woolington 2005). The present population size in 17A probably exceeds 1000 moose. We have seen a continued increase in the number of moose in Subunit 17A since the early surveys.

The moose population in Subunit 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 a minimum of 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. From the available data, it appeared the moose population size in the unit was stable to increasing. In March 2001, a moose population estimation survey was completed in the western portion of 17B, yielding an extrapolated estimate of 1202 (± 141 at 90% CI) moose, including 61 (± 9 at 90% CI) calves (5.1% of moose) (Woolington 2002). In March 2002, a moose population estimation survey was completed in the eastern portion of 17B, yielding an extrapolated estimate of 1953 (± 254 at 90% CI) moose, including 76 (± 12 at 90% CI) calves (3.9% of total moose) (Woolington 2004). In March 2006, another moose population estimation survey was completed in the western 17B, yielding an extrapolated estimate of 1210 (±120 at 90% CI) moose, including 151 (± 13 at 90% CI) calves. These estimates indicate the 17B moose population is less than the population management objective.

The moose population in 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 a minimum of 2800 moose. In March 1999, a moose population estimation survey was completed for 17C north of the Igushik River, yielding an extrapolated estimate of 2955 (± 488 at 90% CI) moose, including 435 (± 76 at 90% CI) calves (14.7% of moose) (Woolington 2002). In March 2004, a moose population estimation survey was completed for 17C north of the Igushik River, yielding an extrapolated estimate of 3670 (± 542 at 90% CI) moose, including 410 (± 96 at 90% CI) calves (11.2% of moose) (Woolington 2006). This estimate indicates the 17C moose population is above the minimum 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. Calves counted in surveys are considered the minimum number present as larger

calves may get counted as adults. 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 population estimation survey indicated a minimum calf percentage of 14.7% in Unit 17C. The 2001 population estimation survey indicated a minimum calf percentage of 5.1% in western Unit 17B, and the 2002 survey indicated a minimum calf percentage of 3.9% in eastern Unit 17B. The 2004 population estimation survey indicated a minimum calf percentage of 11.2% in Unit 17C.

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 throughout the winter.

Data from a joint ADF&G and TNWR radiotelemetry study indicated most moose radiocollared in western 17C stayed in that area, but there was some movement into 17A. One collared 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 17A, some collared moose remained in the same range during winter and summer, while others used different ranges during those seasons. Since then, moose collared in 17A have moved into western 17A and the southern part of Unit 18. These moose seem to be part of a continued westward expansion of moose into previously unpopulated moose habitat (Aderman and Woolington 2005).

MORTALITY

HARVEST

Season and Bag Limit. The fall resident-only registration hunt in Subunit 17A was open 25 August–20 September. The winter resident-only 2-week registration hunt in 17A (RM575) for regulatory year 2005–06 was open 11–24 January. The winter resident-only 2-week registration hunt in 17A (RM575) for regulatory year 2006–07 was open 17–30 December. Registration permit holders could take 1 bull in a regulatory year. There was no general hunt or nonresident hunting season for moose in Subunit 17A.

The general moose hunt in Subunits 17B and 17C was open for resident hunters 1–15 September. The bag limit for residents was 1 bull with spike/fork or 50-inch or greater antler spread or with 3 or more brow tines on at least 1 side. The general moose hunt in 17B for nonresident hunters was open 5–15 September. The bag limit for nonresident hunters was 1 bull with 50-inch or greater antler spread or with 4 or more brow tines on at least 1 side. Nonresidents were prohibited from hunting moose in 17C.

The fall resident-only registration hunt in 17B and 17C (RM583) was open 20 August–15 September. Registration permit holders could take 1 bull in a regulatory year. The fall nonresident-only registration moose hunt in the 17B Nonresident Corridor (RM587) was open 5–15 September. Registration permit holders could take 1 bull with 50-inch or greater antler spread or with 4 or more brow tines on at least 1 side. The area open for this registration hunt was a corridor extending 2 miles on either side of, and including the Nushagak River beginning at the southern boundary of Unit 17B and extending north to the Chichitnok river, and including Harris

Creek, King Salmon River, and the Chichitnok River; Mulchatna River upstream to the mouth of the Chilchitna; Nuyakuk River extending west to the falls; Koktuli River upstream to the mouth of the Swan River; and, Stuyahok River to the confluence of the East and West Forks.

The winter resident-only registration hunt in 17B and 17C (RM585) was open 1–31 December. Registration permit holders could take 1 bull in a regulatory year. Areas that remained closed during this winter hunt were the Mulchatna River drainage upstream and including the Chilchitna River (in 17B), and the Iowithla River drainage, Sunshine Valley, and all portions of the unit west of the Wood River and south of Aleknagik Lake (in 17C).

Registration hunt RM573 permits were valid only in 17A and were available (5 August–25 September) to any Alaska resident who applied in person at Togiak. Registration hunt RM575 permits were valid only in 17A and western 17C and were available (throughout the open season) to any Alaska resident who applied in person at Togiak and Dillingham. Permits for registration hunts RM583 and RM585 were valid for both 17B and 17C. Permits were available to any Alaska resident who applied in person at Dillingham (RM583: 15 July–31 August; RM585: 25 October–31 December).

Board of Game Actions and Emergency Orders. No Board of Game actions regarding moose hunting regulations occurred during this reporting period. Emergency orders during this reporting period consisted of the opening of registration hunt RM575 each winter (2005–06: 11–24 January; 2006–07: 17–30 December).

Hunter Harvest. As a result of the almost 4-fold increase in moose hunters afield in Unit 17 since 1983 (1983–84=293; 2005–06=1182), reported moose harvests have almost tripled (1983–84=127; 2005–06= 380). The reported harvest in the past 5 years in 17B has ranged from 113 to 183, with an annual average harvest of 149 moose. In Unit 17C the 5-year mean annual harvest was 224, with a range of 193 to 251 moose (Table 1).

Hunters continued to harvest moose with large antlers throughout this reporting period. During each of the last 5 seasons, at least 45% of the reported harvest has consisted of moose with antler spreads of 50 inches or greater. The largest antlers reported for each of these seasons have exceeded 69 inches (Table 2).

General Hunt. The general moose hunt in 17B and 17C is shorter and has a more restrictive bag limit than the registration hunt. Greater numbers of nonlocal Alaska residents and nonresidents hunt moose during this hunt than local (Unit 17) Alaska residents (Table 3). Subunit 17A has not had an open general moose hunting season since 1980–81. The reported harvest in the past 5 years for the general moose season in 17B has ranged from 53 to 114, with a mean annual harvest of 88 moose (Table 4). In 17C, the 5-year mean annual harvest for the general hunt was 24 moose, with a range of 21 to 32 (Table 5).

Permit Hunts. Longer seasons and more liberal bag limits have enticed many resident hunters to participate in the registration hunts (RM573, RM575, RM583, and RM585). In fall and winter of 2005–06 1036 resident permits were issued for Unit 17 registration moose hunts, and 800 permittees reported they hunted, killing 269 moose. In fall 2005, 21 nonresidents were issued permits for registration hunt RM587, and 20 permittees reporting they hunted, killing 10 moose.

In the fall and winter of 2006–07, 962 resident permits were issued for Unit 17 registration moose hunts, and 774 hunters reported hunting, killing 301 moose. In fall 2006, 48 nonresidents were issued permits for registration hunt RM587, and 42 permittees reported they hunted, killing six moose. Each year at least 20% of those receiving registration moose hunting permits for Unit 17 reported that they did not hunt (Tables 6, 7, 8, 9).

Hunter Residency and Success. The mean number of moose hunters participating each year in the general moose hunting season in Unit 17 during the past 5 years was 381, a decrease from the previous reporting period (Woolington 2006). Participation by resident hunters in the general hunt has declined because of increased interest in the registration hunt. Unitwide success during the general hunt ranged from 25 to 36% during the past 5 years, with a mean annual success rate of 30%. In regulatory years 2002–03 though 2006–07, nonresidents accounted for 60% of reporting hunters in the general hunt, residents of Unit 17 accounted for 9%, and other residents of Alaska made up 31% of the total number of hunters (Table 3).

The mean number of resident moose hunters participating in registration moose hunts in Unit 17 during the past 5 years was 763, a 9% increase from the previous reporting period (Woolington 2006). Success during the registration hunts in Unit 17 ranged from 32 to 42% during the past 5 years, with a mean annual hunter success rate of 37%. Residents of Unit 17 composed 83%, and other residents of Alaska made up 17% of hunters in the resident registration hunts from regulatory years 2002–03 through 2006–07 (Table 9).

Harvest Chronology. Because of changes in seasons and weather, chronology data did not indicate consistent patterns (Table 10 and 11). 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 and discourage the illegal killing of female moose during closed seasons.

Transport Methods. Aircraft were the primary means of access for successful moose hunters in the general hunt in Unit 17 (5-yr mean = 67%, Table 12). Most successful hunters in the registration hunt used boats for access (5-yr mean = 78%, Table 13). In 1990–91, use of off-road vehicles during the fall, including 3- and 4-wheelers, became prohibited modes of transportation for big game hunters in Unit 17B.

OTHER MORTALITY

Observations of predation by wolves and bears occurred regularly throughout this reporting period. Reports from local resident and nonlocal hunters suggest wolf numbers have been increasing unitwide, 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.

Illegal harvest of moose in Unit 17 was probably more of a problem in the past than during recent years. Unit residents used to actively pursue moose with snowmachines during the winter and spring, when both male and female moose were taken. Attitudes are changing following considerable efforts by state and federal management agencies, working with local communities,

to help hunters see the benefits of reducing illegal moose kills. It is now common to see moose near local villages throughout the winter.

HABITAT

ASSESSMENT

Aderman (1999) established 7 intensive mapping areas in Subunit 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 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 in some areas, 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 probably are 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, human-caused habitat enhancement activity is not practical or necessary.

Lightning-caused wildfires are not uncommon in the unit, particularly in Subunit 17B. During this reporting period, there were no large wildfires.

In most years the most important natural force responsible for enhancing moose habitat has been 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 appeared to increase 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 as the caribou herd declines (Woolington 2005). As the Mulchatna Caribou Herd has declined, reduction in nonresident hunting opportunity for caribou has likely affected the number of nonresident hunters hunting moose in Unit 17.

CONCLUSIONS AND RECOMMENDATIONS

Predation by wolves and bears, and reported harvests of moose increased in recent years. Good browse conditions and a continuing series of average winters resulted in stable-to-increasing moose populations in Subunits 17A and 17C during this reporting period. The moose population exceeded the minimum goal in 17A and continued to increase. Population estimation surveys during the previous and present reporting period indicate the moose population in 17B is below management objectives. Population estimation surveys during previous reporting periods indicate the moose population in 17C is above the minimum 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 have been 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. Regular population estimation surveys of portions of the unit during late winter provide the best moose population information. Unfortunately, they do not provide reliable information on sex or age composition.

The moose population in 17A increased dramatically in recent years. We worked with local residents and staff from TNWR and continued work on a draft moose management guideline that established an objective of 1100–1750 moose in the unit. We also continued work on a cooperative moose research project with TNWR 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 continuing efforts to inform the local public of the advantages of reducing illegal harvest of moose in the unit.

The Board of Game considered impacts of liberalized caribou seasons on the Unit 17 moose population and adjusted the moose season for 1993–94. The board adjusted it again in 1997. The board and the department will need to continue managing these 2 ungulate populations and attempt to monitor predator populations.

Recommended management actions for the next few years include the following:

- Conduct a population estimation survey of subunits each winter on a rotating basis.
- Continue to develop the moose management plan for Subunit 17A in cooperation with Togiak National Wildlife Refuge, local advisory committees, and local citizen groups.
- Continue to seek cost-effective and accurate methods to obtain bull:cow ratios within the unit.

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TABLE 1 Reported moose harvest data for all hunts in Unit 17, 1966–67 through 2006–07

Regulatory Year	Reported Harvest	Hunters afield	Success rate	Unit[a]			
				17A	17B	17C	Unk
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	7
1984–85	158	344	46%	0	86	70	2
1985–86	148	401	37%	0	94	52	2
1986–87	202	486	42%	0	122	73	7
1987–88	207	499	41%	0	152	42	13
1988–89	187	457	41%	0	157	28	2
1989–90	175	438	40%	0	122	48	5
1990–91	225	489	46%	0	178	44	3
1991–92	268	590	45%	0	172	85	11
1992–93	263	705	37%	0	160	90	13
1993–94	249	705	35%	1	150	78	20
1994–95	296	800	37%	0	167	94	35
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
2001-02	419	1175[b]	36%	7	186	222	4
2002-03	404	1147[b]	35%	8	183	210	3
2003-04	426	1168[b]	36%	11	163	251	1
2004-05	383	1204[b]	32%	20	168	193	2
2005-06	380	1182[b]	32%	25	117	232	6
2006-07	384	1103[b]	35%	36	113	233	2

[a] Harvest data not broken down by unit before 1983–84.
[b] Included hunters who registered for both fall and winter registration hunts.

TABLE 2 Unit 17 moose antler sizes (percent) in the reported harvest, 1992–93 through 2006-07

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”
2001–02	19	28	53	72”
2002–03	20	35	46	69”
2003-04	13	33	54	78”
2004-05	15	33	52	72”
2005-06	18	30	52	73”
2006-07	17	38	45	76”

TABLE 3 Unit 17 moose hunter[a] residency and success, 1992-93 through 2006-07

Regulatory Year	Successful				Unsuccessful				Total hunters
	Local resident	Nonlocal resident	Nonresident	Total (%)	Local resident	Nonlocal Resident	Nonresident	Total(%)	
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
2001–02	11	27	125	169 (36)[k]	14	97	191	304 (64)[k]	473
2002–03	12	25	77	120 (25)[l]	19	115	217	351 (75)	471
2003-04	6	38	97	141 (36)	27	96	127	253 (64)[m]	394
2004-05	4	26	97	129 (31)[n]	20	92	169	283 (69)[o]	412
2005-06	12	27	61	100 (29)	21	93	130	245 (71)[p]	345
2006-07	12	25	38	76 (27)[q]	31	60	115	209 (73)[q]	285

[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.
[k] Includes 6 successful and 2 unsuccessful hunters of unknown residency.
[l] Includes 6 successful hunters of unknown residency.
[m] Includes 3 unsuccessful hunters of unknown residency.
[n] Includes 2 successful hunters of unknown residency.
[o] Includes 2 unsuccessful hunters of unknown residency.
[p] Includes 1 unsucessful hunter of unknown residency.
[q] Includes 1 successful and 3 unsuccessful hunter of unknown residency.

TABLE 4 Unit 17B reported moose harvest[a] and accidental death, 1992–93 through 2006-07

Regulatory Year	Hunter Harvest							Accidental death	Grand total
	Reported				Estimated[b]				
	M (%)	F (%)	Unk.	Total	Unreported	Illegal	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
2001–02	141 (100)	0	0	141	0	0	0	0	141
2002–03	96 (100)	0	0	96	0	0	0	0	96
2003-04	114 (100)	0	0	114	0	0	0	0	114
2004-05	107 (100)	0	0	107	0	0	0	0	107
2005-06	68 (100)	0	0	68	0	0	0	0	68
2006-07	53 (100)	0	0	53	0	0	0	0	53

[a] Excludes permit hunt harvest.
[b] No estimates of unreported/illegal harvests have been made for this unit.

TABLE 5 Unit 17C reported moose harvest[a] and accidental death, 1992–93 through 2006-07

Regulatory Year	Hunter Harvest							Accidental death	Grand total
	Reported				Estimated[b]				
	M (%)	F (%)	Unk.	Total	Unreported	Illegal	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	32[f]	0	0	0	0	32
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
2001–02	26 (100)	0	0	26[m]	0	0	0	2	28
2002–03	21 (100)	0	0	21[n]	0	0	0	0	21
2003-04	26 (100)	0	0	26[o]	0	0	0	0	26
2004-05	21 (100)	0	0	21[p]	0	0	0	0	21
2005-06	32 (100)	0	0	32	0	0	0	0	32
2006-07	21(100)	0	0	21[q]	0	0	0	0	21

[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 bull 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.
[m] Does not include 2 bulls from an unspecified portion of Unit 17.
[n] Does not include 3 bulls from an unspecified portion of Unit 17.
[o] Does not include 1 bulls from an unspecified portion of Unit 17.
[p] Does not include 1 bull from an unspecified portion of Unit 17.
[q] Does not include 2 bulls from an unspecified portion of Unit 17.

TABLE 6 Unit 17A reported moose harvest data by permit hunt, 1997–98 through 2006-07

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
	2001–02	56	16	87	15	7 (100)	0	0	7
	2002–03	40	10	78	22	8 (100)	0	0	8
573/575[c]	2003-04	77	21	82	18	11 (100)	0	0	11
	2004-05	97	20	74	26	20 (100)	0	0	20
	2005-06	149	30	75	25	25 (100)	0	0	25
	2006-07	121	24	61	39	36 (100)	0	0	36

[a] Registration permits were valid for only Unit 17A.
[b] Includes only those permittees reporting that they hunted.
[c] Registration hunt RM575 established beginning winter 2003-04

TABLE 7 Unit 17B reported moose harvest data by permit hunt, 1992–93 through 2006-07

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
	2001–02	814	20	72	28	41 (100)	0	0	41
	2002–03	794	19	66	34	83 (100)	0	0	83
	2003-04	880	20	69	31	47 (100)	0	0	47
	2004-05	878	20	75	25	60 (100)	0	0	60
	2005-06	887	22	74	26	39 (100)	0	0	39
	2006-07	841	19	61	39	54 (100)	0	0	54

[a] Registration permit 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 (20 Aug–15 Sep) and winter (1–31 Dec) permit hunts.

TABLE 8 Unit 17C reported moose harvest data by permit hunt, 1992–93 through 2006-07

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
	2001–02	814	20	60	40	200[m](100)	0	0	200
	2002–03	794	19	51	49	193 (100)	0	0	193
	2003-04	880	20	56	44	227 (100)	0	0	227
	2004-05	878	20	65	35	173 (100)	0	0	173
	2005-06	887	22	63	37	199[n] (100)	0	0	199
	2006-07	841	19	61	39	211 (100)	0	0	211

[a] Registration permits 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 (20 Aug–15 Sep) and winter (1–31 Dec) 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 1 unreported 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.
[m] Not included are 2 bulls from an unspecified portion of Unit 17.
[n] Not included are 6 bulls from an unspecified portion of Unit 17.

TABLE 9 Unit 17 moose hunter residency and success[a] for permit hunts, 1992-93 through 2006-07

Regulatory Year	Successful				Unsuccessful				Total hunters
	Local[b] Resident	Nonlocal resident	Nonresident	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Total(%)	
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
2001–02	193	57	0	250 (36)	370	82	0	452 (64)	702
2002–03	228	56	0	284 (42)	323	69	0	392 (58)	676
2003-04	214	71	0	285 (37)	407	82	0	489 (63)	774
2004-05	204	50	0	254 (32)	446	92	0	538 (68)	792
2005-06	224	45	10	279 (34)	451	80	10	541 (66)	820
2006-07	254	47	6	307 (38)	405	68	36	509 (62)	816

[a] Includes only permittees who reported hunting.
[b] Unit 17 residents.
[c] Includes 0 successful and 1 unsuccessful hunter of unknown residency.
[d] Includes 0 successful and 2 unsuccessful hunters of unknown residency.

TABLE 10 Unit 17 reported moose harvest[a] chronology percent by month, 1992–93 through 2006-07

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	40	0	0	0	0	5	184
2001–02	0	3	57	38	0	1	1	0	1	169
2002–03	0	2	55	38	0	0	1	0	3	120
2003-04	0	0	57	39	0	0	0	0	4	141
2004-05	0	0	50	46	0	0	0	0	4	129
2005-06	0	0	56	41	0	0	0	0	9	100
2006-07	0	0	42	53	0	0	0	0	5	76

[a] Excludes permit hunt harvest.
[b] Reported harvest
[c] General season dates: Unit 17B (upstream) – 1–20 Sep
Unit 17B (remainder) - Residents: 1–20 Sep, 1–31 Dec
Nonresidents: 5–15 Sep
Unit 17C (Iowithla, etc.) - Residents: 1–15 Sep
Unit 17C (remainder) - Residents: 1–15 Sep, 1–31 Dec
[d] General season dates Unit 17B – Residents: 1–15 Sep, Nonresidents: Sept 5-15
Unit 17C - Residents: 1–15 Sep

TABLE 11 Unit 17 reported moose harvest chronology for permit hunts, percent by month, 1992–93 through 2006-07

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	Other/ 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
2001–02	11	46	21	10	0	2	2	7	1	250
2002–03	12	41	20	15	0	6	1	1	3	284
2003-04	14	44	20	13	0	1	2	4	2	285
2004-05	8	33	16	22	0	5	5	5	5	254
2005-06	6	42	23	20	0	1	1	1	5	277
2006-07	15	34	19	17	0	1	4	10	1	306

[a] Reported harvest
[b] Registration permits valid for 20–31 Aug.
[c] Registration permits valid for any bull, 20 Aug–15 Sep and 1–31 Dec.
[d] Registration permits valid for any bull; Unit 17A, 25 Aug–20 Sep, Unit 17B and 17C, 20 Aug–15 Sep and 1–31 Dec.

TABLE 12 Unit 17 reported moose harvest[a] percent by transport method, 1992-93 through 2006-07

Regulatory Year	Percent of harvest								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
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
2001–02	64	0	34	1	0	0	0	1	169
2002–03	61	0	38	1	0	0	0	1	120
2003-04	70	0	29	1	0	0	0	0	141
2004-05	75	0	23	1	0	0	0	1	129
2005-06	66	0	28	3	0	0	0	3	100
2006-07	63	0	33	0	0	0	0	4	76

[a] Excludes permit hunt harvest.

TABLE 13 Unit 17 reported moose harvest by permit hunt, percent by transport method, 1992-93 through 2006-07

Regulatory Year	Percent of harvest								Total moose
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unknown	
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
2001–02	10	0	74	1	10	0	1	4	250
2002–03	12	0	82	1	1	1	2	2	284
2003-04	11	0	79	1	7	1	1	1	285
2004-05	6	0	72	3	16	0	0	2	254
2005-06	12	0	79	1	3	0	1	3	277
2006-07	4	0	76	2	14	1	2	1	307

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

LOCATION

GAME MANAGEMENT UNIT: 18 (42,000 mi^2)

GEOGRAPHICAL DESCRIPTION: Yukon-Kuskokwim Delta

BACKGROUND

Moose are 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.

Moose densities are moderate to high and growing in the Yukon River drainage, and low and growing in the lower Kuskokwim River drainage. Although moose are now more common than in the past, overall densities in Unit 18 vary from low to high 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 its larger tributaries.

The boundaries of Unit 18 and those of the Yukon Delta National Wildlife Refuge (YDNWR) nearly coincide. The southern tip of Unit 18 is within the Togiak National Wildlife Refuge (TNWR). The Alaska Department of Fish and Game (ADF&G, the department) shares common interests with the Refuges 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 2500–3500 moose. Allow the lower Kuskokwim River moose population to increase above its estimated size of 75–250 moose to at least 2000 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 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 harvest ticket hunt reports and by contacting hunters in the field. Whenever possible, we collect incisors and take antler measurements; hunter participation is voluntary.

In February and March 2006 we conducted a moose population survey in the Paimiut count area using the Geospatial Population Estimator (GSPE) method developed by Ver Hoef (2001). In the

winter of 2007 weather prevented us from conducting a similar survey anywhere in Unit 18. The survey area boundaries are shown in Figure 1 and are delineated within Unit 18 as follows:

- Paimiut Area: The Yukon River from old Paimiut Village downstream to Pilot Village.
- Andreafsky Area: The Yukon River from Pilot Village downstream to Mountain Village.
- Lowest Yukon Area: The Yukon River downstream from Mountain Village.
- Lower Kuskokwim Area: The Kuskokwim River riparian corridor between Kalskag and Kwethluk.

We altered the size of our survey areas to achieve cost savings, safety, and other efficiencies and to allow us to conduct a census in more than 1 area per year. Table 1 lists the size of the areas surveyed during each census and Figure 1 depicts the larger survey areas. We plan to conduct a GSPE survey in 2 survey areas in 1 year and alternate with 2 more the following year.

We continued a cooperative strategy to establish a moose population along the Lower Kuskokwim River with the Lower Kuskokwim Fish and Game Advisory Committee (LKAC), the Association of Village Council Presidents (AVCP), interested individuals, and the U.S. Fish and Wildlife Service (FWS). As part of this effort, we conducted trend counts with observers from the Kuskokwim River villages to compare the Yukon River moose population to the number of moose on the Kuskokwim River. As a result of these efforts, the LKAC wrote a proposal to the BOG to close moose hunting in the Lower Kuskokwim for 5 years starting the fall of 2004.

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 depicting 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 Alaska Department of Public Safety, Division of Fish and Wildlife Protection (now the Bureau of Wildlife Enforcement (ABWE)) in Bethel and Aniak.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

In February and March 2006, we conducted moose population censuses in the Paimiut survey area Table 1). Unless otherwise noted, the following results are reported at the 95% CI.

The moose population in the Paimiut count area grew from an estimate of 994 ± 19.7% moose in 1992 to 2382 ±16.1% in 2002 and 3614 ± 18.1% in 2006. The moose population in the Paimiut

count area grew at about a 12.5% annually from 1992 to 1998, slowed to about 5% from 1998 to 2002 and grew at 12.5% from 2002 to 2006. The midpoint of the density estimate increased from 0.64 to 2.30 moose/mi^2.

Population Composition

In November of 2005 we classified bulls, cows and calves in the Paimiut and Lowest Yukon count areas (Table 2). Adequate survey conditions are present only every 3 or 4 years so these surveys are not conducted on an annual basis, only as conditions allow. Moose calf survival was extremely high in the Lowest Yukon count area and moderately high in the Paimiut area. Both areas have bull to cow ratios that we would expect in a harvested population with the Paimiut area seeing more hunting pressure and subsequently lower bull to cow ratios. One notable number is the number of twins seen in the Lowest Yukon area, with almost 40% of the cows with calves having twins with them in the early winter (Table 2).

Distribution and Movements

Moose are distributed throughout the Yukon River riparian corridor with highest concentrations occurring during the winter. Within this riparian corridor, the densities are greatest in the Paimiut Area followed by the Lowest Yukon and Andreafsky areas. Moose are usually found at low density near the villages but along the Yukon River that tendency is less pronounced now compared to previous reporting periods. 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 from Lower Kalskag to Bethel. They exist at low densities given the available habitat. Moose are seen in the downriver third of this corridor more and more often.

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 except perhaps in the Kwethluk River drainage, where we received reports of moose wintering in this drainage during 2001 to 2007. The latest report was of 48 moose.

We have some radiotelemetry data, which show that moose are entering Unit 18 from adjacent Unit 17. These moose appear to be colonizing the southern drainages of Unit 18 including the Goodnews and Kanektok river drainages where Togiak NWR staff observed 48 moose in March 2007. We also have reports from local residents of increasing numbers of moose in this area. (Aderman, personal communication, 2007).

During the summer, moose are found in low numbers throughout the unit. Moose have been reported along the Manokinak and Izaviknek rivers, near Chevak, on Nelson Island and even swimming in the ocean beyond the mouth of the Yukon River. While these reports are unusual, they show that moose move about broadly throughout the Yukon-Kuskokwim Delta.

MORTALITY

Harvest

Season and Bag Limit. Seasons and bag limits for this reporting period can be found below. The bag limit throughout Unit 18 is one antlered bull in the fall. In the winter the bag limit is either 1 antlered bull, except in the hunt area below Mt. Village where it is 1 antlered bull or 1 calf.

On federal public lands within Unit 18, federal regulations limit moose hunting to Alaska residents of Unit 18 and residents of Upper Kalskag. Within the Kuskokwim River drainage upriver from and including the Tuluksak River drainage, federal regulations also permit residents of Aniak and Chuathbaluk to hunt on federal public lands.

Federal seasons in Unit 18 were the same as State of Alaska seasons with except that there is no federal season in Unit 18 south of and including the Kanektok River drainages.

2005–2006 Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, Lower Kuskokwim Closed area; easterly of a line from the mouth of the Ishkowik River to the closest point of Dall Lake then to the easternmost point of Takslesluk Lake then along the Kuskokwim drainage boundary to the Unit 18 border and north of and including the Eek River drainage	No Open Season	No open Season
Unit 18, that portion south of the Eek River drainage and north of the Goodnews River drainage:		
1 bull	1 Sep – 30 Sep	No open season
Unit 18, that portion south of and including the Goodnews River drainage	No open season	No open season
Remainder of Unit 18		
1 bull	1 Sep – 30 Sep	1 Sep – 30 Sep
OR 1 bull	10 day season may be announced 1 Dec – 20 Feb	

2006–2007 Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18, Lower Kuskokwim Closed area; easterly of a line from the mouth of the Ishkowik River to the closest point of Dall Lake then to the easternmost point of Takslesluk Lake then along the Kuskokwim drainage boundary to the Unit 18 border and north of and including the Eek River drainage, and that portion south of and including the Goodnews River drainage	No open season	No open season
Unit 18, that portion south of the Eek River drainage and north of the Goodnews River		
1 antlered bull	1 Sep – 30 Sep	No open season
Unit 18, that portion north and west of a line from Cape Romanzof to Kuzilvak Mt to Mt. Village and excluding all Yukon River drainages upriver from Mt. Village(lower Yukon)		
1 antlered bull	1 Sep – 30 Sep	1 Sep – 30 Sep
OR one antlered bull OR one calf (ADFG may close some areas to the taking or calves)	20 Dec – 10 Jan	No open season
Unit 18, Remainder		
One antlered bull	1 Sep – 30 Sep	1 Sep – 30 Sep
Or one antlered bull	20 Dec – 10 Jan	No open season

Board of Game Actions and Emergency Orders. A 21-day winter resident season from 20 December–10 January was passed by the Board of Game (BOG) at its November 2005 meeting in Kotzebue. We asked for and received expedited implementation, so the new season took effect in December of 2005. The season was the same for the area below Mt. Village and the remainder of Unit 18 but the bag limits were different. Upriver of Mt. Village the bag limit was 1 antlered bull but below Mt. Village the bag limit was 1 antlered bull or 1 calf.

The Board of Game closed moose hunting on the Kuskokwim River drainage during its fall 2003 meeting (effective beginning RY 2004) in response to a request by the State and the LKAC for a 5-year moratorium on moose hunting. This closure was agreed upon with the hopes that it would have similar results to the Lower Yukon River moratorium in the late 1980s and earlier 1990s.

Human-Induced Harvest. During the 2005–2006 open season, 661 hunters reported a harvest of 317 moose**.** For the 2006–2007 season, 648 hunters reported a harvest of 330 moose. This continues the general trend of increasing reported moose harvest in Unit 18 that began in the early 1990s (Table 3).

Local demand for moose is high in Unit 18. The annual combined reported and unreported harvest is estimated at 7–12% of the population on the Yukon River. Until recently, harvest has exceeded annual recruitment on the Kuskokwim River and moose have survived there only due to continual immigration from adjacent areas. We believe unreported harvest has drastically declined due to educational efforts during 2001–2004 and the moratorium of moose hunting that began in the fall of 2004.

The reported harvest of moose in Unit 18 does not reflect the actual harvest. Rather, it shows only the harvest by people who operate within the regulatory system. Compliance with regulations is improving, particularly among local residents hunting during the fall season, so harvest summaries based on hunt reports are getting better. On the Yukon River, we believe that harvest reporting has improved largely because of the increase in acceptance of harvest tickets/reports, the willingness of most hunters to harvest only bulls, and the successful cooperative effort that resulted in both a huntable moose population below Mt. Village and greater public confidence in the regulatory system. However, there are hunters who do not report; consequently, reported moose harvests from Unit 18 should be regarded as minimum estimates.

The majority of the reported Unit 18 moose harvest comes from the Yukon River drainage, which accounted for approximately 98% (312 moose) of the reported harvest in 2005–2006 and 96% (318 moose) in 2006–2007. The few other moose reported harvested were either in the Kanektok River drainage (5 moose in 2005–2006 and 7 in 2006-2007) or the location of the kill was not recorded.

There is growing use of Alaska State regulation 5 AAC 92.019 in Unit 18, which 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 regulation, informing them which animals are legal, and describing how to accomplish harvest reporting. We also provide the hunters with a copy of the administrative code (regulation) and contact the Alaska Bureau of Wildlife Enforcement to inform them of the arrangement. This statute regulation 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.

Permit Hunts. There were no permit hunts for moose in Unit 18 during the reporting period.

Hunter Residency and Success. As reported in past years, Alaska residents accounted for most of the moose hunting activity in Unit 18 with the vast majority being Unit 18 residents. Of 661 hunters who participated during the 2005–2006 season, 5 were nonresidents. Of 648 hunters who participated during the 2006–2007 season, 2 were nonresidents. Low moose densities within the Kuskokwim drainage, high cost, and federal restrictions generally make Unit 18 an unattractive destination for nonresident moose hunters.

Based on reported harvest, the moose hunter success rates based on harvest reports were 48% for 2005–2006 and 50% for the 2006–2007 seasons. Successful hunters spent an average of 8.0 days hunting in 2005–2006 and 7.9 days in 2006–2007. Unsuccessful hunters spent an average of 9.6 days hunting in 2005–2006 and 11.2 days in 2006–2007.

On the Kuskokwim River, many of the residents that hunted moose between Kalskag and McGrath (in Unit 19) were from Unit 18. This has changed in recent years as moose populations in Unit 19 have declined and some areas are now closed to moose hunting and other areas are now hunted only under Tier II permits. On the Yukon River, Unit 18 residents regularly hunted in Unit 21E but the number of hunters making these upriver trips is declining.

Harvest Chronology. The majority of reported moose harvest occurs during September when the general season is open. Only small numbers of moose have been reported harvested in the winter season (Table 4).

As the Yukon River moose population grows and becomes more accessible to Yukon River villagers, extended camping trips to hunt moose are being replaced by day trips from home. Harvest chronology is being driven by these day hunts and is influenced more by weather and the workweek than by moose movements. Furthermore, hunters prefer to take moose early in the season citing better meat quality. As a consequence, only about 5% of the fall harvest takes place during the last 5 days of September.

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. We regularly see black and grizzly bears during moose calving surveys and local residents have complained of heavy predation on calves by 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.

Incidental reports from the public and department fur sealing records indicate that wolf numbers have increased considerably during this and the previous 3 reporting periods. This is as expected since caribou have become more available, moose numbers have increased, and trapping pressure has declined. We estimate that 250–300 wolves in 25–30 packs reside in Unit 18. Throughout most of Unit 18 the distribution and density of wolves reflects the distribution and density of moose, especially in the Yukon River drainage. In the lower Kuskokwim River drainage, caribou are the main prey item for wolves and wolf distribution is not as closely linked to moose.

HABITAT

Assessment

We estimate a minimum of 8000 mi^2 of moose habitat exists in Unit 18. Approximately 4500 mi^2 of this habitat occurs along the riparian zone of the Yukon River and the remaining 3500 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. The Yukon Delta has many distributaries fringed by willows and cottonwoods, and even though the moose population has grown in this area it still 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 continued discussions with the LKAC, the YDNWR, 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; we have agreed upon a strategy centered on a 5-year moose hunting moratorium (Appendix 1). The LKAC voted unanimously to submit a proposal to the Board of Game to initiate the moratorium beginning in the fall of 2004. Local support is not universal but it is widespread as exemplified by the signed resolutions and other expressions of support we received from 11 of the 13 affected villages. We believe this support is essential for this strategy to succeed.

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 and, in most areas where moose are present, their numbers are lower than the habitat could support. Calf production and yearling recruitment are high. In the past, we had seen hunting pressure from the relatively dense human population in the unit impede moose population growth and prevent a Kuskokwim River moose population from becoming established. More recent anecdotal information indicates that moose are becoming much more common in the Kuskokwim and Goodnews drainages.

The illegal harvest, particularly of cows and particularly within the Kuskokwim River drainage, has decreased dramatically during this reporting period. Other factors that can still affect moose management are a poorly developed cash economy, declining commercial fishing opportunities, and a high and growing density of people along the major rivers. These factors complicate moose management considerably. More than 20,000 rural residents live in 42 communities throughout Unit 18 and we need continued effort to curb illegal harvest of moose. Another factor is the declining number of Mulchatna caribou, which will affect the ability of local hunters to gather meat.

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 and we are encouraged by the efforts of the LKAC to adopt a strategy to improve moose numbers within the Kuskokwim drainage.

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 also continue to conduct composition counts and trend counts. As populations have increased, habitat assessment will become a more important part of our management activities. The census results, in conjunction with composition surveys, will provide the department with baseline demographic and recruitment information to properly manage the moose population.

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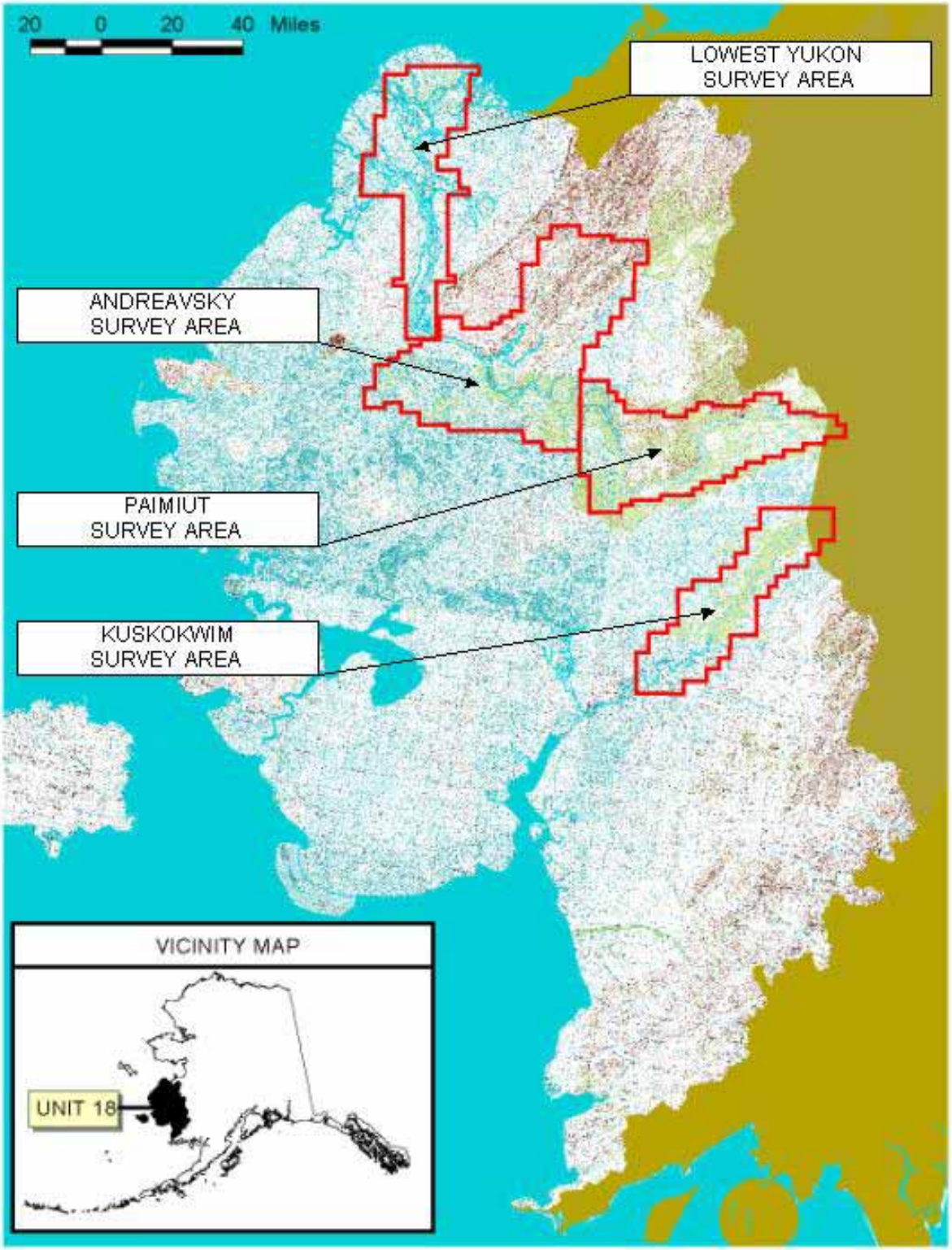

Figure 1 Unit 18 showing geostatistical population survey areas (Ver Hoef style survey areas). The larger area is shown for survey areas where boundaries were adjusted.

TABLE 1 Unit 18 moose population census history

Survey Area	*Year*	*Area (mi^2)*	*Estimate at 95%CI*	*Density (moose/mi^2)*	*Census Technique*
Lowest Yukon	1988	1703	0	NA	Minimum count
	1992	1703	28	0.02	Minimum count
	1994	1703	65	0.04	Minimum count
	2002	1151	674 ± 21.9%	0.59	Spatial method
	2005	1193	1341±21.0%	1.12	Spatial method
Andreafsky	1995	1393	52 ± 74.0%	0.04	Gasaway method
	1999	2279	524 ± 29.8%	0.23	Spatial method
	2002	1150	418 ± 22.4%	0.36	Spatial method
Paimiut	1992	1558	994 ± 19.7%	0.64	Gasaway method
	1998	1558	2024 ± 12.9%	1.30	Gasaway method
	2002	1571	2382 ± 16.1%	1.52	Spatial method
	2006	1571	3614 ± 18.1%	2.30	Spatial method
Lower Kuskokwim	1993	648	216 ± 44.6%	0.33	Gasaway method
	2000	907	86 ± 26.4%	0.09	Spatial method
	2002	907	117 ± 18.3%	0.13	Spatial method
Lower Kuskokwim Unit 18 only	2002	869	94 ± 23.0%	0.11	Spatial method
Lower Kuskokwim Unit 18 Only	2004	869	69.6 ±32.4%	0.08	Spatial method

TABLE 2 Moose composition surveys, Unit 18, November 2005

Survey Area	*Calves:100 cows*	*% calves as twins*	*Bulls:100 cows*
Lowest Yukon(N=211)	92.4	39.3 %	36.9
Paimiut(N=335)	29.8	Not recorded	23.9

TABLE 3 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
2001–2002	428	162
2002–2003	589	223
2003–2004	633	233
2004–2005	528	226
2005–2006	661	317
2006–2007	648	330

TABLE 4 Fall and winter moose harvests for Unit 18, 1978–2007

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	1	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
2001–2002	140	86	9	6	13	8	162
2002–2003	202	91	10	4	11	5	223
2003–2004	220	94	13	6	0	0	233
2004–2005	189	84	36	16	1	1	226
2005–2006	253	80	64	20	0	0	317
2006–2007	256	78	70	21	4	1	330

APPENDIX 1

Lower Kuskokwim Moose Strategy

1) The people of the Lower Kuskokwim River communities desire a larger moose population so a greater harvest can be sustained. This document is an agreement among the signatories on our strategy to achieve our goal.

2) This strategy applies to the Unit 18 portion of the Kuskokwim River drainage, including the Eek River drainage.

3) The moose season in this area will remain closed for 5 years beginning in the year 2004.

4) The fall season will be reopened for bulls only after 5 years of no hunting or there is a minimum moose population in the Lower Kuskokwim moose count area of 1000.

5) We recognize the importance of cow moose to future moose populations. We understand that there will be no cow hunts unless habitat degradation occurs from excessive moose browsing. We understand that most moose in a population are cows and that 20-30 bulls per 100 cows is normal in hunted populations.

6) We anticipate that the moose population will grow to at least 2000 moose in the Lower Kuskokwim count area after adherence to a 5-year moratorium on hunting and continued adherence to a harvest of bulls only.

7) We understand that a larger moose population will better, but not completely, serve the subsistence needs of the residents of this area. We fully expect, however, that the number of moose harvested locally will greatly increase.

8) Enforcement has a role in this strategy that needs to be developed in a cooperative fashion.

9) The reward this strategy promises is substantial and we are committed to achieving our goal of at least 2000 moose in the Lower Kuskokwim moose count area.

WILDLIFE MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 P.O. Box 115526
Juneau, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNITS: 19A, 19B, 19C, and 19D (36,486 mi^2)

GEOGRAPHIC DESCRIPTION: All Kuskokwim River drainages upstream from Lower Kalskag

BACKGROUND

Moose are a relatively recent faunal addition to western Interior Alaska. According to oral history, their initial discovery was sometime after the turn of the twentieth century. As recently as the 1970s, moose populations were at record highs. Currently, moose are found throughout this area, with the exception of the rugged peaks of the Alaska Range. Predation by wolves, black bears, and grizzly bears is the major factor influencing moose abundance in Unit 19, with weather, habitat, and hunting playing important roles.

Unit 19 can be conveniently divided into 2 regions with distinct differences in moose habitat, user access, and hunting practices. Units 19A and 19D are generally lower elevation areas accessible by boat. Hunters in these units generally live in Unit 19 or downriver in Unit 18 and hunt primarily for food. Units 19B and 19C are generally higher elevation areas where access is largely by aircraft. Few people live in these areas, and those who travel there to hunt often seek large bulls for their trophy quality, although meat is an important consideration.

Prior to moose population density estimates such as those conducted in Unit 19A (Table 1a), aerial composition surveys were for several decades the primary means of assessing population status and trend in this large area (Tables 1b–1c). Unfortunately, these older data and relevant survey information (i.e., snow conditions, weather and light conditions, survey dates, observers, techniques used, etc.) that help to interpret these data were lost during a fire that consumed the McGrath office in December 2006.

Regulations that apply in the area include controlled use areas (CUA), management areas (MA), and other requirements to manage moose hunting and reduce conflicts between user groups. For example, the Holitna–Hoholitna CUA imposes a boat motor horsepower restriction; the upper

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

Holitna–Hoholitna MA requires hunters to stop at a checkstation if one is established, and hunters entering the Holitna–Hoholitna MA by aircraft must exit the area by the same means; meat on the bone requirements and meat care education requirements exist for various areas; there are aircraft restrictions in the Upper Kuskokwim CUA in Unit 19D; and moose hunting may occur only with a Tier II permit in parts of Unit 19A, including the Lime Village MA.

Moose populations in Units 19A and 19B declined beginning in the early 1990s; conflicts between users intensified; and moose hunting regulations became more cumbersome. These conflicts led to creation of the Central Kuskokwim Working Group, made up of representatives of multiple user groups, and development the Central Kuskokwim Moose Management Plan (CKMMP), which was finalized in June 2004 (ADF&G 2004) and now guides moose management decisions in Units 19A and 19B. Similar public input has been accomplished in Unit 19D since 1995 through the McGrath Fish and Game Advisory Committee.

Wolf and bear predation plays a significant role in the population dynamics of moose (Gasaway et al. 1992, Boertje et al. 2009). In Unit 19D, wolves, black bears, and grizzly bears were all identified as significant predators (Keech et al. 2002). With this understanding we directed management toward efforts to reduce predation. In 2001 the Experimental Micro Management Area (EMMA; Fig. 1) was established covering a 528-mi^2 area of eastern Unit 19D (Unit 19D East) within a 20-mi radius of McGrath. This area encompasses the highest density of moose in Unit 19D East and was established as a treatment area to test predator population manipulations and other management actions.

In 1995 the Alaska Board of Game adopted a Wolf Control Implementation Plan for Unit 19D East (8513 mi^2, encompassing Unit 19D upriver of, but not including, the Black and Selatna River drainages; Fig. 1). The board updated and reauthorized the same plan in January 2000, March 2001, March 2003, and January 2006, and reauthorized the plan without updates in May 2006.

Predation control programs in Units 19A and 19D are critical for compliance with the intensive management mandates found in 5 AAC 92.106 and 5 AAC 92.108, which identify the Unit 19 moose populations as important for providing high levels of harvest for human consumptive use and set the population and harvest objectives. As moose numbers declined, public planning efforts increased; predator control plans were implemented; research efforts undertaken; and despite wide local support for predator control, legal challenges to these programs remain. Efforts to increase the moose populations in Unit 19 characterize the most important management responsibilities in the McGrath office.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Work toward achieving the intensive management moose population and harvest objectives for Units 19A, 19B and 19D.
- Maintain or increase moose numbers and harvest levels in Unit 19C.

- In Unit 19A and Unit 19D East: reduce predation on moose through predator control activities.

MANAGEMENT OBJECTIVES

In Units 19A and 19B intensive management population and harvest objectives, as listed regulation 5 AAC 92.108, were:

- Achieve a moose population of 13,500–16,500 moose (7600–9300 in Unit 19A) with a harvest of 750–950.

Objectives for Units 19A and 19B recommended in the CKMMP included:

- Maintain a minimum fall posthunt bull:cow ratio of 20–30 bulls:100 cows.
- Maintain a minimum fall posthunt calf:cow ratio of 30–40 calves:100 cows.
- Maintain no fewer than 20% calves in late winter surveys. These were described as short yearlings in the CKMMP and are approximately 10-month-old calves.

In Unit 19C:

- Maintain an annual average antler spread measurement of at least 48 inches in Unit 19C.

In Unit 19D, the intensive management population and harvest objective was to:

- Achieve a moose population of 6000–8000 moose with a harvest of 400–600 moose in Unit 19D East and a moose population of 4000–6000 with a harvest of 250–600 in the remainder of Unit 19D.

ACTIVITIES

Throughout Unit 19:

- Conduct composition–trend surveys, particularly in portions of the unit where harvest levels make significant impacts on moose populations.
- Assess population size through population density estimation surveys.
- Assess moose movements through regular radiotelemetry surveys.
- Assess moose habitat directly through browse surveys, and indirectly through population indices such as twinning rates and body weights, when possible.
- Encourage landowners and land managers to reduce fire suppression on wildfires that do not threaten human life, property, or valuable resources, allowing fire to maintain young, productive, and diverse habitats.

- Monitor harvest through Tier II permits, registration permits, and general hunt harvest reports; analyze harvest data; and assess the accuracy of this data in selected areas when possible.

- Monitor natural mortality and analyze mortality data.

- Provide moose management information to state and federal regulatory bodies.

In Units 19A and 19B additional activities, as recommended in the CKMMP:

- Assemble moose biology and management educational curricula and distribute through newsletters, school materials, posters, and other mechanisms to a variety of audiences, including students, teachers, hunters, and others.

- Fit moose with radio collars in Unit 19A and in Unit 19B and conduct flights to track the locations of these radiocollared moose.

METHODS

To estimate moose population size and density in Unit 19A, spring aerial geospatial population estimator (GSPE; Ver Hoef 2001, Kellie and DeLong 2006) surveys were conducted in approximately 7156 mi^2 south of and along the Kuskokwim River during February 2005; in the western 3444 mi^2 of Unit 19A south of the Kuskokwim River during March 2006, and in the eastern 3874 mi^2 of Unit 19A south of the Kuskokwim River in March 2008 (Table 1a). Surveys results are not reported with sightability correction factors but sightability correction factors measured in Unit 19D are suggested as a guide. Densities calculated from these surveys are extrapolated to larger areas where no population estimation surveys have been conducted.

In Unit 19D, 6 fall GSPE surveys, with sightability measures based on radiocollared moose, were conducted by ADF&G during 2001–2007 (Table 1d; M. Keech, ADF&G, unpublished data, Fairbanks). These included surveys in November 2006 and 2007 focused around the EMMA and the EMMA buffer; the buffer is an area larger than the EMMA delineated to better assess movements and measure population size as the population within the EMMA expands into surrounding areas. Unit 19D moose populations were also surveyed during 2001 and 2003 in the moose survey area (MSA). After the Unit 19D East research program ends, moose population estimates will continue to be conducted in the MSA. The sizes of each of these survey areas are: EMMA, 528 mi^2; EMMA buffer, 1118 mi^2; and MSA, 5204 mi^2 (Fig. 1).

To determine bull:cow, calf:cow, and yearling bull:cow ratios, we conducted fall trend and composition aerial surveys in central Unit 19A in the Holitna River drainage, in western Unit 19A in the Aniak River drainage including the Kuskokwim River from Lower Kalskag to Aniak, and in Unit 19C in the Farewell area. PA-18 aircraft were flown along randomly selected transects, and pilots used Global Positioning System (GPS) navigation devices in the aircraft to maintain the aircraft on transects. Most habitats in these areas are roughly linear and parallel to nearby rivers; transect direction was selected to run perpendicular to habitat types to assure that all habitat types in the area were sampled. We recorded the number of moose and classified them as small, medium, or large bulls; cows; or calves.

To determine twinning rates, we conducted spring trend and composition aerial surveys in central Unit 19A in the Holitna River drainage, and in western Unit 19A in the Aniak River drainage including the Kuskokwim River from Lower Kalskag to Aniak. Surveys consisted of roughly parallel transects flown by experienced contract pilots and observers in PA-18 aircraft at ≤500 feet above ground level; transects were approximately 3–10 miles long at ½-mile intervals perpendicular to riparian moose habitats and including habitats beyond the riparian areas. Each moose observed was classified as a bull, yearling cow, adult cow without a calf, or adult cow with single, twin, or triplet calves. Twinning surveys were flown in late May and twinning rates calculated as the proportion of cows with twins or triplets from the sample of all cows with calves.

We monitored harvest using data from harvest tickets, and registration and Tier II permits. Population and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY06 = 1 Jul 2006–30 Jun 2007). We also received notification of mortuary moose requests consistent with regulation 5 AAC 92.019, coordinated these hunts with enforcement personnel, and recorded harvests.

We fitted 38 moose (29 adult females, 9 adult males) with radio collars in October 2003. Moose were captured using standard helicopter darting procedures, including the use of an immobilization drug mixture of carfentanil citrate (Wildnil®, Wildlife Pharmaceuticals, Fort Collins, Colorado, USA) and xylazine hydrochloride (Anased®, Lloyd Laboratories, Shenandoah, Iowa, USA). Radio collars were deployed on moose distributed in Unit 19A in the lower Holitna River (10 radio collars), the lower Aniak River drainage (10 radio collars), and in Unit 19B in the upper Holitna and Hoholitna drainages (18 radio collars). We conducted radiotracking flights on a regular basis through 2007 to locate these moose. We also used these radiocollared moose to assist our collection of calving data and to determine whether the Unit 19A and 19B moose populations were distinct from each other.

Keech (2006) conducted additional moose population research in Unit 19D East. GSPE survey techniques were used to estimate population numbers, density, and composition. Aerial radiotelemetry surveys and ground observations were used to determine the primary causes of mortality of radiocollared moose calves, and radiocollared yearling and adult moose were tracked to determine reproductive and condition indices, movements, and mortality rates. Browse surveys were also conducted in March 2003 via helicopter and snowmobile throughout the EMMA.

As part of a habitat assessment, browse surveys were conducted in Unit 19A by ADF&G research biologists (Paragi and Haggstrom 2006). Snow depth surveys were conducted in Units 19A and 19D as part of another research project (Paragi and Kellie 2008).

We provided regular educational moose management newsletters to area residents, articles to local newspapers, and other educational materials to media sources when possible.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

Units 19A and 19B. Comparisons of data suggest an increasing population trend in the Holitna–Hoholitna and Stony River drainages (in the western 3444-mi^2 of Unit 19A south of the Kuskokwim River; Table 1a) but densities are likely still well below those of the mid 1990s, when up to 250 moose/hour were detected (Table 1b). This is the same portion of Unit 19A where wolf control efforts have been most successful, suggesting that wolf control during RY04–RY07 may have contributed to the increase in the moose population.

From the February 2005 survey we calculated a moose density of 0.27 observable moose/mi^2 (±16%, 90% CI) with 17% calves in Unit 19A along and south of the Kuskokwim River (Table 1a).

From the March 2006 survey we calculated a moose density of 0.39 observable moose/mi^2 (±15%, 90% CI) with 9% calves in the western half of the area surveyed in 2005 (Table 1a).

From the March 2008 survey we calculated a moose population density of 0.44 observable moose/mi^2 (±28%, 90% CI) with 21% calves in Unit 19A in the eastern half of the area surveyed in 2005. Analysis of February 2005 survey data for this area revealed a density of 0.28 moose/mi^2 (± 17%, 90% CI; Table 1a). During fall 2007 aerial trend and composition surveys in the Holitna River drainage we found moose at a rate of 65 moose/hour (Table 1b), while in fall 2001 the rate of detection in a similar survey was 59 moose/hour.

No direct moose population abundance measures were made in Unit 19B, but densities are likely at or below those found in Unit 19A.

Unit 19C. Moose numbers probably have declined in Unit 19C since the late 1980s and early 1990s. Although no density estimation surveys were conducted in Unit 19C, trend count data revealed an average of 150 moose per hour between 1987 and 1997 (range 100–194 moose per hour). More recent trend count data during 1999–2008 revealed an average of 89 moose per hour (range 81–110 moose per hour; Table 1c) and suggest a stable fall population during RY05–RY06.

Unit 19D. We estimated the moose population using GSPE survey methods, calculated average moose density, and measured sightability during November 2006 and 2007 in and around the EMMA buffer. Within the EMMA buffer, moose densities rose from 1.0 moose/mi^2 in 2006 to 1.2 moose/mi^2 in 2007. This compares to a density of 0.65 moose/mi^2 in 2001. Tables 1d and 1e show that data indicate the population has been increasing since the onset of predation reduction efforts in RY03.

We estimated the number of moose (corrected for sightability) within the EMMA at 524 moose in 2001 and 874 in 2007, and within the combined area including the EMMA buffer at 865 moose in 2001 and 1804 in 2007. These data suggest the number of moose in and around the

EMMA has likely doubled since 2001, coincident with predator reduction efforts (Tables 1d and 1e).

In 2004 we estimated that 2190 total moose inhabited 4676 mi^2 of the MSA outside the EMMA (0.47 moose/mi^2; Table 1f) and this density was used to extrapolate into the unsurveyed portion of Unit 19D East. Therefore, in the 8513 mi^2 of Unit 19D East, 1804 moose are estimated to inhabit the EMMA plus buffer (1118 mi^2), 3476 moose are estimated in the remaining 7395 mi^2 of Unit 19D East, for an estimated moose population in Unit 19D East of 5280 total moose.

Population Composition

Units 19A and 19B. In November 2005 we observed 307 moose; 24 calves:100 cows, and 8 bulls:100 cows (including 12 yearling bulls of 19 bulls observed, or 5 yearling bulls:100 cows) within the Holitna River drainage (Table 1b). In western Unit 19A within the Aniak River drainage, we observed 410 moose, 23 calves:100 cows, and 20 bulls:100 cows.

During the November 2005 survey in the Unit 19B portion of the survey area, we observed 146 moose: 13 yearling bulls, 13 medium bulls (31–50" antlers), 23 large bull (>50" antlers), 75 cows, and 22 calves. We observed ratios of 66 bulls:100 cows, 17 yearling bulls:100 cows, and 29 calves:100 cows.

In November 2007 we conducted moose composition surveys in western Unit 19A in the Aniak River drainage, including the Kuskokwim River from Lower Kalskag to Aniak. We found 122 moose (40.7 moose/hr): 68 cows, 35 calves (29%), and 19 bulls. The calf:cow ratio was 52:100 with 7 sets of twins (26% twins, including 1 set of triplets). There were 28 bulls:100 cows with 6 yearling bulls (5%), 5 medium bulls (4%), and 8 large bulls (7%).

In November 2007 we conducted moose composition surveys in the Holitna River drainage of central Unit 19A. We found 200 moose (64.8 moose/hr): 111 cows, 50 calves (25%), and 39 bulls. The calf:cow ratio was 45:100 with sets of twins (22% twins). The bull:cow ratio was 35:100, with 23 yearling bulls (12%), 12 medium bulls (6%), and 4 large bulls (2%).

The high calf:cow ratios suggest good survival through early spring and summer and are consistent with the higher moose density measured in March 2008. Bull:cow ratios in the Holitna River drainage were also recovering from 8:100 in 2005 to 35:100 in 2007, largely due to higher numbers of young bulls recruited into the population since the hunting season closed.

In the Holitna River drainage during 30–31 May 2007 we conducted composition and twinning surveys and found 71 moose (8 moose/hr) including 29 adult cows (≥24 months old), 22 short yearlings (31%), and a 64% twinning rate (7 of 11 litters were twins). These high twinning rates suggest that higher moose populations could be supported by the habitat in these areas and managing for an increasing moose population is appropriate (Boertje et al. 2007).

We found 62 calves:100 cows, but expected that additional calves would be born. We also found 76 yearlings:100 cows, suggesting good survival. The bull:cow ratio was 26:100, but only 10 medium and large bulls:100 cows, consistent with improvements seen in the fall as bull:cow ratios recover from the 8:100 measured in November 2005. However, spring bull:cow ratios

should be interpreted with the understanding that November is a better time to obtain this measure.

We conducted a spring composition survey in the Aniak River drainage during May 2007. Too few moose were found to provide meaningful data, largely due to low moose densities and early leaf emergence, which obscured moose.

Unit 19C. In November 2006 we conducted a moose composition survey in the Farewell area and found 279 moose (85 moose/hr), including 26 yearling bulls (9%), 8 sets of twins (13%), 41 calves:100 cows, and 46 bulls:100 cows (Table 1b). Additional data obtained during this survey were lost in the December 2006 office fire.

In November 2007 we conducted a moose composition survey in the Farewell area but weather did not allow a complete survey. We found 104 moose (83.2 moose/hr): 38 cows, 26 calves (25%), and 40 bulls. There were 7 sets of twins (37% twins), 68 calves:100 cows, 16 yearling bulls (15%), 13 medium bulls (13%), 11 large bulls (11%), and 105 bulls:100 cows. Bulls were generally found in groups in the western portion of the area, which was more easily surveyed, and cows were generally found in singles and small groups in areas dominated by spruce to the east and in areas strongly influenced by winds coming out of Rainy Pass. Bull:cow ratios from this survey are inflated due to these conditions. The calf:cow ratio is suspect due to incomplete coverage as well.

Unit 19D. Within the EMMA, the calf:cow ratio varied from a low of 34 calves:100 cows in 2001 to a high of 63 calves:100 cows in 2004 while the bull:cow ratio varied from a low of 13 bulls:100 cows in 2004 to a high of 39 bulls:100 cows in 2007. Yearling bull:cow ratios ranged from a low of 5 yearling bulls:100 cows in 2003 to a high of 16 yearling bulls:100 cows in 2007 (Table 1d). Similar composition data was obtained in the EMMA buffer (Table 1e). Moose population composition for the MSA and that portion of Unit 19D East MSA excluding the EMMA is summarized in Table 1f.

Table 1g shows reproduction and condition indices for moose in Unit 19D East during 2001–2006. Parturition for cows older than 2 years ranged from 73% to 97% and twinning rates ranged from 24% to 59%, suggesting that managing for higher moose populations is appropriate (Boertje et al. 2007).

Moose Movements

Movements of moose in Units 19A and 19B are characterized in Figures 3 and 4. Data were collected to better understand seasonal movement of moose in Units 19A and 19B, and to determine whether moose present during surveys were available to hunters during the fall hunting season. Generally, most moose did not move far from their capture locations in Units 19A and 19B. Moose that did move considerable distances wintered to the south in Unit 17. Data from bull moose radiocollared in the Unit 19B portion of the Aniak River drainage were lost during the December 2006 fire that destroyed the McGrath office, but indicated that these bulls remained in Unit 19B during late August and October. Recent radio collar locations obtained in twinning surveys suggest Unit 19A cow moose remain close to their capture locations. In Unit 19D, moose radiocollared in and around the EMMA as part of the mortality

research effort generally remained within 25–30 miles of their capture location and are essentially nonmigratory.

MORTALITY

Harvest

Seasons and Bag Limits.

Seasons and bag limits for RY05 were:

Units and Bag Limits		Open Seasons
Unit 19A, Lime Village Management Area, that portion drained by the Stony River from the mouth of the Stink River, including the Stink River drainage upstream to, but not including the Can Creek drainage.		
RESIDENT HUNTERS: 2 antlered bulls by Tier II permit TM684		10 Aug–25 Sep
	or	20 Nov–31 Mar
NONRESIDENT HUNTERS:		No open season
Remainder of Unit 19A		
RESIDENT HUNTERS: 1 antlered bull by registration permit RM640.		1 Sep–20 Sep
NONRESIDENT HUNTERS:		No open season
Unit 19B within the Nonresident Closed Area		
RESIDENT HUNTERS: 1 antlered bull by registration permit RM640.		1 Sep–20 Sep
Or, 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side.		1 Sep–20 Sep
NONRESIDENT HUNTERS:		No open season
Remainder of Unit 19B		
RESIDENT HUNTERS: 1 antlered bull by registration permit RM640.		1 Sep–20 Sep
Or, 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side.		1 Sep–20 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side. Hunter orientation required.		5 Sep–20 Sep
Unit 19C		
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers, or antlers with 4 or more brow tines on at least one side.		1 Sep–20 Sep
Or, 1 bull by registration permit RM655.		1 Feb–28 Feb

Units and Bag Limits	Open Seasons
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.	1 Sep–20 Sep
Unit 19D, that portion of the Kuskokwim River drainage upstream from the Selatna and Black River drainages, but excluding the Takotna River drainage upstream of Takotna village	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650.	1 Sep–25 Sep
NONRESIDENT HUNTERS:	No open season
Unit 19D, that portion of the Takotna River drainage upstream of Takotna village	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Unit19D, that portion between and including the Cheeneetnuk and Gagaryah River drainages, excluding that portion within 2 miles of the Swift River	
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	1 Sep–20 Sep
Remainder of Unit 19D	
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season

Seasons and bag limits for RY06 and RY07 were:

Units and Bag Limits		Open Seasons
Unit 19A, Lime Village Management Area, that portion drained by the Stony River from the mouth of the Stink River, including the Stink River drainage upstream to, but not including the Can Creek drainage.		
RESIDENT HUNTERS: 2 antlered bulls by Tier II permit TM684		10 Aug–25 Sep
	or	20 Nov–31 Mar
NONRESIDENT HUNTERS:		No open season
Unit 19A, Kuskokwim River drainage downstream of and including the George River drainage and downstream of and excluding the Downey Creek drainage.		
RESIDENT HUNTERS: 1 antlered bull by tier II permit TM680.		1 Sep–20 Sep

Units and Bag Limits	Open Seasons
NONRESIDENT HUNTERS:	No open season
Remainder of Unit 19A	
RESIDENT AND NONRESIDENT HUNTERS:	No open season
Unit 19B within the Nonresident Closed Area	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Remainder of Unit 19B	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers or antlers with 4 or more brow tines on at least one side.	1 Sep–20 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side. Hunter orientation required.	5 Sep–20 Sep
Unit 19C	
RESIDENT HUNTERS: 1 bull with spike-fork or 50-inch antlers, or antlers with 4 or more brow tines on at least one side.	1 Sep–20 Sep
Or, 1 bull by registration permit RM655.	1 Feb–28 Feb
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side.	1 Sep–20 Sep
Unit 19D, that portion of the Kuskokwim River drainage upstream from the Selatna and Black River drainages, but excluding the Takotna River drainage upstream of Takotna village	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650.	1 Sep–25 Sep
NONRESIDENT HUNTERS:	No open season
Unit 19D, that portion of the Takotna River drainage upstream of Takotna village	
RESIDENT HUNTERS: 1 antlered bull by registration permit RM650.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season
Unit19D, that portion between and including the Cheeneetnuk and Gagaryah River drainages, excluding that portion within 2 miles of the Swift River	
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	1 Sep–20 Sep

Units and Bag Limits	Open Seasons
Remainder of Unit 19D	
RESIDENT HUNTERS: 1 bull.	1 Sep–20 Sep
NONRESIDENT HUNTERS:	No open season

Alaska Board of Game Actions and Emergency Orders. Alaska Board of Game changes effective prior to the RY05 season are summarized in Seavoy (2006). No new Board of Game actions affected Unit 19 moose management in RY05. The Board of Game made the following changes effective during the RY06 season:

- Eliminated the RM640 registration permit hunt in Units 19A and 19B.
- Initiated the Tier II permit hunt TM680 in Unit 19A, within the Kuskokwim River drainage downstream of and including the George River drainage and downstream of and excluding the Downey Creek drainage. Up to 300 permits were authorized, but only 200 permits were issued during RY06 and 230 permits were issued during RY07. In addition, 100 federal permits were distributed by federal managers to federally qualified subsistence users in Tuluksak, Lower Kalskag, Kalskag, Aniak, Chuathbaluk, and Crooked Creek during RY06 and RY07.
- Resident and nonresident moose hunting was closed in the remainder of Unit 19A, upriver from the George River and Downey Creek drainages and excluding the Lime Village Management Area.

As a discretionary condition of registration permit hunt RM650, ADF&G maintained an area closed to moose hunting within Unit 19D upriver from the downstream side of Beaver Creek (across from Vinasale Mountain), upstream to the mouth of Big River and on the Takotna River downstream of the confluence with Nixon Fork River. We anticipate resumption of moose hunting in this area during RY08 for a portion of the season.

Harvest by Hunters. During RY05 the overall reported harvest in Unit 19 was 176 moose While it appears that the moose harvest increased toward the end of RY05, it is probably an artifact of increased reporting rates achieved through the use of registration permits. Reported moose harvest fell dramatically in RY06 to 43 moose (Table 2a). The substantial changes to moose hunting regulations explain the decrease in harvest during RY06. Between RY06 and RY07, moose harvest increased 79% in Unit 19A, 13% in Unit 19C and 28% in Unit 19D but declined 43% in Unit 19B (Tables 2a–2d). Nearly all moose reported taken were bulls, consistent with bulls-only bag limits. Some cows were likely taken illegally, but the number is difficult to estimate. Hunter harvest in each unit during RY00–RY07 is reported in Tables 2a–2e by sex and hunt type and in Table 2f by percent bulls.

Prior to RY04 when registration permit hunt RM640 was implemented, nonlocal hunters tended to report at higher rates than local hunters. Because more nonlocal hunters used Units 19B and 19C than local hunters, annual reported harvests in Units 19B and 19C were probably closer to actual harvest than those reported in Unit 19A. Since RY04, local hunters have developed a better understanding of harvest report requirements, and harvest reporting rates in Unit 19A

improved. Unit 19D reporting rates are high and have not changed. Some unreported take occurs, but it is likely small compared with previous years.

Table 2e shows the number of moose taken in areas where the reported harvest location was either missing, ambiguous, illegible, or otherwise indecipherable. All tables include problem reports, such as 1) reports from permit or general harvests tickets for invalid areas and 2) harvests from permit hunts reported or duplicated on harvest tickets. This indicates that some hunters do not understand hunting regulations and decreases harvest data precision. Eight reports in RY05 and 2 reports in RY06 were received with obvious errors or omissions. This is an improvement over the previous 5 years, when on average 11 such reports were received. However, the need to provide better access to regulation information remains.

Permit Hunts. The number of moose reported taken using TM684 in Unit 19A and RM655 in Unit 19C was typically low (Table 3).

Participation and harvest in the RM640 hunt in Units 19A and 19B had been high while that hunt was available. However, harvestable surplus was lower than amounts needed for subsistence, so this hunt was eliminated in RY06. In western Unit 19A the RM640 hunt was replaced with a Tier II permit hunt TM680.

In Unit 19D during RY01–RY07, an average of approximately 250 hunters took about 75 bulls each year using the RM650 permit.

Antler Size. The objective to maintain an annual average antler spread measurement of at least 48 inches in the Unit 19C harvest was essentially assured by antler restrictions during RY04–RY07. During RY03–RY07 the average annual antler spreads were 51, 59, 57, 57, and 57 inches respectively.

Hunter Residency and Success. Hunter residency and success were subdivided by local and nonlocal resident hunters and nonresident hunters (Tables 4a–4e).

In Unit 19A, reporting errors are common due to hunter confusion. We estimate 2–5% of hunt reports contained errors.

Hunter success in Unit 19A increased from 17% in RY05 and 15% in RY06 to 27% in RY07. During RY05–RY06, hunters complained of low water levels and persistent warm weather. Increased hunter success in RY07 was probably due to improved weather-related conditions during the hunt.

In Units 19B and 19C, the total number of resident and nonresident hunters declined from 247 in RY05 to 227 in RY06. This is part of a larger trend in declining participation as the total number of hunters declined from 665 in RY00 to 179 in RY07. Antler restrictions and lower populations of moose and caribou likely explain much of this decline.

Success rates in Unit 19B in RY05 and RY06 were 31% and 26% but dropped to 20% in RY07. Success rates remained stable in Unit 19C in RY05 and RY05 (34% and 32%, respectively), but increased to 43% in RY07.

In Unit 19D, residency restrictions in much of the unit reduced the number of nonresident hunters from about 30 per year during the mid 1990s to about 15 during RY00–RY07. Success rates for resident hunters hunting in the RM650 permit hunt averaged about 39% during RY01–RY07, ranging from 35% in RY04 and RY06 to 47% in RY07.

Transport Methods. In Units 19B and 19C, hunters primarily used aircraft, while in Units 19A and 19D, boat-borne hunters were most common, particularly after the institution of permit hunt requirements (Tables 5a–5e). These methods have always been dominant and remained so throughout this reporting period.

Other Mortality

Under regulation 5 AAC 92.019 hunters were permitted to take moose for customary and traditional Alaska Native funerary or mortuary religious ceremonies. Harvest reporting for these hunts appears to have improved, but the number actually harvested probably has not changed. For example, 4–8 moose were reported during RY06. During RY03–RY05 4–8 moose were likely taken each year, but these data were lost during the December 2006 fire. Between 1 January and 30 June 2007, 3 bulls and 3 cows were reported taken for mortuary ceremonies in Unit 19. In addition, 2 groups of hunters reported being unsuccessful during such hunts.

Keech (2006) found that the primary cause of moose calf mortality was predation by black bears, grizzly bears, and wolves (Fig. 5). Deep snow contributed to nonpredation calf mortality during winter 2004 (Fig. 5). We inferred that predation was additive because after predator numbers declined calf survival increased (Fig. 5). Yearling moose survival was higher than 90% in 2004 and 2005 (Fig. 6) when wolf control and bear removal were conducted, indicating that removing wolves and bears allowed recovery of the moose population. In 2006, when wolf control was hampered by poor conditions, yearling survival fell to 84%.

HABITAT

Assessment

Browse surveys were conducted by helicopter in Unit 19A during 5–10 April 2006 to gauge the extent to which nutrition may be limiting moose productivity (Paragi and Kellie 2008). Paper birch, balsam poplar, and 5 willow species were sampled, representing a sampling of species similar to most areas in Interior Alaska. We sampled 134 plants in 27 plots and calculated a preliminary estimate of 8% biomass consumption (mean plant basis) by moose. This is a relatively low removal rate for Interior Alaska, suggesting that moose in Unit 19A are not limited by forage (Boertje et al. 2007).

Snow depth can restrict moose movement when it reaches 70 cm and make movement very difficult at 90 cm (Coady 1974). Preliminary analysis of snow depths from a survey conducted in April 2008 and historic data suggest that Unit 19 experiences snow depths of this magnitude more frequently than other game management units in Interior Alaska (Paragi and Kellie 2008). Deep snow increases energetic requirements and restricts access to forage, thus may reduce the proportion of Unit 19A available to moose for winter range. Deep snow may also increase vulnerability to wolf predation, particularly if a crust forms in mid to late winter.

High twinning rates (Table 1g) in Unit 19D East indicate favorable nutritional status compared to other regions of higher moose density in Interior Alaska, indicating that nutrition status was adequate to support an increasing moose population (Boertje et al. 2007). In Unit 19A we observed spring twinning rate of 64% within the Holitna River drainage, and fall twinning rates of 26% in the Aniak drainage and 22% in the Holitna River drainage. These data suggest that nutritional status is adequate to support a higher density of moose in Unit 19A.

Enhancement

We continued cooperation with fire management personnel at the Alaska Department of Natural Resources–Division of Forestry to ensure that natural fires are allowed to burn wherever possible to enhance early successional stage habitats that moose prefer. Wildland fires have occurred regularly over large areas of diverse vegetation types in Unit 19, including during summers 2002 and 2005, when over half a million acres burned in southwest Alaska.

Ice scouring events regularly reset habitat succession along rivers in Unit 19. Major flooding events have not occurred since the 1980s and only one large event occurred recently, in 2002. This event produced substantial ice scouring that helped to rejuvenate willow stands but the quality and availability of the moose habitat along the rivers is not as high as it was during the previous decade. The available browse is underutilized.

CONCLUSIONS AND RECOMMENDATIONS

The combined Unit 19A and 19B population and harvest objectives (13,500–16,500 moose and harvest of 750–950) were not achieved. The intensive management population objectives would require a moose density within the entire area of approximately 0.75–0.93 moose/mi^2. Our recent moose density estimates of 0.39 observable moose/mi^2 in western Unit 19A in March 2006 and 0.44 observable moose/mi^2 in eastern Unit 19A during March 2008 were below this objective. Even if we apply a sightability correction factor of 1.3, the estimated density would be 0.5–0.6 moose/mi^2. Combined harvest of 71–218 moose in Units 19A and 19B in RY05–RY07 (Tables 2a and 2b) show we are not meeting the intensive management harvest objective.

Despite a moose population below our objective, moose appear to be increasing in the Holitna, Hoholitna, and Stony River drainages of eastern Unit 19A. Density estimates of equivalent areas surveyed in February 2005 (0.28 moose/mi^2 ±17% [90% CI]) and March 2008 (0.44 moose/mi^2 ±28% [90% CI]) indicate growth may have occurred. Also, 2007 surveys indicated high twinning rates (64%), high fall calf:cow ratios (45 calves:100 cows), high fall percentage of yearling bulls (12%), and apparent high number of May yearlings (31%). Wolf control take in Unit 19A was concentrated in this area. All of these data suggest that the moose population grew between February 2005 and March 2008.

We met our objective of 20–30 bulls:100 cows in the Aniak area and the Holitna River drainage in Unit 19A. In November 2007 we measured almost 28 bulls:100 cows in the Aniak area and 35 bulls:100 cows in the Holitna River drainage.

In November 2004 we reached our fall calf composition objective of 30–40 calves:100 cows with 32 calves:100 cows in Unit 19A, but fell below this objective by November 2005 (24

calves:100 cows in the Holitna River drainage and 23 calves:100 cows in the Aniak River drainage). By November 2007, we met our composition objective for calves in Unit 19A measuring 52 calves:100 cows in the Aniak area and 45 calves:100 cows in the Holitna River drainage.

In Unit 19B we achieved our bull:cow objective, but narrowly missed our calf:cow objective. In November 2005, ratios were 66 bulls:100 cows, and 29 calves:100 cows. No composition data has been collected in Unit 19B since 2005.

During the March 2006 population estimation survey in western Unit 19A, 9% of the moose surveyed were calves, lower than our objective of 20%. However, during the March 2008 population estimation survey in eastern Unit 19A, we achieved our objective with 21% calves.

Radiotelemetry data indicated that moose populations in Units 19A and 19B occupied areas distinct from each other. Moose radiocollared in Unit 19A did not move far from their capture locations. Also, bull moose from Unit 19B did not move into Unit 19A and, consequently, were not available to Unit 19A hunters. We recommend continued monitoring of these radiocollared animals to reaffirm this conclusion and to assist with twinning surveys.

In Unit 19C during RY05 and RY06 the average annual antler spread was 57 inches during both years and we met our objective of an average antler spread of at least 48 inches.

For the next reporting period the Unit 19C goal will be to maintain population indices consistent with stable or increasing moose numbers. The objective in Unit 19C for the next reporting period will be to maintain a fall posthunt bull:cow ratio of at least 30 bulls:100 cows. This ratio provides a better tool to assess whether the level of harvest is appropriate. Also, this ratio can be obtained during routine surveys.

Taking into account the moose population growth within the EMMA buffer, we estimate the population in Unit 19D East to be 4830 moose, which is below our objective of 6000–8000. Reported harvest of 94 and 83 moose in Unit 19D during RY05 and RY06 (Table 2d) did not meet the Unit 19D East harvest objective of 400–600 or the harvest objective of 250–600 in the remainder of Unit 19D.

Department resources are inadequate to conduct multiple GSPE surveys in Unit 19 each year. Generally, we have sufficient resources to conduct one population estimate per year; 3–6 fall composition surveys, dependent upon weather; and 3–5 spring twinning and composition surveys. Therefore, we will attempt to conduct a single moose density estimate each year and rotate these surveys on a 3-year cycle, recognizing that we will occasionally be unable to conduct surveys due to weather. We will conduct GSPE surveys in eastern Unit 19A, the eastern two-thirds of Unit 21E (not included in this report), and the MSA in Unit 19D. To preserve integrity of trend data we should resist adding areas or changing our survey schedule. When population estimates are necessary beyond these areas, we should extrapolate from these surveys to obtain those estimates. To augment these GSPE population estimates, we should continue fall composition and trend surveys and spring twinning and composition surveys in established areas throughout the McGrath area.

Unit 19 has high twinning rates that suggest higher moose densities and higher harvests could be supported by the existing moose habitat. However, habitat research (including the influence of snow depth) is ongoing to better assess the current goals. Other direct habitat assessments should be conducted when possible to augment our data. Current population, harvest, and composition objectives should be reviewed at the earliest opportunity.

Habitat is not limiting; reproduction, condition indices, and twinning rates are high; and we have documented causes of high mortality. These data indicate that by controlling predation, we can expect moose populations to increase. Thus, predation control programs taking place in Units 19A and 19D East are defensible given the Board of Game objectives for moose.

Access to hunting regulations remains limited in Unit 19 and we recommend supporting efforts to improve access to these regulations and reduce their complexity.

The number of hunt reports in Unit 19A and 19B escalated from fewer than 300 to over 1000 after registration permits were instituted in RY04, even though nonresident seasons were eliminated. Previously we relied on license vendors in the villages to provide hunting licenses and harvest tickets, there was no enforcement action against those who failed to report, and we did not get good harvest reporting or participation. Harvest reporting improved when we instituted more restrictive registration permit regulations, dedicated department resources to make them available, and increased enforcement of this permit. This was accomplished with significant increase in personnel and time, but indicates that when materials are available, hunters in the villages along the Kuskokwim are willing participants. We recommend support for reporting programs through village visits to cultivate relationships and to recruit and support vendors.

In RY06 we eliminated the RM640 registration permit for moose hunting in Units 19A and 19B, established the Tier II permit hunt (TM680) in western Unit 19A, and closed moose hunting in most of eastern Unit 19A. High harvest reporting rates continued compared to years prior to RY04. The federal permit system does not have reporting rates as high as the state system, but those reporting rates are still higher than prior to RY04. We recommend continued support for education of hunters and continued cooperation with federal agencies in administering hunts.

We contributed educational moose management articles to local newspapers when possible. These were particularly well received by local residents, provided considerable dividends in public understanding, and increased reception for our management programs. Despite intent to make regular contributions, other priorities prevented more than a few articles. We will strive toward regular contributions as resources and time allow.

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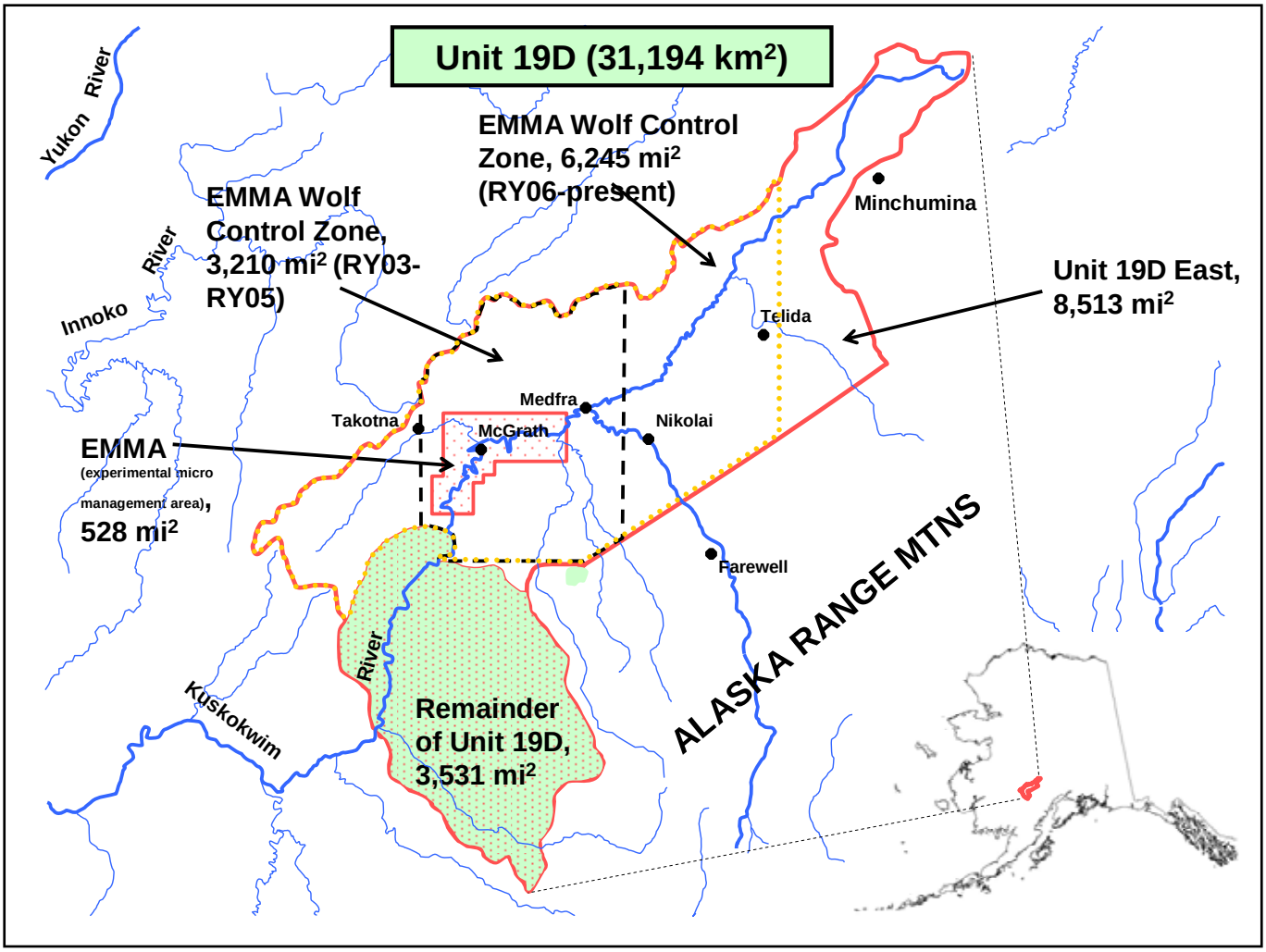


FIGURE 1 Unit 19D showing management activity areas

Note: EMMA = Experimental Micro Management Area; MSA = moose survey area.

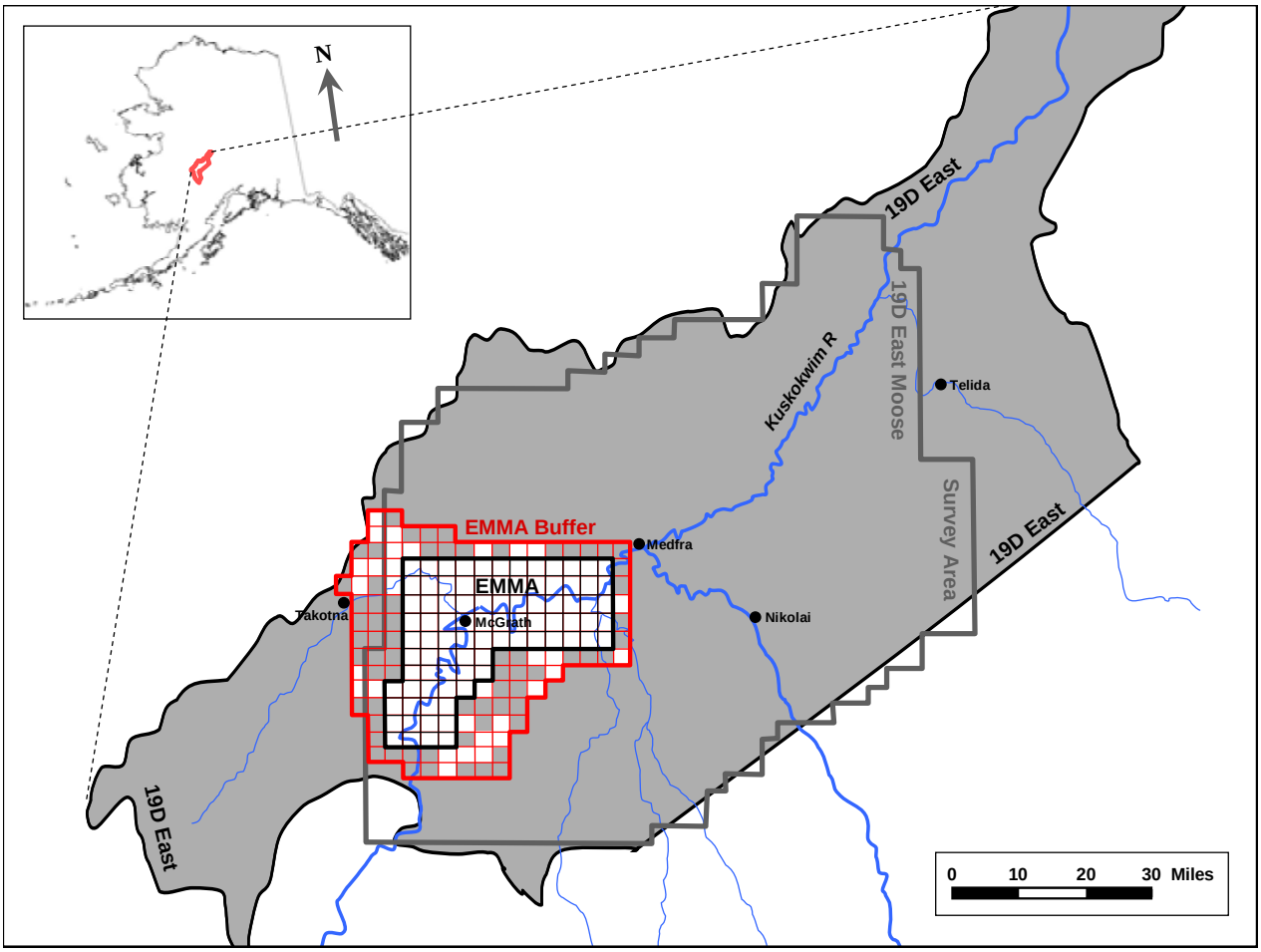


FIGURE 2 Unit 19D East including the 3 moose survey areas (Unit 19D East Moose Survey Area, EMMA in black, and the EMMA Buffer in red) that have been counted since 2001. Sample units depicted in white represent those units which were sampled during the 2007 survey (100% of the EMMA units and 32% of the units in the EMMA Buffer).

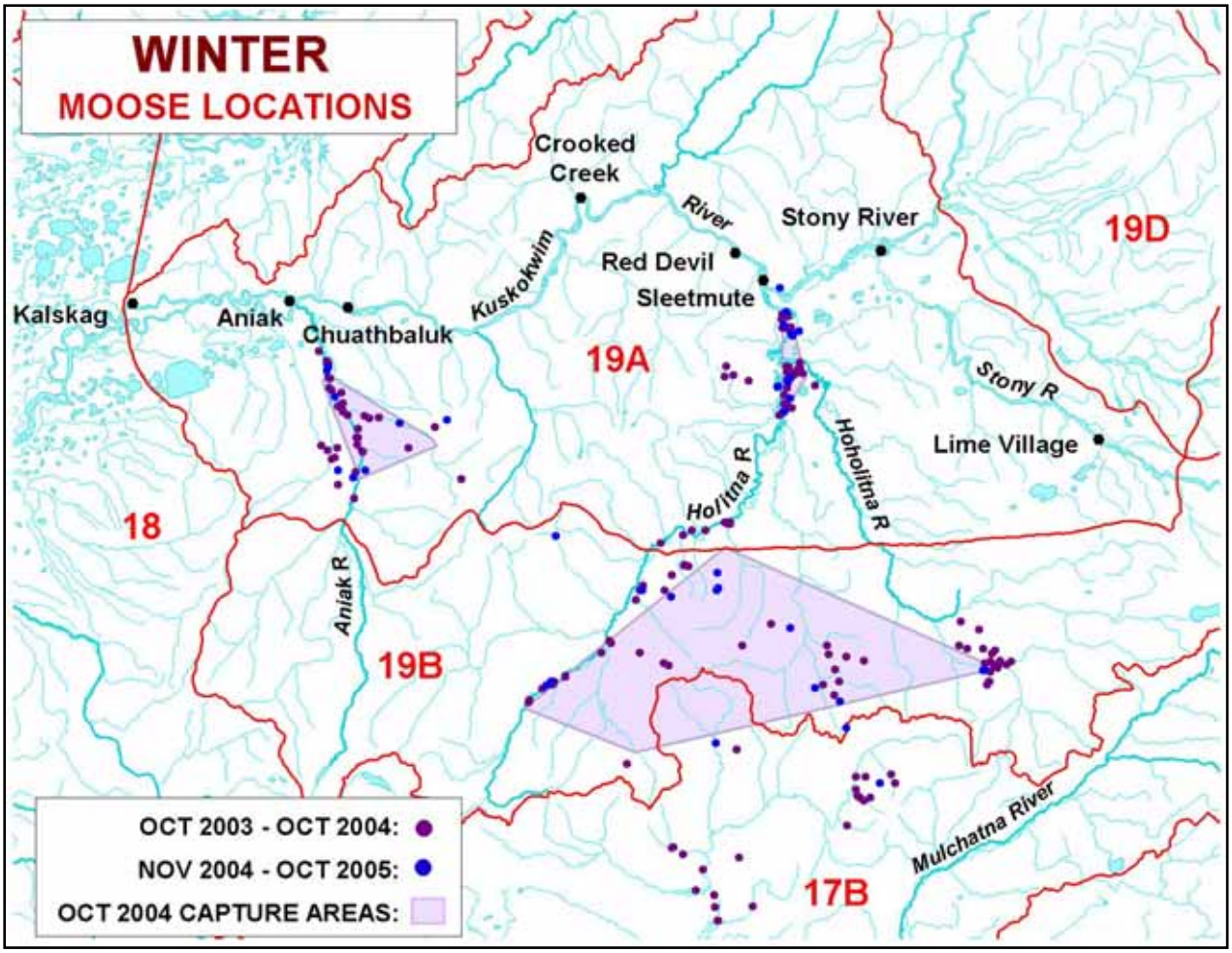


FIGURE 3 Winter moose locations in Units 19A and 19B

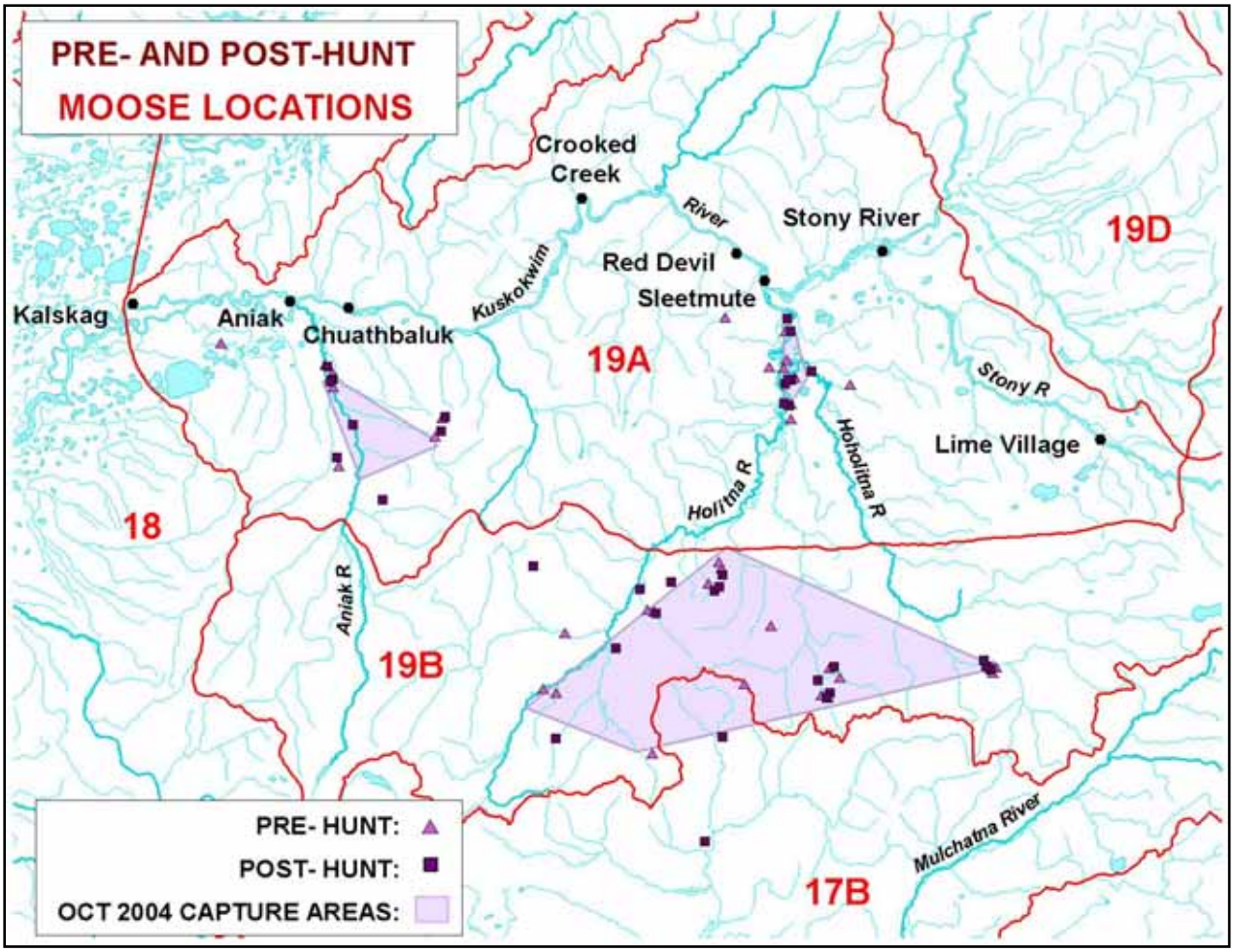


FIGURE 4 Pre- and posthunt moose locations in Units 19A and 19B

Cohort (May-May)	Black bear	Grizzly bear	Wolf	Non-predation	Illegal take	Unknown cause	# of Calves monitored
	Number deaths from birth to September/**Total number deaths 1st yr-of-life**						
2001 cohort	18/**18**	5/**5**	4/**9**	1/**1**	0/**0**	1/**1**	51
2002 cohort	23/**23**	13/**13**	16/**23**	1/**2**	0/**0**	0/**2**	85
2003 cohort*	8/**8**	4/**4**	4/**9**	3/**3**	0/**0**	0/**1**	53
2004 cohort*	3/**3**	0/**0**	4/**8**	3/**19**	0/**1**	0/**0**	52
2005 cohort*	12/**12**	3/**3**	2/**3**	5/**10**	0/**0**	0/**1**	50
2006 cohort*	6/**6**	2/**3**	1/**3**	3/**6**	0/**0**	1/**1**	51
2007 cohort*	7/**7**	14/**14**	2/**5**	1/**2**	0/**0**	1/**1**	51

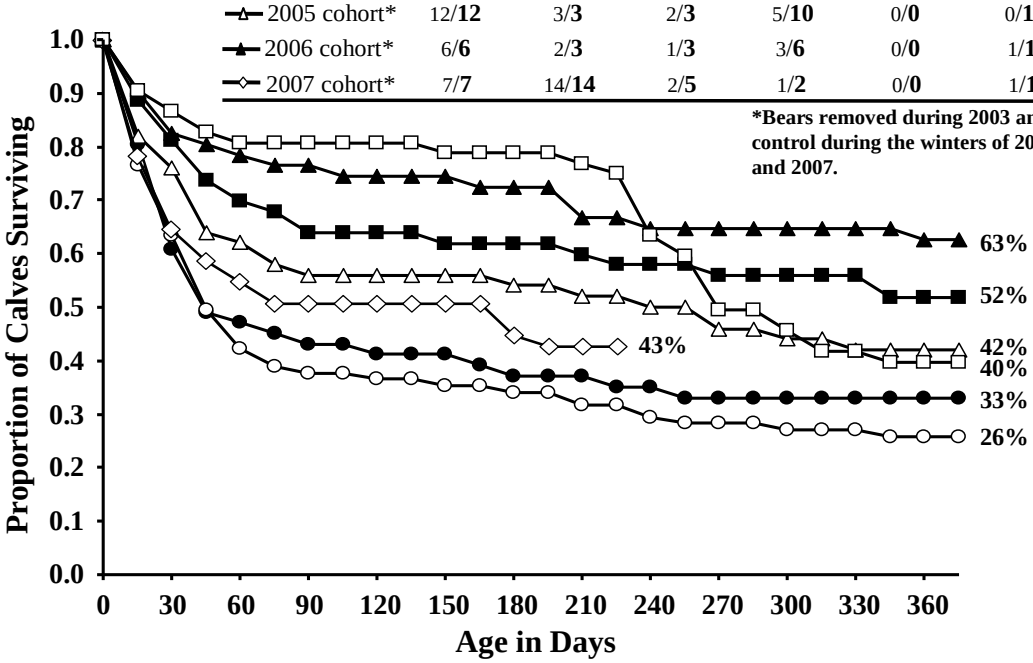
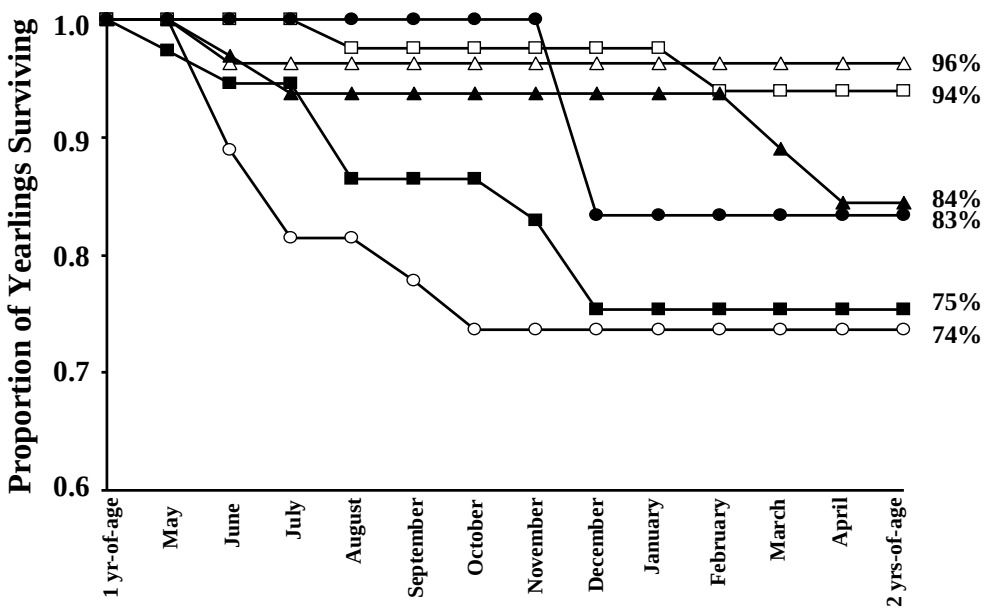


FIGURE 5 Primary causes of moose calf mortality in Unit 19D East and survival curves. Winter snow depths during 2004 were deeper than normal and contributed to nonpredation mortality during that year.

Year (May-May)	Number of Yearlings Killed							
	Wolf	Black bear	Grizzly bear	Non-predation	Hunter	Illegal take	Unknown	# of Yearlings monitored
2001/02	2	0	0	0	0	0	0	12
2002/03	6	0	0	0	2	0	1	27
2003/04*	5	1	0	2	2	0	0	37
2004/05*	1	0	0	0	0	1	0	41
2005/06*	1	0	0	0	0	0	0	27
2006/07*	2	0	0	1	0	0	1	32



***Bears removed during 2003 and 2004, public wolf control during the winters of 2003, 2004, 2005, and 2006.**

FIGURE 6 Primary causes of yearling moose mortality in Unit 19D East and survival curves

TABLE 1A Moose population density estimates for Unit 19A. During February 2005 the entire area south of the Kuskokwim River was surveyed. In March 2006 western Unit 19A south of the Kuskokwim River was surveyed, and in March 2008 eastern Unit 19A south of the Kuskokwim River was surveyed.

Survey date	Area Surveyed (mi^2)	Density: moose/mi^2	90% CI	Total moose
Feb 2005	7156	0.27	±16%	1623–2241
Feb 2005[a]	3874	0.28	±17%	897–1270
Mar 2006	3444	0.39	±15%	1141–1545
Mar 2008	3874	0.44	± 28%	1225–2181

[a] Subanalysis of the 2005 survey for the area surveyed in 2008 to allow for direct comparison to 2006 and 2008 surveys.

TABLE 1B Holitna–Hoholitna Trend Count Area (Unit 19A) fall aerial moose composition counts, regulatory years 1987–1988 through 2007–2008

Regulatory year	Bulls:100 cows	Yearling bulls:100 cows	Calves: 100 cows	Calves	Percent calves	Adults	Moose	Moose/hr
1987–1988	22	4	72	50	36	84	140[a]	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[b]								
1992–1993	31	15	63	172	32	360	542	169
1993–1994[b]								
1994–1995	14	2	42	209	27	568	778	251
1995–1996[b]								
1996–1997	22	10	50	146	29	355	502	152
1997–1998	14	11	34	85	23	286	371	169
1998–1999[b]								
1999–2000[b]								
2001–2002	6	3	8	13	7	183	196	59
2002–2003[b]								
2003–2004[b]								
2004–2005[b]								
2005–2006[a]	8	5	24				307	
2006–2007[b]								
2007–2008	35	21	45	50	25	150	200	65

[a] Records unrecovered since office fire contribute to incomplete data.
[b] No survey.

TABLE 1C Farewell Burn Count Area (Unit 19C) fall aerial moose composition counts, regulatory years 1987–1988 through 2007–2008

Regulatory year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves: 100 Cows	Calves	Percent calves	Adults	Moose	Moose/ hr
1987–1988	53	10	19	32	13	207	242[a]	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[b]								
1994–1995	52	10	19	45	11	353	404[a]	170
1995–1996[b]								
1996–1997	46	11	15	43	9	411	454	158
1997–1998	30	10	27	75	17	368	443	174
1998–1999[b]								
1999–2000[c]	33	11	27	42	17	206	248	86
2000–2001[b]								
2001–2002	25	3	25	76	17	377	454[a]	81
2002–2003[b]								
2003–2004	25	8	34	65	21	240	305	110
2004–2005[b]								
2005–2006[b]								
2006–2007[d]	46		41				279	85
2007–2008[e]	105[d]	42[d]	68	26	25	78	104	83

[a] Calves plus adults do not add to total which probably includes unknown moose, but records were lost in office fire.
[b] No survey.
[c] Fall 1999 – only 77.5% of the survey area flown.
[d] Additional data lost in McGrath office fire December 2006.
[e] Weather influenced survey, resulting in inflated bull:cow and yearling bull:cow ratios.

TABLE 1D Results of 2001 thru 2007 moose surveys in the 528 mi^2 Experimental Micromanagement Area (EMMA). Included are the number of moose observed, sightability correction factors (SCF) calculated for each year (based upon observations of radiocollared moose during the survey), and the estimated number of moose in the area based upon the multiplication of observed moose and the SCF. Ratios are based only on observable moose.

Year	Area	Number of moose observed[a]	SCF (No. collared/ no. seen)	Estimate with SCF applied	Calves:100 Cows	Bulls:100 Cows	Yearling bulls:100 cows
2001	EMMA	440	1.19 (38/32)	524	34	18	8
2003	EMMA	237[a]	1.33 (28/21)	580[b]	55	18	5
2004	EMMA	531	1.25[c]	664	63	13	6
2005	EMMA	479	1.29 (49/38)	618	51	18	9
2006	EMMA	591	1.17 (49/42)	691	58	25	14
2007	EMMA	662	1.32 (41/31)	874	56	39	16

[a] All 87 units within the EMMA were counted in 2001, 2004, 2005, 2006, and 2007, in effect a population census. Only 52% (45) of the 87 EMMA units were counted during the 2003 survey.

[b] In 2003 only 52% of the SUs within the EMMA were counted, and the estimate with SCF applied is based upon a Bayesian statistical treatment of the SCF of 1.33 × the geospatial population estimate for the EMMA of 393 moose.

[c] Sightability of radiocollared moose was not recorded in 2004, therefore, the SCF for 2004 is a combination of the 2001, 2003, 2005, and 2006 SCFs.

TABLE 1E Results of the 2001, 2004, 2006, and 2007 geospatial analysis of moose surveys in the 1118 mi^2 combined area of the Experimental Micromanagement Area (EMMA) and EMMA buffer. Included are the estimated number of moose in the area, sightability correction factors (SCF) calculated for each year (based upon observations of radiocollared moose during the survey), and the estimated number of moose in the area based upon the multiplication of estimated moose and the SCF. Ratios are based upon geospatial estimation techniques.

Year	Area	Number of moose estimated (90% CI)	SCF	Point estimate with SCF applied	Calves:100 Cows	Bulls:100 Cows	Yearling bulls:100 Cows
2001[a]	EMMA w/buffer	727 (± 89)	1.19	865	36	20	8
2004[a]	EMMA w/buffer	940 (± 107)	1.25	1175	66	18	9
2006	EMMA w/buffer	1117 (± 102)	1.17	1307	55	29	12
2007	EMMA w/buffer	1367 (±186)	1.32	1804	54	36	15

[a] Estimates for these years are reconstructed from existing data, they are not from surveys specifically conducted to estimate the number of moose within the EMMA and the EMMA buffer.

TABLE 1F Results of 2001–2004 moose surveys in the remainder of Unit 19D East moose survey area (MSA; that portion of the Unit 19D East MSA excluding the Experimental Micromanagement Area [EMMA]) and combined results for the EMMA and the remainder of Unit 19D East MSA (Unit 19D East MSA). No surveys were conducted in the remainder of Unit 19D East from 2005 through 2007.

Year	Area (mi^2)	Population estimate[a,b]	Calves:100 Cows	Bulls:100 Cows	Yearling bulls:100 cows
2001	Remainder Unit 19D East MSA (4676)	1135, 2005, 2912	10, 24, 45	20, 47, 88	1, 7, 15
2003	Remainder Unit 19D East MSA (4676)[c]	692, 1084, 1528	21, 53, 99	5, 29, 60	0, 2, 4
2004	Remainder Unit 19D East MSA (4676)	1652, 2190, 2728	43, 55, 67	24,35, 45	8, 14, 21
2001	Unit 19D East MSA (5204)	1652, 2536, 3469	14, 25, 42	19, 39, 66	3, 7, 13
2003	Unit 19D East MSA (5204)	1219, 1664, 2195	30, 53, 84	13, 23, 37	0, 3, 13
2004	Unit 19D East MSA (5204)	2287, 2825, 3464	47, 56, 66	22, 30, 37	7, 12, 17

[a] The 3 values given are the lower 90% confidence interval, the estimate, and the upper 90% confidence interval.

[b] Based upon radiocollared moose sightings during surveys, sightability correction factors of 1.19 and 1.33 were applied to population estimates in 2001 and 2003, respectively. Because radiocollared moose were not radiolocated during the 2004 survey, a sightability correction factor of 1.25 (a combination of the 2001 thru 2006 sightability data) was used to estimate population size in 2004.

[c] Because of poor weather conditions, only 7% (52) of the sample units in the remainder of the Unit 19D East MSA were surveyed, therefore, caution needs to be used when interpreting the 2003 survey results for the Unit 19D East MSA.

TABLE 1G Reproduction and condition indices for moose in Unit 19D East, 2001–2006

Year	Observed rate of parturition for radiocollared cows >2 yr old (no. of cows monitored)	Observed rate of parturition for radiocollared cows 3 yr old (no. of cows monitored)	Observed rate of twinning for radiocollared cows >2 yr old (*n*)	Observed rate of twinning for uncollared cows (*n*)	Average maximum adult rumpfat depth in cm (*n*)	Median maximum adult rumpfat depth in cm (*n*)
2001	73%[a] (22)	100% (3)	25% (16)	--	0.71 (25)	0.55 (25)
2002	88%[b] (25)	0% (1)	59% (22)	39% (46)	1.51 (15)	1.58 (15)
2003	84%[c] (31)	56% (9)	24% (25)	36% (39)	--	--
2004	80%[d] (40)	70% (10)	32% (31)	39% (31)	--	--
2005	92%[e] (51)	100% (11)	44% (45)	50% (40)	--	--
2006	97%[f] (62)	100% (13)	40% (60)	35% (29)	--	--

[a] Includes 1 fetal calf found during necropsy of cow in late May, and 2 births observed during June.
[b] Includes 3 births observed during June.
[c] Includes 1 cow considered to have given birth because placenta was observed but no calf was seen, and 1 birth observed during July.
[d] Includes 2 births observed during July.
[e] Includes 5 births observed during June.
[f] Includes 1 birth observed during June.

TABLE 2A Unit 19A moose harvest, regulatory years 2000–2001 through 2007–2008

Regulatory	Moose harvest				Hunt type			
year	M	F	Unk	Total	General	TM684	RM640	TM680 (FM019)[a]
2000–2001	106	0	0	106	104	2	n/a	n/a
2001–2002	93	1	3	97	92	5	n/a	n/a
2002–2003	67	0	0	67	66	1	n/a	n/a
2003–2004	67	0	0	67	67	0	n/a	n/a
2004–2005	107	0	0	107	10	0	97	n/a
2005–2006	174	2	0	176	15	3	158	n/a
2006–2007	43	0	0	43	10[b]	1	n/a	26 (6)
2007–2008	77	0	0	77	5[b]	2	n/a	54 (16)

[a] Federal permits were issued to federally qualified subsistence users to hunt on federal public lands within the hunt area. One hundred permits were issued in regulatory years 2006–2007 and 2007–2008. Reported harvest for these permits is shown in parenthesis.
[b] Incorrect permit for this hunt area.

TABLE 2B Unit 19B moose harvest, regulatory years 2000–2001 through 2007–2008

Regulatory	Moose harvest				Hunt type	
year	M	F	Unk	Total	General	RM640
2000–2001	152	0	1	153	153	n/a
2001–2002	112	0	0	112	112	n/a
2002–2003	81	0	1	82	82	n/a
2003–2004	53	0	0	53	53	n/a
2004–2005	47	0	0	47	40	7
2005–2006	42	0	0	42	31	11
2006–2007	28	0	0	28	28	n/a
2007–2008	16	0	0	16	16	n/a

TABLE 2C Unit 19C moose harvest, regulatory years 2000–2001 through 2007–2008

Regulatory	Moose harvest				Hunt type		
year	M	F	Unk	Total	General	RM655	RM640[a]
2000–2001	122	0	1	123	119	4	--
2001–2002	111	0	0	111	105	6	--
2002–2003	84	0	1	85	79	6	--
2003–2004	71	0	0	71	62	9	--
2004–2005	38	0	1	39	35	3	1
2005–2006	38	0	0	38	36	2	--
2006–2007	38	0	0	38	38	0	--
2007–2008	43	0	0	43	39	4	--

[a] Incorrect permit for this hunt area.

TABLE 2D Unit 19D moose harvest, regulatory years 2000–2001 through 2007–2008

Regulatory year	Moose harvest				Hunt type	
	M	F	Unk	Total	General	RM650
2000–2001	84	0	0	84	84	n/a
2001–2002	94	0	0	94	21	73
2002–2003	115	0	0	115	16	99
2003–2004	91	0	0	91	16	75
2004–2005	70	0	0	70	15	55
2005–2006	93	1	0	94	23	71
2006–2007	82	0	1	83	21	62
2007–2008	106	0	0	106	20	86

TABLE 2E Moose harvest from Unit 19 where specific harvest location was not reported, regulatory years 2000–2001 through 2007–2008

Regulatory year	Moose harvest				Hunt type		
	M	F	Unk	Total	General	RM640	RM650
2000–2001	14	0	0	14	14		
2001–2002	10	0	0	10	10		
2002–2003	8	0	0	8	8		
2003–2004	4	0	0	4	4		
2004–2005	19	0	0	19	5	14	
2005–2006	8	0	0	8	4	2	2
2006–2007	2	0	0	2	2		
2007–2008	5	0	0	5	5		

TABLE 2F Unit 19 reported moose harvest, regulatory years 2000–2001 through 2007–2008

Regulatory year	Reported harvest					
	M	(%)	F	(%)	Unk	Total
2000–2001	478	(100)	0	(0)	2	480
2001–2002	420	(>99)	1	(<1)	3	424
2002–2003	355	(100)	0	(0)	2	357
2003–2004	286	(100)	0	(0)	0	286
2004–2005	281	(100)	0	(0)	1	282
2005–2006	355	(>99)	3	(<1)	1	359
2006–2007	193	(100)	0	(0)	1	194
2007–2008	231	(100)	0	(0)	0	231

TABLE 3 Permit hunt results from Lime Village Tier II (TM684), Unit 19A and 19B RM640, Unit 19A TM680 and FM019, Unit 19C (RM655) and Unit 19D (RM650), regulatory years 1992–1993 through 2007–2008

Unit/Hunt no.	Regulatory year	Successful hunters	Unsuccessful hunters	Did not hunt	Total reports
Unit 19A, TM684[a]	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	3	9	14	26
	2000–2001	2	3	11	16
	2001–2002	5	8	6	19
	2002–2003	1	4	9	14
	2003–2004	0	5	8	13
	2004–2005	0	5	7	12
	2005–2006	3	8	0	11
	2006–2007	1	9	0	10
	2007–2008	2	2	10	13
Unit 19A, TM680 (and FM019)	2006–2007	26 (6)	143 (36)	28 (unk)	197 (unk)
	2007–2008	54 (16)	141 (45)	32 (unk)	227 (unk)
Unit 19C, RM655	1997–1998	1	0	0	1
	1998–1999	2	1	0	3
	1999–2000	0	3	1	4
	2000–2001	4	2	0	6
	2001–2002	6	2	1	9
	2002–2003	7	7	4	18
	2003–2004	9	7	13	29
	2004–2005	3	5	2	10
	2005–2006	2	0	5	7
	2006–2007	0	0	3	3
	2007–2008	4	2	2	8
Units 19A and 19B, RM640	2004–2005	121	634	191	946
	2005–2006	173	688	162	1023
Unit19D, RM650	2001–2002	73	137	67	277
	2002–2003	98	127	40	265
	2003–2004	75	115	53	243
	2004–2005	60	109	70	239
	2005–2006	72	114	51	237
	2006–2007	62	112	74	248
	2007–2008	86	98	69	253

[a] Successful hunters for TM684 is the number of moose taken. Total reports is the number of hunters reporting. The bag limit is 2 antlered bulls.

TABLE 4A Unit 19 moose hunter residency and success, regulatory years 2000–2001 through 2007–2008

Regulatory year	Successful						Unsuccessful						Total hunters[b]
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
2000–2001	77	209	184	10	480	(42)	95	268	294	5	662	(58)	1142
2001–2002	107	174	132	11	424	(35)	182	367	239	9	797	(65)	1221
2002–2003	110	111	131	5	357	(35)	191	282	167	10	650	(65)	1007
2003–2004	99	102	78	7	286	(31)	178	300	141	8	627	(69)	913
2004–2005	103	116	59	4	282	(21)	417	570	93	9	1089	(79)	1371
2005–2006	135	158	59	7	359	(23)	454	656	93	7	1210	(77)	1569
2006–2007	84	61	46	3	194	(25)	286	224	76	5	591	(75)	785
2007–2008	119	74	35	3	231	(35)	211	143	76	3	433	(65)	664

[a] Local residents reside in Unit 19.
[b] Total hunters for Unit 19 may not equal sum of hunters from all subunits due to hunters not reporting locations or unidentifiable reported locations.

TABLE 4B Unit 19A moose hunter residency and success, regulatory years 2000–2001 through 2007–2008

Regulatory year	Successful						Unsuccessful						Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
2000–2001	20	51	31	4	106	(36)	50	74	60	2	186	(64)	292
2001–2002	22	53	11	9	95	(32)	43	114	39	3	199	(68)	294
2002–2003	19	29	18	1	67	(26)	61	90	31	4	186	(74)	253
2003–2004	14	35	16	2	67	(26)	44	125	18	4	191	(74)	258
2004–2005	48	55	4	0	107	(15)	242	350	5	1	598	(85)	705
2005–2006	65	106	5	0	176	(17)	325	517	4	2	848	(83)	1024
2006–2007	27	15	1[b]	0	43	(15)	151	88	2[b]	3	244	(85)	287
2007–2008	39	22	0	0	61	(26)	95	69	5[b]	1	170	(74)	231

[a] Local residents reside in Unit 19A.
[b] Incorrect permit for this hunt area.

TABLE 4C Unit 19B moose hunter residency and success, regulatory years 2000–2001 through 2007–2008

Regulatory year	Successful						Unsuccessful						Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
2000–2001	1	59	88	5	153	(36)	7	99	161	1	268	(64)	421
2001–2002	1	42	68	1	112	(31)	2	106	134	4	246	(69)	358
2002–2003	1	14	65	1	81	(35)	1	66	80	1	148	(65)	229
2003–2004	3	14	34	3	54	(30)	2	50	71	1	124	(70)	178
2004–2005	2	11	33	1	47	(31)	5	48	51	0	104	(69)	151
2005–2006	2	12	28	0	42	(31)	2	49	43	0	94	(69)	136
2006–2007	0	5	20	3	28	(26)	9	35	35	0	79	(74)	107
2007–2008	2	3	11	0	16	(20)	10	20	34	0	64	(80)	80

[a] Local residents reside in Units 19A or 19B.

TABLE 4D Unit 19C moose hunter residency and success, regulatory years 2000–2001 through 2007–2008

Regulatory year	Successful						Unsuccessful						Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total	(%)	
2000–2001	0	69	54	0	123	(50)	0	69	50	2	121	(50)	244
2001–2002	0	74	37	0	111	(44)	0	106	34	2	142	(56)	253
2002–2003	0	48	35	2	85	(42)	0	93	23	0	116	(58)	201
2003–2004	9	37	23	2	71	(36)	7	87	32	1	127	(64)	198
2004–2005	3	18	17	1	39	(35)	3	45	22	1	71	(65)	110
2005–2006	3	18	15	2	38	(34)	1	38	31	3	73	(66)	111
2006–2007	0	19	19	0	38	(32)	1	53	28	0	82	(68)	120
2007–2008	3	21	17	2	43	(43)	2	31	21	2	56	(57)	99

[a] Local residents reside in Units 19C or 19D.

TABLE 4E Unit 19D moose hunter residency and success, regulatory years 2000–2001 through 2007–2008

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
2000–2001	48	32	3	1	84 (60)	26	26	4	0	56 (40)	140
2001–2002	70	14	12	0	96 (35)	124	40	15	0	179 (65)	275
2002–2003	85	22	8	1	116 (42)	117	29	11	3	160 (58)	276
2003–2004	73	15	3	0	91 (36)	114	34	12	1	161 (64)	252
2004–2005	46	19	3	2	70 (29)	98	63	8	3	172 (71)	242
2005–2006	59	22	9	5	95 (37)	108	41	11	2	162 (63)	257
2006–2007	57	21	5	0	83 (33)	112	46	6	1	165 (67)	248
2007–2008	76	23	5	2	106 (45)	97	20	11	0	128 (55)	234

[a] Local residents reside in Unit 19D.

TABLE 5A Unit 19[a] moose harvest percent by transport method, regulatory years 2000–2001 through 2007–2008

Regulatory year	Harvest percent by transport method[b]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
2000–2001	54	1	37	6	1	0	0	<1	<1	464
2001–2002	46	1	41	8	2	<1	<1	1	0	412
2002–2003	44	<1	44	8	2	<1	0	1	0	344
2003–2004	39	<1	50	7	3	<1	<1	0	0	282
2004–2005	26	0	67	6	1	0	0	<1	0	258
2005–2006	21	<1	74	4	<1	0	0	0	0	347
2006–2007	28	2	59	9	0	0	0	2	0	189
2007–2008	21	1	69	5	2	0	1	<1	0	226

[a] Total for Unit 19 may not equal sum of hunters from all subunits due to hunters not reporting, errors, or omissions.
[b] Successful hunters only.

TABLE 5B Unit 19A moose harvest percent by transport method, regulatory years 2000–2001 through 2007–2008

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
2000–2001	27	0	70	1	1	0	0	0	1	106
2001–2002	14	1	81	3	1	0	0	0	0	97
2002–2003	28	0	61	6	0	0	0	4	0	64
2003–2004	25	0	72	1	0	0	1	0	0	67
2004–2005	5	0	89	6	0	0	0	<1	0	105
2005–2006	5	0	93	2	0	0	0	0	0	172
2006–2007	5	0	88	0	0	0	0	7	0	41
2007–2008	0	0	93	3	2	0	2	0	0	61

[a] Successful hunters only.

TABLE 5C Unit 19B moose harvest percent by transport method, regulatory years 2000–2001 through 2007–2008

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
2000–2001	87	0	12	0	0	0	0	1	0	152
2001–2002	85	0	12	1	0	0	2	0	0	112
2002–2003	84	0	14	2	0	0	0	0	0	82
2003–2004	79	0	17	4	0	0	0	0	0	53
2004–2005	74	0	24	2	0	0	0	0	0	46
2005–2006	71	0	29	0	0	0	0	0	0	42
2006–2007	86	0	14	0	0	0	0	0	0	28
2007–2008	69	0	31	0	0	0	0	0	0	16

[a] Successful hunters only.

TABLE 5D Unit 19C moose harvest percent by transport method, regulatory years 2000–2001 through 2007–2008

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
2000–2001	71	3	1	21	4	0	0	0	0	123
2001–2002	64	5	0	24	5	1	0	1	0	110
2002–2003	65	2	0	23	7	1	0	2	0	83
2003–2004	62	1	0	23	13	1	0	0	0	71
2004–2005	62	0	3	27	8	0	0	0	0	37
2005–2006	66	5	0	24	5	0	0	0	0	38
2006–2007	63	5	0	32	0	0	0	0	0	38
2007–2008	65	5	0	19	9	0	2	0	0	43

[a] Successful hunters only.

TABLE 5E Unit 19D moose harvest percent by transport method, regulatory years 2000–2001 through 2007–2008

Regulatory year	Harvest percent by transport method[a]									
	Airplane	Dog Team/ Horse	Boat	3- or 4-Wheeler	Snowmachine	Other ORV	Highway vehicle	Unk	Airboat	*n*
2000–2001	5	0	92	2	0	0	0	1	0	83
2001–2002	14	0	80	3	0	0	0	3	0	93
2002–2003	9	0	88	2	1	0	0	0	0	115
2003–2004	5	0	92	1	0	1	0	0	0	91
2004–2005	7	0	93	0	0	0	0	0	0	70
2005–2006	11	0	88	1	0	0	0	0	0	95
2006–2007	5	1	87	6	0	0	0	1	0	82
2007–2008	7	0	90	2	0	0	<1	<1	0	106

[a] Successful hunters only.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 20A (6796 mi^2)

GEOGRAPHIC DESCRIPTION: Tanana Flats, Central Alaska Range

BACKGROUND

Moose are found throughout the Tanana Flats and adjacent Alaska Range foothills at exceptionally high densities relative to similarly sized areas throughout North America. The Unit 20A moose population is 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 1994. More recent publications that discuss important management implications include those by Young and Boertje (2004, 2008), Young et al. (2006), Boertje et al. (2007), and Boertje et al. (2009).

Preferred moose habitat is composed of riparian willow, poorly drained meadows, shallow lakes, early successional forest, and subalpine shrub communities. Suitable moose habitat covers approximately 5040 mi^2 of the unit (the area below 4000 feet in elevation exclusive of large lakes).

Moose numbers increased in Unit 20A during the 1950s and reached high densities in the early 1960s, perhaps 4–5 moose/mi^2. Reported annual moose harvests averaged 311 moose between 1963 and 1969 (McNay 1993). During 1969–1974, reported harvest increased to an average of 617 moose per year. Cow moose composed 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. During 1975–1978, mean annual reported moose harvest was 64 bulls.

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

Between February 1976 and April 1982 the Alaska Department of Fish and Game (ADF&G) reduced wolf numbers. The moose population in Unit 20A increased rapidly during these reduction efforts and continued to increase at a reduced rate through 2004. During 1979–1982, reported 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. Fish and Game staff reduced wolf numbers by trapping and snaring, and this appeared to influence moose population dynamics. Antlerless hunts were resumed during 1996–1998, suspended in 1999, and again resumed during 2000–2007. Reported harvest of bulls reached all-time highs in the late 1990s ($\bar{x}$ = 623 bulls, 1996–1999), but these harvests were not sustainable. As a result, seasons were shortened in 2000, and antler restrictions were imposed in 2002. Evidence of an increasing, high-density, nutritionally-stressed moose population led to liberal antlerless hunts by registration permit across the entire unit during 2004–2006 (Young et al. 2006; Boertje et al. 2007).

Regulations provided for a wide variety of hunting opportunities in Unit 20A. For example, 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; motorized access, but antler restrictions since 1988), the Healy–Lignite Management Area (HLMA; bowhunting only) and the Yanert Controlled Use Area (YCUA; no motorized access except aircraft, antler restrictions since 1988). Hunts include a November muzzleloader hunt for bull moose in the eastern portion of the WRCUA, limited drawing permit hunts for “any bull” moose (1996) concurrent with the antler restricted general season hunt, and registration hunts for antlerless moose with seasons extending 7 months in portions of the unit.

Approximately one-third of Unit 20A is military land, including 1003 mi^2 used by the U.S. Army at Fort Wainwright, 893 mi^2 by the U.S. Army at Fort Greely, and 17 mi^2 by the U.S. Air Force at Clear Air Force Station. 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 harvest of 1400–1600 moose annually.

- 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

2005 Population Estimation Survey

We surveyed 123 (76 high density and 47 low density; 716 mi^2) of 987 survey units (SU; 5747 mi^2) during 10–29 November. We used the geospatial population estimator method (GSPE; Ver Hoef 2001, Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique. A simple random sample of 100 SUs was selected from each stratum using Microsoft® Excel 2003 software. An additional 23 SUs were selected to fill holes in the coverage, increase survey intensity in the FTMA, and for sightability correction factor (SCF) research.

The GSPE method does not employ an 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 versus 4–6 min/mi^2 (Gasaway et al. 1986), resulting in a higher level of sightability. Search time per SU (SUs with 100% moose habitat) averaged 7.85 min/mi^2 (n = 92 SUs). Preliminary work with the sightability of collared moose known to be in sample units indicates that an SCF of 1.16 to 1.25 is appropriate for most Unit 20A GSPE surveys. We applied an SCF of 1.2 to GSPE estimates in Unit 20A (Boertje et al. 2009).

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 (63%) and excellent (25%), with the remainder reported as fair (11%) or poor (1%).

2006 Population Estimation Survey

We surveyed 115 (71 high-density and 44 low-density; 670 mi^2) of 987 survey units (5747 mi^2) during 11 November–2 December using the methods described above. A simple random sample of 60 high-density and 40 low-density SUs was selected using Microsoft® Excel 2003 software. An additional 15 SUs were selected to fill gaps in the coverage and for SCF research.

Search time per SU (SUs with 100% moose habitat) averaged 7.9 min/mi^2 (n = 69 SUs). Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were mostly good (66%) with the remainder excellent (19%), and fair (15%).

Twinning Surveys

Twinning rate surveys were expanded in 2006 and 2007 beyond the traditional survey areas in the central Tanana Flats to include the eastern and western Tanana Flats. Surveys consisted of roughly parallel transects flown at approximately ½-mile intervals at ≤500 feet above ground level in PA-18 or Scout aircraft by experienced 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 during or within a few days after the median calving date

(Boertje et al. 2007) to minimize potential biases resulting from bear predation on one calf of a pair of twins. 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.

2006 Twinning Surveys. Surveys were flown mornings (06:57–12:00) and late afternoons/evenings (16:30–21:20). Leaf-out was approximately 50%. Weather, turbulence and airsickness were not factors. We were unable to obtain a sample of 50 cows with calves in western (n = 38) or eastern (n = 36) Unit 20A. Total flight time (including ferry time) was 17.2 hours ($3117.70) and total survey time was 14.2 hours. We also observed 1 black bear and 1 wolf.

Northcentral Tanana Flats — Surveys were conducted on 23 May east of Crooked Creek, east of the Tanana River and north of approximately N64˚36.00′. Flight time was 5.1 hours ($918) and survey time was 4.8 hours. We observed 292 moose (≥1 year old) or 61 moose/hour.

Western Tanana Flats — Surveys were conducted on 24 May west of Tatlanika Creek, east of Seventeenmile Slough and north of the Rex Trail. Flight time was 5.2 hours ($936) and survey time was 4.3 hours. We observed 174 moose (≥1 year old) or 41 moose/hour.

Eastern Tanana Flats/Foothills — Surveys were conducted on 25 May east of Delta Creek, west of the Delta River and north of approximately N63˚53.75′. Flight time was 6.9 hours ($1262.70) and survey time was 5.1 hours. We observed 153 moose (≥1 year old) or 30 moose/hour.

2007 Twinning Surveys. Surveys were flown mornings/afternoons (08:15–13:40) and late afternoons/evenings (17:49–22:29). Leaf-out was approximately 100%. Weather, turbulence and airsickness were not factors. We were unable to obtain a sample of 50 cows with calves in western (n = 37) and eastern (n = 40) Unit 20A. Total flight time (including ferry time) was 17.2 hours ($3182) and total survey time was 15.0 hours. We observed 3 black bears (2 in the eastern Flats; 1 in the western Flats).

Northcentral Tanana Flats — Surveys were conducted on 25 May east of Crooked Creek, east of the Tanana River and north of approximately N64˚36.00′. Estimated flight time was 5.5 hours ($1018) and actual survey time was 5.2 hours. We observed 282 moose (≥1 year old) or 54 moose/hour.

Western Tanana Flats — Surveys were conducted on 28 May west of Tatlanika Creek, east of the George Parks Highway and north of the Rex Trail. Estimated flight time was 5.6 hours ($1036) and actual survey time was 4.7 hours. Moose observations were noticeably higher in the 2001 Fish Creek burn. I recommend focusing search effort there next year to maximize efficiency and sample size. We observed 128 moose (≥1 year old) or 27 moose/hour. We observed few moose in the 2006 Parks Highway burn during the last hour of the survey, which lowered the number of moose observed per hour.

Eastern Tanana Flats/Foothills — Surveys were conducted on 2 June east of Delta Creek, west of the Delta River and north of approximately N63˚53.75′. Estimated flight time was 6.1 hours ($1129) and actual survey time was 4.3 hours. We observed 164 moose (≥1 year old) or 38

moose/hour. In 2007, most moose were observed in the northern portion of the survey area (Karla Lake fire perimeter).

HARVEST

We estimated annual harvest from mandatory harvest report cards. This included data from report cards from the general season hunt, registration hunts (i.e., antlerless hunts RM764 and RM768), and drawing hunts (i.e., Nov muzzleloader bull hunt DM766 in the eastern WRCUA, and bull hunts DM768–DM774). Hunters received 1 or 2 reminder letters and usually an e-mail and telephone calls if we did not receive timely harvest reports. We summarized data on 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., RY05 = 1 Jul 2005–30 Jun 2006).

We estimated accidental mortality by motor vehicles and trains from Department of Public Safety and Alaska Railroad Corporation records. We estimated unreported harvest based on 17.7% unreported harvest (including wounding loss) reported by Gasaway et al. (1992). We estimated illegal and other (defense of life or property, dispatched, potlatch, stickdance, and other reported deaths) mortality from Department of Public Safety and ADF&G records and then added an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population multiplied by 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in Unit 20A).

WEATHER

We evaluated weather (snowfall and temperature) using National Weather Service records and personal observations.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Moose densities remained high at an estimated 3.1–3.2 moose/mi^2 during RY05–RY06 (Table 1). These are the highest reported moose densities in Alaska for any comparably-sized area, although a smaller 1890-mi^2 area in southern Unit 20D which includes agricultural lands and recent large burns had 4.6 moose/mi^2 in 2006 (DuBois 2008).

The Unit 20A moose population increased between 1999 and 2003 (Table 1). Comparing the 1999 estimate (SCF = 1.0) of 7213 cows with the 2003 estimate of 9106 cows reveals an average annual finite growth rate of 1.066 during that period. The population appears to have peaked in 2003 at 15,000–20,000 total moose (SCF = 1.2). Lower population estimates in 2004, 2005 and 2006 in conjunction with poor productivity, particularly in 2001, 2003, and 2005 (R. Boertje, ADF&G files, Fairbanks) and liberal antlerless harvests RY04–RY06 suggest a modest population decline.

Population Composition

Bull:cow ratios steadily increased between 2000 and 2005 and remained high in 2006. Mean bull:cow ratios of 35:100 (range 32–38) during 2003–2006 met the unitwide management objective of ≥30 bulls:100 cows (Table 1). An increase from an estimated 26 bulls:100 cows in 2001 to 38 bulls:100 cows in 2005 supports the contention that unitwide antler restrictions (beginning RY02) were effective in improving bull:cow ratios, although high harvest of cow moose contributed to the increase (Young and Boertje 2008).

We also met our objective of ≥20 bulls:cows in the Tanana Flats, western foothills/mountains, and eastern foothills/mountains of Unit 20A. Unlike 2001 when bull:cow ratios were higher in the eastern foothills/mountains (40:100) than the Tanana Flats (26:100) and western foothills/mountains (22:100), bull:cow ratios were similar across the unit in 2003 (Tanana Flats 32:100, western foothills/mountains 31:100, and eastern foothills/mountains 34:100), 2004 (Tanana Flats 35:100, western foothills/mountains 34:100, and eastern foothills/mountains 37:100), 2005 (Tanana Flats 37:100, western foothills/mountains 39:100, and eastern foothills/mountains 36:100), and 2006 (Tanana Flats 33:100, western foothills/mountains 35:100, and eastern foothills/mountains 43:100). This result likely occurred because of 1) higher harvests in the eastern foothills due to increased access and hunting pressure and 2) lower harvests in the Tanana Flats and western foothills/mountains because of antler restrictions. In addition, higher antlerless harvests in the Tanana Flats and western foothills/mountains increased bull:cow ratios to some extent (Young and Boertje 2008).

Bull:cow ratios continued to improve during the report period in southwestern Unit 20A, where numerous trails provide motorized access, and bull:cow ratios had been chronically low in some areas. Previously, bull:cow ratios in the FTMA had declined from an estimated 26:100 in 1994 to 9:100 in 2001. In addition, in the western Tanana Flats, bull:cow ratios were at or below 20 bulls:100 cows in both 2000 (20:100) and 2001 (17:100). Unitwide antler restrictions that went into effect in RY02 appeared to improve bull:cow ratios (Young and Boertje 2008) in those areas (2003: FTMA = 24:100; western Tanana Flats = 36:100; 2004: FTMA = 30:100; western Tanana Flats = 36:100; 2005: FTMA = 23:100; western Tanana Flats = 34:100; 2006: FTMA = 30:100; western Tanana Flats = 35:100).

Yearling recruitment (i.e., yearlings:100 cows) was relatively strong during 2003–2006, averaging 21:100 (range = 18–22:100; Table 1). Estimated percent yearlings in the population averaged 12% (range 11–14%) in 2003–2006. Moose populations with >10% yearlings during fall, particularly in areas where mortality factors such as deep snow or predation are of minimal importance, would likely exceed maintenance level recruitment (Bishop and Rausch 1974:573). Unit 20A has not had a deep snow winter (accumulated snow depth >35.5 inches; Boertje et al. 1996) since 1992–1993 and predation has been relatively low (Boertje et al. 2009), which suggests the moose population could have increased during 2003–2006 if harvest rates of antlerless moose had remained low. The proportion of yearlings in the Unit 20A moose population likely would have been even higher had it not been for 1) recently initiated (RY02) spike, forked, or 50-inch antler restrictions, which typically result in higher harvests of yearling bulls than an "any bull" harvest strategy, and 2) probable misclassification of yearlings with retarded antler development. Surveys conducted in late August 2007 of known-age radiocollared moose revealed that 26% (7 of 27) of the 15-month-old bulls had antlers ≤6 inches in length.

(D. Young, ADF&G files, Fairbanks). To ensure that 2-year-old bulls were not being misclassified as yearlings and artificially inflating the proportion of yearlings in the population, we also surveyed known-age 27-month old bulls. All 27-month old bulls (n = 14) had typical palmed antlers with ≥1 distinct brow tine and likely would have been classified correctly (i.e., as 2-year olds) during fall surveys.

Twinning Rates

Overall twinning rates (i.e., northcentral Tanana Flats, western Tanana Flats and eastern Tanana Flats/foothills) were relatively poor in 2006 and 2007 ($\bar{x}$ = 14%; Table 2). Twinning rates were lowest in the northcentral Tanana Flats ($\bar{x}$ = 7%) followed by the eastern Tanana Flats/foothills ($\bar{x}$ = 13%) and the western Tanana Flats ($\bar{x}$ = 20%). We also documented low parturition rates, reproductive pauses, and delayed age of first reproduction. All these factors indicate the Unit 20A moose population is nutritionally stressed because of high moose densities and declining habitat condition across much of Unit 20A (Boertje et al. 2007).

Distribution and Movements

Moose distribution varies widely across Unit 20A. Boertje et al. (2009) reported that a 2598-mi^2 study area in central Unit 20A contained about 50% of the moose habitat, but about 67% of the moose in November. For example, in 1996 he found 30% higher moose density in the study area compared to the total Unit 20A moose density. In addition, the moose population consists of nonmigratory and migratory subpopulations (Gasaway et al. 1983). From March to May many bull and cow moose migrate from the surrounding foothills (Alaska Range and Chena and Salcha River drainages) to summer range on the Tanana Flats in Unit 20A. They remain there at least through June in most years and return to the foothills from July 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 spring density of moose on the Tanana Flats 2- to 4-fold over the density of resident Unit 20A moose. Boertje et al. (2009) estimated that in the 1807-mi^2 Tanana Flats portion of their central study area, calving and summer density was 1.85 times the November (1996) density.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Unit 20A during RY05 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20A, the Ferry Trail Management Area, Wood River Controlled Use Area, Healy–Lignite Management Area, and the Yanert Controlled Use Area.		

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on one side; or	1 Sep–25 Sep (General hunt only)	
1 antlerless moose by registration permit only; or	1 Sep–10 Dec (General hunt only)	
1 bull with spike-fork antlers or 50-inch antlers or antlers with 4 or more brow tines on one side; by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.	1 Nov–30 Nov	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side; or		1 Sep–25 Sep
1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side; by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.		1 Nov–30 Nov
Remainder of Unit 20A.		
1 moose per regulatory year only as follows:		
RESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on one side; or	1 Sep–25 Sep (General hunt only)	
1 antlerless moose by registration permit only;	1 Sep–10 Dec (General hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		1 Sep–25 Sep

Seasons and Bag Limits. Seasons and bag limits in Unit 20A during RY06 were as follows:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 20A, the Ferry Trail Management Area, Wood River Controlled Use 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 one side; or	1 Sep–25 Sep (General hunt only)	
1 antlerless moose by registration permit only; or	25 Aug–28 Feb (General hunt only)	
1 bull by drawing permit only; up to 500 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	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side; or		1 Sep–25 Sep
1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side; by drawing permit only; by muzzleloading firearms only; up to 75 permits may be issued.		1 Nov–30 Nov
Remainder of Unit 20A.		
RESIDENT HUNTERS: 1 bull with spike-fork antlers or 50-inch antlers or antlers with 3 or more brow tines on one side; or	1 Sep–25 Sep (General hunt only)	
1 antlerless moose by registration permit only; or	25 Aug–28 Feb (General hunt only)	

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull by drawing permit only; up to 500 permits may be issued; or	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		1 Sep–25 Sep

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 one 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 one 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 SF50/4. Those bag limits remained in effect through the RY02 hunting season. The board took action to restrict resident bag limits for moose throughout Unit 20A in RY02. The resident bag limit for the FTMA, HLMA, WRCUA, and YCUA was 1 bull moose with SF50/4, and for the remainder of Unit 20A, 1 bull moose with SF50/3. The nonresident bag limit remained 1 bull moose with SF50/4. Resident and nonresident antler restrictions remained unchanged through RY05. In 2006 the board relaxed antler restrictions for resident hunters in the HLMA from a SF50/4 to SF50/3 bag limit, and adopted a drawing permit hunt for "any bull" moose and authorized up to 500 permits be issued.

The board adopted 3 antlerless moose hunts by drawing permit (up to 300 permits) in RY96. Two (DM760 and DM762) occurred on the northcentral Tanana Flats near Fairbanks, where moose densities were high. The third antlerless hunt (DM764) occurred in the eastern portion of the WRCUA. The antlerless hunts were suspended in RY99 because of an agreement with local advisory committees that cows would only be hunted when the population was increasing, and in 1999 the population was believed to be stable. These 3 hunts were resumed in RY00 when advisory committees and the board agreed to authorize the hunts as long as the moose population was stable or increasing. In RY02 the board authorized an antlerless hunt by registration permit, 1–25 September, for the Unit 20A portion of the Nenana Controlled Use Area (NCUA; i.e., the western Tanana Flats), a calf hunt by drawing permit (up to 300 permits), 1–25 September, and that recipients of antlerless and calf hunt permits be prohibited that year from hunting for antlered bull moose in Unit 20A. That regulation and the highly controversial calf hunts were rescinded in 2004, although the board adopted a unitwide antlerless moose hunt by registration permit 1 September–10 December. Then in 2006 the board expanded this hunt to 25 August–28 February.

The board made no changes during RY99–RY04 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 none were issued RY00–RY04 because of an agreement with local advisory committees not to issue permits until bull:cow ratios recovered. By November 2004, posthunt bull:cow ratios had recovered (35:100) and, subsequently, 75 permits were issued in RY05 and RY06.

The board created the 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 NCUA was eliminated in RY04. A public proposal submitted to the board in 2008 to reinstate the NCUA failed.

Alaska Board of Game Actions, March 2008 — The board took the following actions for moose in Unit 20A:

- Adopted language making it unlawful to take a calf or a cow accompanied by a calf in an antlerless hunt; and

- Authorized up to 1000 permits be issued for the drawing permit hunts for "any bull" moose.

Harvest by Hunters. Overall reported harvest of 1131 and 1051 moose in RY05 and RY06 (Table 3) fell short of the intensive management harvest objective of 1400–1600 adopted by the board in 2004, but harvest densities were the highest recorded for similarly large areas of Interior Alaska.

General Season — Reported harvest of bull moose during the general season increased 66% between RY90–RY91 ($\bar{x}$ = 376 bulls) and RY96–RY97 ($\bar{x}$ = 613 bulls), and remained relatively stable through RY99. Liberalizing the general season from 20 to 25 days in Unit 20A in RY95 likely contributed to the increased harvest. Average annual reported harvest RY00–RY01 declined to 540 bulls (Table 4) after the general season was reduced by 5 days (1–20 Sep) and unitwide antler restrictions were adopted for nonresident hunters. Reported harvest declined further to 353 bulls after unitwide antler restrictions were imposed on resident hunters in RY02. Harvest dipped even lower to 331 bulls in RY03. However by RY05, year 4 of unitwide antler restrictions, reported harvest increased to 444 bulls, probably as a result of higher recruitment of bulls and improved age structure of the population. A slight decline in reported harvest (408 bulls) during the general season in RY06 was likely the result of a drawing permit hunt initiated for "any bull" moose that ran concurrent with the general season hunt. During RY06, 300 drawing permits were issued and 71 bulls were reported harvested. I hypothesize that some general season effort, harvest, and harvest reporting was diverted to the "any bull" drawing permit hunt (i.e., bulls taken by permittees that were legal under the general season spike-fork/50-inch regulation were reported as being taken under the permit hunt regulation). An increase in total reported harvest of bulls from 452 in RY05 to 493 in RY06 supports this assertion (Tables 4 and 5).

Permit Hunts — Permit hunt harvest increased from 127 to 175 antlerless moose during RY02–RY03 because of a regulation change that prohibited recipients of drawing and registration permits for antlerless moose from taking an antlered bull moose in Unit 20A and the addition of a limited registration hunt (30 permits) in the western Tanana Flats (Table 5). After antlerless hunts were liberalized in RY04, permit hunt harvest jumped to 599, 687 and 644 moose during RY04–RY06. There was nearly a 10-fold increase in the number of permits issued during RY04–RY06 ($\bar{x}$ = 4910) compared to RY02–RY03 ($\bar{x}$ = 509). In RY06 the addition of 300 drawing permits for "any moose" resulted in 85 bulls being harvested.

Hunter Residency and Success. Success rates dropped to 30% after unitwide antler restrictions went into effect in RY02 and continued to decline through RY04 (Table 4). Success rates stabilized at 24–25% during RY04–RY06. Nonresidents had higher success rates than residents. During RY05–RY06, the average success rate was 56% for nonresident hunters compared to 20% for resident hunters. This can likely be explained by the greater use of guides by nonresident hunters. During RY05–RY06, 48% (117/242) of the nonresident hunters reported using a registered guide compared to <1% (4/607) of resident hunters.

The number of hunters who reported hunting moose during the general season was similar in RY02 and RY03 (Table 4). However, that number increased from 1189 to 1628 (37%) in RY04, likely because of strong participation in the liberal antlerless hunts (n = 2132 hunters) that were concurrent with the general season. The number of general season hunters reached an all time high of 1816 in RY05, as interest in the antlerless hunts peaked (n = 2717 hunters), and then fell back to 1608 in RY06, apparently as participation in the antlerless hunts waned (n = 2059 hunters).

Harvest Chronology. Moose harvest in Unit 20A has traditionally been well distributed throughout the season and no deviations were apparent during RY05–RY06 (Table 6).

Transport Methods. All-terrain vehicles (3- or 4-wheeler and Other ORV) and airplanes remained the primary modes of transportation used by successful hunters, and no deviations were apparent from the previous reporting period (Table 7).

Other Mortality

A telemetry study of moose mortality begun in 1996 concluded that predation killed 4 times more moose annually than humans and that predators killed mostly healthy moose (75% of which were calves; Boertje et al. 2009). The number of moose reported killed in accidents with motor vehicles and trains has been substantial in some years (Dale 1998), but was relatively low during RY05–RY06 (Table 3). This may be the result of a lack of deep snow (long-term mean annual snowfall for Fairbanks = 68 inches) during winters 2005–2006 (50.4 in) and 2006–2007 (28.0 inches) and poor reporting.

HABITAT

We have documented that this population has the lowest productivity of wild, noninsular moose populations in North America (Boertje et al. 2007). Despite reducing the moose population by an estimated 15–20% between 2004 and 2007, commensurate improvements in productivity have not yet been detected. Thus, we remain concerned about the population still exceeding the

habitat capability and being vulnerable to severe weather patterns. Moreover, we deem a higher moose density as undesirable until productivity and/or 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. Increased summer use by the moose population was observed in 2002, but winter use was not observed until winter 2005–2006. Another large wildfire (130,000-acre Parks Highway fire) occurred on the western Tanana Flats in 2006, but the extent to which moose are using that burn is not known. Research on mortality implemented in 1996 concluded that predation and low productivity of moose had similar major limiting effects on yield, and other factors had minor limiting effects on yield (Boertje et al. 2009).

NONREGULATORY MANAGEMENT PROBLEMS OR NEEDS

The Alaska Railroad Corporation Northern Rail Extension Project's proposed alignment between Fairbanks and Delta Junction would traverse the Tanana Flats just south of the Tanana River potentially between Salcha and Delta Junction. The rail extension would bisect important moose habitat in the Fairbanks area in Units 20A and 20B. Of greatest concern is potential railroad kill, primarily during winter months. If fences are built, these will be impediments to seasonal moose migrations between the Tanana Flats calving areas and the adjacent Tanana Hills in Unit 20B. The Fairbanks Area management staff has been involved in discussions to mitigate these impacts, including the possibility of a cooperative research project with the University of Alaska Fairbanks to be funded by the Alaska Railroad Corporation.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates indicated the Unit 20A moose population remained above the upper limit of the population objective through 2006. Continued low twinning rates, 0% yearling pregnancy rates, delayed age of first reproduction, and reproductive pauses indicate the moose population remains relatively unproductive. Ongoing research indicates that moose production in Unit 20A is reduced because of high moose densities and declining habitat condition (Boertje et al. 2007, Boertje et al. 2009). Therefore, during RY05–RY06 the department continued to recommend liberal antlerless moose hunts to reduce moose density and maintain high harvests. Harvest goals for antlerless moose were reevaluated annually based on the most current harvest and population estimates. In RY05 and RY06 the department recommended harvests of 800 and 700 antlerless moose. The department's long-term objective is to continue to reduce the moose population to within the intensive management population objective of 10,000–12,000 moose, unless we observe improvements in twinning ratios from reduced moose densities and recent habitat improvements (i.e., 2001 Fish Creek and Survey Line fires, 2006 Parks Highway fire). Antlerless moose harvest should continue to be evaluated as a tool to prevent an overabundance of moose that are vulnerable to the synergistic effects of adverse weather and increased predation (Boertje et al. 1996). In addition, it remains important to improve habitat quality and determine the status of the Unit 20A moose population relative to nutrient and climate limitations, and increasing predator numbers.

We met our management objectives of 20 bulls:100 cows in the Tanana Flats, western foothills, and eastern foothills, and 30 bulls:100 cows unitwide. High and increasing bull:cow ratios 2001–2005 indicated that unitwide antler restrictions initiated in RY02 were effective (Young and Boertje 2008) and harvest rates of bulls were below maximum sustainable levels. In RY06, I

recommended retaining unitwide antler restrictions for both resident and nonresident hunters, but also adding a limited drawing permit hunt for "any bull" moose to optimize harvest. I also recommended a harvest rate for bulls of 15–20% of the prehunt bull population. I recommend that we continue to use antler restrictions as the primary mechanism to regulate the harvest of bulls to maintain desired bull:cow ratios and to manage hunter and harvest densities at various spatial scales (e.g., subunit, management area, controlled use area, and subarea). We should continue to closely monitor bull:cow ratios both at unitwide and lesser spatial scales to monitor the effects of current regulatory changes on bull:cow ratios.

We did not meet the harvest objective of 1400–1600 moose annually in RY05 or RY06. To meet this harvest objective, it will be necessary to harvest antlerless moose at a relatively high rate that is not sustainable over the long term. Once the population reaches the desired level, I recommend a selective harvest strategy (i.e., antler restricted bull hunts, limited "any bull" drawing permit hunts, and antlerless hunts including both cows and calves) with a harvest ratio of approximately 60 bulls:20 cows:20 calves to maximize yield.

Regarding GSPE methodology, I recommend the proportion of high-density:low-density SUs be changed from 60:40 to 70:30, due to the higher proportion of SUs in Unit 20A with high moose numbers (J. Ver Hoef, National Oceanic and Atmospheric Administration, personal communication, Fairbanks).

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TABLE 1 Unit 20A aerial moose fall composition counts and estimated population size, 1999–2006

Calendar year	Bulls:100 Cows	Yearlings: 100 Cows[a]	Calves:100 Cows	Percent calves	Adults	Moose observed	Estimated population (90% CI)[b]	Estimated population w/SCF = 1.2[c]	Moose/mi^2 w/SCF = 1.2[d]
1999	23	13	33	21	760	965	11,205 (±14%)	13,446	2.7
2000	23	10	33	21	1089	1377	10,557 (±18%)	12,668	2.5
2001	26	18	26	17	737	887	11,511 (±15%)	13,813	2.8
2002[e]									
2003	32	22	28	18	1212	1483	14,684 (±13%)	17,621	3.5
2004	35	21	36	21	1512	1922	13,566 (±15%)	16,279	3.3
2005	38	18	30	19	1370	1684	13,348 (±15%)	16,018	3.2
2006	36	22	34	20	1232	1536	12,773 (±16%)	15,328	3.1

[a] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[b] Geospatial population estimator (GSPE) method.
[c] Preliminary sightability studies suggest a sightability correction factor (SCF) of 1.16 to 1.25 using the GSPE method.
[d] Based on an estimated 5000 mi^2 of moose habitat in Unit 20A.
[e] Surveys were not conducted due to lack of snow.

TABLE 2 Unit 20A moose twinning rates from transect surveys, 1999–2007

Calendar year	Date	Cows w/Single calf	Cows w/Twins	Cows Total	% Twins[a]
1999[b]	25–26 May	62	2	64	3
2000[b,c]	14 May–9 June	27	3	30	10
2001[b,c]	14 May–6 June	30	1	31	3
2002[b]	24–25 May	52	6	58	10
2003[b]	27–28 May	53	5	58	9
2004[b]	23 May	57	3	60	5
2005[b]	23 May	49	5	54	9
2006[b]	23 May	49	6	55	11
2006[d]	24 May	32	6	38	16
2006[e]	25 May	30	6	36	17
2007[b]	25 May	58	2	60	3
2007[d]	28 May	28	9	37	24
2007[e]	2 Jun	36	4	40	10

[a] Percentage of cows with calves that had twins.
[b] Central Tanana Flats.
[c] No transect surveys were flown in 2000 and 2001. These data were derived from radiocollared cows ≥5 years old plus 4 3- or 4-year-old moose with single calves to simulate the population structure observed in transect surveys. Radiocollared 3- and 4-year-old cows did not produce viable twins during 1996–2006 (R. Boertje, ADF&G files, Fairbanks).
[d] Western Tanana Flats.
[e] Eastern Tanana Flats.

TABLE 3 Estimate of Unit 20A moose harvest[a] and accidental death, regulatory years 1999–2000 through 2006–2007

Regulatory year	Harvest by hunters							Accidental death			Total
	Reported				Estimated						
	M	F	Unk	Total	Unreported[b]	Illegal/Other[c]	Total	Road[d]	Train[e]	Total	
1999–2000	660	1	16	677	120	5	125	3	11[e]	14	816
2000–2001	539	70	4	613	109	9	118	2	34[e]	36	767
2001–2002	541	70	4	615	109	62	171	3	4[f]	7	793
2002–2003	363	115	1	479	85	61	146	7	6[f]	13	638
2003–2004	347	160	0	507	90	106	196	0	6[f]	6	709
2004–2005	431	557	0	988	175	106	281	0	11[f]	11	1280
2005–2006	497	634	0	1131	200	99	299	0	6[f]	6	1436
2006–2007	558	493	0	1051	186	85	271	2	8[f]	10	1332

[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, defense of life or property, dispatched, potlatch, stickdance, and other reported deaths, plus an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population × 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in GMU 20A).
[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 (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.
[f] Confirmed dead between ARR mileposts 371.0 and 411.7; “Missing” moose (moose hit but not recovered) are not included. Data provided by the Alaska Railroad.

TABLE 4 Unit 20A general season moose hunter[a] residency and success, regulatory years 1999–2000 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1999–2000	369	153	129	6	657 (42)	660	180	67	7	914 (58)	1571
2000–2001	326	138	73	4	541 (34)	713	213	115	2	1043 (66)	1584
2001–2002	350	131	56	2	539 (35)	705	219	81	7	1012 (65)	1551
2002–2003	190	77	85	1	353 (30)	567	190	70	1	828 (70)	1181
2003–2004	185	68	78	0	331 (28)	551	202	99	6	858 (72)	1189
2004–2005	191	95	92	15	393 (24)	815	320	85	15	1235 (76)	1628
2005–2006	211	112	119	2	444 (24)	892	385	86	9	1372 (76)	1816
2006–2007	177	107	123	1	408 (25)	755	327	108	10	1200 (75)	1608

[a] Excludes hunters in permit hunts.
[b] Residents of Unit 20.

TABLE 5 Unit 20A moose harvest data by permit hunt, regulatory years 2002–2003 through 2006–2007

Permit hunt	Regulatory year	Permits issued	Did not hunt	(%)	Unsuccessful hunters	(%)	Successful hunters	(%)	Male	(%)	Female	(%)	Unk	Harvest
DM760	2002–2003	50	4	(8)	13	(28)	33	(72)	0	(0)	33	(100)	0	33
	2003–2004	100	24	(24)	25	(33)	51	(67)	0	(0)	51	(100)	0	51
DM762	2002–2003	50	14	(28)	9	(25)	27	(75)	0	(0)	27	(100)	0	27
	2003–2004	100	30	(30)	28	(40)	42	(60)	2	(5)	40	(95)	0	42
DM764	2002–2003	75	36	(48)	20	(51)	19	(49)	0	(0)	19	(100)	0	19
	2003–2004	100	45	(45)	23	(42)	32	(58)	1	(3)	31	(97)	0	32
RM767	2002–2003	30	3	(10)	12	(44)	15	(56)	0	(0)	15	(100)	0	15
	2003–2004	20	1	(5)	3	(16)	16	(84)	1	(6)	15	(94)	0	16
RM764	2004–2005	5430	3298	(61)	1533	(72)	599	(28)	41	(7)	553	(93)	5	599
	2005–2006	5114	2397	(47)	2038	(75)	679	(25)	47	(7)	629	(93)	3	679
	2006–2007	3717	1672	(45)	1493	(73)	552	(27)	66	(12)	477	(88)	9	552
RM768	2006–2007	20	6	(30)	8	(57)	6	(43)	0	(0)	7	(100)	0	7
Totals for all antlerless permit hunts	2002–2003	205	57	(28)	54	(36)	94	(64)	0	(0)	94	(100)	0	94
	2003–2004	320	100	(31)	79	(36)	141	(64)	4	(3)	141	(97)	0	145
	2004–2005	5430	3298	(61)	1533	(72)	599	(28)	41	(7)	553	(93)	5	599
	2005–2006	5114	2397	(47)	2038	(75)	679	(25)	47	(7)	629	(93)	3	679
	2006–2007	3737	1678	(45)	1501	(73)	558	(27)	66	(12)	484	(88)	9	559
DM766	2005–2006	75	40	(53)	27	(77)	8	(23)	8	(100)	0	(0)	0	8
	2006–2007	75	39	(52)	22	(61)	14	(39)	14	(100)	0	(0)	0	14
DM768	2006–2007	10	4	(40)	5	(83)	1	(17)	1	(100)	0	(0)	0	1
DM769	2006–2007	75	24	(32)	37	(73)	14	(27)	14	(100)	0	(0)	0	14
DM770	2006–2007	30	7	(23)	9	(39)	14	(61)	14	(100)	0	(0)	0	14
DM771	2006–2007	35	12	(34)	12	(52)	11	(48)	11	(100)	0	(0)	0	11
DM772	2006–2007	100	55	(55)	28	(62)	17	(38)	17	(100)	0	(0)	0	17
DM773	2006–2007	20	7	(35)	5	(38)	8	(62)	8	(100)	0	(0)	0	8
DM774	2006–2007	30	16	(53)	8	(57)	6	(43)	6	(100)	0	(0)	0	6

Permit hunt	Regulatory year	Permits issued	Did not hunt (%)		Unsuccessful hunters (%)		Successful hunters (%)		Male (%)		Female (%)		Unk	Harvest
Totals for all antlered permit hunts	2002–2003	0	0	(0)	0	(0)	0	(0)	0	0	0	(0)	0	0
	2003–2004	0	0	(0)	0	(0)	0	(0)	0	0	0	(0)	0	0
	2004–2005	0	0	(0)	0	(0)	0	(0)	0	0	0	(0)	0	0
	2005–2006	75	40	(53)	27	(77)	8	(23)	8	(100)	0	(0)	0	8
	2006–2007	375	164	(44)	126	(60)	85	(40)	85	(100)	0	(0)	0	85
Totals for all permit hunts	2002–2003	480	223	(46)	131	(51)	126	(49)	14	(11)	113	(89)	0	127
	2003–2004	537	211	(39)	161	(49)	165	(51)	19	(11)	156	(89)	0	175
	2004–2005	5430	3298	(61)	1533	(72)	599	(28)	41	(7)	553	(93)	5	599
	2005–2006	5189	2437	(47)	2065	(75)	687	(25)	55	(8)	629	(92)	3	687
	2006–2007	4112	1842	(45)	1627	(72)	643	(28)	151	(24)	484	(76)	9	644

TABLE 6 Unit 20A moose harvest[a] chronology percent by month/day, regulatory years 1999–2000 through 2006–2007

Regulatory year	Harvest chronology percent by month/day						
	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25	Unk/Other	*n*
1999–2000	20	15	25	22	15	2	657
2000–2001	26	18	25	27	0	3	541
2001–2002	24	21	24	28	0	3	539
2002–2003	22	18	31	26	0	2	353
2003–2004	18	20	34	24	0	4	331
2004–2005	24	14	20	21	18	3	393
2005–2006	24	15	20	21	17	2	444
2006–2007	19	14	20	24	20	3	408

[a] Excludes permit hunt harvest.

TABLE 7 Unit 20A moose harvest[a] percent by transport method, regulatory years 1999–2000 through 2006–2007

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
1999–2000	36	5	18	20	0	11	4	5	1	660
2000–2001	37	5	19	19	0	10	3	5	1	541
2001–2002	34	5	19	20	0	10	3	7	1	539
2002–2003	36	5	14	23	0	8	3	8	2	353
2003–2004	32	5	13	26	0	10	3	9	2	331
2004–2005	33	5	14	29	0	10	3	4	2	393
2005–2006	37	3	15	28	0	11	3	4	0	444
2006–2007	38	7	13	25	0	7	2	4	1	408

[a] Excludes permit hunt harvest.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

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 and 1982 to 20 days during 1983 through 1987. Subsequent increases in harvest along with declining bull:cow ratios and evidence of low recruitment in some areas resulted in hunting seasons being shortened to 15 days in 1988. Despite this 5-day reduction in the season, harvests increased further from nearly 400 bulls in 1988 to more than 700 bulls in 1998. Moose population trends from the late 1980s through the 1990s were largely unknown because unitwide surveys were not conducted. However, unitwide surveys conducted in 2001, 2003, 2004, 2005, and 2006 indicated that the moose population increased from an estimated 9800 (about 1.1 moose/mi^2) in 1990 to 16,000 (about 1.6 moose/mi^2) in 2006.

Demand for moose hunting opportunities is high 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 8 permit moose hunts in Unit 20B during this reporting period: 2 hunts for "any moose" in the Minto Flats Management Area (MFMA) and 6 hunts for "antlerless moose" (i.e., 1 in the Fairbanks Management Area [FMA] by bow and arrow, 1 in the Creamer's Field

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

Migratory Waterfowl Refuge [Creamer's Refuge] by muzzleloader, and 4 in the central portion of the Unit 20B outside the 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 and 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. This area was closed to hunting in the late 1970s and early 1980s to prevent excessive harvest. Boundaries of the FMA changed numerous times. The most recent changes went into effect in July 2002. The FMA currently encompasses about 300 mi^2, of which an area of about 50 mi^2 has a relatively dense human population. Even though harvest is generally low, this permit hunt for antlerless moose is popular.

For management purposes, Unit 20B is divided into 3 geographic zones: western Unit 20B (2942 mi^2), including the Minto Flats, Tatalina Creek drainage, Tolovana River drainage, and areas west; eastern Unit 20B (2425 mi^2), including the Little Salcha and Salcha River drainages; and central Unit 20B (3829 mi^2).

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., eastern Unit 20B, central Unit 20B, western Unit 20B, and MFMA).

METHODS

POPULATION STATUS AND TREND

2005 Central Unit 20B and MFMA Population Estimation Survey

We surveyed 104 (62 high- and 42 low-density; 586mi^2) of 868 sample units (SUs; 4900 mi^2) in central Unit 20B and the MFMA during 30 November–4 December. We used the geospatial population estimator method (GSPE; Ver Hoef 2001, Kellie and DeLong 2006), a modification of the standard Gasaway et al. (1986) technique. 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. A simple random sample of SUs (n = 90) was selected from each stratum using Microsoft® Office Excel for Windows 98® software. Additional SUs (n = 14) were selected to fill holes in the coverage and increase survey intensity in the MFMA.

The GSPE method does not yet 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 time per SU (SUs with 100% moose habitat; n = 85) averaged 43.8 minutes (8.0 min/mi^2). Preliminary sightability studies suggest a SCF of 1.16 to 1.25 using the GSPE method (Boertje et al. 2009). We applied a SCF of 1.2 to GSPE estimates in Unit 20B to estimate total moose numbers.

Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were reported as good (46%), excellent (19%), fair (1%), and unclassified (33%).

2006 Population Estimation Survey

We surveyed 127 (78 high- and 49 low-density; 717mi^2) of 1628 SUs (9196 mi^2) in Unit 20B during 11 November–4 December. Methods were the same as those described above, except 100 SUs were initially selected randomly and 27 additional SUs were selected to fill holes in the coverage and increase survey intensity.

Search time per SU (SUs with 100% moose habitat; n = 94) averaged 47.0 minutes (8.5 min/mi^2). Survey conditions (Gasaway et al. 1986) with regard to snow (age and cover), light (intensity and type), and wind (strength and turbulence) were mostly good (68%) with the remainder excellent (13%), fair (13%), and poor (6%).

Twinning Rate Surveys

Twinning rates were estimated from surveys conducted in traditional twinning survey trend count areas on Minto Flats and surveys initiated in the central portion of the unit in 2006. Surveys consisted of roughly parallel transects flown at approximately ½-mile intervals at ≤500 feet above ground level in PA-18 or Scout aircraft by experienced pilots. All moose observed were classified as bull; yearling cow; adult cow without a calf; or adult cow with single, twin, or triplet calves. In past years, 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.

2006 Twinning Surveys

Minto Flats Management Area. East–west transects were flown on 24 May between the Tolovana River/Swanneck Slough to the west and Dunbar Trail to the east beginning at 65°02.7'N and ending at Nenana. Leaf-out was approximately 50%. Weather, turbulence, and airsickness were not factors. Total flight time (including ferry time) was 6.0 hours ($1098) and survey time was 5.3 hours.

Central Unit 20B. A Bellanca Scout aircraft was used to search riparian, alpine, and the non-canopied forested habitats in the morning (6:00 AM–12:00 PM) or evening (10:00 PM–1:00 AM) 24–26 May (Fig. 1). Survey flight time was 10.8 hours.

2007 Twinning Surveys

Minto Flats Management Area. East–west transects were flown on 26 May between the Tolovana River/Swanneck Slough to the west and Dunbar Trail to the east, beginning at 65°02.7'N and ending at Nenana. Leaf-out was approximately 100%. Weather, turbulence, and airsickness were not factors.

Central Unit 20B. A Bellanca Scout aircraft was used to search the area including Goldstream Creek from Dunbar to Fox, Luck Dome, and the flats within 10 miles of the Tanana River from Nenana to the Little Salcha River on 29–31 May (Fig. 2). The survey area was defined by known calving locations that were identified in the 2006 central Unit 20B twinning survey. Surveys were conducted between 9:00 PM and 1:30 AM. Evening flights were used for several reasons: 1) the volume of aircraft traffic in the vicinity of Fairbanks, Fort Wainwright, and Eielson Air Force Base decreases during evenings; 2) calving moose are difficult to find in the canopied forest of central Unit 20B, but tend to move into more open habitats to feed during evenings; and 3) turbulence tends to be less of a factor during evenings, allowing greater aircraft maneuverability. Survey flight time was 8.9 hours.

MORTALITY

We estimated harvest based on mandatory harvest report cards. This included data from report cards from the general season; the MFMA registration permit hunts; and the FMA, Creamer's Refuge, and central Unit 20B antlerless drawing permit hunts. Reminder letters were sent to nonreporting general season hunters, and up to 2 letters and an e-mail 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 (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 Jul 2005 through 30 Jun 2006).

We estimated accidental mortality by motor vehicles and trains from Department of Public Safety and Alaska Railroad Corporation records. We estimated unreported harvest based on 17.7% unreported harvest (including wounding loss) reported by Gasaway et al. (1992). We estimated illegal and other (defense of life or property, dispatched, potlatch, stickdance, and other reported deaths) mortality from Department of Public Safety and ADF&G records and then

added an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population × 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in Unit 20A).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Moose numbers appear to have increased in Unit 20B since the early 1990s. In 1990 the population was estimated at 9800 moose (1.1 moose/mi^2; McNay 1993). By the early 2000s, the population was estimated at >12,000 moose (>1.3 moose/mi^2; Table 1). Moose numbers continued to increase to >16,000 moose (>1.7 moose/mi^2) by 2004. Relatively high measures of productivity and recruitment support this observation. The population then appeared to stabilize between 2004 and 2006.

At the scale of the 3 geographic zones, moose numbers in central and western (including the MFMA) Unit 20B showed similar increasing trends (Table 1). In central Unit 20B, moose numbers increased from an estimated 4806 (1.3 moose/mi^2) to 7057 moose (1.8 moose/mi^2) between 2001 and 2005. In western Unit 20B moose numbers increased from 4562 (1.6 moose/mi^2) to 6170 (2.1 moose/mi^2) between 2001 and 2006, while in the MFMA numbers increased from 2252 (2.4 moose/mi^2) to 4136 (4.3 moose/mi^2) between 2001 and 2004. Gasaway et al. (1992) reported that areas of Interior Alaska and the Yukon have densities of 0.1–1.1 moose/mi^2 where predators are lightly harvested. Higher densities occurred where wolves and/or bears were below food-limited levels. The central portion of Unit 20B and the MFMA in the western portion of the unit has had relatively intensive wolf trapping efforts compared with most of Interior Alaska. Black bear harvest is relatively high in roadside areas of Unit 20B while grizzly bears are rare relative to more remote areas of Alaska.

Annual estimates of moose densities in the MFMA during 1999–2001 and 2003–2006 were highly variable (Table 1). Annual variation may be the result of varying survey conditions and sampling effort. In addition, surveys in the MFMA also may have been influenced by changes in moose distribution due to the migratory nature of moose in the area and the timing of the October or November migration (P. Valkenburg and R. Boertje, ADF&G, personal observation). Therefore, inconsistent results may occur regardless of sampling effort. High variability in estimates was exacerbated by the relatively small size of the survey area.

Population Composition

Bull:Cow Ratios. Historically, bull:cow ratios in most of Unit 20B have exceeded the lower limit of the management objective of ≥30:100, but ratios varied by harvest intensity within the unit. For example, the overall Unit 20B bull:cow ratio averaged 40:100 through the early 1990s (McNay 1993). The less intensively harvested areas had higher ratios; Salcha River had a bull:cow ratio of 44:100 (1990) and the MFMA had ratios of 49:100 (1989) and 47:100 (1994). In contrast, the more intensively harvested Chena River had 28:100 (1990), and the most intensively harvested area, the FMA, had 9–14:100 (1989–1994).

Surveys conducted during 2005 and 2006 indicate average posthunting bull:cow ratios of ≥30 bulls:100 cows (90% CI) unitwide and ≥20 bulls:100 cows (90% CI) in Unit 20B East, Unit 20B Central, and Unit 20B West (Table 1). Bull:cow ratios were 8–16:100 cows (90% CI) in the MFMA in 2005, but were estimated at 19 per 100 (14–24 bulls:100 cows) in 2006. I hypothesize that sustained high harvests of bull moose in areas adjacent to the MFMA that do not have antler restrictions may be contributing to lower bull:cow ratios in the MFMA. However, changes in moose distributions (see earlier discussion) may also be a factor.

Calf:Cow Ratios. Calf:cow ratios were high during 2001–2006 (Table 1). In general, calf:cow ratios have tended to be higher in central Unit 20B, where predation tends to be lower, and lower in the eastern portion of the unit, where predation tends to be higher (Young 2006). However, in 2006, calf:cow ratios were high in all portions of the unit, including eastern Unit 20B.

Twinning Rates

Twinning rates in the MFMA appeared to decline 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). Since 2002, twinning rates have been relatively stable and averaged 24% (range = 20–28; 2002–2007). Although we have only 2 years of data, twinning rates of 11% (range = 3–18; 2006 and 2007) in central Unit 20B were lower and more variable than the MFMA.

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 summer range on the Tanana Flats in Unit 20A. Most remain there for the summer and return to the foothills from August through October. Boertje et al. (2009) estimated that 9% of the moose calving in the Tanana Flats in Unit 20A had migrated from Unit 20B.

MORTALITY

Harvest

Seasons and Bag Limits. Seasons and bag limits in Unit 20B in RY05 were:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Creamer's Field Migratory Waterfowl Refuge.		
1 bull with spike-fork or greater antlers by bow and arrow only.	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 antlerless moose by bow and arrow only, by drawing permit; up to 150 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	1 Sep–27 Nov	1 Sep–27 Nov
1 antlerless moose by muzzleloader only, by drawing permit; up to 10 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	21 Nov–27 Nov	21 Nov–27 Nov
Remainder of the Fairbanks Management Area.		
1 bull with spike-fork or greater antlers by bow and arrow only.	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov
1 antlerless moose by bow and arrow only, by drawing permit; up to 150 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	1 Sep–27 Nov	1 Sep–27 Nov
Minto Flats Management Area.		
1 moose by registration permit only; or	1 Sep–25 Sep	No open season
1 bull with spike-fork or 50-inch antlers, or antlers with ≥4 brow tines on one side.	10 Jan–28 Feb 11 Sep–25 Sep	No open season No open season

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Middle Fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek.		
1 bull; or	1 Sep–20 Sep	1 Sep–20 Sep
1 bull by bow and arrow only.	21 Sep–30 Sep	21 Sep–30 Sep
Remainder of Unit 20B.		
1 bull.	1 Sep–15 Sep	5 Sep–15 Sep

Seasons and bag limits in Unit 20B in RY06 were:

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Creamer's Migratory Waterfowl Refuge.		
1 bull with spike-fork or greater antlers by bow and arrow only.	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov
1 antlerless moose by bow and arrow only, by drawing permit; up to 150 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	1 Sep–27 Nov	1 Sep–27 Nov
1 antlerless moose by muzzleloader only, by drawing permit; up to 10 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	21 Nov–27 Nov	21 Nov–27 Nov

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Remainder of the Fairbanks Management Area.		
1 bull with spike-fork or greater antlers by bow and arrow only.	1 Sep–30 Sep 21 Nov–27 Nov	1 Sep–30 Sep 21 Nov–27 Nov
1 antlerless moose by bow and arrow only, by drawing permit; up to 150 permits may be issued in the FMA; a recipient of a drawing permit is prohibited from taking an antlered bull moose in the FMA.	1 Sep–27 Nov	1 Sep–27 Nov
Minto Flats Management Area.		
1 moose by registration permit only; or	1 Sep–25 Sep	No open season
1 bull with spike-fork or 50-inch antlers, or antlers with ≥4 brow tines on one side.	10 Jan–28 Feb 11 Sep–25 Sep	No open season No open season
Middle Fork drainage of Chena River, and Salcha River drainage upstream from and including Goose Creek.		
1 bull; or 1 bull by bow and arrow only.	1 Sep–20 Sep 21 Sep–30 Sep	1 Sep–20 Sep 21 Sep–30 Sep
Remainder of Unit 20B.		
1 bull; or	1 Sep–15 Sep	5 Sep–15 Sep
1 antlerless moose by drawing permit only; up to 300 permits may be issued.	1 Sep–30 Sep	No open season

Alaska Board of Game Actions and Emergency Orders.

Historical Alaska 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. In 1993 the Alaska Board of Game authorized the department to issue up to 250 permits and 200 were issued in RY93 and RY94. In RY95 the Tier II bag limit was changed from "1 bull" to "1 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. In RY96 the number of Tier II permits was increased to 100, where it remained through RY03.

The board also approved a drawing hunt for antlerless moose in the FMA beginning in RY95 and replaced the registration bull-only hunt with a general season. The number of FMA antlerless moose permits that could be issued was increased from 25 to 100 in RY00 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 harvest of cows, and provide additional hunting opportunity. In addition, 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.

At the spring 2004 meeting the board eliminated the Take a Child Hunting early season hunt for moose in Unit 20B; created a new winter (21–27 Nov) drawing permit hunt for antlerless moose by muzzleloading rifle only on Creamer's Refuge; increased the number of antlerless drawing permits for the FMA from 100 to 150, prohibited drawing permit winners for antlerless hunts in the area from taking an antlered bull in the management area, and redefined the FMA boundaries (See Young 2006 for the boundary description). At the same meeting, the board changed the Tier II hunt in the MFMA to registration hunts RM775 (fall) and RM785 (winter) and lengthened the fall seasons (general and registration) to 1–25 September.

Report Period Alaska Board of Game Actions — At the spring 2006 meeting, the board authorized the department to issue up to 300 drawing permits for antlerless moose in the central portion of Unit 20B.

Spring 2008 Alaska Board of Game Actions — The board redefined the bag limit for antlerless moose in Unit 20B (except the MFMA), prohibiting the taking of a calf moose or a cow moose accompanied by a calf.

Harvest by Hunters.

General Season — The reported harvest of 496 bulls in RY05 and 527 bulls in RY06 ($\bar{x}$ = 512) was similar to the average reported harvest of 526 bulls during the previous 4-year period (Table 3).

The majority of harvest was in central Unit 20B, followed by eastern Unit 20B and then western Unit 20B (Table 3). This differs from RY03–RY04 when more moose were reported taken from western Unit 20B than eastern Unit 20B, but sample sizes were small. Harvest density in central

Unit 20B (72 moose/1000 mi^2) was 1.8 times that reported in eastern Unit 20B (39 moose/1000 mi^2) and 2.8 times that reported for western Unit 20B (26 moose/1000 mi^2). Like that mentioned above for calf:cow ratios, this is probably a function of higher moose densities due to lower predator densities in central Unit 20B than in eastern and western Unit 20B.

In the FMA, harvests were relatively high during the previous 8- to 9-years (Young 2000, 2002, 2004, 2006). 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 indicating that moose densities, productivity, and early calf survival were high in the FMA between 1993 and 2001 support this assertion. A decline in general harvest within the FMA was reported in RY04 (Young 2006), and observed in RY05 and RY06 (Table 3). This may be a function of lower moose densities resulting from increased antlerless harvests, but we have not surveyed the FMA intensively since 2001. The antlerless harvests were designed to reduce moose–human conflicts, particularly moose–vehicle collisions in the FMA.

Permit Hunts — There were no apparent trends in harvest, effort, or success rates in permit hunts RY00 through RY06 (Table 4). Harvest of antlerless moose increased in hunt DM788 in RY04, and hunts RM775 and RM785 in RY05, but that can be explained by substantial increases (i.e., 50–100%) in the number of permits issued. Despite increases in the number of permits issued, success rates in those hunts remained relatively stable.

Hunter Residency and Success. 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, between RY01 and RY06, 18–21% ($\bar{x}$ = 19%) of the hunters in Unit 20B were successful (Table 3), whereas annual success rates in Units 20A and 20C typically exceed 35% (Young 2000). Success rates of 19% in RY05 and RY06 were the same as the average reported during RY01–RY04. During RY01–RY04, success rates were similar in central ($\bar{x}$ = 20%), eastern ($\bar{x}$ = 21%), and western Unit 20B ($\bar{x}$ = 21%). Typically, success rates are lower in areas with higher hunter densities and/or lower bull:cow ratios, such as central Unit 20B, and higher in areas with lower hunter densities and/or higher bull:cow ratios, such as eastern Unit 20B. During RY05–RY06, central Unit 20B had the lowest success rates ($\bar{x}$ = 18%), followed by western ($\bar{x}$ = 20%) and then eastern Unit 20B ($\bar{x}$ = 25%).

Harvest Chronology. Between RY97 and RY00, more bull moose were killed during the first 5 days of the season ($\bar{x}$ = 35%) than during any other 5-day period (Young 2004). However, during RY01–RY03, harvest shifted slightly towards the 11–15 September period ($\bar{x}$ = 34%; Table 5). During RY05 and RY06 harvests were highest 1–5 September ($\bar{x}$ = 37%) followed by the 11–15 September ($\bar{x}$ = 29%) and 6–10 September ($\bar{x}$ = 21%) periods.

Transport Methods. Highway vehicles and 3- or 4-wheelers were the primary methods of transportation used by successful hunters (Table 6). Methods of transportation used by successful hunters were relatively consistent during RY01–RY06.

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 averaged 83 animals per year RY05–RY06 compared to 93 animals per year during RY01–RY04. Additionally, on average 63 moose were reported killed on roads in the remainder of Unit 20B each year during RY05–RY06. Generally, few moose are reported killed by trains in Unit 20B (Young 2006) and this trend continued during RY05 and RY06 with an average of 7 (range 6–8) reported killed each year.

HABITAT

Assessment/Enhancement

Browse architecture surveys conducted in spring 2003 indicated that moose utilization of preferred browse species in the MFMA was higher than any other area sampled in Interior Alaska (Young 2004). In response, to increase harvest to limit moose population growth, the board lengthened the general season by 5 days and the department increased the number of permits issued in hunts RM775 and RM785 beginning in RY04. Additional browse utilization surveys conducted in spring 2007 indicated that moose utilization of preferred browse species in central Unit 20B was also moderately high. This supported the department's recommendations that will limit population growth through conservative antlerless harvests in portions of central Unit 20B.

The department has conducted moose habitat enhancement in portions of the Fairbanks area. These efforts included the use of prescribed fire and regeneration of decadent willows by planting and crushing willows in recently logged areas. In addition, existing habitat improvement projects for grouse in Unit 20B benefit moose.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

During RY05–RY06 we continued to collect 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 received many complaints about human–moose conflicts, such as moose in gardens or yards, moose attacking dogs in dog yards and along dogsled trails, and moose "trapped" within the confines of the urban area. Besides attempting to reduce moose densities through increased harvest, the department continues to work with the public through direct interaction and through the media to reduce nonhunting mortality and human–moose conflicts.

CONCLUSIONS AND RECOMMENDATIONS

Unitwide population estimates conducted in 2003, 2004, and 2006 suggest that the Intensive Management population objective of 12,000–15,000 moose has been met or exceeded. Reported harvests reached the Intensive Management objective's lower limit of 600 moose in RY05 (n = 600) and RY06 (n = 790). At the spring 2009 Alaska Board of Game meeting I will recommend maintaining a conservative antlerless moose harvest (<2% of the prehunt moose population) in central Unit 20B and in the MFMA portion of western Unit 20B to limit population growth and increase yield to meet Intensive Management harvest objectives.

Surveys conducted since 2001 indicate we are consistently meeting our management objective of a posthunting ratio of ≥30 bulls:100 cows unitwide and ≥20 bulls:100 cows in each of the 3 geographic zones (i.e., eastern Unit 20B, central Unit 20B, western Unit 20B), but not in the relatively small MFMA (12 bulls:100 cows in 2005). Lower bull:cow ratios in the MFMA (900 mi^2) and FMA (300 mi^2) are of less concern than in larger areas because the areas are small in relation to the annual home range of moose in the unit. If insufficient bulls are available for breeding, cows in estrous can easily move to the periphery or outside the management areas where bull:cow ratios are higher, and bulls seeking females can readily migrate into the management areas. This is particularly true of the smaller FMA. High calf:cow ratios indicate there have been sufficient bull moose in the MFMA and FMA to breed estrous cows.

I concur with Dale (1998) that we need to continue to collect unitwide population data on an annual basis to better assess the status of the moose population, particularly now that the department has recommended that antlerless hunts include not only the MFMA and FMA, but also most of central Unit 20B. I recommend continuing twinning rate surveys in the MFMA and central Unit 20B to evaluate nutritional status in those portions of Unit 20B. Twinning rates and annual population estimates will be necessary to annually reevaluate management objectives and to gain public approval of those management objectives. Also, I recommend an intensive survey of the FMA in 2008 to evaluate the effectiveness of increased antlerless harvests to reduce moose numbers/densities and moose–vehicle collisions.

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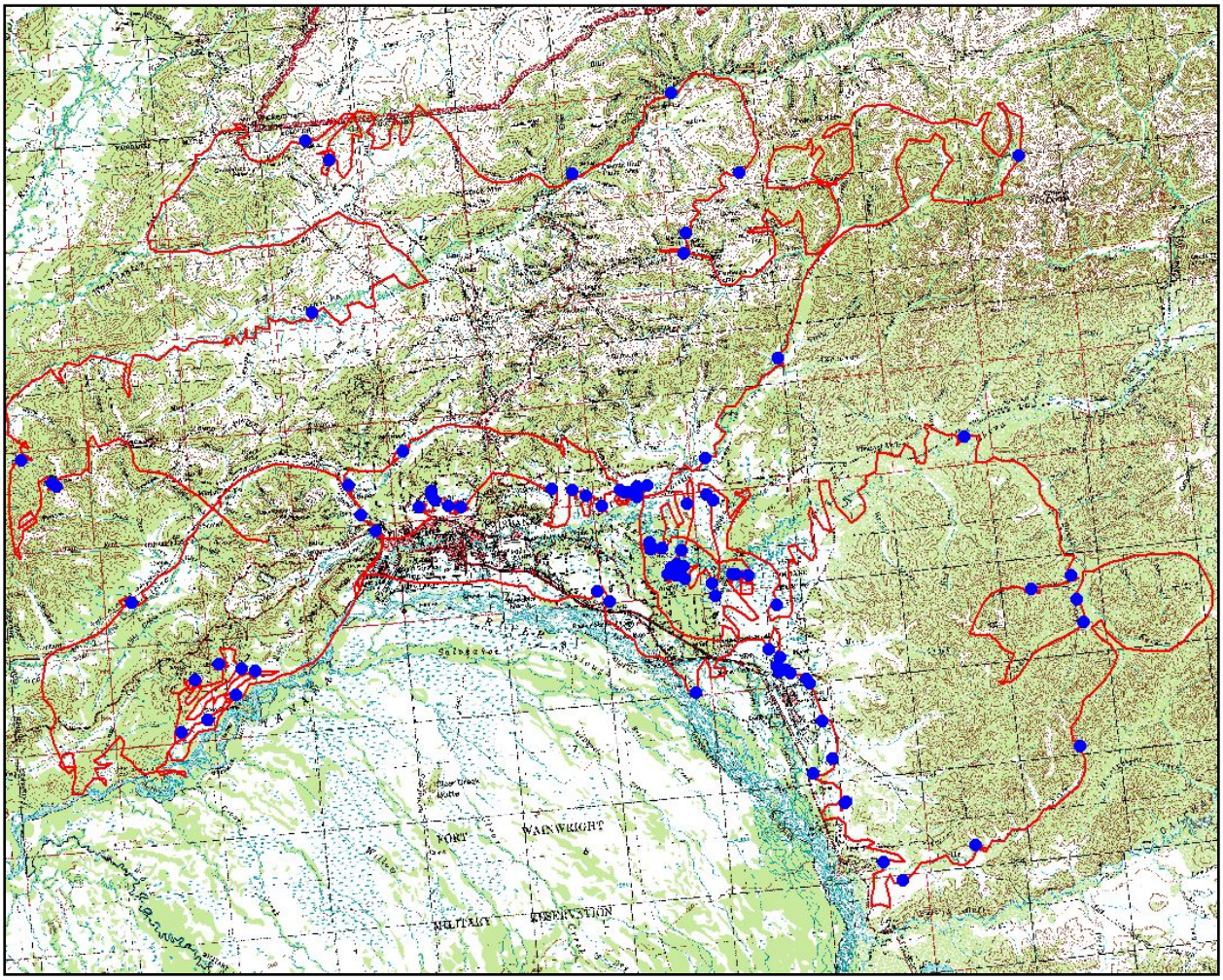

FIGURE 1 Central Unit 20B twinning survey GPS track and moose locations, 2006

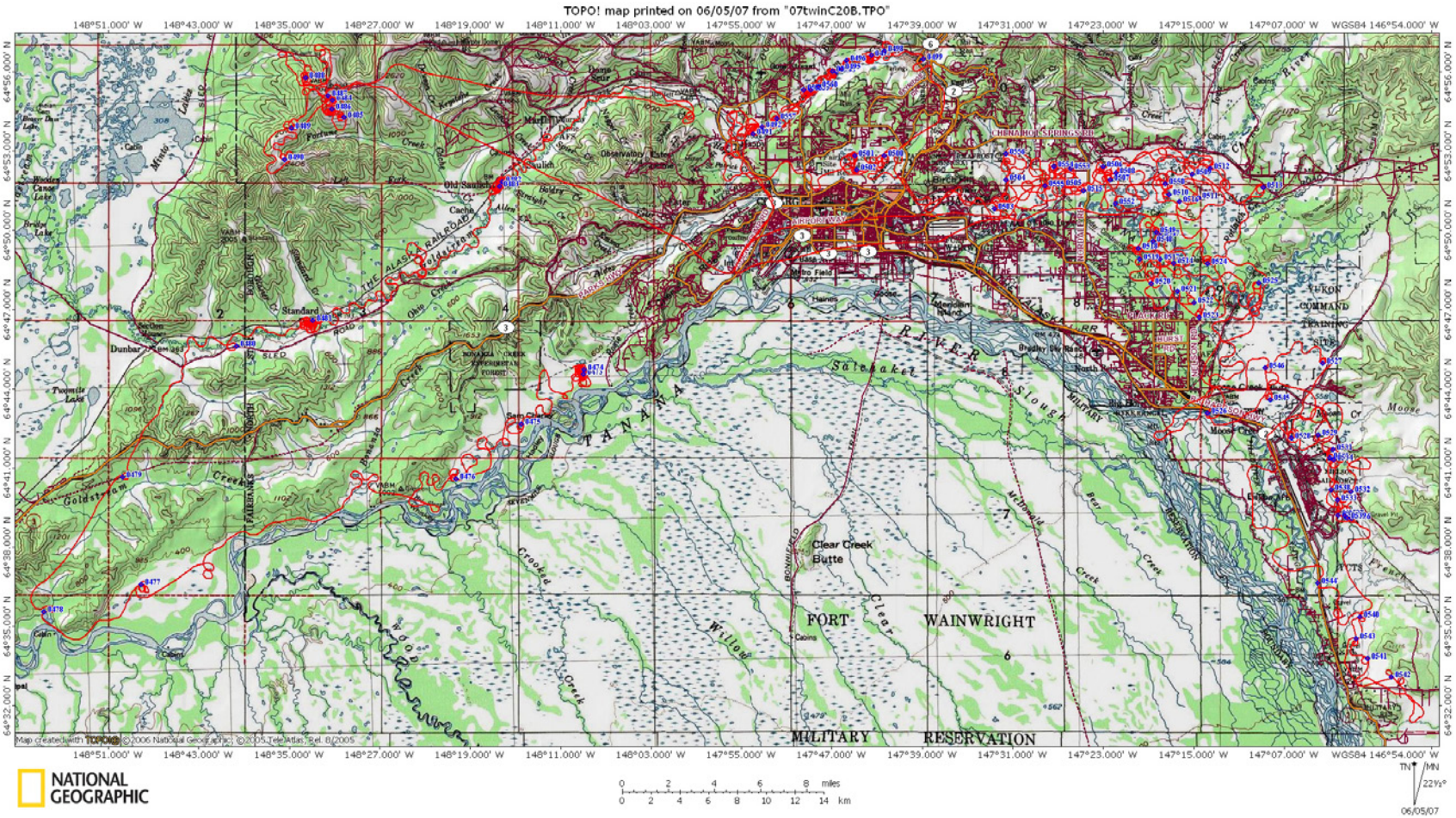

FIGURE 2 Central Unit 20B twinning survey GPS track and moose locations, 2007

TABLE 1 Unit 20B aerial moose fall composition counts and estimated population size, 2001–2006

Count area	Calendar year	Bulls:100 Cows	Yearlings: 100 Cows[a]	Calves:100 Cows	Percent calves	Adults	Moose observed	Estimated population[b] (90% CI)	Estimated population w/SCF = 1.2[c]	Moose/mi^2 w/SCF = 1.2
Unit 20B	2001	33	15	30	18	751	914	10,261 (±17%)	12,313	1.3
Unit 20B	2003	33	23	39	22	399	514	13,400 (±23%)	16,080	1.7
Unit 20B	2004	32	18	42	25	551	730	13,810 (±28%)	16,572	1.7
Unit 20B	2006	29	22	43	26	838	1127	13,321 (±21%)	15,986	1.6
East[d]	2001	47	15	24	11	271	305	2454 (±22%)	2945	1.2
East[d]	2006	36	24	46	24	180	236	2728 (±34%)	3274	1.4
Central[e]	2001	27	13	34	26	205	278	4005 (±25%)	4806	1.3
Central[e]	2003	26	21	35	21	191	242	3995 (±37%)	4794	1.3
Central[e]	2004	33	22	46	27	158	216	5276 (±41%)	6331	1.7
Central[e]	2005	26	26	40	24	493	645	5881 (±18%)	7057	1.8
Central[e]	2006	28	22	41	17	328	397	5451 (±29%)	6541	1.7
West[f]	2001	30	16	29	17	274	331	3802 (±22%)	4562	1.6
West[f]	2006	27	20	44	22	384	494	5142 (±24%)	6170	2.1
MFMA[g,h]	2001	30	16	28	17	191	230	1877 (±21%)	2252	2.4
MFMA[h]	2003	44	20	36	23	89	116	1352 (±63%)	1622	1.7
MFMA[h]	2004	26	11	47	24	302	399	3447 (±19%)	4136	4.3
MFMA[h]	2005	12	12	40	26	296	400	2937 (±17%)	3524	3.7
MFMA[h]	2006	19	15	45	28	243	337	2724 (±23%)	3269	3.4
FMA[i,j]	2001	12	13	39	29	70	99	461 (±34%)	553	1.7

[a] Yearlings:100 cows = Yearling bulls:100 cows × 2.
[b] Geospatial population estimator method (GSPE, see methods).
[c] Preliminary sightability studies suggest a sightability correction factor (SCF) of 1.16 to 1.25 using the GSPE method.
[d] A 2425-mi^2 count area.
[e] A 3829-mi^2 count area.
[f] A 2942-mi^2 count area.
[g] Minto Flats Management Area.
[h] A 951-mi^2 count area.
[i] Fairbanks Management Area.
[j] A 318-mi^2 count area.

TABLE 2 Results of twinning rate surveys for moose in Unit 20B (Minto Flats Management Area and central Unit 20B), 1997–2007

Year	Date	Cows w/Single calf	Cows w/Twins	Cows 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
2003	29 May	40	10	50	20
2004	25 May	61	21	82	26
2005	25 May	39	15	54	28
2006[b]	24 May	44	15	59	25
2006[c]	24–26 May	23	5	28	18
2007[b]	26 May	47	16	63	25
2007[c]	29–31 May	29	1	30	3

[a] Percentage of cows with calves that had twins.
[b] Minto Flats Management Area.
[c] Central Unit 20B.

TABLE 3 Unit 20B moose hunter[a] residency and success, regulatory years 2001–2002 through 2006–2007

Area/ Regulatory year	Successful: Local[b] resident	Successful: Nonlocal resident	Successful: Nonresident	Successful: Unk	Successful: Total	Successful: % 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)												
2001–2002	49	3	9	1	62	20	212	18	18	0	248	310
2002–2003	78	8	7	0	93	23	260	28	22	0	310	403
2003–2004	58	1	10	0	69	20	235	22	15	0	272	341
2004–2005	49	6	11	3	69	22	205	10	20	4	239	308
2005–2006	77	11	8	0	96	25	243	13	24	1	281	377
2006–2007	76	6	7	0	89	24	235	29	15	5	284	373
Unit 20B Central (UCUs 207, 208, 209, 211, 212, 213, 301, 401, 402, 403, 404, 405, 406, 501)												
2001–2002	241	16	20	2	279	19	1009	77	84	4	1174	1453
2002–2003	275	40	20	1	336	21	1095	82	50	6	1233	1569
2003–2004	232	33	23	0	288	19	1099	94	55	5	1253	1541
2004–2005	203	18	25	5	251	19	916	56	57	22	1051	1302
2005–2006	211	21	29	0	261	17	1070	97	70	8	1245	1506
2006–2007	239	25	28	2	294	18	1110	109	76	8	1303	1597
Unit 20B West (UCUs 101, 201, 202, 203, 204, 205, 206, 210)												
2001–2002	58	18	9	0	85	20	249	67	23	2	341	426
2002–2003	72	22	8	0	102	22	256	71	22	3	352	454
2003–2004	65	19	3	0	87	21	244	69	17	1	331	418
2004–2005	56	16	6	2	80	22	214	51	13	4	282	362
2005–2006	53	15	8	0	76	20	233	47	15	1	296	372
2006–2007	57	16	5	0	78	20	241	63	8	4	316	394
FMA[c] general archery hunt[d] (UCUs 0212, 0213, 0300, 0301, 0401, 0402, 0403, 0501; archery only)												
2001–2002	38	1	1	0	40							
2002–2003	44	3	1	0	48							
2003–2004	54	5	1	0	60							
2004–2005	31	0	2	0	33							
2005–2006	18	2	1	0	21							
2006–2007	21	1	1	0	23							
MFMA[e] general hunt (UCUs 0201, 0205, 0210; Nonresident hunters and antlerless harvest censored)												
2001–2002	27	9	0	0	36	26	80	19	0	1	100	136
2002–2003	40	12	0	0	52	30	103	20	0	1	124	176
2003–2004	39	10	0	0	49	30	96	19	0	0	115	164
2004–2005	28	8	0	0	36	25	90	16	0	0	106	142

Area/ Regulatory year	Successful						Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	% Successful	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total	
2005–2006	28	10	0	0	38	25	100	17	0	0	117	155
2006–2007	33	11	0	0	44	25	102	30	0	1	133	177
Unit 20B remainder general hunt (Includes FMA general archery hunt, but excludes MFMA)												
2001–2002	388	35	44	3	470	18	1845	187	145	7	2184	2654
2002–2003	475	76	43	2	596	20	1991	226	110	9	2336	2932
2003–2004	358	47	38	0	443	18	1775	198	99	8	2080	2523
2004–2005	324	41	45	13	423	20	1479	129	101	35	1744	2167
2005–2006	368	43	47	0	458	19	1690	170	114	14	1988	2446
2006–2007	394	45	42	2	483	19	1784	203	109	17	2113	2596
All general hunts												
2001–2002	415	44	44	3	506	18	1925	206	145	8	2284	2790
2002–2003	515	88	43	2	648	21	2094	246	110	10	2460	3108
2003–2004	397	57	38	0	492	18	1871	217	99	8	2195	2687
2004–2005	352	49	45	13	459	20	1569	145	101	35	1850	2309
2005–2006	396	53	47	0	496	19	1790	187	114	14	2105	2601
2006–2007	427	56	42	2	527	19	1886	233	109	18	2246	2773

[a] Excludes drawing, registration and Tier II permit hunt harvest.
[b] Residents of Unit 20.
[c] Fairbanks Management Area.
[d] Subtracted number of bulls reported harvested by bow and arrow on Eielson Air Force Base (in UCU 0501, but outside FMA).
[e] Minto Flats Management Area.

TABLE 4 Unit 20B moose harvest data by permit hunt, regulatory years 2001–2002 through 2006–2007

Hunt	Regulatory year	Permits issued	Did not hunt	(%)	Unsuccessful hunters	(%)	Successful hunters	(%)	Bulls	(%)	Cows	(%)	Unk	Harvest
DM788	2001–2002	75	14	(19)	33	(54)	28	(46)	2	(7)	26	(93)	0	28
	2002–2003	75	10	(13)	28	(43)	37	(57)	3	(8)	34	(92)	0	37
	2003–2004	100	19	(19)	53	(65)	28	(35)	0	(0)	28	(100)	0	28
	2004–2005	150	28	(19)	73	(60)	49	(40)	1	(2)	48	(98)	0	49
	2005–2006	148	38	(26)	72	(65)	38	(35)	2	(5)	36	(95)	0	38
	2006–2007	150	31	(21)	63	(53)	56	(47)	4	(7)	52	(93)	0	56
DM789	2004–2005	10	3	(30)	7	(100)	0	(0)	0	(0)	0	(0)	0	0
	2005–2006	10	2	(20)	7	(88)	1	(13)	0	(0)	1	(100)	0	1
	2006–2007	10	4	(40)	4	(67)	2	(33)	0	(0)	2	(100)	0	2
DM776	2006–2007	60	5	(8)	26	(47)	29	(53)	5	(17)	24	(83)	0	29
DM777	2006–2007	40	10	(25)	13	(43)	17	(57)	1	(6)	16	(94)	0	17
DM778	2006–2007	40	5	(13)	14	(40)	21	(60)	1	(5)	20	(95)	0	21
DM779	2006–2007	60	7	(12)	19	(36)	34	(64)	0	(0)	34	(100)	0	34
TM785	2001–2002	100	17	(17)	26	(31)	57	(69)	31	(54)	26	(46)	0	57
	2002–2003	100	16	(16)	32	(38)	52	(62)	30	(58)	22	(42)	0	52
	2003–2004	100	24	(24)	30	(39)	46	(61)	23	(50)	23	(50)	0	46
RM775	2004–2005	50	2	(4)	12	(25)	36	(75)	24	(67)	12	(33)	0	36
	2005–2006	50	4	(8)	13	(28)	33	(72)	21	(64)	12	(36)	0	33
	2006–2007	101	13	(13)	24	(27)	64	(73)	37	(58)	27	(42)	0	64
RM785	2004–2005	60	26	(43)	7	(21)	27	(79)	6	(23)	20	(77)	1	27
	2005–2006	65	12	(18)	22	(42)	31	(58)	5	(16)	26	(84)	0	31
	2006–2007	92	17	(18)	35	(47)	40	(53)	8	(20)	32	(80)	0	40
YM301	2002–2003	257	36	(14)	170	(77)	51	(23)	51	(100)	0	(0)	0	51
YM301	2003–2004	280	25	(9)	216	(85)	39	(15)	39	(100)	0	(0)	0	39
Totals	2001–2002	175	31	(18)	59	(41)	85	(59)	33	(39)	52	(61)	0	85
for all	2002–2003	432	62	(14)	230	(62)	140	(38)	84	(60)	56	(40)	0	140
permit	2003–2004	480	68	(14)	299	(73)	113	(27)	62	(55)	51	(45)	0	113

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk	Harvest
hunts	2004–2005	270	59 (22)	99 (47)	112 (53)	31 (28)	80 (72)	1	112
	2005–2006	273	55 (20)	113 (52)	105 (48)	28 27	77 73	0	105
	2006–2007	553	90 (16)	201 (43)	262 (57)	56 21	206 79	0	262

TABLE 5 Unit 20B moose harvest[a] chronology percent by month/day, regulatory years 2001–2002 through 2006–2007

Regulatory year	Harvest chronology percent by month/day					Unk/Other	*n*
	9/1–9/5	9/6–9/10	9/11–9/15	9/16–9/20	9/21–9/25		
2001–2002	27	27	33	5	1	7	506
2002–2003	32	23	33	6	1	5	648
2003–2004	24	26	35	8	1	7	492
2004–2005	33	27	29	6	2	4	459
2005–2006	38	22	27	6	2	4	496
2006–2007	35	20	31	5	2	6	527

[a] Excludes drawing, registration and Tier II permit hunt harvest.

TABLE 6 Unit 20B moose harvest[a] percent by transport method, regulatory years 2001–2002 through 2006–2007

Regulatory year	Harvest percent by transport method									*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Other/ Unknown	
2001–2002	3	0	21	31	0	4	34	3	2	506
2002–2003	3	0	21	29	0	5	36	2	3	648
2003–2004	4	0	20	28	0	4	36	3	5	492
2004–2005	4	0	16	30	0	3	39	3	4	459
2005–2006	4	0	21	31	2	5	34	2	3	496
2006–2007	3	1	19	38	1	2	31	3	4	527

[a] Excludes drawing, registration and Tier II permit hunt harvest.

TABLE 7 Estimate of Unit 20B moose harvest[a] and accidental death, regulatory years 2001–2002 through 2006–2007

	Harvest by hunters							Accidental death					
	Reported				Estimated			Road[b]					
Regulatory year	M	F	Unk	Total	Unreported[c]	Illegal/ Other	Total	FMA[d]	Unit 20B remainder	Total	Train[e]	Total	Total
2001–2002	531	53	6	590	104	37[f]	141	72	50	122	9	131	862
2002–2003	725	61	2	788	139	47[f]	186	118	71	189	12	201	1175
2003–2004	549	52	2	603	107	50[f]	157	87	64	151	13	164	924
2004–2005	488	84	1	573	101	56[f]	157	95	62	157	30	187	917
2005–2006	519	77	4	600	106	109[g]	215	79	57	136	6	142	957
2006–2007	571	212	7	790	140	105[g]	245	88	68	156	8	164	1199

[a] Includes general, registration 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] Fairbanks Management Area.
[e] 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.
[f] Includes illegal, defense of life and property, dispatched, potlatch, stickdance, and other reported deaths.
[g] Includes illegal, defense of life and property, dispatched, potlatch, stickdance, and other reported deaths, plus an additional estimate of mortality caused by snaring calculated from annual estimates of the posthunt moose population × 0.005361 (estimated mortality rate caused by snares based on radiocollared sample of moose in Unit 20A).

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNITS: 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 Hot Springs, and into the Yukon River drainage in the area 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 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, as indicated by the high proportion of large bulls in the harvest. If harvest rates of bulls were not sustainable large bulls would be rare in the harvest. Thus, we can conclude that harvest is a minor factor affecting population dynamics relative to predation.

These units contain some tracts of mature black spruce that are poor quality moose habitat. However, using aerial reconnaissance, it appears that many riparian areas, subalpine hills, and burns have habitat capable of sustaining moose at relatively high densities (≥2 moose/mi^2).

Trends in moose populations have been difficult to identify, but densities probably fluctuate within 0.1 and 1.1 moose/mi^2, and more likely between 0.2 to 0.7 moose/mi^2 based on Alaska

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

and Yukon studies in large areas (>800 mi^2) 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 this area. Radiocollared moose were monitored in movement, behavior, and reproductive studies. Also, composition surveys and population estimates have been conducted by DNPP biologists since 1970.

Moose in these units are an important source of food, antlers, and recreation for many local rural residents, other residents throughout Alaska, and nonresidents. Nonconsumptive uses are also important, particularly in DNPP.

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 in areas with aerial surveys and ≥20% large bulls in the harvest in areas without aerial surveys.

METHODS

No aerial moose surveys were completed in Units 20F and 25C during this reporting period (RY05–RY06). A composition survey was completed in Unit 20C during 14–22 November 2006 by pilot Marty Webb and observer Tom Seaton. The northern and eastern portions of Unit 20C were surveyed because these areas experience the most hunting pressure in the unit. Starting along the Tanana River corridor near the village of Tanana, the survey followed a north–south transect pattern, then proceeded upstream within about 5 miles of the river. Transects were separated by the width of the geospatial population estimator (GSPE; Ver Hoef 2001, Kellie and DeLong 2006) moose survey sample units in the area. Between the Kantishna and Nenana Rivers, the survey was flown in east–west transects from the Tanana River to Denali National Park.

We completed a GSPE moose survey (Ver Hoef 2001, Kellie and DeLong 2006) in Unit 25C (5000 mi^2) during November–December 1997 in cooperation with the Bureau of Land Management (BLM). This technique does not yet commonly incorporate a sightability correction factor (SCF). However, preliminary data by Boertje and others suggest an SCF of 1.1 to 1.2 is appropriate for most of these units if October or November surveys are flown with good survey conditions (Gasaway et al. 1986, Boertje et al. 2009).

In the Lake Minchumina area (1007 mi^2) of Unit 20C, DNPP biologists conducted a census using Gasaway methods (Gasaway et al. 1986) during November 1994. We completed stratification

flights associated with the GSPE technique for that portion of Unit 20C outside of DNPP on 19 December 2000.

We estimated annual moose mortality using 1) data from harvest report cards after sending reminder letters to increase response, 2) our records of telephone calls from the public concerning nonhunting mortality, 3) Alaska Wildlife Trooper records of moose–motor vehicle collisions, and 4) Alaska Railroad records of moose–train collisions between railroad mileposts 327 and 371 in Unit 20C. Also, to estimate unreported harvest in the village of Tanana, we used a 1987 study conducted by ADF&G–Division of Subsistence. Data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 July 2005–30 June 2006).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Based on the 1997 GSPE without an SCF, we conservatively estimated Unit 25C moose density at 0.46 moose/mi^2 of moose habitat, with a total population estimate of 2279 moose (90% CI ±16.5%). With a conservative SCF of 1.12, the estimated moose density was 0.5 moose/mi^2. Both estimates are within the expected range of 0.1–1.1 moose/mi^2 (average ≈0.6 moose/mi^2) found in all large areas of Interior Alaska (>800 mi^2) with lightly harvested bear and wolf populations (Gasaway et al. 1992). Very few moose density estimates have been outside this range during the last 30 years, except in areas where predation is reduced by humans.

We conservatively estimated 3500–4500 moose inhabited Unit 20C moose habitat: 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 (Oct 1991 census, T. Meier, National Park Service [NPS], personal communication) and 0.25 moose/mi^2 outside Denali National Park. Based on a November 1994 survey, Denali Park biologists estimated the moose density in the Lake Minchumina area at 0.34 moose/mi^2 (K. Stahlnecker, NPS, personal communication).

We conservatively 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).

Population Composition

During the 2006 composition survey in Unit 20C, we classified 509 moose: 317 cows, 95 bulls, and 97 calves. The calf to cow ratio was 31:100, and the bull to cow ratio was 30:100. These ratios suggest moderate hunting pressure and moderate predation on calves.

During the 2004 spatial trend survey in Unit 25C, the calf to cow ratio was 14:100, and the bull to cow ratio was 45:100 (Table 1). These ratios suggest light hunting pressure and high predation on calves.

Population composition data in Unit 20F (and Unit 20C in most years) were limited to the percentage of large bulls (antlers wider than 50 inches) in the harvest (Fig. 1). If harvest rates of

bulls were too high to be sustainable, the percentage of large bulls in the harvest would decline within a few years. The percentage of large bulls in the reported harvest was 26–50% in Unit 20C between RY95 and RY06. The percentage of large bulls in the Unit 20F reported harvest was more variable than Unit 20C, ranging between 24% and 55%. These data suggest there was no danger of overharvest of bulls in these units during RY95–RY06.

MORTALITY

Harvest

Season and Bag Limit. The following hunting seasons and bag limits have been in effect since RY93.

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 albino (more than 50% white) moose may not be taken.		5 Sep–15 Sep
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 Alaska Board of Game actions were taken and no emergency orders were issued during this reporting period.

Harvest by Hunters. During RY98–RY06 reported moose harvest remained stable in Units 20C and 20F, but declined slightly in Unit 25C (Table 2). During this time, the reported harvest was 97–143 moose in Unit 20C, 20–45 in Unit 20F, and 51–84 in Unit 25C.

Unreported Harvest and Estimated Nonhunting Mortality — We cannot easily estimate the number of unreported kills in Units 20C, 20F, and 25C. Harvest report cards returned by residents of Tanana, Rampart, Manley, Livengood, Central, Circle, and Circle Hot Springs likely represent minimal harvest reporting. For example, information collected by the Division of Subsistence indicates that only 10–20% of the actual harvest by 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 Alaska Wildlife Troopers mortality logs. Data concerning deaths caused by train collisions in Unit 20C were obtained from the Alaska Railroad. During RY98–RY06 documented causes of accidental mortality were minimal (0–3 annually) in Unit 20F and Unit 25C, but mostly higher in Unit 20C (0–21 annually) due to deaths caused by train collisions (Table 3).

Hunter Residency and Success. Between RY98 and RY06 the reported number of hunters increased slightly in Units 20C and 25C, and decreased slightly in Unit 20F (Table 2). During RY04 and RY05, all 3 units saw relatively low numbers of hunters and of moose taken. Much of Interior Alaska was covered in a thick blanket of smoke in autumn 2004 and 2005, due to record-setting wildfires. The smoke and fire may have decreased the number of hunters in the field and their effectiveness. Also, Unit 20A had road accessible, liberal antlerless hunts in RY04 and RY05, which increased moose harvest opportunity nearby, and may have reduced the number of moose hunters in remote areas such as Units 20C, 20F, and 25C.

During RY98–RY06, as many as 6 nonresident hunters annually reported hunting in Unit 20F (Table 2), even though the unit had no open moose season for nonresidents. Reported moose harvest by nonresidents in Unit 20F was 10% of the reported harvest in RY00. Unit 20F nonresident harvest data may be attributed to misreporting by hunters, data management errors by department staff, or legitimate harvest reports from illegal nonresident hunters.

In Units 20C and 20F, most successful hunters resided in Unit 20. In Unit 25C, however, most successful hunters (95%) resided outside of Unit 25, including nonlocal residents of Alaska and nonresidents (Table 2). This difference can be attributed to 1) relatively few people reside in Unit 25, 2) Unit 25C was road accessible and within 2 hours of the population center of Fairbanks, 3) motorized vehicle restrictions were uncommon in Unit 25C, and 4) Unit 25C was one of the few road-system areas with a bag limit of any bull for residents and nonresidents.

Harvest Chronology. During RY98–RY06 the highest proportion of the harvest occurred during the second week of the season in all 3 units. In Units 20C and 20F, the first and third weeks shared similar proportions of the harvest (Table 4). Few moose were reported harvested during the December season in Unit 20F.

Transport Methods. In Unit 20C most successful hunters used boats, airplanes, or 3- or 4-wheelers for transportation (Table 5). 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 used highway vehicles, 3- or 4-wheelers, or boats. The transportation methods used throughout this area reflected access opportunities in the area.

HABITAT

Moose densities in areas like Units 20C, 20F, and 25C are typically limited by predation rather than forage, because predators kill a large majority of all calves produced on an annual basis (Gasaway et al. 1992, Boertje et al. 2009). However, bear densities decline in burned areas and bears are the dominant predator on moose calves in most of Alaska (Boertje et al. 2009; C. Gardner, ADF&G, unpublished data). Also, enhanced habitat can boost moose numbers by increasing moose calving rates. In remote country such as this, the most effective means of habitat improvement is wildfire. Wildfires also increase deadfall, which may decrease the efficiency of predators (Boertje et al. 1995). Several wildfires and prescribed burns have occurred in the area over the last 25 years, especially during the record wildfire seasons of 2004 and 2005. A map of the burned areas is available from BLM. Some small-scale habitat improvements are being completed in the area. 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.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Harvest reporting in these units was 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 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 the Department of Natural Resources and BLM and encourage more controlled burns to enhance habitat.

CONCLUSIONS AND RECOMMENDATIONS

Moose populations in Units 20C, 20F, and 25C are at low densities. Hunting pressure was relatively low. We met our objective to maintain a bull:cow ratio of ≥30:100 in areas with aerial surveys and ≥20% large bulls in the harvest in areas without aerial surveys.

No regulatory changes are recommended at this time. We estimated hunting, other human-caused mortality, and nonhunting mortality, and worked to gather information on reporting rates from rural communities to produce a more comprehensive harvest estimate. We met our goal to promote natural fires to enhance moose habitat through the department's efforts on the Interagency Fire Management Team. We met our goal of providing for sustained harvest of these low-density populations.

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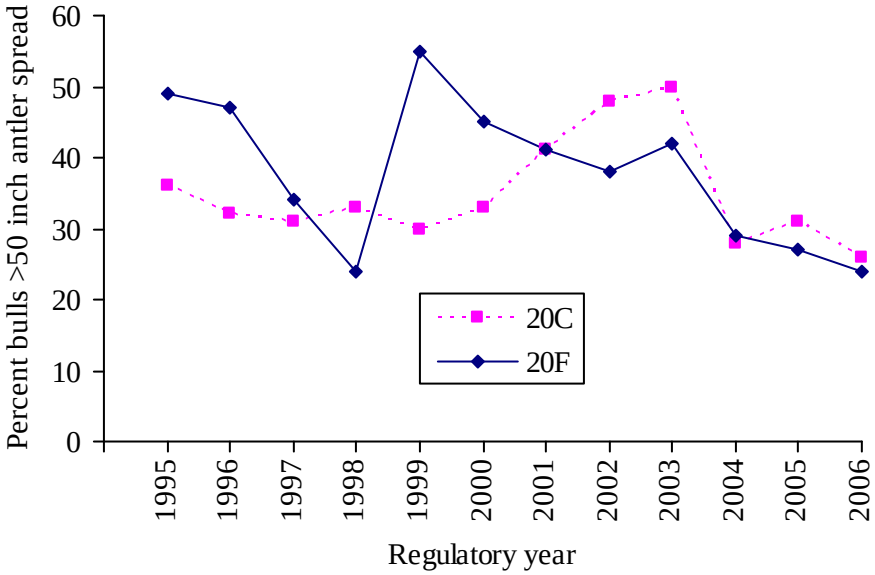

FIGURE 1 Percent of bull moose in the reported fall harvest with an antler spread >50 inches in Units 20C and 20F, regulatory years 1995–1996 through 2006–2007

TABLE 1 Unit 25C fall aerial moose composition counts, 1986–2004

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Calves	Percent calves	Adults	Moose observed
1986[a]	103	13	21	8	9	77	85
1987[a]	77	11	28	13	14	83	96
1988[a]	129	37	33	16	13	112	128
1996[a]	119	19	11	3	5	57	60
1996[b]	160	0	20	2	7	26	28
1997[c]	53	13	37	80	20	319	399
2002[a]	71	16	9	4	5	77	81
2002[b]	59	31	19	6	11	51	57
2004[d]	45	14	14	4	9	42	46

[a] O'Brien Creek count area.
[b] Ophir Creek count area.
[c] Geospatial population estimator moose population estimate.
[d] Spatial trend survey.

TABLE 2 Units 20C, 20F, and 25C reported moose hunter residency and success, regulatory years 1998–1999 through 2006–2007

Regulatory year	Successful hunters: Local[a] resident	Successful hunters: Nonlocal resident	Successful hunters: Nonresident	Successful hunters: Total (%)	Unsuccessful hunters: Local[a] resident	Unsuccessful hunters: Nonlocal resident	Unsuccessful hunters: Nonresident	Unsuccessful hunters: Total (%)	Total hunters
Unit 20C									
1998–1999	87	39	14	140 (35)	185	57	13	255 (65)	395
1999–2000	98	21	13	132 (32)	196	66	17	279 (68)	411
2000–2001	87	31	13	131 (28)	222	82	25	329 (72)	460
2001–2002	89	36	16	141 (31)	198	98	24	320 (69)	461
2002–2003	85	34	12	131 (26)	237	98	31	366 (74)	497
2003–2004	59	36	10	105 (21)	252	116	26	394 (79)	499
2004–2005	66	23	8	97 (21)	228	108	19	355 (79)	452
2005–2006	86	36	7	129 (30)	204	81	19	304 (70)	433
2006–2007	92	35	16	143 (28)	218	124	35	377 (73)	520
Unit 20F									
1998–1999	29	15	1	45 (29)	83	23	3	109 (71)	154
1999–2000	25	7	1	33 (25)	69	27	2	98 (75)	131
2000–2001	27	9	4	40 (24)	89	38	2	129 (76)	169
2001–2002	20	9	0	29 (20)	80	33	3	116 (80)	145
2002–2003	25	12	2	39 (28)	70	28	4	102 (72)	141
2003–2004	12	8	0	20 (15)	85	29	0	114 (85)	134
2004–2005	18	7	0	25 (22)	60	26	1	87 (78)	112
2005–2006	27	8	1	36 (29)	64	23	2	89 (71)	125
2006–2007	27	12	1	40 (33)	58	22	2	82 (67)	122
Unit 25C									
1998–1999	5	68	11	84 (34)	23	130	13	166 (66)	250
1999–2000	8	47	14	69 (26)	21	156	19	196 (74)	265
2000–2001	7	53	19	79 (24)	29	198	20	247 (76)	326
2001–2002	2	50	9	61 (19)	23	218	26	267 (81)	328
2002–2003	7	54	13	74 (21)	23	224	33	280 (79)	354
2003–2004	3	43	6	52 (17)	20	210	19	249 (83)	301
2004–2005	4	41	6	51 (21)	15	164	15	194 (79)	245
2005–2006	3	56	4	63 (17)	17	248	39	304 (83)	367
2006–2007	3	53	6	62 (18)	18	226	41	285 (82)	347

[a] Hunters who live within the unit (Unit 20 or Unit 25) in which they reported hunting were considered local.

TABLE 3 Estimate of Units 20C, 20F, and 25C moose harvest and accidental death, regulatory years 1999–2000 through 2006–2007

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											
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	142	0	0	142	25	0	25	0	1	1	168
2002–2003	131	0	0	131	23	0	23	0	0	0	154
2003–2004	105	0	0	105	19	0	19	0	0	0	124
2004–2005	99	0	0	99	18	1	19	0	0	0	118
2005–2006	131	1	2	134	23	0	23	0	1	1	158
2006–2007	141	0	2	143	25	0	25	0	3	3	171
Unit 20F											
1999–2000	33	0	0	33	6	2	8	1		1	42
2000–2001	40	0	0	40	7	0	7	0		0	47
2001–2002	29	0	0	29	5	1	6	0		0	35
2002–2003	40	0	0	40	7	1	8	0		0	48
2003–2004	20	0	0	20	4	1	5	0		0	25
2004–2005	27	0	0	27	5	0	5	0		0	32
2005–2006	35	0	1	36	6	0	6	0		0	42
2006–2007	39	0	0	39	7	0	7	0		0	46
Unit 25C											
1999–2000	66	0	0	66	11	0	11	0		0	77
2000–2001	79	0	0	79	14	1	15	0		0	94
2001–2002	62	0	0	62	11	0	11	0		0	73
2002–2003	75	0	0	75	13	2	15	0		0	90
2003–2004	52	0	0	52	9	0	9	0		0	61
2004–2005	52	0	0	52	9	1	10	1		1	63
2005–2006	63	0	0	63	11	0	11	0		0	74
2006–2007	62	0	0	62	11	0	11	0		0	73

[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 Bureau of Wildlife Enforcement wildlife mortality logs and ADF&G records.
[d] Documented kills from Fairbanks Bureau of Wildlife Enforcement 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.

TABLE 4 Units 20C, 20F, and 25C reported moose harvest chronology by month/day, regulatory years 1998–1999 through 2006–2007

Regulatory year	Harvest chronology by month/day[a]				
	9/1–9/7	9/8–9/15	9/16–9/20	12/1–12/10	*n*
Unit 20C					
1998–1999	35	54	42		131
1999–2000	35	52	39		126
2000–2001	41	48	36		125
2001–2002	28	58	49		135
2002–2003	33	61	31		125
2003–2004	21	55	26		102
2004–2005	30	26	36		92
2005–2006	31	50	43		124
2006–2007	49	47	38		134
Unit 20F					
1998–1999	11	25	6	3	45
1999–2000	5	18	4	5	32
2000–2001	10	21	5	4	40
2001–2002	5	13	9	1	28
2002–2003	9	21	8	1	39
2003–2004	5	6	7	1	19
2004–2005	7	11	8	1	27
2005–2006	9	14	11	1	35
2006–2007	12	18	9	0	39
Unit 25C					
1998–1999	35	47			82
1999–2000	31	37			68
2000–2001	28	50			78
2001–2002	22	36			58
2002–2003	18	55			73
2003–2004	22	27			49
2004–2005	23	29			52
2005–2006	23	36			59
2006–2007	25	32			57

[a] Does not include kills reported outside open hunting seasons or hunters that did not report date of kill.

TABLE 5 Units 20C, 20F, and 25C reported moose harvest percent by transport method, regulatory years 1998–1999 through 2006–2007

	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									
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	23	1	33	20	0	13	10	0	142
2002–2003	21	1	41	14	0	18	4	1	131
2003–2004	27	5	24	24	0	12	7	2	105
2004–2005	30	1	27	22	0	14	5	0	99
2005–2006	21	1	32	25	1	13	3	3	134
2006–2007	29	1	27	27	0	10	3	3	143
Unit 20F									
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	0	0	48	24	3	7	14	3	29
2002–2003	10	0	30	28	3	15	15	0	40
2003–2004	0	0	50	30	5	10	5	0	20
2004–2005	0	0	37	22	4	11	26	0	27
2005–2006	6	0	28	31	3	6	25	3	36
2006–2007	5	0	33	31	0	18	13	0	39
Unit 25C									
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	6	0	26	55	0	6	5	2	62
2002–2003	4	1	25	45	0	3	20	1	75
2003–2004	6	0	29	44	0	8	12	2	52
2004–2005	4	0	17	46	0	4	27	2	52
2005–2006	0	0	30	48	0	6	14	2	63
2006–2007	6	0	21	53	0	6	13	0	62

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 20D (5637 mi^2, 5028 mi^2 of moose habitat)

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- to 72-day bull season and a 1- to 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 unit 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 unit. 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 unit was gradually reversed by a combination of continued hunting restrictions, mild winters, and wolf control in adjacent Unit 20A (1976–1982) and western Unit 20D (1980–1983).

In 1978, Unit 20D 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.

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

In 1983 the closed area around Delta Junction, 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 because 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. In southeastern and northern Unit 20D, the seasons were also increased. Antler restrictions were implemented in southwestern Unit 20D in 1988 to stabilize the increasing harvest and to improve the age structure in the bull segment of the population. In March 1995 the Alaska Board of Game determined that the preferred use of moose in Unit 20D was for human consumption and established a moose population objective of 8,000–10,000 and an annual harvest objective of 240–500. The harvest objective was increased to 500–700 moose in 2000.

The Bison Range Youth Hunt Management Area (BRYHMA) was created in 2002 to regulate moose hunting in the fields of the Delta Junction Bison Range. This drawing permit hunt was implemented primarily to reduce the impact of moose hunting on bison management on the Bison Range.

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.

Indices of density-dependent nutritional limitation provide scientific and objective means for prudent management of a rapidly growing moose population. Boertje et al. (2007) ranked nutritional status of moose populations across Interior and northern Alaska using several density-dependent indices to moose nutrition. Using these density-dependent thresholds, I have developed the following interim population and harvest objectives for Unit 20D.

Population Objective

- Intensively manage the northern and southern Unit 20D moose populations independently (north and south of the Tanana River) for optimal population size based on indices to density-dependent nutritional limitation, to guard against eventual site-specific long-term range damage and starvation from overabundance.

Moose populations will be managed for:

1) increasing population growth when the average 2-year prior twinning rate exceeds 20%, but a reduced rate of growth as this twinning rate average approaches 20%,

2) stable population size when the 2-year prior twinning rate averages 11–20%, and

3) decreasing population growth when the 2-year prior twinning rate averages ≤10%.

An attempt will be made to use at least one additional index to verify the respective increases in nutritional limitation implied by steps 1 to 3 above, such as increasing browse removal rates, decreasing late-winter calf weights, or decreasing reproductive indices other than twinning rates.

Harvest Objective

- Harvest the northern and southern Unit 20D moose population (north and south of the Tanana River) independently. The bull segment of the population will be managed in any portion of Unit 20D for a sustainable harvest to take the maximum number of bulls.

The bull bag limit will be liberal for any significant portion of Unit 20D with a ratio of ≥30 bulls:100 cows for ≥2 consecutive years. If, in any portion, the bull:cow ratio decreases to <30 bulls:100 cows for ≥2 consecutive years, regulations will be adopted to restrict bull harvest sufficient to maintain a ratio of >20 bulls:100 cows.

Antlerless moose harvest will be implemented as needed to manage for increasing population growth, no growth, or decreasing population growth as described in the population objective. Antlerless harvest will not be implemented on a declining population when the 2-year prior twinning rate averages >20%.

METHODS

POPULATION ESTIMATES

The geospatial population estimator (GSPE, Ver Hoef 2001) method was used to conduct a moose population estimate in southern Unit 20D. Guidelines recommended by Kellie and DeLong (2006) to maximize accuracy and precision of GSPE surveys were to allocate 60% of sampling effort to the high-density stratum and 40% of effort to the low-density stratum.

Sample units (SU) were stratified as having an anticipated high or low density of moose based on previous or updated 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, I placed borderline SUs in the high stratum to minimize variance in the low stratum.

GSPE SUs are squares drawn with boundaries every 2 degrees of latitude on even increments and every 5 degrees of longitude on multiples of 5 degrees. Sample units varied in size from approximately 5.7 to 5.9 mi^2 in Unit 20D. Each SU is identified by the latitude and longitude of its southeast corner.

Sample unit selection was optimized for the GSPE spatial sampling design by selecting adjacent pairs of SUs distributed somewhat 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 SU pairs in each stratum. The number of SU pairs that could be surveyed based on funding was determined. Then the number of SU pairs to be surveyed per stratum was divided into the total number of SU pairs to determine the number of survey blocks to be represented by a pair of SUs. I grouped SUs with similar anticipated moose densities, habitat types, and topographic features into blocks. Ten percent of available SUs were not allocated initially, but held in reserve and placed in the survey area where SUs had greater separation than 50 km. If SUs are separated by greater than 50 km, autocorrelation cannot be calculated for the population estimate (Kellie and DeLong 2006).

Sample units were surveyed with a Piper PA-18 Super Cub and flown at altitudes of approximately 300–800 ft above ground level, depending on vegetative cover. Flight speed was 60–70 mph. When terrain permitted, east–west linear transects were flown every 0.15 degrees of latitude, or north–south every 0.25 degrees of longitude. A global positioning system receiver was used to follow transect headings. In hilly or mountainous terrain, the flight path followed terrain contours within SU boundaries, rather than transects. Our objective was to spend 8–10 min/mi^2 of search effort in each SU sampled to achieve consistently high sightability of moose. However, large areas of nonmoose habitat (i.e., lakes, areas covered with ice) within these SUs 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: 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.

GSPE methodology allows survey areas to be subdivided into smaller portions with separate population estimates calculated for each separate area if there are at least 20 SUs sampled in each stratum. In southern Unit 20D, separate population estimates were calculated for southwest and southeast Unit 20D for those years when GSPE surveys met the criteria.

Population estimates were calculated by entering SU data into ADF&G's GSPE application software (DeLong 2006) to calculate a population estimate of observable moose, i.e., we did not correct for moose not seen during the survey (Kellie and DeLong 2006). Inclement weather during the 2007 southern Unit 20D population estimate prevented me from surveying anywhere except southwest Unit 20D, thus the low density stratum did not meet the minimum of 20 SUs/stratum for ADF&G's GSPE application software calculations. Therefore, the high density stratum estimate was calculated using GSPE software and the low density stratum estimate was calculated using the Gasaway methodology (Gasaway et al. 1986). Stratum estimates were then

combined using methods described in Gasaway et al. (1986) for summing population estimates from adjacent areas. Population ratios were calculated using GSPE software.

In prior reports, GSPE population estimate data were smoothed by using parametric empirical Bayes (PEB) methods (Ver Hoef 1996). However, the department did not have a statistician on staff during this reporting period to calculate smoothed population estimates. Unsmoothed data will be smoothed as soon as possible. PEB methods use 2 sources of variation with one being variation of replicate counts of SUs (i.e., sampling variance) and the other being variation around the population trendline among years (i.e., regression variance). The PEB method borrows strength from multiple surveys to fit the individual yearly estimates closer to the population trendline. Therefore, previous population estimates reported for southern Unit 20D will vary from the "smoothed" estimates calculated. Also, the PEB method allows for population estimates to be calculated from the trendline for those years that surveys were not conducted. Population composition ratios were calculated from unsmoothed data.

Because the Board of Game has adopted specific moose population objectives for Unit 20D, a sightability correction factor (SCF) was applied to GSPE estimates based on recent research by Boertje and others (Boertje et al. 2009; R. Boertje, ADF&G, unpublished data, Fairbanks; M. Keech, ADF&G, unpublished data, Fairbanks). An SCF of 1.20 was applied to estimates for southern Unit 20D and an SCF of 1.25 was applied to estimates for northern Unit 20D.

Population estimates in southern and northern Unit 20D were combined in some years to estimate a total unitwide estimate following the methods described in Gasaway et al. (1986), with the area specific SCFs applied to the area population estimates before calculation of the standard error for the combined estimate.

Fort Greely Survey

The U.S. Army Garrison Alaska (USAGAK) requested that the department conduct an aerial moose survey inside the Fort Greely fenced compound. The surveys were flown in a Piper PA-18 Super Cub fixed-winged aircraft flying approximately 1000 feet above ground level at an airspeed of approximately 65 mph. This survey altitude is higher than standard ADF&G surveys, but was used at Fort Greely to improve sightability in the dense spruce and deciduous vegetation (higher survey altitude improves sightability in tall forest vegetation) and to maintain separation between the aircraft and people on the ground. To provide a view looking down into the trees, we flew a series of overlapping circles over portions of Fort Greely that had spruce or deciduous trees. We flew linear transects at intervals of every 0.15 degrees of latitude (approximately 0.12 miles) over portions of Fort Greely that were more open or burned. I subdivided the survey into 3 portions consisting of 1) Allen Airfield, 2) Fort Greely cantonment area, and 3) Fort Greely surrounding the missile complex. We did not fly directly over the missile complex or the portions of the cantonment area with the main buildings, residential area, or Fort Greely School. I recorded survey start and stop times for each area as well as the number of moose observed. We circled all moose seen to look for other moose and to identify sex and age.

Twinning Surveys

Surveys were flown in a Piper PA–18 at an altitude of 300–700 feet above ground level and at an airspeed of approximately 60–70 mph by flying linear transects spaced approximately 0.25 miles

apart. The survey objective was to observe a sample of 50 cows with calves. Large areas where there was little chance of spotting a moose (i.e., large agricultural grain fields, areas of dense spruce) were not surveyed.

Sample units were drawn on 1:63,360 scale U.S. Geological Survey topographic maps using topographic features as boundaries. Twinning surveys were flown in 6 SUs south of the Tanana/River between the Gerstle and Delta Rivers in the following SUs: Big Lake, Butch Lake, Clearwater Lake, Sawmill Creek North, Donnelly, and Delta Agricultural Project West. In addition to surveying the SUs listed above, we also classified and recorded moose observed while flying en route to SUs.

When moose were spotted, a low pass was made to determine the sex and to look for newborn calves. Moose ≥1 year old with visible antlers were classified as bulls; all others were classified as cows. If no calves were observed with cows, 2–4 additional low passes were made over the cow to improve sightability of calves, if present. Data recorded for each observation included the sex of the moose, the presence or absence of calves or yearling offspring, and the moose location.

Harvest Monitoring

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 bull moose killed, and the type of weapon used to kill the moose. Hunters who participated 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., RY06 = 1 Jul 2006–30 Jun 2007). One reminder letter was sent to holders of harvest tickets who did not report and 2 letters to holders of permits who did not report.

HABITAT ASSESSMENT

Biomass removal browse surveys were conducted by randomly selecting GSPE SUs to be surveyed. The center of the browse survey plot was the latitude–longitude of the southeast corner of each SU. Browse plots were accessed by highway vehicle, snowmachine, or helicopter. The following data were recorded for each plot: coordinates of the plot, plot identification number, date, name of people conducting the survey, strata classification, slope, aspect, and snow depth. Each plot was 15 meters in radius, determined by visual estimation. Preferred browse species were defined as willow (*Salix* sp.), aspen (*Populus tremuloides*), birch (*Betula papyrifera*), or cottonwood (*P. balsamifera*) with current annual growth (CAG) leaders that were 0.5–3.0 m from the ground. If there were no preferred species in the plot, this was noted on the data form and an alternate plot was selected in the same strata class. Only browse above the snow was measured. Bark stripping and browsing by snowshoe hares was noted on the data form. For all the preferred browse species the number of plants was visually estimated. The number of preferred browse species with main stems broken by moose was recorded as an index to browsing intensity.

Browsing was estimated by randomly selecting 3 plants in the plot of each preferred species. The following information was recorded for each plant: height; number of CAG stems that were 0.5–3.0 m from the ground; number of CAG leaders present before browsing; proportion of dead plant material between 0.5–3.0 m recorded as X = no or very little dead material, L = less dead than live material, or M = more dead than live material.

For each preferred browse species plant selected, 10 twigs were randomly selected from a plant and recorded as browsed or unbrowsed. If the twig was unbrowsed, the diameter was measured at the base of the CAG and at the end of the CAG. If the twig was browsed, the diameter was measured at the end of the CAG and at the point of browsing. If the bite diameter was suspected to be below the CAG, this was noted. The goal was to sample 30 CAG leaders per species per plot. If 30 twigs from 3 plants were not available, we continued to select plants. If there were not 30 twigs in the whole plot, we measured all twigs available.

Architecture class was recorded for each plant as a measure of browsing intensity over the entire history of the plant. The plant was recorded as broomed if either of the following conditions were met: 1) for saplings, the main apical stem was broken by moose; or 2) for bushy plants, more than half of the CAG stems arose from lateral stems that were produced as a result of browsing. The architecture class was recorded as browsed if 1) there was any evidence of browsing, but it had not significantly affected the growth of the plant; or 2) if less than half of CAG stems that were 0.5–3.0 m arose from lateral stems that were produced from browsing. The plant was recorded as unbrowsed if there was no evidence of browsing.

The number of non-preferred plants and their estimated average height in the plot was estimated. Non-preferred species included spruce, tamarack, alder (*B. glandulosa* or *B. nana)*, mature aspen, birch, or cottonwood with no browse below 3.0 m. We observed non-preferred species for evidence of browsing. If they were browsed we measured the browsing on one plant as described above.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

2005

A GSPE survey was flown in Unit 20D south of the Tanana River during 2–29 November 2005 for a cost of $11,970. The southern Unit 20D survey area included 320 SUs and covered 1890.2 mi^2 averaging 5.9 mi^2 per SU. The high-density stratum had 187 SUs totaling 1104.1 mi^2 and the low-density stratum had 133 SUs totaling 786.1 mi^2. Fifty-nine SUs were searched during the survey including 38 highs (64%) and 21 lows (36%), meeting the objective of surveying 60% high SUs. Search effort during this survey met the objective in high density SUs and averaged 48 min/SU (8.3 min/mi^2) but did not meet the objective in low density SUs that averaged 43.6 min/SU (7.5 min/mi^2).

The population estimate was 5553 observable moose (without an SCF applied, Table 1) with a 90% confidence interval of 4513–6593 (±25%). The 2005 estimate has not been smoothed at this

time (Table 2). Applying an SCF to the unsmoothed estimate resulted in an SCF corrected estimate of 6664 moose (Table 3) for a density of 3.5 moose/mi^2.

The southwest Unit 20D (West of Johnson River) population estimate increased modestly in RY05 to 4863 moose with composition of 34 calves:100 cows and 20 bulls:100 cows (Table 4). The southeast Unit 20D population (East of Johnson River) estimate decreased to 690 moose in RY05 with composition of 24 calves:100 cows and 51 bulls:100 cows (Table 4).

The 2004 northern Unit 20D (Table 5) and 2005 southern Unit 20D population estimates were corrected for sightability and combined to calculate a total Unit 20D estimate of 9074 (7901–10,247; Table 6). This estimate meets the population objective.

Twinning surveys were flown on 24, 26, and 31 May 2005. Total flight time was 14.8 hours for a cost of $2590 and total survey time of 10.6 hours. Moose were seen at the rate of 19.5 moose/hr with 217 moose observed. Fifty cow–calf groups were observed with 11 (22.0%) being cows with twins (Table 7).

2006

A GPSE survey was flown in Unit 20D south of the Tanana River during 30 October–20 November 2006 for approximately $12,155. The southern Unit 20D survey area included 320 SUs and covered 1890.2 mi^2, averaging 5.9 mi^2 per SU. The high-density stratum had 186 SUs totaling 1098.2 mi^2 and the low-density stratum had 134 SUs totaling 792.0 mi^2. Fifty-one SUs were searched during the survey, including 29 high-density (57%) and 22 low-density (43%), slightly missing the objective of surveying 60% high-density SUs. Average SU search time was 55.8 minutes (9.5 min/mi^2) in the high-density and 40.9 minutes (6.9 min/mi^2) in the low-density stratum. Search effort met the objective in the high-density SUs and was below the objective in the low-density SUs.

The population estimate was 7243 observable moose (without an SCF applied) with a 90% confidence interval of 5659–8827 moose (Table 1). I was unable to calculate a smoothed estimate for this survey (Table 2). Appling an SCF of 1.20 to the estimate resulted in an SCF estimate of 8692 moose (Table 3), and a density of 4.6 moose/mi^2. The 2006 southern Unit 20D estimate was not combined with the 1999 northern Unit 20D to calculate a total unit estimate because I considered the time interval between the surveys too long.

The observed population estimate in southwest Unit 20D increased to 6245 moose with composition of 41 calves:100 cows and 21 bulls:100 cows (Table 4). Most of the population growth in Unit 20D occurred in the southwest portion. The observed population estimate in southeast Unit 20D was 998 moose, with composition of 41 calves:100 cows and 20 bulls:100 cows (Table 4).

Twinning surveys were flown on 24–26 May 2006 for a total of 12.1 hours of survey time and a cost of $3006. Moose were seen at the rate of 24.5 moose/hr with 297 moose observed. Fifty-four cow–calf groups were observed with 14 (25.9%) being cows with twins (Table 7).

Reconnaissance twinning surveys were also flown in the Shaw Creek Flats and Volkmar River Flats in northern Unit 20D. The Volkmar River Flats reconnaissance twinning survey was flown

on the evening of 24 May 2005 from 1945 to 2036 hours for 51 minutes of survey time. Only 4 moose were seen and none were cow–calf pairs. The Shaw Creek survey was flown on the evening of 26 May 2007 for 76 minutes of survey time from 1922 to 2048 hours adjacent to and east of the trans-Alaska pipeline. Thirty-nine moose were seen at the rate of 29.2 moose/hr. Only 4 cow–calf pairs were seen and none were twins. The results of these reconnaissance surveys indicate that if additional twinning surveys were to be flown in Unit 20D, they should probably be flown in the Shaw Creek Flats.

An aerial survey was flown inside the Fort Greely fenced compound on 17 November 2006 with a survey time of 85 minutes. I observed 23 moose inside the Fort Greely compound including no moose inside the Allen Airfield compound, 13 moose inside the Fort Greely cantonment area, and 10 moose inside the fence surrounding the National Missile Defense Site.

2007

My intent was to fly a GSPE survey in southern Unit 20D again in 2007 because of public concerns about the antlerless moose hunt that occurred in southwest Unit 20D in 2006 and 2007. However, inclement weather prevented completion of all of southern Unit 20D surveys so the survey was confined to southwest Unit 20D.

A GSPE survey was flown in southwest Unit 20D (south of the Tanana River and west of the Johnson River) during 17–29 November 2007 and 8–18 January 2008 for a cost of $10,718. The southwest Unit 20D survey area included 214 SUs and covered 1260 mi^2 averaging 5.9 mi^2/SU. The high-density stratum had 143 SUs totaling approximately 843 mi^2 and the low-density stratum had 71 SUs totaling 418 mi^2. Thirty-seven SUs were searched including 24 high-density SUs (65%) and 13 low-density SUs (35%), meeting the objective of surveying 60% high SUs. Search effort during this survey met the objective in high density SUs and averaged 51.4 min/SU (8.7 min/mi^2) but did not meet the objective in low density SUs that averaged 43.7 min/SU (7.4 min/mi^2).

The population estimate was 5926 observable moose (without an SCF applied, Table 4) with a 90% confidence interval of 4525–7327. The estimate was based on a GSPE calculation of 5485 moose in the high stratum and a Gasaway calculation of 441 moose in the low stratum. Applying an SCF to the unsmoothed estimate resulted in an SCF corrected estimate of 7111 moose for a density of 3.5 moose/mi^2.

Twinning surveys were flown on 24–27 and 29 May 2007 for a total of 14.2 hours of survey time and a cost of $2682. Moose were seen at the rate of 18.9 moose/hr with 312 moose observed. Forty-eight cow–calf groups were observed with 8 (16.7%) being cows with twins (Table 7).

An aerial survey was flown inside the Fort Greely fenced compound on 10 January 2008 with a survey time of 105 minutes. I observed 30 moose inside the Fort Greely compound including 3 moose inside the Allen Airfield fence, 10 moose inside the Fort Greely cantonment area, and 17 moose inside the fence surrounding the National Missile Defense Site.

Population Composition

2005. Southern Unit 20D population composition from the fall 2005 GSPE survey was 24 bulls:100 cows (17–31) and 33 calves:100 cows (28–38; Table 1).

2006. Southern Unit 20D population composition from the fall 2006 GSPE survey was 21 bulls:100 cows (17–24) and 41 calves:100 cows (36–45; Table 1).

2007. The southwest Unit 20D population composition from the fall 2007 GSPE survey was 36 bulls:100 cows and 30 calves:100 cows (Table 4). The increase in the bull:cow ratio is due to the number of cow moose shot in southwest Unit 20D in RY06 and RY07.

Distribution and Movements

No data were collected on moose distribution or movements during RY05–RY06.

MORTALITY

Harvest

Season and Bag Limit. Hunting seasons and bag limits are listed in Table 8.

Alaska Board of Game Actions and Emergency Orders.

2006 — At the spring 2006 meeting, the Alaska Board of Game adopted regulation proposal 88 establishing an antlerless moose hunt for cows not accompanied by calves in southwest Unit 20D during 1–15 October, authorizing issuance of 75 drawing permits, and changing the bag limit for the BRYHMA to include a cow not accompanied by a calf.

2007 — In March 2007 the Alaska Board of Game adopted proposal 153, reauthorizing and increasing the number of drawing permits for antlerless moose hunting in southwest Unit 20D. This action created 3 drawing permit hunts in southwest Unit 20D.

Human-Induced Mortality

RY05. Estimated moose mortality in Unit 20D from all human causes in RY05 was 339 moose (Table 9). This total included 232 moose reported killed by hunters in fall 2005, an estimated unreported harvest of 41 moose, an illegal harvest of 14 moose, and an estimated 52 moose killed in vehicle collisions (not all vehicle collisions result in mortality). Illegal harvest is thought to be much higher but undocumented. The total reported hunting mortality of 232 was 2.6% of the corrected population estimate and below the harvest objective of 500–700.

RY06. Estimated moose mortality from all human causes in RY06 was 500 moose (Table 9). This total included 356 moose reported killed by hunters in fall 2006, an estimated unreported harvest of 63 moose, an illegal harvest of 15 moose, and an estimated 66 moose killed in vehicle collisions (not all vehicle collisions result in mortality). Illegal harvest is thought to be much higher but undocumented. The total reported hunting mortality of 356 was below the harvest objective of 500–700.

RY07. Estimated moose mortality from all human causes in RY07 was 996 moose (Table 9). The substantial increase in mortality was due to the antlerless moose hunts in southwest Unit 20D. This total included 800 moose reported killed by hunters in fall 2006, an estimated unreported harvest of 142 moose, an unknown illegal harvest, and an estimated 54 moose killed in vehicle collisions (average of last 3 years). Illegal harvest is thought to be high but undocumented. The total reported hunting mortality of 800 exceeded the harvest objective for Unit 20D.

Southwest Unit 20D Harvest by Hunters. General season moose harvest and the number of hunters in southwest Unit 20D has continued to increase. Additional harvest in southwest Unit 20D occurred with the implementation of cow moose permit hunts in RY06 and RY07.

In RY05, reported harvest by hunters totaled 139 moose. Hunters reported taking 126 moose during the general hunting season (Table 10), 8 moose during DM790 (Table 11), and 5 moose during DM792 (Table 12). Hunter success was 30% during the general season, 89% during DM790, but only 25% during DM792 due mainly to the bag limit changing from 1 bull to 1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least one side.

In RY06, reported harvest by hunters totaled 222 moose. Hunters reported taking 155 moose during the general hunting season (Table 10), 7 moose during DM790 (Table 11), 8 moose during DM792 (Table 12), and 52 moose during DM793 (Table 13). Hunter success was 31% during the general season, 88% during DM790, 80% during DM792, and 87% during DM793.

In RY07, reported harvest by hunters totaled 684 moose, resulting in the Unit 20D harvest objective being met in southwest Unit 20D alone. Hunters reported taking 164 moose during the general hunting season (Table 10), 6 moose during DM790 (Table 11), 7 moose during DM792 (Table 12), 321 moose during DM797, 93 moose during DM798, and 93 moose during DM799 (Table 13). Hunter success was 27% during the general season, 60% for DM790, 70% for DM792, 77% for DM797, 74% for DM798, and 70% for DM799.

Southeast Unit 20D Harvest by Hunters. Moose harvest in southeast Unit 20D continued to be low, although the 3-year average harvest for RY05–RY07 increased to 23 moose/year from 15 moose/year during RY02–RY04 (Table 10).

During the RY05–RY07 general seasons, reported harvest ranged from 19 to 26 moose (Table 10). Hunter success rates varied from 34% to 53% during this period. Harvest during the general hunting season remains low in this area primarily because of motorized access restrictions in the Macomb Plateau Controlled Use Area, which make moose hunting difficult.

Northwest Unit 20D Harvest by Hunters. Northwest Unit 20D has the second highest harvest in the unit. During RY05–RY07, harvest ranged from 61 to 82 moose/year (Table 10). Hunter success ranged from 22% to 30%. There were no permit hunts in northwestern Unit 20D.

Northeast Unit 20D Harvest by Hunters. The number of hunters and harvest remained low in northeast Unit 20D during the RY05–RY07 general seasons. Harvest was 12–19 moose annually, with 30–44 hunters, and success rates of 31–43% (Table 10). 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 ridge top airstrips.

Despite the additional August hunting season in the Healy River drainage that was originally requested by residents of Healy Lake village, no moose were reported killed during the August moose hunting season (Table 14).

Hunter Residency. Most hunters in Unit 20D during RY05–RY07 were nonlocal residents as hunting in this area has become increasing popular around the state (Table 15). The proportion of nonresident hunters continued to be low.

Hunter Effort. Mean days hunted during the general hunting season ranged 5.3–5.4 days for successful hunters and 6.5–6.7 days for unsuccessful hunters during RY05–RY07 (Table 16).

Permit Hunts. Permit hunt DM790 (DJMA) had 10 drawing permits issued each year during RY05–RY07 with harvest ranging 6–8 moose/year (Table 11). The number of applicants for DM790 averaged 602 applicants/year (range 555–671).

Permit hunt DM792 (BRYHMA) had 24 permits in RY05, but the number of permits was reduced to 10 per year for RY06 and RY07 at the request of the Delta Fish and Game advisory committee because the bag limit was changed to include cow moose not accompanied by a calf. In RY05, permit recipients had only a 21% success rate, killing 5 bull moose. Success increased to 70–80% in RY06–RY07 with the change in bag limit (Table 12). The number of applicants for DM792 averaged 173/year (range 154–193).

Unit 20D antlerless moose hunts were implemented in RY06 with 75 permits for DM793 (772 applicants) for the taking of a cow moose not accompanied by a calf. Sixty-nine percent of DM793 permit recipients took a moose, killing 52 cows (87% success; Table 13).

DM793 was replaced in RY07 with 3 separate antlerless moose hunts: DM797, DM798, and DM799. DM797 was south of the Alaska Highway from the Delta River to the 1408 Road. Five hundred forty-one permits were issued (1531 applicants) and 59% of permit recipients killed a moose (321 moose; Table 13). DM798 was located south of the Alaska Highway from the 1408 Road to the Gerstle River. One hundred eighty permits were issued (1022 applicants) and 52% of permit recipients killed a moose (93 moose, 74% success by those who hunted; Table 13). DM799 was located north of the Alaska Highway and south of the Tanana River from the Delta River to the Little Gerstle River. One hundred eighty permits were issued (935 applicants) and 52% of permit recipients killed a moose (93 moose, 70% success by those who hunted; Table 13).

Harvest Chronology. During RY05–RY07 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 17).

Transport Methods. During RY05–RY07 3- or 4-wheelers, highway vehicles, and boats continued to be the most common modes of transportation used by successful hunters (Table 18).

Natural Mortality

No estimates of natural mortality were calculated during RY05–RY07. However, predation by wolves, grizzly bears, and black bears is believed to be 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

2006. On 22 March and 3–4 April 2006, I conducted 11 plant architecture browse transects in southwest Unit 20D to evaluate their usefulness for assessing browse usage. It was my impression that plant architecture surveys did not provide the type of browse survey data that I needed. Therefore, data were not completely analyzed and plant architecture surveys were later replaced by plant biomass surveys which measure year to year browse usage (C. T. Seaton, ADF&G, personal communication).

2007. Browse surveys measuring biomass removal were conducted in southwestern Unit 20D in April 2007 (Figs. 1 and 2). Biomass removal by moose in the foothills (30%) was significantly higher (Fig. 3) than removal in the flats (22%), which included the mixture of highly productive burns south of the Alaska Highway, varying production across fallow agricultural clearings, and poor production in mature forest north of the highway. Similar to biomass removal, brooming was higher in the foothills than the flats (Fig. 4). Brooming of plants by moose in the 1987 Granite Creek burn increased 80% from 2000–2001 to 2007 (Fig. 4). In 2007 we also observed a comparably high level of brooming in the 1994 Hajdukovich Creek burn (Fig. 4). Our few plot samples are inadequate to make a landscape estimate of browse biomass production, but they do suggest that biomass increased in the 1987 burn area between 2001 and 2007 and that the burns contribute substantially to overall production in southwest Unit 20D (Fig. 5).

Enhancement

No moose habitat enhancement was accomplished during RY05–RY07, however, plans were developed during this time period to conduct moose habitat enhancement to mitigate for habitat lost with the Fort Greely vehicle test track, and to rejuvenate habitat in the 1987 Granite Creek burn using matching funds from the Natural Resource Conservation Service.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates were completed in southern Unit 20D in RY05 and RY06 and in southwest Unit 20D in RY07. No population estimates were conducted in northern Unit 20D during this reporting period because of the intensive moose management issues (i.e., antlerless moose hunts) in southern Unit 20D. The moose population objective was met in 2005 for the first time since the population objective was established in 1995, when the combined 2004 northern Unit 20D estimate and the 2005 southern Unit 20D estimate resulted in 9074 moose. The bull:cow ratio in southern Unit 20D increased as a result of antlerless moose hunting in RY06–RY07.

Interim population and harvest objectives were developed to replace current population and harvest objectives. The interim objectives are based on density-dependent thresholds. The

interim objectives will be used to manage the Unit 20D moose population until a Unit 20D intensive moose management plan has been completed.

Unit 20D moose harvest exceeded the objective in RY07 with the advent of a liberal antlerless moose hunt in southwest Unit 20D. The cow harvest will continue within the guidelines of the interim harvest objectives.

Moose browse surveys conducted in 2007 indicate that browsing rates are at moderately high levels. The high level of brooming in the foothills should be cause for concern because of associated mortality in some species of browse highly preferred by moose. An increase in brooming can decrease the amount of available forage because the dense growth form and dead stems hinder selective foraging for optimal stem diameter. The proportion of forage removal may remain constant or even increase on broomed plants as a moose population increases, but that occurs because moose bite larger diameter stems (older than current year growth), which have lower energy and nutritional content than smaller stems. This type of heavy utilization is expected to be higher in winters when deep snow hinders movement by moose and forces individuals to forage in relatively smaller areas. Shallow snow during winter 2007–2008 likely did not hinder browse selection by moose. Brooming is also expected to increase as higher population density increases competition among moose, regardless of winter severity. Based on the browse information we collected, the proposed cow harvest to slow population growth of moose in southwest Unit 20D is warranted.

A relatively high proportion of southwest Unit 20D has been disturbed since the late 1970s by land clearing and wildland fire, which combined with relatively low predation rates, contributed to the current high density moose population. Unless a comparable rate of disturbance continues to make new browse production available in the future, browse production available to moose will decline with habitat succession. Continued growth of the moose population is expected to result in a decline in nutritional condition unless a net increase in browse production occurs.

In conclusion, the Unit 20D moose population met or exceeded population and harvest objectives. No changes are planned for the general season hunt and the antlerless moose hunts will continue at a reduced level until density-dependent indices are reduced. Habitat enhancement will be planned in southwest Unit 20D to retard plant succession and provide additional moose browse. Substantial acreage in northern Unit 20D was burned by wildland fire in 2003 and 2004. The moose population in northern Unit 20D should start growing and contributing toward the population objective. The extent of the growth will likely be determined by the amount of predation on the moose population.

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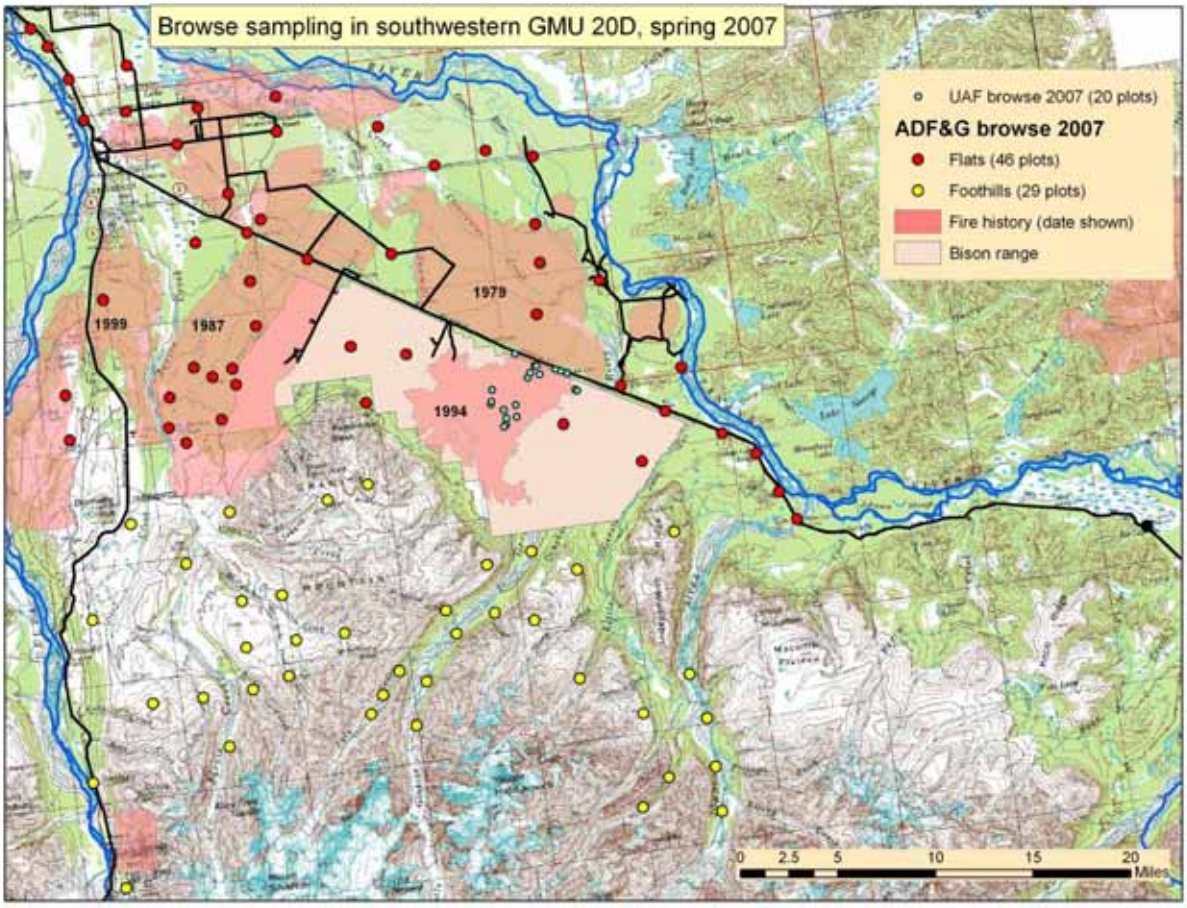

FIGURE 1 Location of all browse plots sampled in 2007

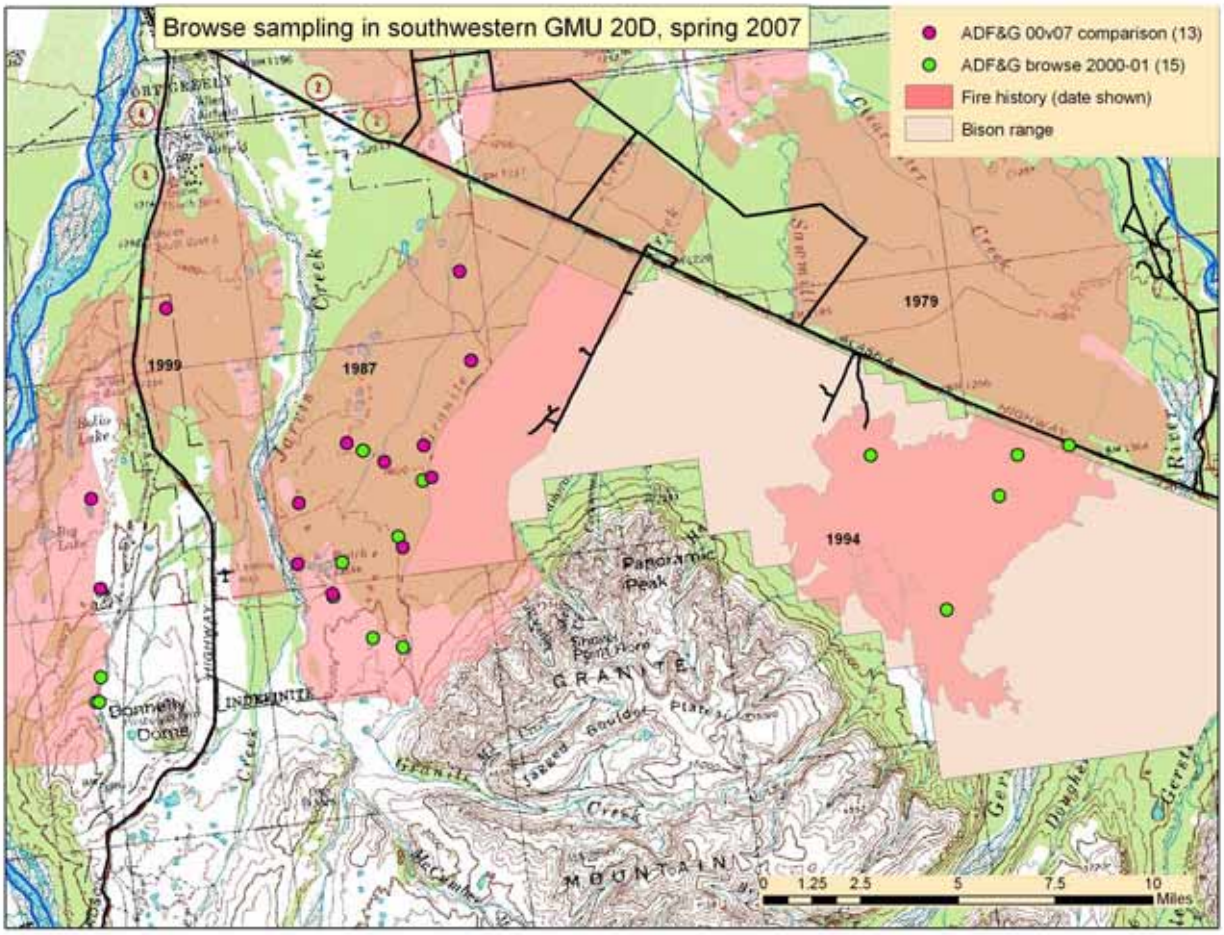

FIGURE 2 Location of browse plots (sample size in parentheses) that were sampled in 2000–2001 and the subset of plots sampled in spring 2007 (noted as "00v07 comparison") used to examine differences in browse production and utilization over time in the 1987 Granite Creek burn

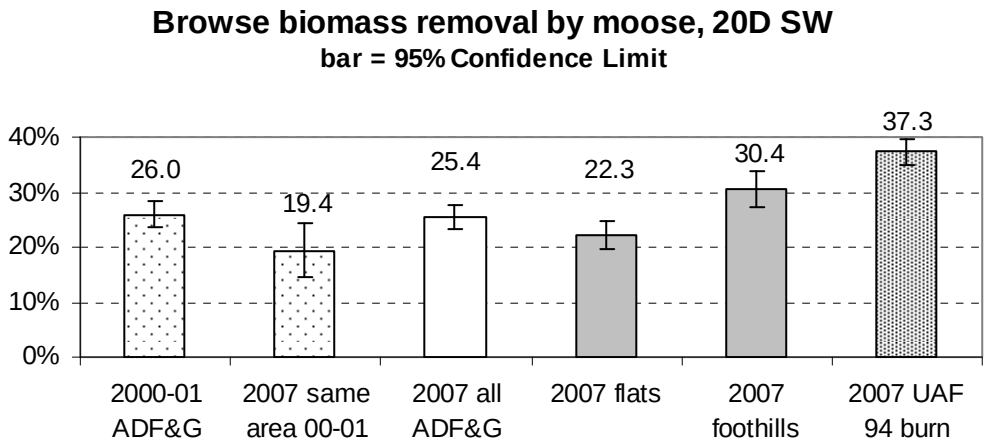

FIGURE 3 Estimates of the proportion of current annual growth (plus occasionally older growth) of browse species that was removed by moose

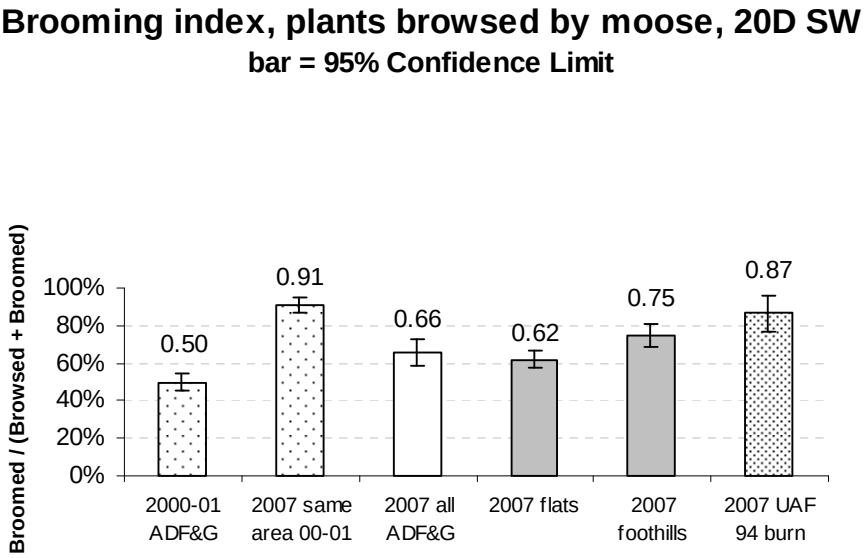

FIGURE 4 Proportion of browse plants that had a growth form indicating a history of heavy utilization by moose

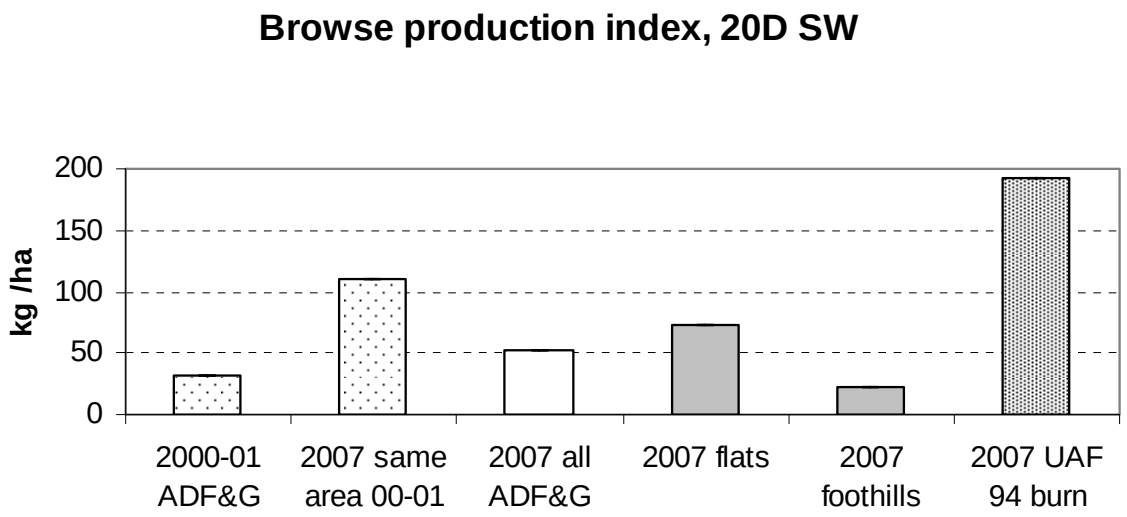

FIGURE 5 Relative production of browse over time in the 1987 burn (2000 and 2001 compared to 2007) and the 2006 annual production among different areas of southwest Unit 20D (measured in spring 2007)

TABLE 1 Results of observed population estimates for southern Unit 20D using a Gasaway method survey in 1995 and a geospatial population estimator (GSPE) survey for all other years, 1995–2006

Year/Method	Total population estimate	Total cows	Total calves	Total bulls	Calves: 100 cows	Bulls:100 cows
1995 (Gasaway)	2522	1626	552	343	34	21
(LCI–UCI)[a]	1979–3065	1271–1981	411–693	249–437	29–39	17–25
1998	3630	2321	863	479	37	21
(LCI–UCI)[a]	2533–4727	1570–3072	630–1097	305–653	32–42	16–25
2000	3932	2530	676	671	27	27
(LCI–UCI)[a]	3245–4618	2021–3039	498–855	530–813	22–31	19–34
2001	3435	2424	575	392	24	16
(LCI–UCI)[a]	2643–4227	1840–3009	453–697	281–504	16–32	10–22
2003	5493	3476	1097	790	32	23
(LCI–UCI)[a]	3924–7061	2363–4588	830–1364	462–1118	27–37	19–26
2005	5553	3473	1219	817	33	24
(LCI–UCI)[a]	4513–6593	2757–4188	984–1453	560–1075	28–38	17–31
2006	7243	4494	1815	929	41	21
(LCI–UCI)[a]	5659–8827	3485–5501	1386–2244	696–1162	36–45	17–24

[a] LCI = lower confidence interval at 90% and UCI = upper confidence interval at 90%.

TABLE 2 "Smoothed" moose population estimates for southern Unit 20D, 1995–2007

Year[a]	Estimate	90% Lower CI	90% Upper CI
1995	**2507**	**2037**	**2938**
1996	2751	2298	3170
1997	2992	2638	3379
1998	**3242**	**2917**	**3639**
1999	3462	3072	3854
2000	**3719**	**3324**	**4119**
2001	**3920**	**3378**	**4399**
2002	4195	3574	4838
2003	**4456**	**3752**	**5209**
2004	n/a	n/a	n/a
2005[b]	**n/a**	**n/a**	**n/a**
2006[b]	**n/a**	**n/a**	**n/a**
2007[b]	n/a	n/a	n/a

[a] Years in bold are years surveys were flown. Other years were estimated from the population trendline.
[b] Estimate has not been statistically smoothed at this time due to lack of biometrician services.

TABLE 3 Observed, smoothed, and sightability-corrected geospatial population estimator (GSPE) moose population estimates for southern Unit 20D, 1995–2006

Year	Observed estimate	Smoothed estimate	Sightability-corrected estimate
1995	2522	2507	3008[a]
1998	3360	3242	3890[b]
2000	3932	3719	4463[b]
2001	3435	3920	4704[b]
2003	5493	4456	5347[b]
2005	5553	--	6664[c]
2006	7243	--	8692[c]

[a] Sightability correction factor (SCF) calculated during Gasaway survey.
[b] 1.20 SCF applied to GSPE smoothed population estimate.
[c] 1.20 SCF applied to GSPE observed, unsmoothed population estimate.

TABLE 4 Results of observed population estimates for southwest and southeast Unit 20D using geospatial population estimator (GSPE) surveys, 2001–2007

Parameter	2001	2003	2005	2006	2007
East of Johnson River					
Total pop estimate	853	968	690	998	--
LCI[a]	544	321	290	328	--
UCI[b]	1162	1616	1090	1668	--
Total cows	463	356	402	625	--
LCI	185	139	130	198	--
UCI	740	573	676	1051	--
Total calves	128	87	97	267	--
LCI	74	16	6	90	--
UCI	182	158	189	443	--
Total bulls	106	139	205	128	--
LCI	65	47	117	36	--
UCI	147	230	292	225	--
Bulls:100 Cows	23	39	51	20	--
LCI	5	29	19	10	--
UCI	41	49	84	30	--
Calves:100 Cows	28	24	24	41	--
LCI	5	9	10	28	--
UCI	50	40	38	54	--
West of Johnson River					
Total pop estimate	2583	4524	4863	6245	5926
LCI	1190	3269	3933	4931	4525
UCI	3175	5779	5792	7559	7327
Total cows	1962	3229	3070	3869	3767
LCI	1507	2137	2432	3033	2697
UCI	2416	4320	3708	4705	4837
Total calves	447	1049	1121	1549	1128
LCI	358	719	913	1195	805
UCI	537	1379	1330	1902	1450
Total bulls	286	664	613	801	1351
LCI	203	393	396	608	940
UCI	370	936	829	994	1762
Bulls:100 Cows	15	21	20	21	36
LCI	9	17	13	17	21
UCI	20	24	27	24	51
Calves:100 Cows	23	32	34	41	30
LCI	16	27	29	36	18
UCI	30	38	39	45	42

[a] LCI = Lower confidence interval.
[b] UCI = Upper confidence interval.

TABLE 5 Results of northern Unit 20D moose population estimation surveys, 1996–2004

Parameter	1996 and 1997 GAS[a]	1999 GSPE[b]	2004 GSPE[b]
Total estimate	2026	2395	1929
LCI[c]	1583	2070	1443
UCI[d]	2469	2719	2415
Total bulls	504	957	515
LCI	364	805	351
UCI	644	1109	679
Total cows	1255	1181	1101
LCI	967	979	776
UCI	1543	1384	1426
Total calves	268	213	338
LCI	171	165	189
UCI	365	262	486
Bull:100 cows	NW 1996 = 47 NE 1997 = 32	81	47
LCI		69	28
UCI		93	66
Calves:100 cows	NW 1996 = 24 NE 1997 = 18	18	31
LCI		14	19
UCI		22	43

[a] GAS is a Gasaway population estimate with a sightability correction factor applied to the observable number of moose estimated. Northwestern Unit 20D was surveyed in 1996 and northeastern Unit 20D was surveyed in 1997 with the results combined to calculate an overall northern Unit 20D population estimate.

[b] GSPE is a geospatial population estimator survey conducted with a higher search intensity than a GAS, but without a sightability correction factor applied to the observable moose estimate. Northern Unit 20D was surveyed in its entirety each GSPE survey.

[c] LCI = Lower confidence interval.

[d] UCI = Upper confidence interval.

TABLE 6 Results of Unit 20D combined southern and northern population estimates, 1995–2005

Year/Location	Population estimate
1995 southern + 1996 northwestern + 1997 northeastern	4548
1998 southern + 1999 northern	6684
1999 northern + 2000 southern	7457
2003 southern + 2004 northern	7758
2004 northern + 2005 southern	9074

TABLE 7 Results of moose twinning surveys in southwest Unit 20D, 2001–2007

Year	Cows w/single calves	Cows w/twin calves	% Cows w/twins	Moose per hour	Total moose
2001	40	7	14.9	22.4	282
2002	48	13	21.3	22.5	268
2003	41	10	19.6	21.2	273
2004	46	18	28.1	23.7	294
2005	39	11	22.0	19.5	217
2006	40	14	25.9	24.5	297
2007	40	8	16.7	18.9	312

TABLE 8 Unit 20D moose hunting seasons and bag limits, regulatory years 2005–2006 through 2007–2008

Regulatory year	Area	Season		Bag limit
2005–2006	South of Tanana River and west of Johnson River, except Delta Junction Management Area and the Bison Range Youth Hunt 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 DM790.
		NONRESIDENT:	5–15 Sep	1 bull with 50-inch antlers[a] by drawing permit DM790.
	Within the Bison Range Youth Hunt Management Area.	RESIDENT:	1–30 Sep	1 bull with spike-fork or 50 inch antlers or 4 or more brow tines on at least one side, by permit DM792.
		NONRESIDENT:	1–30 Sep	1 bull by permit DM792.
	South of Tanana River and east of Johnson River except within the Robertson River drainage south of the confluence of east and west fork, and within 1 mile west of the west fork.	RESIDENT:	1–15 Sep	1 bull.
		NONRESIDENT:	No open season	
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1–15 Sep	1 bull.
			1 Jan–15 Feb	
		NONRESIDENT:	5–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least 1 side.
	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.
2006–2007	South of Tanana River and west of Johnson River, except Delta Junction Management Area and	RESIDENT:	1–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least one side.
			1–15 Oct	DM793 one antlerless moose (taking calves or

Regulatory year	Area	Season		Bag limit
	the Bison Range Youth Hunt Management Area.			cows accompanied by calves is prohibited).
		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 DM790.
			1–15 Oct	DM793 one antlerless moose (taking calves or cows accompanied by calves is prohibited)
		NONRESIDENT:	5–15 Sep	1 bull with 50-inch antlers[a] by drawing permit DM790.
	Within the Bison Range Youth Hunt Management Area.	RESIDENT AND NONRESIDENT:	1–30 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least one side, or one antlerless moose (taking calves or cows accompanied by calves is prohibited) by permit DM792. Only one moose per lifetime is allowed for this hunt, hunters must be 10 to 17 years old.
	South of Tanana River and east of Johnson River except within the Robertson River drainage south of the confluence of east and west fork, and within 1 mile west of the west fork.	RESIDENT:	1–15 Sep	1 bull.
		NONRESIDENT:	No open season	
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1–15 Sep	1 bull.
		NONRESIDENT:	5–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least one side.
	Within the Healy River drainage.	RESIDENT:	15–28 Aug	1 bull with spike-fork antlers.
			1–15 Sep	1 bull.
		NONRESIDENT:	1–15 Sep	1 bull.
	Remainder of Unit 20D (north of Tanana River).	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	1 Sep–15 Sep	1 bull.

Regulatory year	Area	Season		Bag limit
2007–2008	South of Tanana River and west of Johnson River, except Delta Junction Management Area and the Bison Range Youth Hunt Management Area.	RESIDENT:	1 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least one side.
			1 Oct–15 Nov	One antlerless moose (taking calves or cows accompanied by calves is prohibited) by permit DM797 south of AK Hwy, west of 1408 Road, DM798 south of AK Hwy east of 1408 Road, DM799 north of AK Hwy east of Little Gerstle River.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers or four or more brow tines on at least one side.
	Within Delta Junction Management Area.	RESIDENT:	1 Sep–15 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines by drawing permits DM790.
			1 Oct–15 Nov	DM797 one antlerless moose (taking calves or cows accompanied by calves is prohibited).
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers[a] by drawing permit DM790.
	Within the Bison Range Youth Hunt Management Area.	RESIDENT AND NONRESIDENT:	1 Sep–30 Sep	1 bull with spike-fork or 50-inch antlers or 4 or more brow tines on at least one side, or one antlerless moose per lifetime (taking calves or cows accompanied by calves is prohibited) by permit DM792.
	South of Tanana River and east of Johnson River except within the Robertson River drainage south of the confluence of east and west fork, and within 1 mile west of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	No open season	
	Within the Robertson River drainage south of the confluence of east and west forks, and within 1 mile of the west fork.	RESIDENT:	1 Sep–15 Sep	1 bull.
		NONRESIDENT:	5 Sep–15 Sep	1 bull with 50-inch antlers, or at least 4 brow tines on at least one side.

Regulatory year	Area	Season		Bag limit
	Within the Healy River drainage.	RESIDENT:	15 Aug–28 Aug	1 bull with spike-fork antlers.
			1 Sep–15 Sep	1 bull.
		NONRESIDENT:	1 Sep–15 Sep	1 bull.
	Remainder of Unit 20D (north of Tanana River).	RESIDENT AND NONRESIDENT:	1 Sep–15 Sep	1 bull.

[a] Fifty-inch antlers defined as having a spread of at least 50 inches or at least 4 brow tines on at least one side.

TABLE 9 Unit 20D moose harvest and accidental death, regulatory years 1986–1987 through 2007–2008

Regulatory year	Harvest by hunters							Accidental death		Total
	Reported				Estimated					
	M	F	Unk	Total	Unreported[a]	Illegal	Total	Road	Total	
1986–1987	130	0	0	130	23	4	27	15	15	172
1987–1988	126	0	0	126	22	10	32	26	26	184
1988–1989	126	0	0	126	22	13	35	27	27	188
1989–1990	128	0	0	128	23	9	32	16	16	176
1990–1991	118	1	0	119	21	4	25	11	11	155
1991–1992	143	1	0	144	25	11	36	13	13	193
1992–1993	143	0	1	144	25	5	30	32	32	206
1993–1994	154	0	1	155	27	14	41	30	30	226
1994–1995	128	0	0	128	23	7	30	31	31	189
1995–1996	138	0	0	138	24	20	44	25	25	207
1996–1997	214	0	0	214	38	22	60	39	39	313
1997–1998	210	0	0	210	37	15	52	48	48	310
1998–1999	234	0	0	234	41	11	52	31	31	317
1999–2000	184	0	0	184	33	7	40	40	40	264
2000–2001	246	0	0	246	44	20	64	37	37	347
2001–2002	182	0	0	182	32	17	49	32	32	263
2002–2003	228	0	0	228	40	6	46	33	33	307
2003–2004	227	0	0	227	40	12	52	43	43	322
2004–2005	202	0	0	202	36	13	49	43	43	294
2005–2006	232	0	0	232	41	14	55	52	52	339
2006–2007	296	58	2	356	63	15	78	66	66	500
2007–2008	284	514	2	800	142	unk	142	54[b]	54	996

[a] Based on 17.7% unreported harvest estimated by Gasaway et al. (1992).
[b] Three-year average of the last 3 known years.

TABLE 10 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 2007–2008

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
2002–2003	119[h]	17[c]	56[c]	5[i]	7	204	426[h]	39[c]	281[c]	39[i]	51	836
2003–2004	124[h]	16[c]	53[c]	13[i]	6	212	447[h]	40[c]	230[c]	41[i]	36	794
2004–2005	107[h]	12[c]	56[c]	14[i]	8	197	415[h]	50[c]	238[c]	42[i]	27	772
2005–2006	126[h]	19[c]	61[c]	13[i]	0	219	407[h]	56[c]	206[c]	30[i]	22	721
2006–2007	155[h,j]	26[c]	82[c]	19[i]	4	286	517[h,j]	49[c]	279[c]	44[i]	26	915
2007–2008	164[h,j]	23[c]	68[c]	12[i]	6	273	553[h,j]	63[c]	305[c]	39[i]	35	995

[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 one antler.
[f] Subsistence–resident season 1–15 Sep; 1 bull with spike-fork or 50-inch antlers or 3 brow tines on one antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 3 brow tines on one 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 one 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 one antler. Nonresident season 5–15 Sep; 1 bull with 50-inch antlers or 4 brow tines on one antler.
[i] Resident season 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.
[j] Includes antlerless moose hunting season.

TABLE 11 Unit 20D Delta Junction Management Area moose drawing permit harvest, regulatory years 1996–1997 through 2007–2008

Hunt	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	100	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	25	75	100	0	0	6
DM790	2001–2002	10	20	50	50	100	0	0	4
DM790	2002–2003	10	0	40	60	100	0	0	6
DM790	2003–2004	10	20	25	75	100	0	0	6
DM790	2004–2005	10	30	43	57	100	0	0	4
DM790	2005–2006	10	10	11	89	100	0	0	8
DM790	2006–2007	10	20	13	88	100	0	0	7
DM790	2007–2008	10	0	40	60	100	0	0	6

TABLE 12 Unit 20D Bison Range Youth Hunt Management Area moose drawing permit harvest, regulatory years 2002–2003 through 2007–2008

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Percent bulls	Percent cows	Unk	Harvest
DM792	2002–2003	24	0	29	71	100	0	0	17
DM792	2003–2004	24	21	63	37	100	0	0	7
DM792	2004–2005	24	4	91	9	100	0	0	2
DM792	2005–2006	24	17	75	25	100	0	0	5
DM792	2006–2007	10	0	20	80	0	100	0	8
DM792	2007–2008	10	0	30	70	14	86	0	7

TABLE 13 Unit 20D antlerless moose hunt harvest, regulatory years 2006–2007 through 2007–2008

Hunt	Regulatory year	Permits issued	Did not hunt (%)	Unsuccessful hunters (%)	Successful hunters (%)	Percent bulls	Percent cows	Unk	Harvest
DM793	2006–2007	75	20	13	87	4	96	0	52
DM797	2007–2008	541	23	23	77	3	97	0	321
DM798	2007–2008	180	30	26	74	0	100	0	93
DM799	2007–2008	180	26	30	70	2	98	0	93

TABLE 14 Unit 20D Healy River (Uniform Coding Unit 501) reported moose harvest, regulatory years 1993–1994 through 2007–2008

Regulatory year	Unit 20D Healy River			
		Harvest month		
	Hunters	Aug	Sep	Jan
1993–1994[a]	9	0	2	0
1994–1995[a]	13	0	2	0
1995–1996[a]	24	0	2	0
1996–1997[a]	10	0	2	0
1997–1998[a]	14	0	3	0
1998–1999[b]	19	0	5	0
1999–2000[b]	21	0	7	0
2000–2001[b]	24	0	6	0
2001–2002[b]	23	0	5	0
2002–2003[b]	10	0	1	0
2003–2004[b]	10	0	5	1
2004–2005[c]	15	0	1	0
2005–2006[c]	14	0	6	0
2006–2007[c]	22	0	8	0
2007–2008[c]	16	0	5	0

[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.
[c] Resident moose hunting season: 15–28 Aug, 1 spike-fork bull; 1–15 Sep, 1 bull.

TABLE 15 Unit 20D general hunting season moose hunter residency and success[a], regulatory years 1986–1987 through 2007–2008

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
2002–2003	132	57	20	0	209	(25)	478	126	34	2	640	(75)	849
2003–2004	143	52	13	13	221	(27)	396	145	27	27	595	(73)	816
2004–2005	70	101	13	6	190	(24)	213	315	44	14	586	(76)	776
2005–2006	73	138	21	2	234	(26)	233	381	46	4	664	(74)	898
2006–2007	84	176	27	2	289	(31)	236	364	45	7	652	(69)	941
2007–2008	81	164	24	11	280	(27)	250	420	46	33	749	(73)	1029

[a] Excludes hunters in permit hunts.
[b] Local means reside in Unit 20D.

TABLE 16 Southwestern, southeastern, northwestern, and northeastern Unit 20D general season moose and mean days hunted[a], regulatory years 1986–1987 through 2007–2008

Regulatory year	Successful hunters					Unsuccessful hunters				
	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	9.2	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
2002–2003	5.8	6.4	7.0	1.5	6.3	6.7	5.2	6.9	7.3	6.8
2003–2004	6.0	5.7	6.3	4.5	6.0	7.1	5.6	7.1	4.3	6.9
2004–2005	10.0	5.0	5.9	4.4	6.2	5.9	6.1	7.2	6.0	6.8
2005–2006	5.3	3.8	5.9	4.9	5.3	6.4	6.3	7.0	6.1	6.5
2006–2007	5.3	7.4	5.3	4.3	5.4	6.4	5.4	6.8	3.4	6.6
2007–2008	5.0	6.5	5.7	4.9	5.3	6.4	6.6	7.0	4.9	6.7

[a] Excludes permit hunt harvest.

TABLE 17 Unit 20D general season moose harvest[a] chronology percent by month/day, regulatory years 1990–1991 through 2007–2008

Regulatory year	Harvest chronology percent by month/day				
	9/1–9/5	9/6–9/10	9/11–9/15	Unk	*n*
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	48	28	23	1	246
2001–2002	44	34	21	2	172
2002–2003	36	37	22	5	174
2003–2004	39	30	30	1	158
2004–2005	40	29	29	3	189
2005–2006	50	21	27	2	230
2006–2007	45	27	23	4	288
2007–2008	43	26	27	4	275

[a] Excludes permit hunt harvest.

TABLE 18 Unit 20D moose harvest percent[a] by transport method, regulatory years 1987–1988 through 2007–2008

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
2002–2003	9	0	16	39	0	4	30	2	1	178
2003–2004	4	2	18	41	0	3	26	2	4	160
2004–2005	5	3	22	39	0	6	21	0	5	190
2005–2006	5	2	18	45	0	4	22	0	5	235
2006–2007	7	2	20	37	0	4	27	1	1	289
2007–2008	5	3	16	49	1	4	19	0	3	280

[a] Excludes permit hunt harvest.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

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, following federal predator control, 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 1976–2006 the moose population in Unit 20E remained at low densities (1600–4800 moose in 8000 mi^2 of moose habitat, 0.2–0.6 moose/mi^2 of moose habitat). 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 (ADF&G) 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 shooting by ADF&G and public trapping efforts. In addition, grizzly bear hunting regulations were liberalized in 1981, causing moderate increases of grizzly bear harvest in portions of the unit, 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 2006 it remained at 0.5–0.6 moose/mi^2.

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

Historically, harvest was low in relation to the moose population and was largely restricted to the Taylor Highway corridor and the Mosquito Fork Fortymile River drainage. During the 1960s, high moose densities supported a long hunting season and a bag limit of 1 moose.

As moose numbers declined, harvest was 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. Since at least 1977, local communities have expressed concern about chronically low moose density due to predation. They proposed various predator control programs to increase moose numbers and moose harvest to meet their needs. Improved moose density prompted the Alaska Board of Game (board) to approve a 10-day bulls-only season in 1982, which continued until 1991.

Local residents and residents from Fairbanks and Southeast Alaska were the primary moose hunters in Unit 20E through 1991. During 1992–2006, more hunters from Southcentral Alaska traveled to Unit 20E to hunt moose in response to more restrictive moose hunting regulations in that area and for the opportunity to hunt moose and caribou at the same time. In response to improved moose densities the board lengthened the moose season to 15 days during 1991–2000. In response to an 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. This season structure is currently in place.

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 posthunting ratio of at least 40 bulls:100 cows in all survey areas.

INTENSIVE MANAGEMENT OBJECTIVES

Management objectives in that portion of Unit 20E within the Fortymile and Ladue River drainages are as follows:

- Maintain a population of 8000–10,000 moose.
- Maintain a harvest of 500–1000 moose annually.

METHODS

POPULATION STATUS

We conducted moose population estimation surveys in southern Unit 20E, within the Tok West and Tok Central survey areas during 2003–2006. We used a geospatial population estimator (GSPE; Ver Hoef 2001, Kellie and DeLong 2006), a modification of the Gasaway technique (Gasaway et al. 1986). In 2003 a GSPE survey was conducted in a 1200-mi^2 portion of northern Unit 20E within the Yukon–Charley Rivers National Preserve (YCNP) by the National Park Service (NPS; Burch 2003). All GSPE surveys in Unit 20E used a search intensity of about 4 min/mi^2 with no sightability correction factor. Therefore, population estimates provide numbers of observable moose with a cost-efficient, low-intensity search.

These data were used to determine population trends and composition in the survey areas and to estimate moose numbers in the entire unit by extrapolation. The Tok West, Tok Central and YCNP areas differed in habitat quality, wolf and grizzly bear population densities, and hunter use. These variables were considered when extrapolating moose density estimates throughout the unit.

The Fortymile Nonlethal Wolf Control Program (nonlethal program) was conducted in western Unit 20E, northern Unit 20D, and eastern Unit 20B during 1997–2001. To evaluate effects of the nonlethal program on moose, ADF&G surveyed portions of western Unit 20E and northern Unit 20D (Tok West study area; Boertje and Gardner 1999) during RY98–RY05 using the GSPE. The portion of this study area within Unit 20E was included in the Tok West moose survey area.

COMPOSITION SURVEYS

We estimated sex and age composition during 2003–2006 while conducting population estimation surveys in the Tok West and Tok Central survey 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.

TWINNING SURVEYS

Twinning rates were estimated during 2004–2007 from spring surveys conducted in southern Unit 20E. Reconnaissance-style twinning rate surveys were flown on 28 May 2004 (9.0 hr), 26–27 May 2005 (11.9 hr), 31 May 2006 (6.9 hr), and 29 May 2007 (16.9 hr) in areas historically used as moose calving areas. Roughly parallel contour-transects were flown at approximately ½-mile intervals at ≤500 feet above ground level in PA-18 aircraft by experienced contract pilots and ADF&G observers. All moose observed were classified as bull; yearling cow; adult cow without a calf; or adult cow with single, twin, or triplet calves. Between 1 and 2 reconnaissance flights were conducted each year prior to the twinning survey to locate an adequate number of cows. If <50% of the cows had calves, we terminated surveys, excluded the data, and attempted the survey a few days later when more cows had calved. For statistical reasons we established, a priori, a minimum sample size of 30 cows with calves. Twinning rate was calculated as the proportion of cows with twins or triplets from the sample of all cows with newborn calves.

HARVEST

Harvest was estimated from harvest reports from drawing and general season hunts (after reminder letters were sent), and during 2001–2006 within most of Unit 20E by registration permit reports. Information obtained from these 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., RY06 = 1 Jul 2006–30 Jun 2007).

HABITAT ENHANCEMENT

Natural wildfires were managed under the *Alaska Interagency Fire Management Plan* (Alaska Wildland Coordinating Group 1998). No prescribed fires were planned in Unit 20E during RY05–RY06.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Available evidence suggests the moose population in Unit 20E was much higher (1.0–1.5 moose/mi^2) in the 1960s, but has been at low density (<1.0 moose/mi^2) since the late 1970s. During 1981–2006 we conducted 12 moose density estimation surveys, which confirmed persistently low numbers. I discuss moose population trends in Unit 20E during 1981–2002 in the 2004 moose management report (Gross 2004).

The highest densities of moose were in a portion of southern Unit 20E where habitat availability and quality were highest. This area was entirely within the Tok West and Tok Central moose survey areas and included the Mosquito Fork Fortymile River drainage downstream from and including the Mosquito Flats, the West Fork Fortymile River drainage and the northern Mount Fairplay–lower Dennison Fork Fortymile River areas. Moose density averaged 0.59 moose/mi^2 (0.37–0.98 moose/mi^2) during RY03–RY06 (Table 1). The remainder of southern Unit 20E had lower moose densities, but higher densities than northern Unit 20E.

The NPS conducted population estimation surveys in northern Unit 20E within YCNP west of Washington Creek and south of the Yukon River in 1994 and 1997 and found about 0.30 moose/mi^2 during both years (Burch and Demma 1997; B. Dale, ADF&G, personal communication, Palmer). Additionally, NPS surveyed both north and south of the Yukon River, including a 1200-mi^2 portion of Unit 20E, and estimated the moose density for the entire area at 0.37 and 0.22 moose/mi^2 in 1999 and 2003 (Burch 1999, 2003). The portion of the survey area outside Unit 20E had a higher moose density than the portion within Unit 20E. Therefore, to help estimate unitwide moose numbers during RY04–RY06, I used a density estimate of 0.2–0.4 moose/mi^2 for the 1200-mi^2 portion of Unit 20E surveyed by the NPS.

No formal surveys were conducted in northeastern Unit 20E (approximately 2170 mi^2 of moose habitat) during RY03–RY06. I estimated the moose population size (0.3 moose/mi^2) in northeastern Unit 20E by including the amount of suitable moose habitat, harvest data, and the number of moose concentration areas compared to areas surveyed.

Most of the 15 wolf packs affected by the nonlethal wolf control program had recovered by 2005. Studies of the effects of the nonlethal program are ongoing (Boertje et al. 2006). No effects from the nonlethal program were apparent on the moose population in Unit 20E during RY03–RY06, presumably because grizzly bears were the major predator on moose, particularly calves, in this area (Gasaway et al. 1992). Wolves are the major predator on caribou in this area, and the nonlethal wolf control program was designed to increase caribou numbers.

RY03. The 2003 population estimate for Unit 20E was 4000–4800 moose, with an estimated density of 0.50–0.60 moose/mi^2 of moose habitat (8000 mi^2). Only habitat clearly not suitable for moose was excluded, e.g., high portions of mountains (Gasaway et al. 1986).

RY04. The 2004 population estimate was 2200–3600 moose, with an estimated density of 0.28–0.45 moose/mi^2 of moose habitat (8000 mi^2).

RY05. The 2005 population estimate was 2900–4300 moose, with an estimated density of 0.36–0.54 moose/mi^2 of moose habitat (8000 mi^2).

RY06. The 2006 population estimate was 3300–4900 moose, with an estimated density of 0.41–0.61 moose/mi^2 of moose habitat (8000 mi^2).

Predator–prey relationships between moose, wolves and brown bears in Unit 20E during RY81–RY03, were discussed previously (Boertje et al. 1987, Boertje et al. 1988, Gasaway et al. 1992, Gross 2004).

Population Composition

I discussed the moose sex and age composition trends in Unit 20E during 1981–2002 in Gross (2004). During RY98–RY02, calf survival to 5 months (≤25 calves:100 cows) was below levels expected to increase the population (≥30 calves:100 cows). Calf survival to fall was poor in RY03 in both the Tok Central and Tok West survey areas (11–15 calves:100 cows; Table 1), indicating a population decline. In RY04, calf survival to fall increased slightly (23–26 calves:100 cows), but remained below the level that might indicate a population increase.

In RY05, calf survival in the Tok West survey area increased to 30 calves:100 cows, but remained low (16 calves:100 cows) in the Tok Central survey area. Large fires in the Tok West survey area in 2004 likely contributed to higher calf survival because bears, the major predator on moose calves (Gasaway et al. 1992), avoided these areas (C. Gardner, ADF&G, unpublished data, Fairbanks). In addition, the RY04 wolf and brown bear control in the Upper Yukon–Tanana Predator Control Program (UYTPCP) may have contributed to RY05 calf survival in the Tok West survey area by reducing wolf predation on calves.

In RY06, after 2 years of wolf reductions under the UYTPCP and bear avoidance of the burns, the calf:cow ratio in the Tok West survey area was 37 calves:100 cows, while calf numbers in the Tok Central survey area remained low (24 calves:100 cows). More wolves removed through predator control as well as hunting and trapping during RY05–RY06 in the Tok West, compared to the Tok Central, survey area may have contributed to the higher calf survival in the Tok West area, but several more years of surveys are required to test whether moose numbers increase.

The Unit 20E bull:cow ratio remained above 40 bulls:100 cows each year during RY03–RY06, but varied across the unit. In the most popular hunting areas (Nine Mile Trail, Mitchell's Ranch, and along the Yukon River and Taylor Highway) bull populations were noticeably lower, but remained ≥40:100.

Twinning Rates

Twinning rates in southern Unit 20E were moderate at 24–30% in 2004, 2005 and 2007, but higher at 47% in 2006. These twinning rates indicate that nutritional status is adequate to support an increase in the moose population (Boertje et al. 2007).

Distribution and Movements

Moose are distributed throughout Unit 20E below elevations of 4500 feet. During 1984–1986 most radiocollared moose moved seasonally from lowland summer habitat to upland rutting areas, where they remained until March. In fall 1988, 1992, 1999, and 2000, early deep snowfall (>22 inches) appeared to cause moose to move to lower elevations during November.

MORTALITY

Harvest

Seasons and Bag Limit. Season and bag limits during RY03–RY06 are summarized in Table 2.

Alaska Board of Game Actions and Emergency Orders.

Predator Control — Since at least 1977, communities in and adjacent to Units 12 and 20E have expressed concern about chronically low moose densities due to predation by wolves and bears and proposed various predator control programs to increase moose numbers. During the spring 2004 board meeting, the Upper Tanana–Fortymile advisory committee and the public provided testimony to explain the problem and made proposals to increase the moose population. The board requested that ADF&G prepare a draft wolf and brown bear predation control implementation plan. ADF&G then developed the UYTPCP to increase moose survival in portions of Units 12 and Unit 20E.

At their November 2004 meeting, the board approved the UYTPCP, which allowed the department to conduct a wolf and brown bear population reduction or regulation program for up to 5 years, beginning 1 January 2005 in the Upper Yukon–Tanana predator control area in Units 12 and 20E. Wolf control was approved for a 6600-mi^2 area in southern Unit 20E and the portion of Unit 12 north of the Alaska Highway and west of the Taylor Highway. Grizzly bear control was approved for a 2700-mi^2 portion of southern Unit 20E to reduce predation on moose calves.

During the May portion of the spring 2006 meeting, the board enlarged the Upper Yukon–Tanana predator control area to 18,750 mi^2 to include most of the Fortymile caribou herd's annual range largely to benefit the caribou herd. Wolf control was authorized for the entire predator control area. Brown bear control was limited to a 4050-mi^2 portion of southern Unit 20E to reduce predation on moose calves.

Other Actions: During the spring 2000 meeting, the board created a registration permit hunt in Unit 20E (excluding the Middle Fork Fortymile River) and 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 also stipulated that a hunter could hunt both moose and caribou, but not hold a registration permit for both species at the same time. These actions were in response to increased moose harvest due to increasing numbers of caribou hunters in most of Unit 20E and were designed to stabilize moose harvest to maintain the bull:cow ratio within the management objective.

During the spring 2002 meeting, the board reduced the season within the Yukon River drainage to match the season in the remainder of Unit 20E (24–28 Aug and 8–17 Sep). To encourage hunters to harvest more grizzly bears to benefit moose calf survival, the board also eliminated the grizzly bear tag fee requirement for resident hunters in Unit 20E except in the Yukon–Charley Rivers National Preserve.

In spring 2000 the board also identified the moose population within the Fortymile and Ladue River drainages as important for providing 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 a reduction in harvest becomes necessary because of dwindling moose numbers or productivity. The board established the moose population objective within the Fortymile and Ladue River drainages at 8000–10,000 moose with an annual harvest objective of 500–1000 moose.

In May 2006 the board identified the entire Unit 20E moose population as being important for providing high levels of human consumptive use and applied the intensive management objectives of 8000–10,000 moose and harvest of 500–1000 to the entire unit.

Harvest by Hunters. During RY03–RY06, reported harvest during the general season remained stable, averaging 122 (93–137) bull moose annually (Table 3), about 3% of the estimated population. The average reported harvest for RY98–RY02 was 142 (127–169). The number of hunters in Unit 20E increased from 472 in RY98 to 913 in RY02, but remained below the 2002 level during RY03–RY06 ($\bar{x}$ = 653, range = 484–798). Probable causes for the increase in hunter participation during RY98–RY02 include: 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 15-day any bull bag limit with relatively long season dates gave hunters a false impression that numbers of moose were high; and 4) more hunters came looking for large-antlered bulls. Probable causes for the subsequent decline in hunter participation during RY03–RY06 include: 1) increasing opportunity for antlerless moose hunting in Unit 20A and increasing moose densities in southwest Unit 20D drew hunters away from Unit 20E, where they experienced low success rates; 2) hunters learned that the relatively liberal any bull bag limit in Unit 20E was not an indication of high moose densities; 3) the extensive fires in Unit 20E during 2004 created poor hunting conditions and hunters were discouraged from coming to Unit 20E that year; and 4) the Fortymile caribou season closed in Unit 20E near the Taylor Highway before the moose season began in RY05 and RY06.

Permit Hunts. Two winter drawing permit hunts (DM794 and DM796) occurred within portions of the Ladue River Controlled Use Area. These hunts allowed greater hunting opportunity in remote areas that supported a high proportion of bulls (>60 bulls:100 cows) but were rarely hunted due to difficult access in the fall.

During RY03–RY06, 3 DM794 and 7 DM796 permits were issued annually. Two bulls were harvested in the DM794 hunt (1 each in RY04 and RY05) and no bulls were harvested in the DM796 hunt (Table 3). During RY03–RY06, an average of 60% of DM794 permit holders hunted each year, and an average of 39% of DM796 permit holders hunted. Hunting conditions, including access, were extremely difficult with unpredictable snow conditions and extreme cold. This likely accounted for the low participation in these hunts. Hunters who applied for these hunts often expected an easy moose hunt, but once they determined how remote the hunt areas were and how difficult the conditions could be, many hunters chose not to participate. In addition, hunters indicated that during RY03–RY06 they were searching for larger bulls than the bulls that had been taken in previous years. I will continue to encourage hunters to travel to this remote area when snow conditions allow, to harvest large bulls with antlers ≥60 inches.

Hunter Residency and Success. Of the 93–137 bulls harvested annually during the general and registration hunt in RY03–RY06, 59–65% were taken by nonlocal Alaska residents (Table 4). Prior to 1992, most nonlocal hunters were from Interior and Southeast Alaska, but since RY92 most nonlocal hunters were from Southcentral Alaska. Nonlocal hunters made up 61–66% of the hunters during RY03–RY06. Local hunters represented 21–25% of the hunters and took 15–21% of the harvest. Nonresident hunters were prohibited from hunting moose in Unit 20E during RY83–RY90. During RY91–RY02, nonresidents represented 9% of the hunters and accounted for an average of 9% of the harvest. During RY03–RY06, nonresidents represented an average of 13% (12–14%) of the hunters and took and average of 19% (13–21%) of the harvest. Hunter residency and success during RY05–RY06, remained similar to that reported during RY03–RY04.

Hunter success was 16–22% during RY03–RY06. Success rate declined from an average of 28% during RY93–RY00 to an average of 19% during RY01–RY06. This decline was likely primarily due to more restrictive regulations and perhaps lower bull:cow ratios in accessible areas.

Harvest Chronology. During RY90–RY94, an average of 35 bulls were harvested during 1–6 September, averaging 40% (range = 27–50%) of the fall harvest. During RY95–RY00, total harvest during 1–6 September remained the same (36 bulls) but represented only 25% of the harvest (range = 16–33%). As hunter numbers increased, a greater percentage hunted later in the season.

During RY93–RY00, 16–42 bulls ($\bar{x}$ = 31) were harvested during the first five days of hunting, 1–5 September. In RY01 the hunting season in most of Unit 20E was split into 2 periods: 24–28 August and 8–17 September. During RY01–RY06, 2–14 bulls ($\bar{x}$ = 9) were harvested during 24–28 August, a 71% reduction in the average harvest during the first 5 days of the general season (Table 5). August harvest during RY05–RY06 remained at levels similar to those reported during RY01–RY04.

Transport Methods. During RY01–RY06 there was an increase in the percentage of moose harvested by hunters who used 4-wheelers and a decrease in use of highway vehicles compared to previous years. Use of 4-wheelers increased from an average of 28% (range = 22–32%) during RY92–RY00, to an average of 39% (range = 34–49%) during RY01–RY06 (Table 6). In addition, the proportion of moose taken by hunters who used highway vehicles declined substantially from an average of 21% during RY92–RY00 to an average of 13% during RY01–RY06. This is coincident with the decline in the roadside bull:cow ratios and more restrictive regulations during RY01–RY06. The number of hunters who used other transportation types and the harvest associated with these transportation types remained relatively constant. There was little variation transportation type used by those who successfully harvested a moose during RY05–RY06 compared to RY01–RY04.

In combination with the increasing number of hunters, increasing access by 4-wheelers is a growing management concern in portions of Unit 20E. Increasing quality and dependability of all-terrain vehicles (ATVs) allowed hunters to access areas further from roads that had previously been refugia for moose. These hunters tended to have a concentrated effect on moose in areas along trail systems.

Other Mortality

Predation by wolves and grizzly bears was identified as the greatest source of moose mortality in Unit 20E (Gasaway et al. 1992) and maintained the population at a low density (0.32–0.64 moose/mi^2). Boertje et al. (2009) summarized proportions of postcalving moose populations killed in 4 studies in Alaska and Yukon; 31% of the southern Unit 20E postcalving moose population was killed by wolves and bears in the early 1980s compared with 41% in the southwestern Yukon, 34% near McGrath prior to predator control, and 19% south of Fairbanks after predator control.

HABITAT

Assessment

Availability of browse in Unit 20E did not appear to limit moose population growth. Past browse studies found that use of preferred browse plants was less than 5% (Boertje et al. 1985). While habitat may have improved since then, the moose population has not increased. Currently, the greatest expanse of excellent habitat is in southern Unit 20E as a result of 2 large wildfires (>1,000,000 acres) during the mid 1960s. This area supports the greatest moose densities in the unit (0.7–1.0 moose/mi^2). Prescribed fires and wildfires burned over 400,000 acres during 1998–1999 and >1.2 million acres within or adjacent to Unit 20E in 2004–2005. Habitat quality in these areas is expected to improve during the next 10–15 years.

Enhancement

The *Alaska Interagency Wildland Fire Management Plan* (Alaska Wildland Fire Coordinating Group 1998) restored a near-natural wildfire regime to over 60% of Unit 20E. Under the plan, most state and federal land was assigned limited fire protection. Nearly all land selected by or conveyed to Native corporations was assigned 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 with marketable timber. More acceptance of fire as a management

tool has occurred in 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 ADF&G, in cooperation with the Alaska Department of Natural Resources, to prescribe burn 90,000 acres during 1998 and 1999 in central Unit 20E. Costs 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 have begun to increase and are expected to continue to increase over the next 15–20 years, likely due in part to lessened grizzly bear densities in large burns in Unit 20E (C. Gardner, unpublished data).

In RY03 one wildfire burned 2400 acres of moose habitat in Unit 20E. In RY04 and RY05, over 1 million (1600 mi^2) and 187,000 acres (290 mi^2), respectively, of moose habitat burned within or immediately adjacent to Unit 20E due to extremely dry conditions. These were the most substantial fire years on record in Unit 20E. In RY06, wet conditions resulted in a low fire year with only 4800 acres of moose habitat burned. The large fires of RY04 and RY05 are expected to contribute significantly to moose habitat quantity and quality for the next 30–40 years. By RY06, benefits to the moose population were already being realized in much of the burned areas, primarily due to aspen and willow regeneration.

CONCLUSIONS AND RECOMMENDATIONS

Population estimates during RY05–RY06 indicated we did not meet the unitwide intensive management objectives of 8000–10,000 moose with an annual harvest of 500–1000 moose. Unitwide harvest of 137 and 130 moose during RY05 and RY06, respectively, was well below the intensive management objective. During RY01–RY04 the moose population declined and was estimated at 0.28–0.45 moose/mi^2 in fall 2004. During RY05–RY06 the population remained stable to slightly increasing and was estimated at 2900–4900 moose in the 8000 mi^2 of moose habitat (0.36–0.61 moose/mi^2).

Predation by wolves and grizzly bears was the primary factor limiting the moose population. Unitwide wolf predation on moose may continue at a reduced rate during the next few years. Wolf numbers were reduced in portions of southern Unit 20E for the past 9 winters (RY98–RY06) and further reductions in wolf numbers may be forthcoming. Brown bear numbers were not reduced under the UYTPCP; however, the revised UYTPCP implemented in RY06 allows more liberal methods of taking brown bears and could result in a reduced brown bear population over the next few years.

I recommend both wolf and brown bear numbers be further reduced in an attempt to approach the unitwide moose population objective. We continued to meet the management objective of 40 bulls:100 cows. Human-induced mortality had little impact on the moose population but caused some reduction in local bull:cow ratios. Annual posthunt harvest rates were historically less than 2% of the fall population estimate but increased above 2% of observable moose in RY95 and were 2.5–3.5% during RY97–RY06, with a 3.3% and 3.2% harvest rate in RY05 and RY06 respectively.

The number of moose hunters in Unit 20E increased significantly (P = 0.001) from RY91 to RY06. Most of the additional hunters were from Southcentral Alaska. As during previous years, the preferred transportation type during RY05–RY06 was 4-wheelers.

Maintaining a sustainable moose harvest is a management challenge in Unit 20E. Our primary concern is the increasing number of hunters. Regulatory changes reduced high incidental take of moose by caribou hunters, but as harvest regulations became more restrictive in other units along the road system, more moose hunters were displaced to Interior units, including Unit 20E. The split hunting season throughout Unit 20E and the shortened season along the Yukon River appears to have reduced hunter efficiency and lowered harvest. If these harvest management methods do not hold the harvest at current levels, more restrictive regulations will be necessary to maintain the desired bull:cow ratio. The moose population must increase before the sustainable harvest can be increased (Boertje et al. 2009).

Since the late 1990s more local residents have accepted the role of fire in improving moose habitat in Unit 20E. During 2004 and 2005, over 1600 mi^2 of Unit 20E moose habitat burned in wildfires. Under the current Division of Forestry and Bureau of Land Management leadership, the interagency fire management plan has a great chance of benefiting the moose population.

For the next reporting period, the objectives will be changed slightly to reflect the 2006 Board of Game change to make the intensive management objectives pertain to all of Unit 20E instead of the area restricted to the Fortymile and Ladue River drainages:

MANAGEMENT OBJECTIVE

- Maintain a posthunting ratio of at least 40 bulls:100 cows in all survey areas.

INTENSIVE MANAGEMENT OBJECTIVES

- Maintain a population of 8000–10,000 moose.
- Maintain a harvest of 500–1000 moose annually.

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TABLE 1 Unit 20E moose population estimates, fall 1998–2007

Year	Bulls:100 Cows	Yearling bulls:100 Cows	Calves:100 Cows	Percent calves	Total moose observed	Density estimate	Population estimate
1998[a]	64	18	19	10	278	0.56 (90% CI±44%)	1086 (90% CI±44%)
1998[b]	59	14	23	14	450	0.62 (90% CI±25%)	1694 (90% CI±25%)
1999[a]	80	16	22	10	365	0.47 (90% CI±20%)	901 (90% CI±20%)
2000 [a]	60	11	14	8	561	0.58 (90% CI±19%)	1115 (90% CI±23%)
2000[c]	49	11	21	13	347	0.70 (90% CI±24%)	1272 (90% CI±24%)
2001[a]	76	9	14	7	531	0.47 (90% CI±19%)	915 (90% CI±17%)
2001[d]	51	6	10	6	624	0.75 (90% CI±23%)	2026 (90% CI±23%)
2002[a]	59	10	25	14	364	0.60 (90% CI±19%)	1166 (90% CI±27%)
2002[d]	71	8	20	10	396	0.63 (90% CI±28%)	1707 (90% CI±28%)
2003[e]	64	9	15	9	355	0.58 (90% CI±25%)	1128 (90% CI±25%)
2003[d]	53	5	11	6	297	0.51 (90% CI±23%)	1379 (90% CI±23%)
2004[f]	61	11	26	14	283	0.59 (90% CI±22%)	1435 (90% CI±22%)
2004[g]	48	11	23	14	233	0.37 (90% CI±19%)	802 (90% CI±19%)
2005[f]	55	13	30	16	543	0.73 (90% CI±17%)	1801 (90% CI±17%)
2005[g]	48	8	16	10	344	0.50 (90% CI±19%)	1097 (90% CI±19%)
2006[f]	39	9	37	20	584	0.98 (90% CI±19%)	2398 (90% CI±19%)
2006[g]	46	3	24	14	520	0.45 (90% CI±19%)	979 (90% CI±19%)
2007[f]	50	11	30	16	503	0.86 (90% CI±18%)	2098 (90% CI±18%)
2007[g]	46	11	22	13	440	0.62 (90% CI±22%)	1348 (90% CI±22%)

[a] Tok West Survey Area (1932 mi^2) sampled using the geospatial population estimator (GSPE) sampling method (Ver Hoef 2001).
[b] Tok Central Survey Area (2750 mi^2) sampled using GSPE.
[c] Tok Central Survey Area (1821 mi^2) sampled using GSPE.
[d] Tok Central Survey Area (2703 mi^2) sampled using GSPE.
[e] Tok West Survey Area (1944 mi^2) sampled using GSPE.
[f] Tok West Survey Area (2452 mi^2) sampled using GSPE.
[g] Tok Central Survey Area (2178 mi^2) sampled using GSPE.

TABLE 2 Unit 20E moose hunting seasons and bag limits, regulatory years 2003–2004 and 2006–2007

Regulatory year	Area		Season	Bag limit[a]
2003–2004	Unit 20E draining into the Middle Fork Fortymile River upstream from the drainage of the North Fork Fortymile River.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull, or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.
	Remainder of Unit 20E.	RESIDENT:	Registration 24–28 Aug Registration 8–17 Sep Drawing 1–30 Nov	1 bull by permit RM865, or 1 bull by permit RM865, or 1 bull by permit DM794–DM796 in the Ladue River Controlled Use Area.
		NONRESIDENT:	Registration 8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by permit RM865.
2004–2005 through 2006–2007	Unit 20E drainages of the Middle Fork Fortymile River upstream from and including the Joseph Creek drainage.	RESIDENT:	24–28 Aug 8–17 Sep	1 bull, or 1 bull.
		NONRESIDENT:	8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side
	Remainder of Unit 20E.	RESIDENT:	Registration 24–28 Aug Registration 8–17 Sep Drawing 1–30 Nov	1 bull by permit RM865, or 1 bull by permit RM865, or 1 bull by permit DM794–DM796 in the Ladue River Controlled Use Area.
		NONRESIDENT:	Registration 8–17 Sep	1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by permit RM865.

[a] Fifty-inch antlers are defined as having a spread of at least 50 inches or at least 4 brow tines on at least one side.

TABLE 3 Unit 20E moose harvest and accidental death, regulatory years 1998–1999 through 2006–2007

Regulatory year	General and registration harvest							Drawing permit harvest		Accidental death		Total
	Reported				Estimated							
	M (%)	F (%)	Unk	Total	Unreported	Illegal	Total	DM794	DM796	Road	Total	
1998–1999	145 (100)	0 (0)	5	150	0–5	5–10	5–15	1	10	0	0	166–176
1999–2000	127 (100)	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 (100)	0 (0)	1	138	0–5	5–10	5–15	5	3	0	0	151–161
2002–2003	169 (100)	0 (0)	1	170	0–5	5–10	5–15	1	3	0	0	179–189
2003–2004	129 (100)	0 (0)	0	129	0–5	5–10	5–15	0	0	0	0	134–144
2004–2005	93 (100)	0 (0)	1	94	0–5	5–10	5–15	1	0	0	0	100–110
2005–2006	137 (100)	0 (0)	0	137	0–5	5–10	5–15	1	0	0	0	143–153
2006–2007	129 (99)	1 (1)	0	130	0–5	5–10	5–15	0	0	0	0	135–145

TABLE 4 Unit 20E moose hunter residency and success during the general and registration hunt season, regulatory years 1998–1999 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[a] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
1998–1999	47	91	12	0	150 (32)	76	205	39	2	322 (68)	472
1999–2000	36	77	17	1	131 (23)	98	299	30	4	431 (77)	562
2000–2001	36	84	15	0	135 (26)	98	255	33	1	387 (74)	522
2001–2002	33	88	16	1	138 (19)	222	323	58	4	607 (81)	745
2002–2003	29	119	20	1	169 (18)	200	449	92	3	744 (82)	913
2003–2004	21	81	26	1	129 (16)	143	448	74	4	669 (84)	798
2004–2005	20	55	19	0	94 (19)	102	238	47	3	390 (81)	484
2005–2006	25	83	29	0	137 (22)	129	311	58	1	499 (78)	636
2006–2007	27	85	18	0	130 (19)	131	364	68	2	565 (81)	695

[a] Residents of Unit 12 and Unit 20E and eastern Unit 20D are considered local residents. Major population centers are Eagle, Chicken, Boundary, Northway, Tetlin, Tok, Tanacross, Slana, and Dot Lake.

TABLE 5 Unit 20E moose harvest chronology by month/day during the general hunt, regulatory years 1998–1999 through 2006–2007

Regulatory year	Harvest chronology by month/day							Total[a]
	8/15–8/31	9/1–9/6	9/7–9/13	9/14–9/20	9/21–9/27	9/28–10/5	11/1–11/30	
1998–1999	0	35	78	23	6	2	11	161
1999–2000	0	30	57	28	13	0	12	143
2000–2001	1	22	61	41	8	0	8	143
2001–2002	14	0	71	43	7	0	8	146
2002–2002	7	0	103	51	2	0	4	173
2003–2004	8	3	76	32	0	1	0	129
2004–2005	2	2	57	30	1	0	1	94
2005–2006	12	4	73	44	2	0	1	137
2006–2007	11	0	72	43	2	0	0	130

[a] Difference between total and summation of harvests by week represents moose taken on unknown dates.

TABLE 6 Unit 20E moose harvest and percent by transport method during the general season, regulatory years 1998–1999 through 2006–2007

Regulatory year	Harvest and percent (%) by transport method								
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	*n*
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
2002–2003	44 (26)	1 (1)	17 (10)	65 (38)	4 (2)	20 (12)	16 (9)	3 (2)	170
2003–2004	37 (29)	2 (2)	7 (5)	53 (41)	0 (0)	15 (12)	12 (9)	3 (2)	129
2004–2005	20 (21)	1 (1)	8 (9)	32 (34)	1 (1)	15 (16)	17 (18)	0 (0)	94
2005–2006	27 (20)	1 (1)	15 (11)	48 (35)	1 (1)	27 (20)	17 (12)	1 (1)	137
2006–2007	27 (21)	0 (0)	13 (10)	46 (35)	0 (0)	20 (15)	23 (18)	1 (1)	130

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNITS: 21A (10,797 mi^2) and 21E (7,995 mi^2) (18,792 mi^2 combined)[2]

GEOGRAPHIC DESCRIPTION: Unit 21A, the Innoko River drainage upstream from and including the Iditarod River drainage; and the Nowitna River drainage upstream from the confluence of the Little Mud and Nowitna Rivers (beginning 1 Jul 2006, Unit 21A no longer includes the upper Nowitna drainage). Unit 21E, the Yukon River drainage from Paimiut upstream to, but not including, the Blackburn Creek drainage, and the Innoko River drainage downstream from the Iditarod River drainage.

BACKGROUND

Currently, moose are found throughout Units 21A and 21E. The major factors influencing moose abundance in the area include predation, weather, and hunting. Hunting pressure is thought to be low to moderate except in a few easily accessible areas. Low harvest reporting rates, particularly by local residents, is a continuing issue.

Units 21A and 21E have distinct differences in moose habitat, user access, and hunting practices. Unit 21A contains the upper Innoko River drainage and access is largely restricted to aircraft. Few people live in Unit 21A, and those who travel there are primarily nonlocal Alaskans and nonresidents. Unit 21E contains the lower Innoko and the adjoining Yukon River, a number of communities, including Anvik, Grayling, Holy Cross, and Shageluk, and is easily accessible by boat. Hunters in Unit 21E are generally local residents from Units 18 and 21E; however, nonresidents and other Alaskans also use the area.

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

[2] As of 1 July 2006, Unit 21A no longer includes the upper Nowitna drainage; this change reduced Unit 21A by 4476 mi^2, so the combined size of Units 21A and 21E is now 18,792 mi^2.

The Alaska Department of Fish and Game (ADF&G) has limited information on the moose population in Unit 21A and in recent years has conducted 1 fall composition count (15 Nov 2007). Density estimates conducted by Innoko National Wildlife Refuge (INWR) as well as extrapolated data from Unit 21E have been used to estimate moose numbers in Unit 21A. In Unit 21E, aerial composition surveys as well as geospatial population estimator (GSPE) surveys (Ver Hoef 2001) have been the primary means of assessing population status and trend.

In general, long-term historical moose survey information is limited. Changes in moose survey techniques and the logistical challenges of moose surveys in remote areas have resulted in a discontinuous database of moose counts that often are not comparable. As a result, we use proportions of large bulls in the harvest to evaluate whether harvest is having an adverse effect on bull numbers. In heavily hunted areas, the proportion of large bulls in the harvest declines rapidly and remains low.

Regulations used to manage moose hunting and reduce conflicts between user groups have existed in the area for many years. The Paradise Controlled Use Area (CUA) is closed to the use of aircraft for hunting moose, restricting access primarily to local residents with boats. This CUA includes the area between the Innoko River and the Yukon River and falls primarily within Unit 21E.

MANAGEMENT DIRECTION

In 2005 a planning effort was initiated to establish management direction for Units 21A and 21E. The Yukon–Innoko Moose Management Plan (YIMMP) emerged from this effort in December 2006 (Alaska Department of Fish and Game 2006). This plan established that future management of moose in the area would be proactive in order to maintain an abundant moose population which provides for high levels of human consumptive use. The following management goals, objectives, and activities were based on recommendations in the YIMMP:

MANAGEMENT GOALS

- Work toward achieving the intensive management moose population objective in Unit 21E of 9000–11,000.
- Work toward achieving the intensive management moose harvest objective in Unit 21E of 550–1100.
- Work to ensure the moose population is stable or growing, using current population, habitat, harvest, predation, and weather data.
- Maximize hunting opportunity when possible while ensuring that harvest remains within sustained yield and there is a priority for subsistence use.

MANAGEMENT OBJECTIVES

Population Objectives

- Maintain or increase moose numbers and harvest levels in Unit 21A.

- Maintain a minimum posthunt bull:cow ratio of 25–30 bulls:100 cows.
- Maintain a minimum posthunt calf:cow ratio of 30–40 calves:100 cows.
- Maintain a minimum calf overwinter survival of 20% of the total population in late winter moose population surveys.

Harvest Objectives

- Maintain a harvest of <4% of the estimated moose population, until the intensive management population objective has been achieved.
- Provide for the harvest of approximately 310 moose in Unit 21E by residents of Unit 21E and other Alaska residents.
- Provide for a harvest of up to 40 antlerless moose in winter.

MANAGEMENT ACTIVITIES

- Conduct a moose twinning survey in Unit 21E every spring.
- Conduct a moose composition survey in Unit 21E every other fall.
- Conduct early winter composition surveys in Unit 21A every 2–3 years.
- Conduct a moose population estimation survey in Unit 21A in spring 2008.
- Conduct a moose population estimation survey in Unit 21E in spring 2010.
- Develop information and education programs to encourage better harvest reporting and understanding of state and federal hunting regulations.
- Work with tribal councils to track winter harvest of moose.
- Maintain the Paradise Controlled Use Area.
- Implement a permit hunt in Unit 21E to cap nonresident harvest at 30 bulls.
- Increase harvest of predators through liberalized regulations.
- Prepare an intensive management plan for the March 2008 Alaska Board of Game meeting.
- Ensure optimal moose habitat is maintained so that it does not become a factor limiting moose productivity.

METHODS

Twinning surveys were conducted in Unit 21E during early June 2000, 2002, 2003, 2004, and 2007. Surveys were flown in east–west transects along the Yukon River from Paimiut to Holy Cross and then between the Yukon and Innoko Rivers from Holy Cross north to Anvik and from Holy Cross to Shageluk.

Estimates of moose numbers in Unit 21E were derived from aerial surveys in February 2000 and March 2005 using GSPE methods (Kellie and DeLong 2006). Surveys were conducted in a 5070-mi^2 area in eastern Unit 21E and extrapolated to all of Unit 21E. In 2005, 150 randomly selected sample units were surveyed (98 high density sample units and 52 low density sample units). Survey time averaged 38 minutes per sample unit (6.3 min/mi^2).

In November 2007 we flew a fall composition survey in Unit 21E between the Innoko and Yukon Rivers. Transects were flown east to west approximately ¾ of a mile apart beginning at a point 14 miles south of Shageluk and ending at a point 5 miles north of Holy Cross. Each moose or group was circled to determine composition.

In November 2007 a fall composition survey was conducted in Unit 21A beginning at the INWR cabin (63°38.34'N, 158°01.84'W) on the Innoko River to the confluence with the North Fork Innoko River. Transects were flown north–south approximately ¾ of a mile apart to Rennie's Landing. At that point the river flows more northerly, so transects were then flown east–west. Each moose or group of moose was circled to determine sex and age class.

Innoko National Wildlife Refuge has conducted aerial moose density estimates since 1994 in Unit 21A using a line transect method (S. Kovach, Innoko National Wildlife Refuge, McGrath, personal communication), primarily along river corridors. We derived estimates for Unit 21A based on INWR survey data in Unit 21A and extrapolated ADF&G survey data from Unit 21E.

Two methods were used to determine harvest in Units 21A and 21E. First, we used harvest ticket reports, on which hunters report residency, effort, location of hunt, transportation method, commercial services used, success, sex of kill, and antler width. Second, ADF&G–Division of Subsistence conducted household surveys to determine the number of moose harvested by local residents. Population and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 Jul 2005–30 Jun 2006).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

Unit 21A. Based on survey data from INWR, and ADF&G data extrapolated from Unit 21E, we estimate there are 4300–6480 moose in the unit (0.4–0.6 moose/mi^2). Survey data from INWR indicate that moose densities declined in Unit 21A during 1998–2002.

Unit 21E. The February 2000 GSPE survey indicated a density of 1.0 observable moose/mi^{2,} or 5151 moose ±13% (90% CI) in the survey area. Survey results in March 2005 indicated a density

of 0.9 observable moose/mi^2 or 4673 moose ±17% (90% CI) in the survey area. These survey results are not statistically different and indicate the winter moose population in Unit 21E was likely stable during 2000–2005. The current estimate for all moose in Unit 21E is 7000–9000.

Population Composition

We conducted a fall composition count in Unit 21A on 15 November 2007 and found 36 bulls:100 cows and 36 calves:100 cows.

A fall composition count was conducted in Unit 21E on 7 November 2007 for the first time since 1998. We found 74 bulls:100 cows and 66 calves:100 cows. The high bull:cow ratio suggests one or more of the following: 1) hunting pressure is low, 2) hunting pressure is low in areas away from the river, 3) harvest of cows is significant, 4) the nonresident take has decreased after the institution of the drawing permit hunt in RY07, or 5) transient moose (with a higher percentage of bulls) moved into the area for winter.

Unit 21E twinning surveys indicated 14/36 (38%), 8/40 (20%), 14/47 (30%), 9/28 (32%), and 7/25 (28%) of observed cows had twins during early June 2000, 2002, 2003, 2004, and 2007, respectively.

Distribution and Movements

During the 1980s, ADF&G cooperated with INWR and the Bureau of Land Management on a moose radiotelemetry study in which 15 cows and 20 bulls were radiocollared. Approximately half the cows and 25% of the bulls spent the entire year in the lowlands. Most of the remaining moose spent winters in the lowlands and summers in the mountains. Two bulls spent the entire year in the mountains, and 1 bull and 1 cow showed extreme movements. The bull was captured near Holikachuk in Unit 21E and spent summers in the upper Iditarod River area. The cow was captured north of Holy Cross and spent summer downriver of Mountain Village in Unit 18.

MORTALITY

Harvest

Seasons and Bag Limits. Bag limits and season dates by regulatory year.

Unit and bag limits	Open season
RY05	
Unit 21A within the Nowitna River drainage	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–20 Sep
Remainder of Unit 21A	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–25 Sep

Unit and bag limits	Open season
Unit 21E	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–25 Sep
RY06	
Unit 21A	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–20 Sep
Unit 21E	
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.	5 Sep–20 Sep

Alaska Board of Game Actions and Emergency Orders. At the January 2006 Alaska Board of Game meeting, the board revised the boundary between Units 21A and 21B. The upper Nowitna River drainage was transferred from Unit 21A to Unit 21B, so Unit 21A now encompasses only the Innoko River drainage. At the spring 2006 meeting, the board reduced the nonresident season in Unit 21E by 5 days, to align it with the season in Unit 21A, and established a nonresident drawing permit hunt in Unit 21E, which hunters apply for during the winter drawing period. The first permit hunt occurred in RY07.

Harvest by Hunters. Harvest by hunters during RY02–RY06 is reported in Tables 1a and 1b. During this time, annual harvest in Unit 21A was lowest in RY06. In Unit 21E, annual harvest was lowest in RY04 and RY05. The YIMMP suggests the nonreporting rate is 50% in Unit 21E.

Permit Hunts. There were no permit hunts in Units 21A or 21E during RY05–RY06. Beginning in RY07 however, nonresidents will be required to obtain drawing permits to hunt moose in Unit 21E.

Hunter Residency and Success. Hunter residency in Unit 21A has been mixed, with few local hunters and more nonresident than resident hunters in some years. During RY05–RY06 the majority of hunters, including hunters in both Units 21A and 21E, were Alaska residents (Tables 2a and 2b). In Unit 21E a large number of hunters were locals from Anvik, Grayling, Holy Cross, and Shageluk (Table 2b), though most hunters were nonlocal Alaskans.

From RY02 to RY06, average reported success was 34% in Unit 21A (range = 22–45%) and 58% in Unit 21E (range = 50–66%). Success rates declined slightly during RY05–RY06 to 31% in Unit 21A and 56% in Unit 21E.

Antler Size. From RY02 through RY06 the average antler size of harvested bulls in Unit 21A (49.5 inches) remained larger than in Unit 21E (45.7 inches). However, Unit 21A had a high

proportion of nonresident hunters, who were required to take bulls with a minimum antler size of 50 inches or at least 4 brow tines on one side. Unit 21E had a higher proportion of resident hunters who hunted without antler restrictions.

Transport Methods. During RY05–RY06, as in previous years, aircraft and then boats were the most common methods of hunter transportation in Unit 21A (Table 3a). In Unit 21E, boats followed by aircraft were the most commonly used methods of transportation (Table 3b).

Other Mortality

Predation is an important factor affecting moose population dynamics in Units 21A and 21E, based on calf mortality studies in adjacent areas on the lower Nowitna, Koyukuk, and Kuskokwim drainages (Osborne 1991, Gasaway et al. 1992, Boertje et al. 2009; M. Keech, ADF&G, unpublished data). Based on information from local residents, guides and transporters, predation on moose has increased in recent years, and these groups believe moose populations are declining. However ADF&G surveys in 2000 and 2005 have not detected a statistically significant decline in the Unit 21E population.

Data are incomplete for moose harvested for mortuary or ceremonial potlatches during RY05–RY06 because records were lost when the ADF&G office burned down at the end of 2006. One moose was taken under these regulations during January–June 2007.

HABITAT

Assessment

In forested regions of Interior Alaska, abundant moose browse is generally associated with recent disturbance, such as flooding of riparian habitats and post-fire seral stages on upland sites. Riparian habitat in Units 21A and 21E is found along the Yukon and Innoko Rivers and their tributaries. Additional riparian habitat exists along smaller creeks and around boreal lakes and ponds.

In spring 2006, ADF&G conducted a moose browse survey in Unit 21E. Snow depth and age of dominant plant species were recorded at 77 sites. Observers noted abundant felt leaf willow on the islands and floodplain of the middle Yukon River and diamond leaf willow in extensive meadows adjacent to the Yukon and lower Innoko Rivers. Overall, browse availability was less abundant than historic highs because the last major flooding disturbance on the Yukon River was in the early 1970s. This has allowed willow on the higher terraces to grow beyond the reach of moose. Snow was also deep enough during these surveys to restrict movements of moose.

A direct measure of carrying capacity is difficult to estimate for free-ranging wildlife populations due to variability in habitat composition at the landscape scale. Additionally, annual weather conditions influence forage production of both summer and winter range and affect winter energy expenditure. Based on browse removal rates and twinning rates in Unit 21E, nutritional status was adequate to support growth of the moose population (Boertje et al. 2007). Thus nonnutritional factors are likely limiting growth of the moose population (Boertje et al. 2009).

Enhancement

Allowing natural forces to create or rehabilitate successional forage communities used by moose is a good long-term strategy. We continued to cooperate with fire management personnel at the Alaska Department of Natural Resources–Division of Forestry to ensure that natural fires are allowed to burn wherever possible.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

In January 2005 a citizen advisory group called the Yukon–Innoko Moose Management Working Group (working group) convened to develop a plan which would proactively manage moose populations in the area. The YIMMP was the result of this process and was finalized in December 2006.

The YIMMP recommended managing predation on moose to maintain an abundant moose population for human consumptive use. In 2007 we drafted an intensive management plan and work is currently being conducted to finalize this plan for presentation to the Alaska Board of Game in March 2009. As part of this process a GSPE moose survey and a wolf survey are planned for early 2009 to collect necessary baseline information.

Maintaining or improving moose habitat was also recommended by the working group and habitat quality was assessed in Unit 21E in 2005. However, no habitat work has been conducted in Unit 21A. Continued habitat assessments in Unit 21E as well as new work in Unit 21A should be conducted to ensure nutrition is adequate to support growth of the moose population.

Land management in Units 21A and 21E is complex, with a mix of federal, state, and Native lands. The working group identified the need to develop cooperative management programs which involve local residents and improve overall moose management in the area.

CONCLUSIONS AND RECOMMENDATIONS

No population estimate has been conducted in Unit 21A and it is uncertain if we met our objective to maintain or increase moose numbers in Unit 21A. Harvest has decreased in Unit 21A and the objective to maintain or increase harvest in Unit 21A did not occur. The posthunt objective of 25–30 bulls:100 cows was met, with 36:100 in Unit 21A and 74:100 in Unit 21E. The posthunt objective of 30–40 calves:100 cows was met with 36:100 in Unit 21A and 66:100 in Unit 21E. The objective to maintain calf overwinter survival of 20% of the late winter population may not have been met in Units 21A or 21E.

The objective to maintain harvest below <4% in both Units 21A and 21E was met in RY05–RY06. The management objective to provide for a harvest of approximately 310 moose for residents of Unit 21E and other Alaska residents was not met during RY05–RY06. We did not meet the objective to provide for a winter harvest of up to 40 moose in Unit 21E, as the winter season was closed.

Moose populations over the reporting area appear to be stable to declining, although ADF&G has not conducted a moose population estimate in Unit 21A in recent years. More data are available for Unit 21E; and GSPE surveys conducted in February 2000 and March 2005

indicated that calves made up 16% and 18% of the population, respectively, indicating good production and survival. Twinning surveys on the lower Innoko River in Unit 21E indicate high twinning rates and nutritional status appears adequate to support population growth.

The YIMMP was developed in 2006, and should guide moose management in Units 21A and 21E. This plan identifies both harvest and population goals, as well as many other management objectives. The plan was adopted by local residents, the Alaska Board of Game, and the Federal Subsistence Board.

In addition to management guidance in the YIMMP, ADF&G must also manage moose in Unit 21E for high levels of human consumptive use. Alaska Statute 16.05.255 directs the Board of Game to adopt regulations to provide for intensive management to restore the abundance or productivity of big game populations to achieve human consumptive use goals. Regulations 5 AAC 92.106 and 5 AAC 92.108 identify the Unit 21E moose population as important for providing high levels of harvest for human consumptive use and set the population and harvest objectives. Therefore, we include these intensive management and harvest objectives in our management decisions for Unit 21E.

The following changes will be made to the management population and harvest objectives for the next reporting period:

- Maintain a minimum posthunt calf:cow ratio of 30–40 calves:100 cows in Unit 21E.
- Maintain a minimum calf overwinter survival of 20% of the total population in late winter moose population surveys in Unit 21E.
- Maintain a harvest of <4% of the estimated moose population in Unit 21A, and <4% of the estimated moose population in Unit 21E until the intensive population management objective has been met.
- Provide for a sustained harvest of up to 40 antlerless moose in a winter season in Unit 21E.

In order to monitor the management objectives, the following changes will be made to the activities for Units 21A and 21E:

- Conduct a moose composition survey in Unit 21E every fall rather than every other fall.
- Conduct early winter composition surveys in Unit 21A every year rather than every 2–3 years.
- Conduct moose density estimation surveys in Unit 21A and within the INWR in cooperation with INWR staff whenever possible. Their current schedule is to alternate surveys between the northern and southern halves of the refuge with surveys being conducted every other year.
- Conduct a GSPE moose density population estimation survey in Unit 21E every 3 years. The next survey is planned for spring 2009 rather than spring 2010.

- Prepare an intensive management plan for Board of Game meetings as scheduled by the Board of Game. This was completed by March 2008 as planned, but action was delayed by the board until March 2009.

We plan to conduct both wolf and moose surveys in Unit 21E in early 2009 to provide important data necessary for implementation of an intensive management plan. A Unit 21E intensive management plan was presented to the Alaska Board of Game in March 2008; however the board deferred action until March 2009. This plan recommends wolf control in a portion of Unit 21E if the moose population declines from the 2000 GSPE estimate. Additionally, a snow depth model is currently being developed by ADF&G research staff. This information will help us to more accurately assess feasibility of the current intensive management and harvest objectives by identifying areas where snow depths may have a negative impact on moose.

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TABLE 1A Unit 21A moose harvest, regulatory years 2002–2003 through 2006–2007

Regulatory year	Reported harvest					Total
	Male	(%)	Female	(%)	Unknown	
2002–2003	73	(100)	0	(0)	0	73
2003–2004	48	(100)	0	(0)	0	48
2004–2005	50	(100)	0	(0)	0	50
2005–2006	65	(98)	1	(2)	2	68
2006–2007	30	(100)	0	(0)	0	30

TABLE 1B Unit 21E moose harvest, regulatory years 2002–2003 through 2006–2007

Regulatory year	Reported harvest					Total
	Male	(%)	Female	(%)	Unknown	
2002–2003	142	(89)	17	(11)	2	161
2003–2004	147	(99)	1	(1)	0	148
2004–2005	113	(96)	5	(4)	0	118
2005–2006	118	(96)	5	(4)	0	123
2006–2007	125	(96)	5	(4)	1	131

TABLE 2A Unit 21A moose hunter residency and success, regulatory years 2002–2003 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	
2002–2003	1	32	40	0	73 (45)	3	36	47	2	88 (55)	161
2003–2004	1	18	28	1	48 (31)	6	43	57	0	106 (69)	154
2004–2005	4	23	23	0	50 (31)	11	44	57	0	112 (69)	162
2005–2006	4	34	30	0	68 (37)	6	39	70	0	115 (63)	183
2006–2007	1	20	9	0	30 (22)	5	46	53	1	105 (78)	135

[a] Local resident from Anvik, Grayling, Holy Cross, Shageluk, McGrath, Takotna.

TABLE 2B Unit 21E moose hunter residency and success, regulatory years 2002–2003 through 2006–2007

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total (%)	
2002–2003	41	84	35	1	161 (66)	13	40	30	0	83 (34)	244
2003–2004	44	70	30	4	148 (62)	15	45	29	1	90 (38)	238
2004–2005	32	57	26	3	118 (50)	23	50	41	3	117 (50)	235
2005–2006	40	69	14	0	123 (58)	13	49	25	1	88 (42)	211
2006–2007	39	74	17	1	131 (54)	32	47	29	2	110 (46)	241

[a] Local resident from Anvik, Grayling, Holy Cross or Shageluk.

TABLE 3A Unit 21A moose harvest percent by transport method of successful hunters, regulatory years 2002–2003 through 2006–2007

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
2002–2003	77	0	15	1	0	3	3	0	1	73
2003–2004	58	0	35	2	0	2	2	0	0	48
2004–2005	66	0	30	4	0	0	0	0	0	50
2005–2006	60	0	32	3	1	1	0	0	1	68
2006–2007	57	0	30	7	0	0	3	0	3	30

TABLE 3B Unit 21E moose harvest percent by transport method of successful hunters, regulatory years 2002–2003 through 2006–2007

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unknown	*n*
2002–2003	16	0	70	0	13	0	0	0	1	161
2003–2004	9	0	86	0	1	1	1	0	2	148
2004–2005	14	0	77	3	4	0	0	0	2	118
2005–2006	13	0	77	0	9	0	0	0	1	123
2006–2007	12	0	79	1	5	2	0	0	2	131

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 21B (9311 mi^2)

GEOGRAPHIC DESCRIPTION: Nowitna River drainage east of Poorman Road, Yukon River drainage 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 but later effective fire suppression substantially altered the normal fire regime. The 1982 Tanana–Minchumina Fire Plan and more recently the *Alaska Interagency Wildland Fire Management Plan* (Alaska Wildland Fire Coordinating Group 1998) provided for allowing 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.

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

A moose population survey in 1980, using methods described by Gasaway et al. (1986), estimated 2386±429 moose in a 2774-mi^2 portion of the unit in the lower Nowitna drainage. A 1986 population estimation survey conducted in a 1596-mi^2 portion of the 1980 survey area suggested a reduction in moose numbers in a comparable area (1389±375 in 1980; 878±209 in 1986), but the difference was not significant at the 90% confidence level. A 1990 population estimate conducted in essentially the same area suggested that the population had increased (1560 mi^2; 1214 moose ±219). However, once again the difference in the estimate was not significant statistically. Results of a 1995 population estimation survey in a 1338-mi^2 (1031 moose ±206) portion of the unit were not significantly different (90% CI) from those of the 1990 survey. More recently, the 2001 population estimation survey, the first without a sightability correction factor (SCF), indicated the population was not significantly different from the 1995 estimate.

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 drainages. These areas produce 43–75% of the reported Unit 21B harvest. The Alaska Board of Game (board) made several changes to Unit 21B in 2004 and 2006 that substantially changed the data collection and analysis reflected in this report. In 2004 the board adopted regulations to implement 3 drawing hunts and a registration hunt for the entire unit. In 2006 the board adopted regulations to change the unit boundary to include all of the Nowitna River drainage, adding the upper Nowitna drainage that was formerly part of Unit 21A; and they adopted an additional drawing permit and a registration permit hunt in a portion of the area added. They also adopted an additional 10 days of fall hunting opportunity for residents in 2006.

Previous Unit 21B management reports contain 3 substantial differences from this report in data analysis. The first change occurred 1 July 2006 when the size of Unit 21B nearly doubled, from 4871 mi^2 to 9311 mi^2,with the addition of the Nowitna River upstream from the Little Mud River. The second change was a modest increase in harvest data from this upriver portion of the Nowitna River drainage. The third change was an increase in the reported hunter participation and harvest as a result of the improved reporting rates when the new registration and drawing permit hunts were implemented in 2004.

MANAGEMENT DIRECTION

MANAGEMENT GOAL, OBJECTIVES, AND ACTIVITY

Management was directed according to the following goal and objectives during the reporting period.

GOAL 1: 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.

OBJECTIVE 1: Provide for harvest of 50–200 moose or 5% of the annual moose population estimate, whichever is less.

OBJECTIVE 2: In combination with Unit 21C, implement at least 2 habitat enhancement activities every 5 years.

OBJECTIVE 3: Maintain a moose population of ≥4000–5000.

Activity — Conduct trend count surveys annually or population estimation surveys when funding is available, and notify relevant wildlife agencies if the population declines below 4000–5000 moose.

METHODS

Established trend count areas (TCA) were surveyed cooperatively with U.S. Fish and Wildlife Service (FWS) 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 about 4–5 min/mi^2. A moose population estimation survey was conducted in November 1995 using a regression survey method developed by Alaska Department of Fish and Game (ADF&G) biometricians that used a probability sample and regression estimator (Särndal et al. 1992).

Moose population estimation surveys conducted over 4754 mi^2 of Unit 21B in 2001 used the geospatial population estimator techniques (GSPE; Kellie and DeLong 2006, Ver Hoef 2008) without an SCF. Preliminary studies indicate an SCF will eventually need to be applied. Survey techniques were modified from those outlined by Gasaway et al. (1986). An important change from the Gasaway methodology was that, 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.

Hunting mortality and harvest distribution was monitored through the statewide harvest ticket system, registration permits, drawing permits, door-to-door subsistence surveys, and operating a moose hunter checkstation on the Nowitna River. General season hunters received 1 reminder letter to report harvest. Hunters with registration, or drawing permits received 1 reminder letter 3 weeks after the end of the hunt and a second reminder letter 3 weeks later. Report and survey information obtained was used to determine total harvest, harvest location, hunter residency and success, harvest chronology, and transportation used. Survey and harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 Jul 2005–30 Jun 2006).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size and Trend

Using the results of the 1995 population estimation survey and a survey conducted in 1990, Woolington (1998) estimated there were 2324–3530 observable moose in Unit 21B below the Little Mud River (4871 mi^2). The highest moose densities existed in favorable habitat along the Nowitna floodplain and immediately adjacent to the Yukon River. Densities were relatively low to moderate away from the river.

Results from the population surveys conducted in November 2001 indicated a total of 3161 observable moose without an SCF (1828–4493; 90% CI) over 4754 mi^2 of moose habitat in Unit 21B (Table 1). This total was within the range reported for RY97–RY98 by Woolington (1998) in a 4871-mi^2 portion of Unit 21B (2324 to 3530 moose). Until more data are collected we will assume the total moose estimate for RY05–RY06 is unchanged from the previous report.

Only 4 TCA surveys were conducted in the added portion of Unit 21B upstream of the Little Mud River drainage (Our Creek; 1980, 1993, 1996, 2001), and results from those surveys indicated very low densities of moose. Based on densities in similar habitat in Unit 21B and Unit 21D, I extrapolated a density of 0.20 observable moose/mi^2 for a total of 888 observable moose in the new portion of Unit 21B. For RY05–RY06, I estimated the total Unit 21B population was 4049 observable moose (±1600; without an SCF).

Survey data collected in early winter from established TCAs along the lower Nowitna suggested moose densities were stable or slightly increasing during 1991–1998 then declining in the 2000s (Tables 2 and 3). Point estimates for western Unit 21B and data from surveys conducted from 1999 to 2001 also indicated the population was probably decreasing. Recent TCA data indicated that total moose densities along the riparian corridor were relatively constant, as a result of robust productivity. However, despite improved productivity, adult cow numbers (within the limited sampling area of high density habitat) declined from 2000 to 2007 (Figs. 1 and 2).

Population Composition

In cooperation with FWS staff, we flew composition surveys in established TCAs on the Nowitna National Wildlife Refuge (Tables 2–4). Bull:cow ratios were lowest near the mouth of the Nowitna River (10–20 bulls:100 cows) during RY03–RY06, where hunting was concentrated, but increased in RY07 to 22 bulls:100 cows in the Nowitna Mouth TCA and 31 bulls:100 cows in the Nowitna/Sulatna confluence as a result of harvest restrictions implemented in 2004. Calf:cow ratios ranged widely among years (24–42 calves:100 cows), as in much of Alaska. Overall, the values indicated a fairly stable population trend since RY03, due mostly to recruitment of the 2003 and 2004 cohorts.

The 2001 population estimation data indicated the bull:cow ratio over the entire game management unit (38 bulls:100 cows) was not as depressed as near the mouth of the Nowitna River (15 bulls:100 cows) or at the confluence of the Nowitna and Sulatna Rivers (18 bulls:100 cows). For the entire 2001 survey area the GSPE analysis (Table 1) indicated 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). The trend of the proportion of yearling bulls:100 cows indicated stable recruitment (7–10 yearling bulls:100 cows).

Distribution and Movements

Based on movements of radiocollared cow–calf pairs, most cows spend the summer months around open grass and shrub 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
RY05		
Unit 21B, that portion within the Nowitna River drainage upstream from the Little Mud River (formerly part of Unit 21A).		
RESIDENT HUNTERS: 1 antlered bull.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–20 Sep
Remainder of Unit 21B.		
RESIDENT HUNTERS: 1 bull, by registration permit only: or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull, by drawing permit only; up to 250 permits may be issued in Unit 21B excluding that portion upstream from the Little Mud River.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only, up to 250 permits may be issued in Unit 21B excluding that portion upstream from the Little Mud River.		5 Sep–20 Sep

Unit and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY06		
Unit 21B, that portion within the Nowitna River drainage downstream from the Little Mud River drainage and outside a corridor extending 2 miles on either side of and including the Nowitna River.		
RESIDENT HUNTERS: 1 bull.	22 Aug–31 Aug 5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Remainder of Unit 21B.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	22 Aug–31 Aug 5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 300 permits may be issued in Unit 21B.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 300 permits may be issued in Unit 21B.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. At the 2004 board meeting, regulations were adopted to eliminate the general harvest permit and implement a resident registration hunt that requires the destruction of trophy value. A drawing permit was implemented for resident and nonresident hunters for the entire unit. Through the discretionary authority of the department, 3 separate drawing permit areas were designated which included a 10-mile wide corridor on the Nowitna River as one permit area, and the lands east and west of the corridor as the other 2 permit areas. Additionally, the board eliminated the November season in the Nowitna River drainage upstream from the Little Mud River (within Unit 21A at that time) and changed the bag limit from 1 bull to 1 antlered bull. Unit 21B boundaries were expanded at the January 2006

board meeting, and at the March 2006 meeting an additional drawing permit hunt was implemented for a 4-mile wide corridor on the Nowitna River above the Little Mud River. Also in 2006, the nonresident season was extended to 25 September to simplify regulations, and a 22 August to 31 August resident season was added to provide additional fall hunting opportunity.

Harvest by Hunters. Reported harvest for the unit averaged 75 (range = 68–81) moose annually during RY97–RY06 (Table 5; including harvest in Nowitna River drainage above the Little Mud River). In addition, the Unit 21B unreported harvest was estimated at 5 moose per year for Ruby residents, 15 moose per year for Tanana residents, and 5 moose per year taken in the Nowitna River drainage above Little Mud River. The lower Nowitna drainage produced 42–75% ($\bar{x}$ = 57%) of Unit 21B reported harvest during RY97–RY06 (Tables 6 and 7). However, in RY04–RY06, the proportion of harvest coming from the Nowitna River averaged 46% compared to 61% during RY97–RY03, which indicates that regulations to improve distribution of harvest were successful in moving hunters away from the Nowitna River corridor.

To estimate unreported harvest of 25 moose, we examined ADF&G–Division of Subsistence's estimated RY99 harvest by residents of Unit 21B (47 moose, Anderson et al. 2001). The estimated unreported harvest (Table 5) incorporated this moose harvest data for Ruby and Tanana (approximately 36 moose annually; 3-year $\bar{x}$), less the harvest reported by those same villages (approximately 15 moose annually). Because subsistence harvest remained relatively constant among years, we applied the difference of approximately 20 unreported moose to the reported harvest during RY01–RY02 and an additional 5 moose beginning in RY03 to account for the area of the upper Nowitna River drainage that was added to Unit 21B.

Checkstation Results. Since RY88 a moose hunter checkstation has been located at the mouth of the Nowitna River. 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; however, the 3-year mean number of hunters increased from 132 during RY94–RY96 to 167 during RY01–RY03, when regulations in Unit 21D likely deflected some hunters to Unit 21B (Table 6). The mean number of hunters then declined in RY04–RY07 to 126 with a low of 90 hunters in RY07, likely because of new drawing and registration hunt regulations in Unit 21B.

Hunter Residency and Success. Based on harvest reports, the majority of Unit 21B hunters were Alaska residents who resided outside the unit, particularly in Fairbanks (Table 6). Average success rate for all hunters during RY97–RY06 was 38% (Table 7; range = 26–62%). For RY05–RY06, success rate dropped (Table 7) to 28%, due to 2 issues. First, more hunters were forced to hunt off of the Nowitna corridor due to the new drawing and registration hunt regulations. Second, reporting rates by unsuccessful hunters increased with the higher level of reporting accountability associated with registration and drawing permit systems. Both outcomes were implemented by design, and improved our ability to manage moose in Unit 21B.

Harvest Chronology. During RY97–RY06, hunter reports indicated that most moose ($\bar{x}$ = 69%), were shot in the last half of the September season (Table 8). 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, when bulls are actively engaged in rutting behavior.

Harvest was not reported on harvest or permit report cards 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 (RY05–RY06; $\bar{x}$ = 72%) used boats to hunt moose (Table 9). Most airplane access was by commercial transporters. Highway vehicle transportation occurred exclusively on the Poorman Road south of Ruby. Snowmachines were used during winter, but winter reporting rates were low because there was no announced season, and therefore snowmachine use was underrepresented.

Other Mortality

Predation mortality on moose calves is significant in Unit 21B (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 River, but most packs were not observed during moose surveys. A reconnaissance survey in spring 2001 indicated wolf numbers were similar to previous estimates (Stout 2003). A sample unit probability estimator survey (SUPE; Becker et. al. 1998) flown in spring 2004 by the FWS indicated the wolf population estimate was similar to the 2001 estimate (B. Scotton, FWS, personal communication).

HABITAT

Assessment

No new habitat data were collected during RY05–RY06. Moose twinning rates were 58% in 1984 and 48% in 1988 during the calf mortality studies (Osborne et al. 1991). These twinning rates were relatively high and indicate above average nutritional status (Boertje et al. 2007) that could support a population increase if predation declines. Regeneration from a 1986 fire 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. The dense stand of black spruce between the 1986 burn and the Nowitna River should be considered for a prescription burn.

CONCLUSIONS AND RECOMMENDATIONS

Classification data from TCAs indicated a near stable trend in total moose numbers from 2003 to 2007, although adult cow numbers were declining. Bull:cow ratios improved in both TCAs along the heavily hunted portion of the Nowitna River due to reduced harvest after new drawing and registration permit regulations were implemented. The absolute number of bulls observed also increased. The previous low bull:cow ratios were instrumental in the board's decision to implement a drawing permit hunt on the Nowitna River corridor, with the understanding that the department would issue permits to achieve at least a 50% reduction in harvest of bulls within the

corridor. A ratio of approximately 25 bulls:100 cows would improve fall hunter success rates and provide for an increase in the number of desirable large bulls that are harvested, and serves as a practical management objective. The bull:cow ratio during RY06 for the combined trend count areas of the lower Nowitna River was 26 bulls:100 cows (Figure 1), exceeding 25 bulls:100 cows for the first time since RY93.

The management goal, to 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, was met during RY05–RY06. The moose population continued to support the consumptive demands as well as the nonconsumptive uses identified.

We also met the harvest objective of 50–200 moose or 5% of the population. Total estimated harvest ranged from 95 to 102 moose during the reporting period, less than 3% of the Unit 21B observable population for RY05–RY06.

The objective to implement habitat enhancement projects was not met. Activities to meet this objective were limited to review of fire management plans and fire suppression policies. Previous reports recommended a prescribed burn in the upland area east of the Nowitna floodplain and north of the Little Mud River to Bering Creek. In 2005 a wildfire burned 193,400 acres in the upper drainage of the Little Mud River that effectively addressed the need to convert the spruce communities to an earlier seral habitat. No efforts were made to suppress the Little Mud fire and the burn should be monitored to evaluate the benefits for moose in 10–20 years. The area west of the Nowitna in the upper Big Creek drainage is also dominated by late seral spruce and birch communities and should be allowed to burn to enhance potential moose habitat.

Population estimation surveys conducted in 2001 (without an SCF) indicated no clear change in population trend for all of Unit 21B since 1990. However, in the western half of the unit, point estimates for the moose numbers appeared to have declined in 1995 and again in 2001. The comparison between those years was confounded by differences in the size of the survey area, statistical analysis used, and survey techniques. Based on the 2001 population survey and recent TCA data, the current estimate for the former area of Unit 21B is unchanged from the previous reporting period at 3160 moose (1828–4494; 90% CI; without an SCF). The number of moose in Unit 21B with the new boundaries is estimated to be 4049 moose (±1600; without an SCF). We recommend a population estimation survey during the next reporting period to determine the status of the population throughout the expanded unit.

Predators remained abundant and predation continued to be the primary factor limiting moose abundance in Unit 21B. Harvest of wolves within the unit was low, and few black bears were harvested. The moose calf mortality study conducted in the late 1980s 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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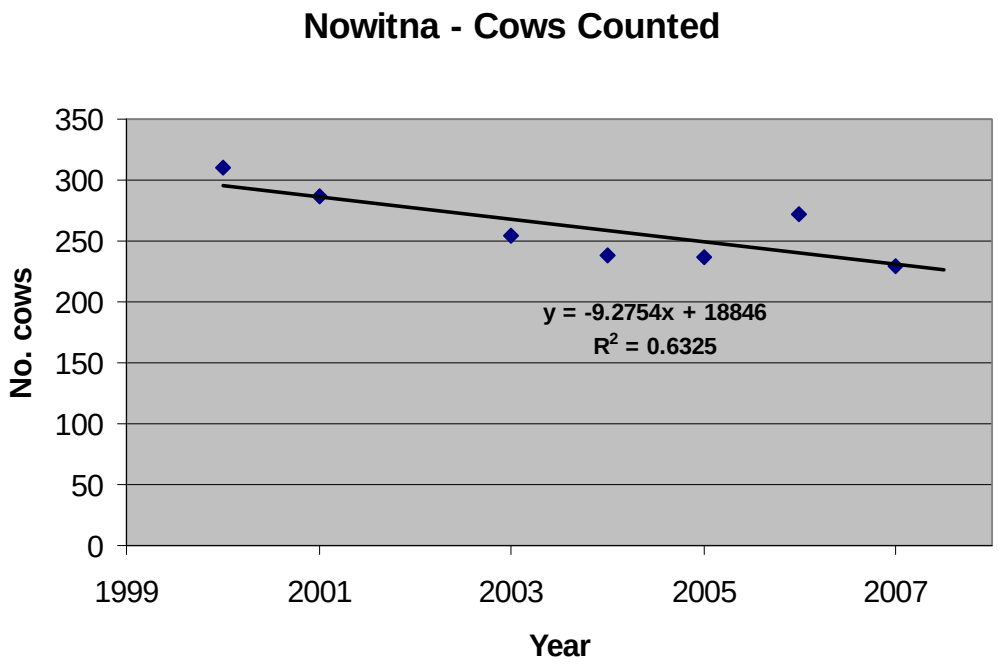

FIGURE 1 Number of cows counted in combined lower Nowitna River aerial moose composition trend count areas

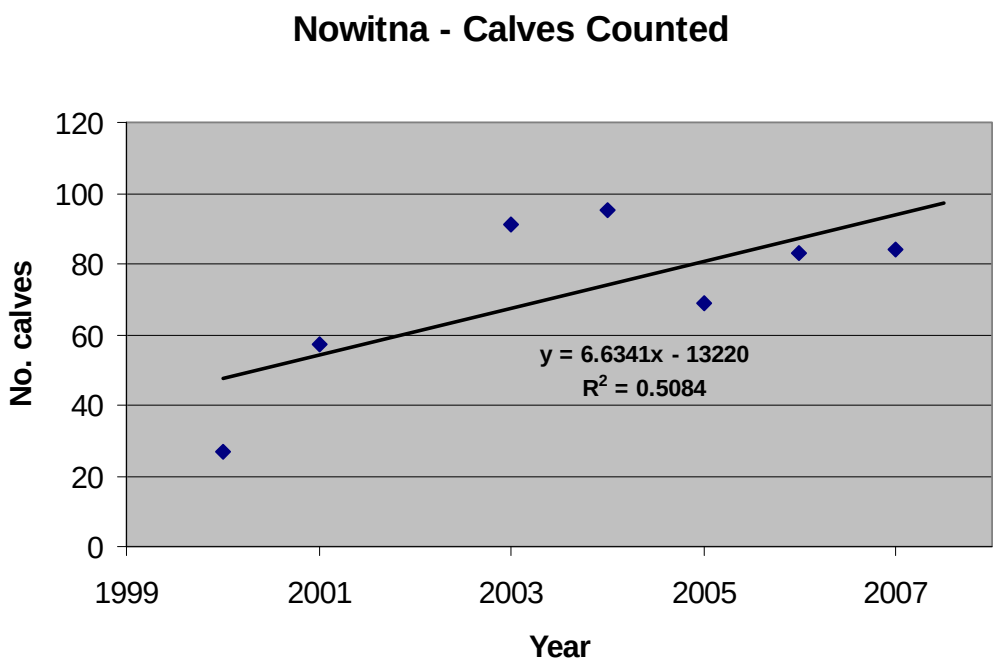

FIGURE 2 Number of calves counted in combined lower Nowitna River aerial moose composition trend count areas.

TABLE 1 Unit 21B Lower Nowitna River moose population estimates, regulatory years 1980–1981 through 2001–2002

Regulatory year/Area	Area mi^2	Population	90% CI[a]	Bulls:100 Cows	Calves:100 Cows	Yrlg bulls:100 Cows	Density
1980–1981/West[b]	1556	1389	27	41[c]	34[c]	13[c]	0.89
1986–1987/West[b]	1596	878	24	34[c]	40[c]	6[c]	0.55
1990–1991/West[b]	1560	1214	18	39.9	39.1	9.9	0.78
1995–1996/West[d]	1338	1031	20	33.8	30.1	14.5	0.77
2001–2002/West[e]	1531	759	20	25.8	19.4	7.2	0.50
2001–2002/Total[e]	4754	3161	42	38.2	18.3	9.0	0.67

[a] Confidence interval (% ±).
[b] MOOSEPOP analysis.
[c] Ratios calculated from observed values.
[d] MOOSEPOP analysis of regression survey.
[e] Geospatial population estimate analysis without sightability correction factor.

TABLE 2 Unit 21B Nowitna/Sulatna confluence aerial moose composition counts, regulatory years 1991–1992 through 2007–2008[a]

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yrlg bulls: 100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi^2
1991–1992	76	21	9	29	8	20	200	2.7
1992–1993	76	18	1	48	7	29	171	2.3
1993–1994	76	22	7	20	0	14	195	2.6
1994–1995	76	16	6	20	4	15	191	2.5
1995–1996	76	15	4	33	6	22	148	2.0
1996–1997	76	18	8	23	6	13	216	2.9
1998–1999	76	19	2	28	6	19	180	2.5
1999–2000[b]	76	6	1	23	12	18	106	1.5
2000–2001	149	25	7	11	0	8	202	1.4
2001–2002	120	18	6	18	0	12	200	1.7
2003–2004	143	15	10	28	3	20	172	1.2
2004–2005	149	23	12	41	15	25	188	1.3
2005–2006	149	29	10	37	12	22	167	1.1
2006–2007	149	25	7	25	3	16	207	1.4
2007–2008[b]	149	31	9	42	19	24	177	1.2

[a] U.S. Fish and Wildlife Service.
[b] Low snow conditions during survey.

TABLE 3 Unit 21B Nowitna mouth aerial moose composition counts, regulatory years 1992–1993 through 2007–2008[a]

Regulatory year	Survey area (mi^2)	Bulls:100 cows	Yrlg bulls:100 cows	Calves:100 cows	Twins:100 cows	Percent calves	Moose	Moose/mi^2
1992–1993	59	21	0	31	0	20	138	2.9
1993–1994	59	32	6	32	6	20	189	3.2
1994–1995	59	19	8	23	0	22	148	2.5
1995–1996	59	16	5	26	0	18	116	2.0
1996–1997	59	21	7	22	0	16	185	3.1
1998–1999	59	20	3	12	0	9	182	3.0
1999–2000[b]	59	11	8	21	0	16	87	1.4
2000–2001	102	21	6	7	0	5	206	2.0
2001–2002	102	15	7	15	6	18	191	1.9
2003–2004	102	10	5	42	10	28	206	2.0
2004–2005	102	19	13	39	7	25	194	1.9
2005–2006	102	20	9	24	0	16	195	1.9
2006–2007	102	19	8	37	17	24	208	2.0
2007–2008[b]	102	22	5	32	0	21	196	1.9

[a] U.S. Fish and Wildlife Service.
[b] Low snow conditions during survey.

TABLE 4 Unit 21B Deep Creek (52.5 mi^2) aerial moose composition counts, regulatory years 1982–1983 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
1982–1983	90	35	42	0	18	72	1.4
1987–1988	43	7	55	14	27	87	1.7
1993–1994	45	15	20	0	12	66	1.3
1995–1996	48	8	30	8	17	89	1.7
1996–1997	29	5	24	0	16	89	1.7
2001–2002	31	10	18	0	12	73	1.4

[a] U.S. Fish and Wildlife Service.

TABLE 5 Unit 21B[a] moose harvest, regulatory years 1996–1997 through 2007–2008

Regulatory year	Harvest by hunters				Unreported	Total
	Bull	Cow	Unk	Total		
1996–1997	78	0	0	78	15	93
1997–1998	67	1	0	68	15	83
1998–1999	74	2	0	76	15	91
1999–2000	81	0	0	81	20	101
2000–2001	65	1	7	73	20	93
2001–2002	75	0	4	79	20	99
2002–2003	77	0	0	77	20	97
2003–2004	75	0	0	75	25	100
2004–2005	63	1	0	64	25	89
2005–2006	77	0	0	77	25	102
2006–2007	70	0	0	70	25	95
2007–2008[b]	78	0	0	78	25	103

[a] Including the Nowitna River drainage above the Little Mud River.
[b] Preliminary data.

TABLE 6 Unit 21B Nowitna River checkstation hunters (R), harvest (H) and percent success (%S), regulatory years 1990–1991 through 2007–2008[a]

Regulatory year	Local villages[b]			Fairbanks			Other residents			Nonresident			Total		
	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	21	1	5	133	53	40
1994–1995	16	6	37	63	27	43	41	16	39	13	5	38	133	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	27	0	0	62	21	34	48	8	17	23	5	22	160	34	21
2002–2003	18	3	17	56	25	45	45	20	44	15	3	20	134	51	38
2003–2004	22	4	18	80	29	36	80	19	24	26	4	15	208	56	27
2004–2005	19	2	11	59	13	22	60	12	20	13	0	0	151	27	18
2005–2006	17	2	12	44	14	32	61	19	31	8	3	38	130	38	29
2006–2007	21	2	10	66	17	26	41	14	34	5	0	0	133	33	25
2007–2008	20	1	5	28	11	39	38	14	37	4	0	0	90	26	29

[a] U.S. Fish and Wildlife Service.
[b] Tanana, Ruby, and Galena.

TABLE 7 Unit 21B moose hunter residency and success, regulatory years 1996–1997 through 2007–2008

Regulatory year	Successful					Unsuccessful					Total hunters
	Local resident[a]	Nonlocal resident	Nonresident	Unk	Total	Local resident[a]	Nonlocal Resident	Nonresident	Unk	Total	
1996–1997	1	66	10	1	78	27	78	18	2	125	203
1997–1998	10	51	7	0	68	27	74	9	0	110	178
1998–1999	9	57	9	1	76	11	30	6	0	47	123
1999–2000	13	55	12	1	81	13	69	15	3	100	181
2000–2001	8	44	18	3	73	4	54	22	0	80	153
2001–2002	14	43	21	1	79	20	65	21	0	106	185
2002–2003	8	56	13	0	77	10	69	16	0	95	172
2003–2004	14	51	10	0	75	18	86	18	1	123	198
2004–2005	15	43	5	1	64	38	108	22	1	169	233
2005–2006	17	52	8	0	77	63	99	9	0	171	248
2006–2007	11	50	8	1	70	39	142	22	0	203	273
2007–2008[b]	22	45	11	0	78	33	75	15	0	123	201

[a] Tanana, Ruby, and Galena.
[b] Preliminary data

TABLE 8 Unit 21B moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2007–2008

Regulatory year	Harvest chronology percent by month/day			
	8/22–8/31[a]	9/1–9/14	9/15–9/25	*n*
1996–1997	n/a	40	60	73
1997–1998	n/a	33	67	64
1998–1999	n/a	39	61	69
1999–2000	n/a	37	63	79
2000–2001	n/a	35	65	68
2001–2002	n/a	24	76	76
2002–2003	n/a	28	72	74
2003–2004	n/a	31	69	74
2004–2005	n/a	33	67	62
2005–2006	n/a	37	63	73
2006–2007	3	15	85	67
2007–2008[b]	3	26	74	76

[a] August season started in 2006.
[b] Preliminary data.

TABLE 9 Unit 21B moose harvest percent by transport method, regulatory years 1996–1997 through 2007–2008

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Unk	
1996–1997	17	0	82	1	0	0	0	0	77
1997–1998	7	0	87	0	3	0	3	0	68
1998–1999	20	0	74	0	3	0	3	0	74
1999–2000	15	1	74	0	0	1	8	0	78
2000–2001	30	0	69	0	0	1	0	0	67
2001–2002	23	0	65	0	1	0	11	0	75
2002–2003	18	0	80	0	0	0	1	0	76
2003–2004	15	0	75	1	3	0	5	0	73
2004–2005	13	0	78	0	0	2	8	0	64
2005–2006	20	0	76	1	0	0	3	0	76
2006–2007	24	0	68	0	0	2	6	0	66
2007–2008[a]	17	0	67	3	0	5	9	0	78

[a] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 21C (3671 mi^2)

GEOGRAPHIC DESCRIPTION: Melozitna River drainage upstream from Grayling Creek, and Dulbi River drainage upstream from and including the Cottonwood Creek drainage

BACKGROUND

Moose have been present in Unit 21C throughout the recent history of Interior Alaska (S. Huntington, personal communication). Moose densities are low presumably due largely to predation by bears and wolves (Gasaway et al. 1992, Boertje et al. 2007, Boertje et al. 2009), and population trends are unknown. Access into the unit is limited and is mostly by aircraft. Thus, hunter numbers and harvest have been low and probably do not adversely impact the moose population. Because there are no human settlements in this area and harvest has been low, there has been little need to extensively monitor the moose population in this area.

Terrain in the unit 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 for moose. Numerous fires have resulted in large expanses of potentially good winter habitat, particularly north of the Melozitna River.

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.

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

MANAGEMENT OBJECTIVE

- Maintain ≥20% large bulls (bulls with antlers 60 inches or greater) in the harvest.

METHODS

POPULATION STATUS AND TREND

We conducted a moose stratification survey during 18 and 19 April 2000 using the geospatial population estimator (GSPE), a modification of the Gasaway technique (Gasaway et al. 1986) using spatial statistics (Ver Hoef 2001, Kellie and DeLong 2006). The stratification survey, along with data from other similar areas in the state, provided the basis for a rough population estimate of Unit 21C and can be used to conduct population estimation surveys in the future. The methods used in that survey are detailed in earlier reports (Lenart 2000; Kellie and DeLong 2006).

HARVEST

We monitored harvest and hunting pressure using mandatory harvest reports submitted by hunters. General season hunters received a reminder letter to report harvest. Hunters with registration and drawing permits received a postcard reminder, a telephone call, and a certified letter. We summarized total harvest, antler size of harvested moose, hunter residency and success rate, the chronology of harvest, and transportation used to hunt. Each of these parameters were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 Jul 2005–30 Jun 2006).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

No surveys were completed in Unit 21C during RY05–RY06. However, elsewhere where moose persist with lightly harvested populations of bears and wolves, low-density moose populations have persisted since density estimates were first flown in the late 1970s (Gasaway et al. 1992, Boertje et al. 2009).

Therefore, we estimated moose density (0.35–0.45 moose/mi^2 of moose habitat; 1284–1651 moose) using the results of the April 2000 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 was lower than expected for the area and was probably partially a result of low sightability of moose during spring surveys (Lenart 2000). Based on the stratification (Lenart 2000) and declines observed in moose numbers in similar habitat in Unit 24 to the north, we believe that the moose population in Unit 21C is generally declining.

Population Composition

No moose population composition surveys were conducted in Unit 21C during RY05–RY06.

MORTALITY

Harvest

Season and Bag Limit for RY05–RY06.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 21C, the Dulbi River drainage.		
RESIDENT HUNTERS: 1 bull by permit DM812; or 1 bull by permit RM834 (trophy value of antlers must be destroyed in RM834).	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side, by permit DM812.		5 Sep–25 Sep
Remainder Unit 21C.		
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 at least one side.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. In March 2004 the Alaska Board of Game adopted a regulation to establish a drawing permit hunt (DM812) and a resident registration permit hunt (RM834) for the Dulbi River drainage in Unit 21C. The board also adopted a regulation that limited nonresident hunters throughout the unit to harvesting bulls with 50-inch antlers or antlers with 4 or more brow tines on one side.

Harvest by Hunters. Moose harvest in Unit 21C averaged 24.6±2.9 ($\bar{x}$ ±SE) moose during RY97–RY06 (Table 1) but only 12.5 moose/year during RY05–RY06; thus, average harvest in this period was about half of the long-term average. Although data are preliminary, the number of moose harvested in RY07 appears to also have been similarly low (Table 1). During RY97–RY06, the numbers of hunters in Unit 21C averaged 46±3.1 ($\bar{x}$ ±SE). The total number of hunters during RY05–RY06 (35.5 per year) declined 27% relative to the preceding 8-year average (48.9 per year, RY97–RY04). Higher costs for transportation, increasing moose numbers and liberal seasons elsewhere, and more restrictive regulations in Unit 21C during RY04–RY06, may have reduced the harvest and number of hunters. An alternative hypothesis is that the moose population declined due to factors unrelated to harvest.

Six moose have been reported harvested on drawing hunt permit DM812 since RY04 (Table 2). To date, only 1 moose has been reported harvested by a hunter using registration hunt permit

RM834 in Unit 21C; low participation in this hunt is likely partly because of the stipulation that antler trophy value must be destroyed.

At high harvest levels, the percentage of large bulls in the harvested population would be expected to decline within a few years. Except for RY99 (14%), the percentage of large bulls (≥60 inches) in the reported harvest in Unit 21C ranged from 25% to 43% during RY95–RY04 and was 31% during RY05–RY06. Furthermore, average antler size of all bulls in the RY05–RY06 reported harvest was 56 inches (n = 22). These data suggest that bulls were not overharvested in Unit 21C.

Hunter Residency and Success. Alaska residents composed 49% of the 71 hunters who hunted moose in Unit 21C during RY05–RY06 (Table 1). On average, only 5 residents were successful per year during this period, while 10 resident hunters per year successfully harvested moose during RY97–RY04, a 50% decline in resident hunter harvest. Nonresident hunter numbers were previously relatively stable. Yet, similar to numbers of residents, success among nonresident hunters declined by 59% during RY05–RY06 ($\bar{x}$ = 7 successful nonresidents per year) compared to the previous 8-year period, RY97–RY04 ($\bar{x}$ = 17 successful nonresidents per year). Percent success for all hunters was 56% during RY97–RY04, and decreased to an average of 35% during RY05–RY06. Despite these declines, success rates were typical for Alaska and 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, and most harvest consistently occurred during the third week in September (Table 3). During RY05–RY06, no clear trend in harvest chronology is apparent, due mostly to the small number of moose harvested in RY06.

Transport Methods. While boats are used by moose hunters in Unit 21C, hunters mainly used aircraft for transport (Table 4). A waterfall and series of rock piles near the mouth of the Melozitna River restrict travel up the river and extensive sandbars often impede boat access into the upper Dulbi River at the low water levels common in the fall.

Other Mortality

Wolves and grizzly and black bears live throughout the unit. Osborne et al. (1991) found predators killed most moose calves born in the adjacent Nowitna and Koyukuk drainages. In 1995 Osborne (1996) estimated a minimum of 60 wolves in the unit 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 probably influenced moose population status in the past (Gasaway et al. 1992) and may be increasing. Wolf and bear harvests were low (<10 annually) because hunter access is limited.

CONCLUSIONS AND RECOMMENDATIONS

Total moose density in Unit 21C was estimated at 0.35–0.45 moose/mi^2 of all terrain, with an estimated 1284–1651 moose present in the unit. Human use of the moose population was low, and recent harvest could be sustained even if the population experienced a reduction. However,

declines in hunter success indicated that moose harvest along the river corridor was possibly approaching maximum desirable levels. Therefore, ADF&G supported changes that restricted nonresidents to harvesting large bulls and implemented registration and drawing permit hunts on the Dulbi River drainage portion of Unit 21C.

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. Although harvest has remained low, we recommend obtaining a population estimate and/or a bull:cow ratio estimate to more closely monitor effects of harvest on the population.

During this reporting period, the management objective was to maintain ≥20% large bulls (bulls with antlers 60 inches or greater) in the harvest. Data indicate that we achieved this management objective during RY05–RY07 with 29% of the bulls harvested with antler widths of >60 inches. As access to Unit 21C is difficult and expensive, and most hunters who use the area are nonlocals, it is generally believed that those who hunted in Unit 21C were primarily interested in harvesting large-antlered (≥60 inches) bulls. Harvest composition data suggest no significant change in average bull antler width occurred in bulls harvested either by residents or nonresidents during RY05–RY07 compared to the average antler width from RY95–RY07 (Fig. 1). Since nonresidents are limited to taking moose with antler spreads ≥50 inches, excessive harvest may more readily be reflected in declines in the size of antler spreads in moose harvested by residents. However, because resident harvest levels have declined to an average of only 5 moose per year, the sample size for this analysis is not adequate at this time.

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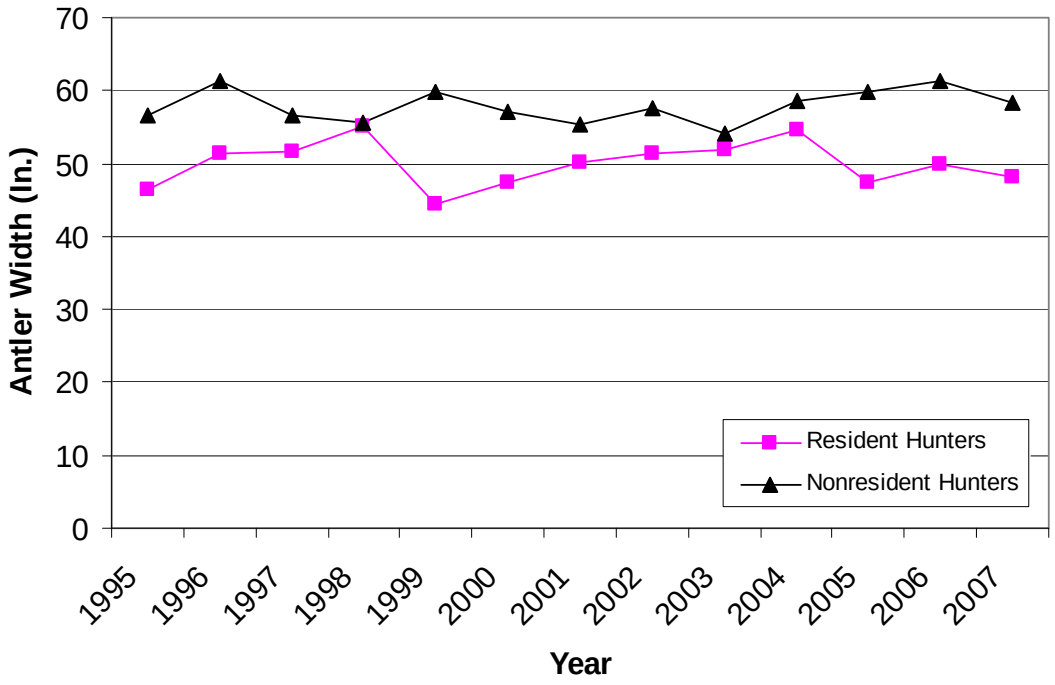

FIGURE 1 Average bull moose antler spread by hunter residency, Unit 21C, 1995–2007

TABLE 1 Unit 21C moose hunter residency and success, regulatory years 1990–1991 through 2007–2008

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	11	20	0	31 (61)	0	13	7	0	20	51
2001–2002	0	13	17	0	30 (53)	0	16	11	0	27	57
2002–2003	0	10	20	1	31 (51)	0	18	11	1	30	61
2003–2004	0	5	16	0	21 (46)	0	19	6	0	25	46
2004–2005	0	3	11	1	15 (41)	0	15	7	0	22	37
2005–2006	1	4	11	0	16 (37)	0	12	15	0	27	43
2006–2007	0	6	3	0	9 (32)	2	10	7	0	19	28
2007–2008[b]	0	8	6	0	14 (37)	3	15	6	0	24	38

[a] Local resident resides in Units 21C or 21B.
[b] Preliminary data.

TABLE 2 Unit 21C, outside Koyukuk Controlled Use Area, moose harvest by permit hunt, regulatory years 2004–2005 through 2007–2008

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
DM812	2004–2005	20	70	33	67	4 (100)	0 (0)	0	4
	2005–2006	20	80	50	50	2 (100)	0 (0)	0	2
	2006–2007	20	95	100	0	0 (0)	0 (0)	0	0
	2007–2008	29	97	100	0	0 (0)	0 (0)	0	0
RM834	2004–2005	4	0	100	0	0 (0)	0 (0)	0	0
	2005–2006	0	0	0	0	0 (0)	0 (0)	0	0
	2006–2007	2	0	100	0	0 (0)	0 (0)	0	0
	2007–2008	4	0	75	25	1 (100)	0 (0)	0	1

TABLE 3 Unit 21C moose harvest chronology percent by month/day, regulatory years 1995–1996 through 2007–2008

Regulatory year	Harvest chronology percent by month/day				
	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	15	22	30	33	27
2002–2003	7	21	43	29	28
2003–2004	19	14	43	24	21
2004–2005	33	7	40	20	15
2005–2006	27	27	33	13	15
2006–2007	0	33	67	0	9
2007–2008[a]	29	36	21	14	14

[a] Preliminary data.

TABLE 4 Unit 21C moose harvest percent by transport method, regulatory years 1990–1991 through 2007–2008

Regulatory year	Harvest percent by transport method							
	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	60	0	37	0	0	3	0	30
2002–2003	71	0	29	0	0	0	0	31
2003–2004	76	0	14	0	0	0	10	21
2004–2005	67	0	33	0	0	0	0	15
2005–2006	81	0	19	0	0	0	0	16
2006–2007	100	0	0	0	0	0	0	9
2007–2008[b]	69	0	31	0	0	0	0	13

[a] Includes airboats.
[b] Preliminary data.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 21D (12,096 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 floodplain areas of the lower Koyukuk and Yukon Rivers indicated generally increasing moose densities through about 1993 (Tables 1–9). 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 corroborated 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.

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

Results from a 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 observed in the TCAs since 1997 and a population estimation survey in 2001 indicated the population had declined to 8500–9500 moose by winter 2001–2002. The population estimate declined slightly by winter 2005–2006, based on our population estimation survey in 2004 and TCA surveys.

Residents of the 4 villages within Unit 21D (Kaltag, Nulato, Koyukuk, and Galena) and one village (Ruby) in Unit 21B near the boundary with Unit 21D have traditional hunting areas within Unit 21D. Local residents often traveled as much as 100 miles up the Koyukuk River in the 1980s–2000s, until fuel prices began to restrict travel by 2005. Nonresidents and Alaskans residing outside Unit 21D primarily hunt the Koyukuk River between the Kateel River and Dulbi Slough. Hunting pressure from nonlocal hunters appeared to be gradually shifting farther upriver as hunters from outside the unit learned to deal with the logistics of accessing the area. In 1979 the Koyukuk Controlled Use Area (CUA) was established in an attempt to reduce participation of nonlocal hunters and the perceived conflict of hunters in airplanes, 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. Registration permitting and education and enforcement efforts have further improved the reporting rate by local residents, but more than a fourth of the harvest is still likely unreported.

A hunter checkstation has been operating on the Koyukuk River since 1983. In 1990 the Ella's cabin checkstation located 15 miles upstream from the village of Koyukuk 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 Koyukuk CUA within Unit 21D during the fall hunting season. 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 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 unit. 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 one side. In 1992 the minimum number of brow tines on one side was increased to 4. Also beginning in 1992, meat of the hindquarters, forequarters, and ribs of any moose taken in the Koyukuk CUA 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 Koyukuk CUA, 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. By 2006, all of Unit 21D was managed through subsistence registration hunts with antler cutting disincentives or limited drawing permit hunts.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

Koyukuk River Drainage

Management was directed according to the following management goals and objectives during the reporting period.

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

Population Estimation

Previously established TCAs of 4–6 contiguous 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 approximately 500 feet above ground level at ground speeds of 70–80 mi/hr. Moose were classified as cows, calves, yearling bulls (<30" antler spread and no brow tine definition), medium bulls (30–49" antler width), or large bulls (≥50" antler width). Sample units of approximately 12 mi^2 each were searched at a rate of approximately 5 min/mi^2. We also established TCAs using a grid system based on latitude and longitude coordinates (Kellie and DeLong 2006). Data were recorded on standard data forms and moose locations were also recorded on 1:63,000 U.S. Geological Survey quadrangle maps and as Global Positioning System (GPS) waypoints. 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 both sightability and moose distribution.

Population estimation surveys were conducted in October and November 2001 and 2004 using similar techniques described by Gasaway et al. (1986) but modified for analysis using the geospatial population estimator (GSPE; Ver Hoef 2001, Kellie and DeLong 2006). The GSPE 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. In the 2001 survey of the 985 sample units in the survey area, 291 were surveyed with an average survey time of 30.8 minutes per 5.6 mi^2 sample unit. All sample units were stratified in advance of the intensive survey; 254 of the sample units were classified as high moose density and the remaining 731 sample units were classified as low moose density (Bryant and Stout 2003). In 2004 the survey area included 986 sample units, of which 271 were stratified as high density and 715 were low density. In 2004, 452 sample units were surveyed with an average survey time of 27.0 minutes per 5.6 mi^2 sample unit.

The current moose population estimate is based on previously reported values, trend count surveys conducted in RY05–RY07, and the population estimation surveys completed in 2001 and 2004. Declining moose recruitment among the trend areas was a key indicator of the apparent overall decline in the population. In fall 2004, 5526 mi^2 were surveyed in Unit 21D and southern Unit 24. Of the 986 sample units in the survey area, 452 sample units were surveyed intensively. We counted 6309 moose during the intensive surveys with an average survey time of 27.0 minutes per 5.6 mi^2 sample unit. Nine hundred eighty-six sample units were stratified in advance of the intensive survey, with 271 of the sample units classified as high moose density, and the remaining 715 sample units classified as low moose density. In the 3684-mi^2 portion of Unit 21D that was surveyed, we estimated 4786 moose, not including a sightability correction

factor (Table 10). In the remaining 8412 mi^2 of Unit 21D not surveyed, I subdivided the area by drawing hunt areas (Table 11). I used survey data to estimate moose numbers in drawing hunt areas when that information was available. If a portion of the hunt area was not surveyed, I used density estimates from comparable habitats that were surveyed and extrapolated that data to estimate the population size for the remainder of the hunt area.

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 suggest little hunting pressure in most cases, but 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 may 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.

Twinning surveys were flown in May to determine the proportion of moose calf twins among all cows with calves 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. Timing of surveys was critical. Surveys were flown when approximately 50% of the cows observed had calves to avoid early mortality factors such as black bear predation, which might cause underestimation of twinning rates if bears killed 1 calf among twins.

Mortality

Hunting mortality and harvest distribution was monitored through the statewide harvest monitoring system, including general harvest ticket reports, registration and drawing permit reports, door-to-door subsistence surveys, and a hunter checkstation at Ella's cabin checkstation. General season hunters received 1 reminder letter to report harvest. Hunters with registration or drawing permits received 1 reminder letter 3 weeks after the end of the hunt and a second reminder letter 3 weeks later. Report and survey information was used to determine total harvest,

harvest location, hunter residency and success, harvest chronology, and transportation used. Data collected at the checkstation included hunter residency, harvest chronology, time in the field, hunting party size, sex and age structure of harvest (tooth extraction), antler size, method of harvest, location of harvest, caliber of firearm, and method of transportation. Harvest data were summarized by regulatory year (RY), which begins 1 July and ends 30 June (e.g., RY05 = 1 July 2005 through 30 June 2006).

Meat evaluation was conducted to evaluate Goals 3 and 4. Every moose checked at Ella's cabin checkstation was evaluated by ranking the level of dryness, cleanliness, smell, overall care, and days in the field. Rankings were subjectively scored on a scale of 1–5, with a score of 1 being a low performance score.

We evaluated predation by interviewing trappers, by field observations, and through aerial wolf surveys flown in cooperation with the U.S. Fish and Wildlife Service (FWS). Winter calf and yearling mortality was also monitored beginning October 2005, when FWS deployed 30 radio collars on calves in Unit 21D and on an additional 29 calves in October 2006.

Wildlife Viewing

Hunters who came through the checkstation were also given a wildlife viewing survey card that consisted of 8 brief questions about wildlife observed during their days in the field. At least 1 person per boat was given the voluntary questionnaire. Eighty-five people filled out the wildlife viewing questionnaire at Ella's cabin in 2006. The survey consisted of a 3×5 card with 8 questions. Typically, we handed out one card per party rather than each individual, but we were more liberal in asking for participants in 2006, as was recommended in 2005. We presented the card to several members of each hunting party while we were checking them on their way out of the area. There were 274 hunters that registered at Ella's, so this is roughly a 31% sample (17% in 2005, 15% in 2004, 16% in 2003, 25% in 2002) of all the people who registered at the checkstation this fall.

Habitat

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 browse removal rate (Boertje et al. 2007).

Planning

The formal planning process to address concerns related to continued increase of hunters in the Koyukuk River drainage ended during the last reporting period. 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, Fairbanks) that was submitted to the Alaska Board of Game during the March 2000 meeting, and the board endorsed the plan at its January 2001 meeting. The draft plan was used as a guide for management goals, objectives, activities, and biological decision-making criteria in this management report. Public meetings were hosted by the department in January 2004 and October 2005 to update interested

individuals concerning the status of activities related to the moose management plan. Approximately 1300 copies of a newsletter produced by ADF&G, the *Galena Area Moose Management News*, were mailed out in late April 2007 to inform people of management activities and, with the enclosed questionnaire, assess the viewpoints of hunters and local residents on planning, intensive management, and the other moose management issues.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

The moose population increase observed in Unit 21D for almost 2 decades ended between 1993 and 1997, after which TCAs showed stable or declining trends (Stout 2000). Although peak moose densities were apparently reached between 1993 and 1997, declining calf numbers and recruitment of yearlings began to be apparent in fall of 1998 or 1999 in most TCAs (Tables 1–9). From the peak around 1994, the Unit 21D population trend was downward through RY03. Counts from several TCAs during 1999–2003 supported this conclusion, as did the 2001 and 2004 population estimation surveys. However, by 2001–2003, the rate of decline appeared to be decreasing, and by 2005 and 2006 the Koyukuk River drainage in Unit 21D appeared to be stabilizing. The population estimate calculated from the 2004 survey was not significantly different (95% CI) from the 2001 estimate; however, the point estimate for 2004 was lower than 2001. The regression analysis of the 1987–2004 survey estimates indicated a slight decline (Fig. 1). Unfortunately, no population estimation surveys were conducted between 1987 and 1997, so the regression analysis does not include a data point during the estimated peak in the Three Day Slough TCA that occurred during RY93–RY97. I estimated 8342 observable moose (±1000) by the end of RY05 and the estimate was unchanged at the end of RY06. Relative to the previous 2 reports (Stout 2004, 2006), numbers of cows were declining.

Population Composition

From 1995 through 2003, the posthunt bull:cow ratio for the Three Day Slough TCA was declining, and the fall 2003 ratio was the lowest recorded (15 bulls:100 cows; Table 1). Bull:cow ratios vary widely among other TCAs (Tables 2–9), but most indicated some level of decline beginning in the mid 1990s and more recent recovery (Fig. 2). The percentage of large bulls (antlers ≥50") observed in the Three Day Slough TCA was 19–33% in the early 2000s, while the percentage of large bulls in the harvest from Three Day Slough was 37–58% (Table 12). Bull:cow ratios from the 2004 GSPE survey were estimated at 30:100, well above the minimum needed for adequate productivity.

For the area surveyed in 2004, the calf:cow ratio was estimated at 37:100, within the range (20–40:100) for maintaining a stable or increasing population. Data from most TCAs also had high ratios. Trend count area data in RY06 and RY07 indicated improvements in bull:cow ratios, calf:cow ratios and yearling bull:cow ratios which could be attributed to moderate winters.

Moose twinning rates in May during 2003–2006 suggested above average nutritional status and productivity in Unit 21D riparian habitats (Tables 13 and 14) and the Huslia Flats–Treat Island TCAs just to the north in Unit 24 (Boertje et al. 2007). Exceptionally high twinning rates in 2006

and relatively high recruitment of that cohort may have affected the ability of cows to twin 2 consecutive years. These above-average values are, in part, likely related to the mild winters during RY03–RY06 and the corresponding length of the intervening snow-free seasons. Although no objective measurements of habitat were conducted during this period, I observed no dramatic changes in vegetative characteristics that would account for the apparent improvements in twinning rates in recent years. I do not believe a density-dependent effect decreased twinning rates because the decline was temporary (RY97–RY01) and the riparian moose population maintained relatively high densities since the early 1980s, including during RY97–RY01.

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.

Moose movements and calf body weight dynamics were studied in southern Unit 21D by FWS personnel. Moose observed on the Kaiyuh Flats migrated seasonally 20 miles north or west along the Yukon River to winter near Pilot Mountain and Squirrel Creek, then returned to Kaiyuh Flats just prior to calving (Brad Scotton, FWS Galena, personal communication, 2008).

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 breakup, 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

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY05		
Unit 21D, that portion within the Koyukuk River drainage west of the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 bull, by drawing permit only: up to 500 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit; up to 500 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area		5 Sep–25 Sep
Unit 21D, that portion north of the Yukon River and east of the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull, by drawing permit only; up to 500 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area: or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit; up to 500 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Unit 21D, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 moose by registration permit only; a person may not take a cow accompanied by a calf; or	27 Aug–31 Aug (Subsistence hunt only)	
1 bull by registration permit only; or	1 Sep–20 Sep (Subsistence hunt only)	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
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 bull.	1 Dec–10 Dec	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit; up to 80 permits may be issued in combination with Unit 24, that portion within the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Remainder of Unit 21D		
RESIDENT HUNTERS: 1 moose per regulatory year; however, antlerless moose may be taken only from 21 Sep–25 Sep; a person may not take a cow accompanied by a calf; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
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RY06		
Unit 21D, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 bull by registration permit only;	27 Aug–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.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
4 or more brow tines on one side 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 21D.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	22 Aug–31 Aug 5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 600 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 600 permits may be issued in Unit 21D outside the Koyukuk Controlled Use Area.		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 RY03 and RY04, but we notified the board that the antlerless seasons would be closed by emergency order because of conservation concerns. The board closed fall antlerless seasons outside the Koyukuk CUA in 2004, then closed all remaining antlerless seasons at the spring 2006 meeting.

At the spring 2004 meeting, the board adopted changes to the moose regulations in Unit 21D that implemented drawing and registration hunts in the Gisasa River, Kateel River, and Bear Creek drainages. The board also closed the February any-moose season and opened a 10-day December bulls-only season. At the spring 2006 meeting, the board closed the December season and opened a subsistence season for bulls during 22 August–31 August. The board expanded the drawing and registration permit hunts to all of Unit 21D, eliminating all general harvest ticket hunting in the unit. With the establishment of the additional drawing permit hunts, some nonresident permit hunts were also divided according to a 50:50 allocation to guided and nonguided hunters.

Harvest by Hunters. Continuing the trend of the previous reporting period, harvest of moose in Unit 21D during RY05–RY06 continued to decline compared to the increases observed during the 1990s (Tables 15–17). Reduced harvest reversed the trend of declining bull:cow ratios in the Koyukuk CUA portion of Unit 21D, but hunting pressure in the Koyukuk River mouth and Pilot Mountain Slough areas was still high and suppressed bull:cow ratios. Reported cow harvest during announced seasons was zero in RY05–RY06, due to elimination of the all antlerless moose seasons in Unit 21D. However, illegal and unreported cow harvest continued to occur during the winter. Potlatch, stickdance, and ceremonial moose harvest was also predominantly cows.

Distribution of harvest changed, with fewer hunters in northern Unit 21D within the Koyukuk River drainage, but numbers of hunters in the southern portion of the unit remained consistent. Changing harvest distribution was a manifestation of regulations implemented in the Koyukuk CUA and increasing fuel prices. From RY96 through RY04, the majority of the harvest in Unit 21D ($\bar{x}$ = 76%) occurred in the Koyukuk River drainage, with a high of 88% in 1996 (Table 18). However, during RY05–RY07, harvest in the Koyukuk River drainage declined to $\bar{x}$ = 57%, with a low of 53% in RY06. During that period, the number of moose harvested decreased 55% in northern Unit 21D (RY96–RY04 $\bar{x}$ = 267 moose; RY05–RY07 $\bar{x}$ = 120 moose).

Checkstation Results. Ella's cabin checkstation was made mandatory in RY90. The number of hunters who checked in at Ella's reached an all-time high in RY99, but the number dropped significantly when drawing hunts were implemented in RY00. During the period of increase, the additional hunters in the Koyukuk CUA were primarily nonlocal Alaska residents and, secondarily, nonresidents (Table 18). Numbers of local residents (residents of Units 21B, 21D and 24) increased beginning in RY00 and again in RY05 due to expanded registration hunts and improved reporting of unsuccessful hunters who did not turn in permit reports at the checkstation. Harvest success was high for nonresidents and nonlocal residents during RY98–RY07 ($\bar{x}$ = 52% for residents, $\bar{x}$ = 67% for nonresidents). Local resident harvest success reported for the fall hunt was lower ($\bar{x}$ = 33%). This was likely because many hunting parties consisted of several family members and each individual of each hunting party obtained a permit, but not all permit holders intended to deliberately hunt. Success rates generally remained high except for RY05 and RY06 when weather was extremely warm during the fall hunting season.

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 Koyukuk CUA, 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 who came through the checkstation were notified of this regulation at the time permits were distributed. Hunters were 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 when it was implemented. Beginning in

RY00 hunters were required to cut the antlers at the kill site, which improved that aspect of the hunter contact.

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 12). The 27-year average (1981–2007) and the 3-year average (2005–2007) percentage of harvested bulls with antler width of >60 inches was 17% (RY05 = 17.9%, RY06 7.3%, RY07 = 21.7%). However, the percentage of large bulls >60 inches harvested has declined since RY00, possibly due to 3 factors: 1) high harvest rates in the 1990s, 2) declining recruitment in the 1990s, and 3) improved recruitment in the last 3 years that have biased the age structure of the population in favor of young bulls.

Age-related antler widths for the moose harvested in the Koyukuk CUA were summarized from RY81 through RY03. During RY97–RY00, mean antler widths of the 5 age classes (3–7 yr olds) were below the 23-year mean antler widths for the respective age classes (Stout 2006). Among those 20 data points (5 age classes × 4 years), 10 of 20 mean antler widths were significantly lower than the 23-year mean widths for the respective age classes. Antler widths for age classes below 3 years old or above 7 years old did not show consistent differences from their 23-year mean widths. After RY00, antler widths appeared to return to the range of the 23-year mean values for all age classes, with the exception of the 1993 cohort. The 4-year decrease in antler widths coincided with the observed decline in the twinning rates during RY97–RY00. Declines in antler development and twinning rates have been associated with energy deficits, and the 4-year declines in both of these measurements for the Koyukuk CUA suggest a temporary negative environmental effect.

Meat evaluation surveys conducted at the checkstation indicated meat care was generally very good with an average overall score of 4.6 in RY07 (Table 19), but with no improvement since RY05. In RY07 the majority of hunters (83%) had their meat out of the field in 4 days or less. In RY07, 4 hunters (4.8%) had their meat out 7 days or longer, and in RY06 and RY05 there were 2 hunters (2.2%) and 4 hunters (4.3%) respectively that kept their meat out that long. In RY07, 8 hunters (9.5%) were given average overall scores of 3 or less, while that number was 2 hunters (2.2%) in RY06, 5 hunters (5.3%) in RY05, 11 hunters (11.4%) in RY04, 43 hunters (22%) in RY03, and 27 hunters (15%) in RY02. In general, meat scores improved and the number of days hunters kept their meat in the field decreased. Scores might have improved more in RY07 if sale of game bags and tarps at the Ella's Cabin checkstation had continued.

Not all respondents answered all questions in the wildlife viewing questionnaire at Ella's Cabin; so percentage values presented are based on the number of responses to the particular question. The questions asked and the answers given are summarized below for RY02–RY06:

Question 1: <u>How many days spent viewing wildlife</u>?

Respondents reported spending an average of 6.7 days viewing wildlife in 2006, which was up from last year, but more consistent with the previous 2 years (7.2 days in 2005, 5.2 days in 2004, 6.9 days in 2003, 7.0 days in 2002). We had another relatively warm and "buggy" season and hunting was difficult, so I was not surprised to see the average days viewing decrease as hunters spent generally less time in the field.

Question 2: Why were you visiting the Koyukuk?

The majority (59% in 2006) of respondents (47% in 2005, 40% in 2004, 45% in 2003, 43% in 2002) said they were hunting only, while 35% (51% in 2005, 58% in 2004, 53% in 2003, 55% in 2002) of the people said they were "Hunting and Viewing", and 6% (2% in 2005, 2% in 2004, 1% in 2003, 2% in 2002) said they were viewing only. This is a substantial shift away from "hunting and viewing" and may be an indication of fewer nonlocal hunters in the sample as permit restrictions have changed the hunting demographic. I still believe this question and Question #1 may be the 2 best measures to determine if the viewing activities are changing, unfortunately the change was not in the direction which would meet our objective of increasing viewing activity.

Question 3: Did you view any wildlife that you were not hunting?

In 2006 the majority (80%) (85% in 2005, 73% in 2004, 81% in 2003, 83% in 2002) of the people said yes, while only 20% (15% in 2005, 27% in 2004, 19% in 2003, 17% in 2002) of the respondents said no. Again, the results were comparable to previous years, and 2004 appears to be more of an outlier.

Question 4: What wildlife species did you see and how many?

There were 68 people that listed some of the animals they saw in 2006. Like last year, very few of them were willing to write down a comprehensive list of all the wildlife they observed. This year, 25 of respondents took the time to fill in the "how many" section. Porcupine, beaver, moose, ducks, geese, and wolves were the top species listed. There were 28 species identified this year compared to 23 in 2005, 19 in 2004, 32 in 2003, and 23 in 2002.

Question 5: Viewing which of these animals was most important to you…..?

Response to this question improved in 2006. The top 5 species people wanted to see are as follows: moose = 96% of first place rank (96% in 2005, 96% in 2004, 86% in 2003, 74% in 2002) were first again this year; bears = 68% of the second place rank (57% in 2005, 63% in 2004, 75% in 2003, 58% in 2002) were consistent at second again; wolves = 57% of the third place rank (63% in 2005, 57% in 2004, 56% in 2003, 57% in 2002) were also unchanged for the fifth year; waterfowl were consistent with 74% of the fourth place rank (fourth in 2005, sixth in 2004, fourth in 2003, fourth in 2002); and furbearers were back up to fifth this year (seventh in 2005, fourth in 2004, fifth in 2003, fifth in 2002). Small mammals and songbirds were ranked sixth (eighth in 2005, seventh in 2004, eighth in 2003, sixth in 2002) and seventh (sixth in 2005, eighth in 2004, seventh in 2003, seventh in 2002) respectively. Caribou were ranked eighth (fifth in 2005, fifth in 2004, sixth in 2003, eighth in 2002). The percentage calculation is a cumulative percentage.

Question 6: How important was the activity of viewing wildlife for you?

Of the people who responded in 2006, 45% (53% in 2005, 63% in 2004, 62% in 2003) said viewing was VERY IMPORTANT, 42% (42% in 2005, 33% in 2004, 33% in 2003) said it was SOMEWHAT important, and only 13% (5% in 2005, 4% in 2004, 5% in 2003) said it was NOT IMPORTANT. Considering the responses to Question #2 and Question #6 together, I am once again inclined to believe that there was another decline in viewing activities in 2006.

Question 7: How important was seeing wildlife sign… to your overall experience?

Like Question 6 this question was improved in 2006 from 2004. Of the people who responded 54% (56% in 2005, 71% in 2004, 52% in 2003) said viewing was VERY IMPORTANT, 35% (39% in 2005, 25% in 2004, 44% in 2003) said it was SOMEWHAT important, and only 12% (5% in 2005, 4% in 2004, 4% in 2003) said it was NOT IMPORTANT.

Question 8: Where did you get information about the Koyukuk?

Friends was slightly higher for number-one source this year at 39% (37% in 2005, 42% in 2004, 51% in 2003, 45% in 2002) with Personal knowledge (i.e., I live here) at 38% (37% in 2005, 31% in 2004, 18% in 2003, 23% in 2002), Family was third at 16% (17% in 2005, 18% in 2004, 9% in 2003, 4% in 2002), ADF&G was fourth at 4% (6% in 2005, 7% in 2004, 9% in 2003, 17% in 2002), Internet was last at 1% (4% in 2005, 2% in 2004, 5% in 2003, 3% in 2002). U.S. Fish and Wildlife Service was also at 1% this year. This question also appears to be biased by the changing demography of fewer nonlocal hunters.

With the establishment of the baseline data for the meat evaluation and wildlife viewing, efforts to improve the activities can be implemented according to management goals 3 and 4.

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 RY03 through RY07 varied among years by only 15% (Table 20). Use of the registration permit among local residents is relatively stable, while use of the permit by other Alaska residents declined (Table 17). With implementation of the drawing hunts, hunter numbers were better regulated and distribution of hunters improved (Table 21). Hunters who did not want to destroy the trophy value of their bull moose applied for a drawing permit. Also, hunters commented favorably on the changes to season dates that separated drawing hunters from registration hunters and evenly distributed drawing hunters in either the first or second half of the season. However, with repeated warm weather patterns in the last several seasons, an increasing number of local hunters requested that hunting be allowed into October.

Hunter Residency and Success. Hunter residency and success can be misleading because Unit 21D residents historically did not report unsuccessful hunt information (Table 22). Harvest and hunter participation by Unit 21D residents was relatively constant according to Subsistence Division surveys (Anderson et al. 1998; Table 15). In contrast, nonresident and nonlocal resident hunter participation increased steadily from RY83 through RY99, but declined in RY00–RY07. The increase of nonlocals during the 1980s and 1990s created tension among user groups in the area and was the impetus for creating the KWG. With implementation of drawing permits within the Koyukuk CUA in RY00, local hunter participation appeared to increase (RY01–RY07; Table 17). Local success rates in RY05 (28%), RY06 (35%), and RY07 (34%) are low compared to RY90–RY97, when annual success rates of local hunters averaged 62%. It is unclear how much of declines in success rates were due to a change in harvest effort or whether reporting rates for unsuccessful activities improved. Maintaining high success rates for local hunters in the fall is particularly important, because if locals do not get their moose in the fall, they are more likely to hunt in the winter when more than 60% of the moose harvested are cows (Anderson et al. 1998).

Harvest Chronology. Table 23 shows the chronology for reported harvest; however, about 20% of the annual harvest probably occurred during winter, when reporting rates were low. Much of the unreported harvest was likely taken during October–March (Anderson et al. 1998).

Transportation Methods. The presence of the Koyukuk CUA and the area's extensive river system made boats the primary transportation method (Table 24). Snowmachines were the main transportation during winter.

Other Mortality

Unit 21D has high populations of wolves and black bears. Grizzly bears were common in the uplands 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 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 Unit 21D game populations reported wolf numbers had increased substantially 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 within the Koyukuk National Wildlife portion of 21D. This minimum count indicates an increase of at least 17% from the number of wolves in packs observed for the same area during the 1994 survey (89 wolves ± 12; 98% CI = 76-108). We do not have information to indicate the status of the population since the 1999 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. Twinning data indicate a ranking of moderate to high nutritional status during RY03–RY05 relative to 14 other areas in Alaska (Tables 13 and 14; Boertje et al. 2007) Nutritional status of moose in Unit 21D is adequate to support an increasing population if predation decreases, as indicated by the increasing moose population in Unit 20A despite very poor nutritional status (Boertje et al. 2007).

MANAGEMENT PLANNING

The KWG was essentially disbanded in RY02 due to the turnover of advisory committee membership. The group's *Koyukuk River Moose Management 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 nearby Units 24 and 21B. Two public meetings were hosted by the department, one

in January 2004 and the other in 2005, to provide an update on the status of management-related activities outlined in the moose management plan. Participants at the 2005 meeting recommended that the department extend the active period of the plan through 2007.

Approximately 1300 questionnaires were mailed out in late April 2007 with copies of the *Galena Area Moose Management News*. Fifty-one questionnaires were returned by October 2007, a response rate of about 4%. The responses to the questionnaire indicate continued support for several of the most significant components of the Galena Management Area moose management programs. Even though the overall response rate was low, these results did provide additional insight on people's opinions about key management issues and the newsletter and questionnaire provided useful information to those interested in Galena area moose management issues. A full summary of the questionnaire results is on file at the Galena ADF&G office and with ADF&G's Region III Planner in Fairbanks.

CONCLUSIONS AND RECOMMENDATIONS

Moose were relatively numerous in the riparian lowlands of Unit 21D. I estimated 8342 (±1000) moose in Unit 21D without a sightability correction factor. Unitwide populations may have declined during 1998–2004, but numbers likely stabilized in northern Unit 21D. Calf:cow ratios and yearling bull:cow ratios indicated predation had a negative influence on the moose population. Nutritional status was above average and could support an increasing population (Boertje et al. 2007). Four years of liberalized cow harvest removed an important reproductive component of the population. The apparent slight decline in moose numbers was consistent with the increasing trend in wolf numbers observed during the aerial wolf reconnaissance survey in 1999, observations of black bears in the field, and increased observations of grizzly bears by hunters. The population may continue to decline unless an effort to reduce predation is implemented and the harvest of antlerless moose continues to decrease.

The 3 key management issues facing Unit 21D continued to be 1) the repercussions of declining fall success rates by local hunters, 2) cow harvest, and 3) declining moose numbers and unregulated harvest in the Kaiyuh portion of Unit 21D. Although harvest data indicate local villages are harvesting more moose, public input and emergency petitions for additional hunting opportunities suggest subsistence needs are not being achieved. Local villages were increasingly pursuing additional opportunity through federal regulations and possibly additional ceremonial potlatch-type requests. Cow harvest must continue to decrease, especially during winter and particularly in the Kaiyuh Flats if the moose population is to return to previous levels. More than two-thirds of the moose harvested in the winter are cows. Actions were taken to close all the fall cow seasons by emergency order during RY02–RY05, and in RY06 the antlerless seasons were eliminated by the Board of Game. Additionally, the winter season was eliminated in favor of a bulls-only season in August. However, it is clear that dependency on moose harvested during the winter will continue as long as fall hunting success declines. Management efforts must continue to improve fall success rates by local hunters in order to reduce the winter harvest of cows.

The objective of maintaining the population at 9000–10,000 observable moose was not achieved. However, the intensive management population objective of 7000–10,000 moose set by the board of game in regulation 5 AAC 92.108 may have been achieved. Analysis of RY05–RY07

data indicated improved recruitment; however, adult numbers did not increase. Poor recruitment prior to RY04, due in part to high predation, appeared to be the primary factor causing the decline. The objective to provide for a harvest of moose not to exceed 700 moose was achieved. The intensive management harvest objective of 450–1000 moose set by the Board of Game in regulation 5 AAC 92.108 was not achieved in RY05–RY07. Estimated total harvest was highest in RY05 (381 moose). Using the RY06 moose population estimate, this was a harvest rate of 4.1–5.2%. The objective to provide for moose hunting opportunity, not to exceed 950 hunters per regulatory year was achieved with a total of 714 hunters in RY05, 603 hunters in RY06, and 580 in RY07.

The long-term objective to implement at least 2 habitat enhancement activities was achieved during RY03–RY05. The FWS treated 9610 acres of grass–willow meadows in the area of Three Day Slough using prescribed fire in spring 2006. In summer 2004, FWS burned an unspecified number of acres near Bishop and Squirrel Creeks as part of the Bonanza Creek fire suppression effort. Two large fires, the Bonanza Creek fire in 2004 and the Holtnakatna Creek fire in 2005, burned 265,915 and 194,015 acres respectively. Both 2004 and 2005 were active fire seasons and many other fires burned throughout Unit 21D; mostly upland sites predominately in spruce forest and relatively small amounts of prime riparian habitat were affected.

In RY05 and RY06 we continued to monitor the objective of reducing spoiled meat observed at Ella's cabin checkstation and at hunting camps by 10% each regulatory year. Although it is early in the program, I believe encouraging proper meat care had a positive impact on meat quality within the Koyukuk CUA. I believe regulations adopted by the board in 1992 that required meat to remain on the bone of all 4 quarters and the ribs was also a positive move toward achieving the objective of reducing spoiled meat. This requirement was expanded to all of Unit 21D in RY02.

Finally, our monitoring program to evaluate the number of people engaged in nonconsumptive activities was continued and baseline data were established so we will be able to determine whether we meet the objective to increase the number of people engaged in nonconsumptive uses of wildlife by >1% each regulatory year.

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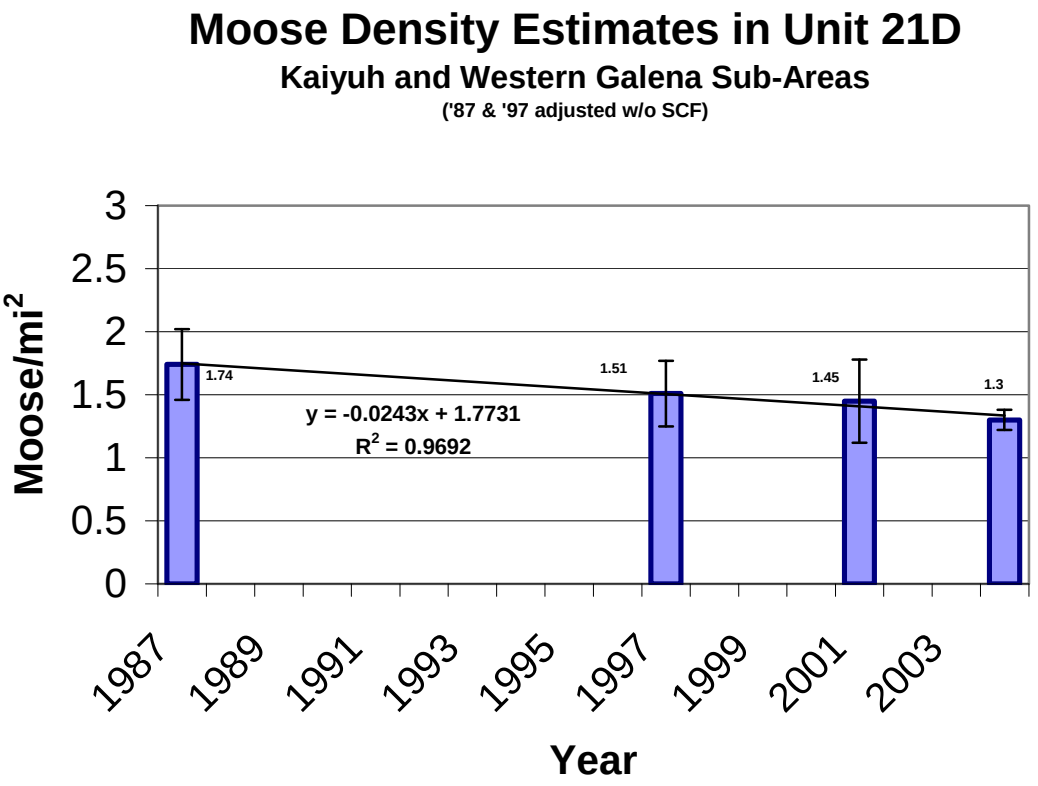

FIGURE 1 Moose density estimates and regression analysis based on 4 population estimation surveys. The 1987 estimate was calculated using MOOSEPOP, 1997 was a regression analysis estimate, 2001 and 2004 were geospatial population estimates. All values presented do not include sightability correction factors and are presented as density of observable moose/mi^2.

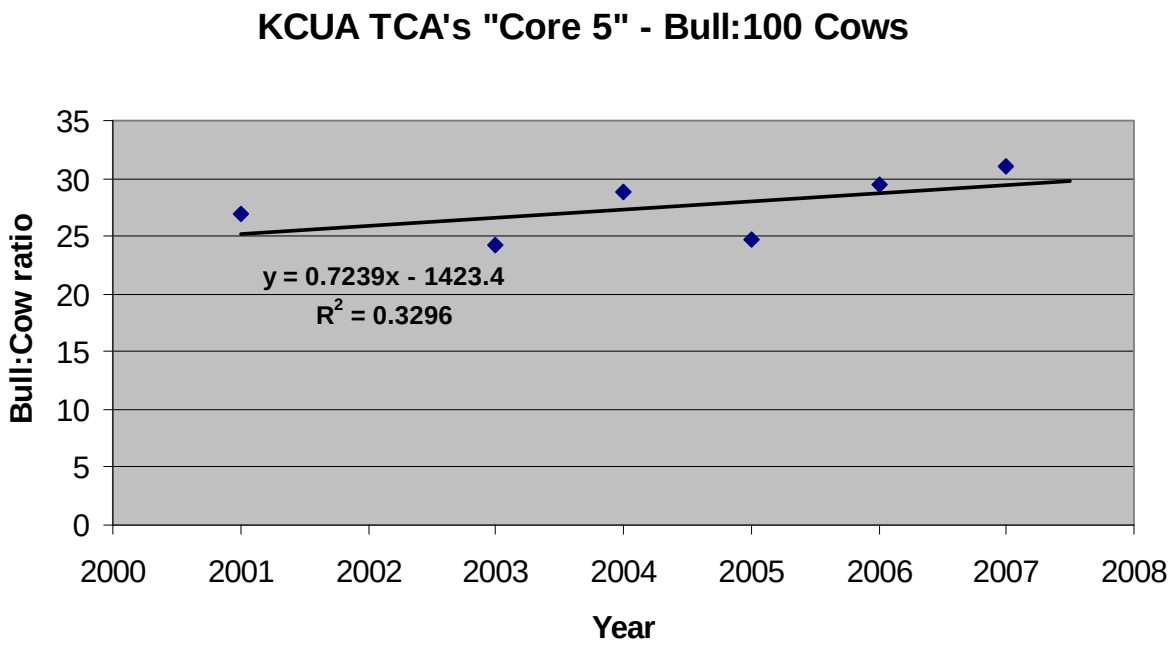

FIGURE 2 Cumulative bull:100 cow ratio for the Koyukuk Controlled Use Area that includes the 5 aerial trend count survey areas surveyed each year since 2001. "Core 5" trend count areas are at the Koyukuk Mouth, Three Day Slough, Dulbi Slough, Treat Island, and Huslia Flats in Units 21D and 24.

TABLE 1 Unit 21D Three Day Slough trend count area aerial moose composition counts, regulatory years 1981–1982 through 2007–2008

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	85.1	35	12	42	10	24	327	3.8
1982–1983	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	83.3	36	13	32	11	19	791	9.5
1988–1989	83.3	33	13	45	14	25	832	10.0
1989–1990[b]	83.3	28	8	25	11	16	763	9.2
1991–1992	83.3	34	10	31	6	19	909	10.9
1992–1993	83.3	35	10	31	7	18	1088	13.1
1993–1994	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[a,b]	83.3	20	9	24	3	17	721	8.7
1998–1999	83.3	30	9	13	0	9	990	11.9
1999–2000[a,b]	83.3	17	3	17	18	13	568	6.9
2001–2002	85.0	22	7	13	0	8	678	8.0
2003–2004[b]	85.0	15	8	21	14	14	586	6.9
2004–2005[b]	85.0	24	10	21	6	14	623	7.3
2005–2006[b]	85.0	24	5	20	8	14	494	5.8
2006–2007[a]	85.0	26	7	43	11	25	795	9.4
2007–2008[b]	85.0	36	12	26	4	16	486	5.7

[a] Low snow year.
[b] Late survey (after 21 Nov).

TABLE 2 Unit 21D Dulbi River mouth trend count area aerial moose composition counts, regulatory years 1982–1983 through 2007–2008[a]

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	122.3	21	6	16	3	11	343	2.8
2003–2004	116.7	17	6	23	5	17	411	3.5
2004–2005	122.0	21	6	40	7	25	406	3.3
2005–2006	122.0	18	8	23	4	16	333	2.7
2006–2007	116.7	24	6	32	8	21	403	3.5
2007–2008	116.7	36	13	47	11	26	454	3.9

[a] Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 3 Unit 21D Kateel River mouth aerial moose composition counts, regulatory years 1984–1985 through 1997–1998

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

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 2007–2008[a]

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	53.9	43	10	36	6	20	175	3.2
1996–1997	66.5	42	6	45	7	24	308	4.6
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	118.8	40	8	16	0	11	429	3.6
2003–2004	118.8	25	11	35	6	22	521	4.4
2004–2005	118.8	33	15	47	12	24	551	4.6
2005–2006	118.8	24	10	38	7	24	443	3.7
2006–2007	118.8	21	7	25	8	17	457	3.9
2007–2008	118.8	23	7	46	9	27	528	4.5

[a] Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 6 Unit 21D Squirrel Creek aerial moose composition counts, regulatory years 1981–1982 through 2007–2008[a]

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	4.5
1997–1998	48.6	54	24	32	8	17	253	5.2
1998–1999	48.6	41	12	31	13	18	283	5.8
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	102.3	44	5	24	2	15	332	3.2
2003–2004	96.6	32	8	25	23	16	242	2.5
2004–2005	102.3	44	14	45	9	24	248	2.4
2005–2006	90.9	32	7	23	9	15	252	2.8
2006–2007	90.9	35	4	35	3	21	164	1.8
2007–2008	96.6	45	17	29	11	17	248	2.6

[a] Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 7 Unit 21D Pilot Mountain Slough aerial moose composition counts, regulatory years 1983–1984 through 2007–2008[a]

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	91.0	18	8	21	5	15	299	3.3
2003–2004	91.0	13	10	48	11	30	342	3.8
2004–2005	91.0	10	3	41	12	27	377	4.1
2005–2006	102.4	19	7	54	11	31	365	3.6
2006–2007	91.0	16	8	31	15	21	326	3.6
2007–2008	91.0	15	7	40	9	26	409	4.5

[a] Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 8 Unit 21D Kaiyuh Slough aerial moose composition counts, regulatory years 1985–1986 through 2007–2008[a]

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	129	2.0
2000–2001	64.3	41	9	31	15	18	127	2.0
2001–2002	229.8	70	6	9	0	5	159	0.7
2003–2004	178.0	55	19	38	14	20	204	1.2
2004–2005	229.8	53	18	52	25	25	252	1.1
2005–2006	229.8	66	18	29	0	15	180	0.8
2006–2007	126.3	42	5	21	5	13	171	1.4
2007–2008	126.3	45	7	27	7	16	190	1.5

[a] Beginning in regulatory year 2001, geospatial population estimate units replaced Gasaway units (Stout 2004).

TABLE 9 Unit 21D Ruby Slough aerial moose composition counts, regulatory year 2006–2007

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
2006–2007	154	20	12	41	10	25	178	1.2

TABLE 10 Unit 21D aerial moose population estimation surveys, 1987–2004

Survey year	Subarea (survey area mi^2)			Total survey area
	Kaiyuh Slough	Western Galena	Upper Koyukuk[d]	
1987[a]	1790±322 (1582)	4118±576 (1508)	n/a n/a	5908±898 (3090)
1997[b]	1335±230 (1582)	3250±403 (1508)	n/a n/a	4585±633 (3090)
2001[c]	1800±591 (1843)	3403±603 (1734)	3642±572 (1949)	8924±1161 (5526)
2004[c]	1487±144 (1843)	3299±161 (1841)	3181±148 (1843)	7967±290 (5526)

[a] MOOSEPOP analysis estimate, with sightability correction factor.
[b] Regression analysis estimate, with sightability correction factor.
[c] Geospatial population estimation, without sightability correction factor.
[d] Predominantly within Unit 24.

TABLE 11 Unit 21D moose population estimate by drawing hunt areas, regulatory year 2007–2008

Drawing hunt area	Density estimate	Moose estimate
(DM816) Yuki R./Bishop Creek	(545 mi^2 @ 1.30 moose/mi^2)	698
	(1555 mi^2 @ 0.35 moose/mi^2)	544
	Subtotal	1242
(DM817) Nulato R./Kaiyuh Flats	(612 mi^2 @ 1.30 moose/mi^2)	796
	(2329 mi^2 @ 0.35 moose/mi^2)	815
	Subtotal	1611
(DM818) Papa Willie Slough	(360 mi^2 @ 1.30 moose/mi^2)	468
	(1096 mi^2 @ 0.35 moose/mi^2)	383
	Subtotal	851
(DM823–DM830) Koyukuk Controlled Use Area	(1841 mi^2 @ 1.79 moose/mi^2)	3299
	(559 mi^2 @ 0.35 moose/mi^2)	196
	Subtotal	3495
(DM814/DM815/DM819) Bear Creek	(916 mi^2 @ 0.75 moose/mi^2)	687
(DM820) Gisasa/Kateel	(2283 mi^2 @ 0.20 moose/mi^2)	456
Unit 21D total	(12,096 mi^2)	8342 (±1000)

TABLE 12 Unit 21D large bull[a] moose percent harvested and number of all bulls measured during the hunting season and percent counted during aerial surveys in the Three Day Slough area (UCU 0804), regulatory years 1990–1991 through 2007–2008

Regulatory year	% Large Bulls Harvested (Sep)	Number of Bull measured (Sep)	% Large Bulls Counted during surveys (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
2002–2003	46	97	–[b]
2003–2004	58	108	25
2004–2005	42	138	19
2005–2006	46	120	33
2006–2007	53	125	27
2007–2008	39	91	30

[a] Fifty-inch or greater antler spread.
[b] No survey.

TABLE 13 Unit 21D moose aerial twinning surveys in the Three Day Slough trend count area, regulatory years 1989–1990 through 2006–2007

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	45	100	23–25
1993–1994	110	39	11	22	55	23–24
1994–1995	78	37	18	33	38	22
1995–1996	200	39	14[b]	26	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	29–6/1
2002–2003	18	37	14	27	21	27,28
2003–2004	44	35	25	42	31	26,27
2004–2005[d]	77	27	16[b]	37	25	24–27
2005–2006	118	26	24	48	62	25–27
2006–2007	65	33	12	27	33	25–27

[a] Percent of cows with calves that 2 or more calves.
[b] Including 1 cow w/3 calves.
[c] The 1999 survey was delayed to 4–7 June due to weather.
[d] Extensive flooding and early leaf-out, survey conditions difficult.

TABLE 14 Unit 21D moose aerial twinning surveys in the Pilot Mountain Slough to Kaiyuh Slough trend count areas, regulatory years 2003–2004 through 2006–2007[a]

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[b]	Yearlings	Dates in May
2003–2004	52	32	18	36	28	24,25
2004–2005	63	26	31	54	12	24–26
2005–2006	86	32	20	38	29	25,26
2006–2007	69	29	18	38	35	22–26

[a] U.S. Fish and Wildlife Service data.
[b] Percent of cows with calves that had twins.

TABLE 15 Unit 21D moose harvest, regulatory years 1990–1991 through 2007–2008

Regulatory year	Harvest by hunters				Unreported harvest[a]	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	4	580
1997–1998	343	70	1	414	150	4	568
1998–1999	340	80	3	423	150	1	574
1999–2000	336	127	3	466	150	3	619
2000–2001	320	35	0	355	150	10	515
2001–2002	247	49	2	298	150	13	461
2002–2003	316	10	0	326	150	14	490
2003–2004	310	9	1	320	150	14	484
2004–2005	227	0	0	227	150	12	389
2005–2006	218	0	0	218	150	13	381
2006–2007	211	0	0	211	150	12	373
2007–2008[b]	204	1	0	205	150	13	368

[a] Unreported harvest based on ADF&G–Subsistence Division's door-to-door survey and other sources.
[b] Preliminary data.

TABLE 16 Ella's cabin checkstation moose harvest, regulatory years 1990–1991 through 2007–2008[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[b]
2001–2002	183	3	2	187[b]
2002–2003	217	0	0	217
2003–2004	248	0	0	248
2004–2005	153	0	0	153
2005–2006	147	0	0	147
2006–2007	164	1	1	167[c]
2007–2008	157	1	1	158

[a] Contains moose harvested in Units 21D and 24.
[b] Including one moose of unknown sex.
[c] Including two moose of unknown sex.

TABLE 17 Ella's cabin checkstation[a,b] moose hunter residency and success, regulatory years 1989–1990 through 2007–2008

Regulatory year	Local resident[c]		Nonlocal resident[d]		Nonresident		Total	
	Hunter	Moose	Hunter	Moose	Hunter	Moose	Hunter	Moose
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	208
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	244	175	43	26	490	278
2001–2002	199	49	279	124	35	14	513	187
2002–2003	215	70	219	130	24	18	458	218
2003–2004	230	80	274	148	40	20	544	248
2004–2005	255	74	158	75	7	4	420	153
2005–2006	261	73	174	68	7	6	442	147
2006–2007	265	92	139	67	9	8	413	167
2007–2008	239	81	130	68	9	9	378	158

[a] Includes hunters reporting in both Units 21D and 24.
[b] Includes hunters reporting at Huslia.
[c] Local residents of Units 21B, 21D and 24
[d] Other than local residents.

TABLE 18 Unit 21D distribution of reported moose harvest, north of the Yukon River and in the Koyukuk River drainage compared to remainder of southern Unit 21D, 1996–1997 through 2007–2008

Regulatory year	Percent harvest		Total
	Northern Unit 21D	Southern Unit 21D	
1996–1997	88	12	426
1997–1998	80	20	414
1998–1999	72	28	397
1999–2000	84	16	466
2000–2001	74	26	340
2001–2002	65	35	268
2002–2003	68	32	318
2003–2004	79	21	313
2004–2005	70	30	192
2005–2006	59	41	218
2006–2007	53	47	211
2007–2008[a]	59	41	205

[a] Preliminary data.

TABLE 19 Overall scores for meat evaluation at Ella's cabin, regulatory years 2002–2003 and 2007–2008

Regulatory year	Avg. no. days hanging	Avg. clean score[a]	Avg. dry score[a]	Avg. smell score[a]	Avg. overall score[a]	Sample size (*n*)
2002–2003	3.3	4.3	4.3	n/a	4.3	184
2003–2004	3.3	4.2	4.4	4.8	4.2	199
2004–2005	2.6	4.3	4.8	4.8	4.6	96
2005–2006	2.7	4.8	4.8	4.8	4.8	95
2006–2007	2.6	4.8	4.8	4.8	4.8	90
2007–2008	2.4	4.4	4.5	4.8	4.6	84

[a] Subjective ranking scale of 1–5, with a score of 1 being lowest.

TABLE 20 Units 21D and 24 Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 2001–2002 through 2007–2008[a]

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	2001–2002	403	15	62	38	126 (97)	3 (2)	1	130
	2002–2003	359	17	51	49	145 (100)	0 (0)	0	145
	2003–2004	401	12	55	45	155 (100)	0 (0)	2	157
	2004–2005	399	8	62	38	141 (100)	0 (0)	0	141
	2005–2006	411	9	63	37	132 (100)	0 (0)	0	132
	2006–2007	382	7	58	42	142 (100)	0 (0)	1	143
	2007–2008	349	8	59	41	131 (100)	0 (0)	0	131
DM823	2005–2006	2	0	0	100	2 (100)	0 (0)	0	2
	2006–2007	2	0	50	50	1 (100)	0 (0)	0	1
	2007–2008	2	0	0	100	2 (100)	0 (0)	0	2
DM825	2005–2006	3	33	0	100	2 (100)	0 (0)	0	2
	2006–2007	4	0	0	100	4 (100)	0 (0)	0	4
	2007–2008	4	0	0	100	4 (100)	0 (0)	0	4
DM827	2001–2002	26	19	68	32	5 (83)	1 (17)	0	6
	2002–2003	20	35	31	69	9 (100)	0 (0)	0	9
	2003–2004	26	19	63	37	7 (100)	0 (0)	0	7
	2004–2005	5	20	25	75	3 (100)	0 (0)	0	3
	2005–2006	3	33	0	100	2 (100)	0 (0)	0	2
	2006–2007	3	66	0	100	1 (100)	0 (0)	0	1
	2007–2008	3	66	0	100	1 (100)	0 (0)	0	1
DM828	2001–2002	103	63	54	46	17 (100)	0 (0)	0	17
	2002–2003	79	56	45	55	17 (100)	0 (0)	0	17
	2003–2004	103	48	40	60	27 (100)	0 (0)	0	27
	2004–2005	20	55	43	57	4 (100)	0 (0)	0	4
	2005–2006	20	55	56	44	4 (100)	0 (0)	0	4
	2006–2007	20	50	40	60	6 (100)	0 (0)	0	6
	2007–2008	20	75	20	80	4 (100)	0 (0)	0	4

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
DM829	2001–2002	26	15	50	50	8 (100)	0 (0)	0	8
	2002–2003	20	45	0	100	11 (100)	0 (0)	0	11
	2003–2004	26	12	38	62	13 (100)	0 (0)	0	13
	2004–2005	5	40	67	33	1 (100)	0 (0)	0	1
	2005–2006	2	50	100	0	0 (0)	0 (0)	0	0
	2006–2007	2	0	0	100	2 (0)	0 (0)	0	2
	2007–2008	2	0	0	100	2 (0)	0 (0)	0	2
DM830	2001–2002	103	51	43	57	26 (100)	0 (0)	0	26
	2002–2003	79	38	16	84	41 (100)	0 (0)	0	41
	2003–2004	103	36	24	76	44 (100)	0 (0)	0	44
	2004–2005	20	60	43	57	4 (100)	0 (0)	0	4
	2005–2006	20	45	27	73	8 (100)	0 (0)	0	8
	2006–2007	20	32	53	47	9 (100)	0 (0)	0	9
	2007–2008	20	25	26	74	14 (100)	0 (0)	0	14
Total	2001–2002	661	29	59	41	182 (98)	4 (2)	1	187
	2002–2003	557	27	46	54	223 (100)	0 (0)	0	223
	2003–2004	659	22	50	50	246 (100)	0 (0)	2	248
	2004–2005	449	13	62	38	153 (100)	0 (0)	0	153
	2005–2006	461	15	60	40	150 (100)	0 (0)	0	150
	2006–2007	433	12	56	44	165 (100)	0 (0)	1	166
	2007–2008	400	15	54	46	158 (100)	0 (0)	0	158

[a] RM830 ended in regulatory year 2000–2001 and was replaced by drawing hunts DM827, 828, 829, and 830.

[b] Percent successful and percent unsuccessful were calculated using the total number of hunters who completed their report cards with enough information to determine whether they harvested a moose.

TABLE 21 Unit 21D outside Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 2004–2005 through 2007–2008

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
DM814	2004–2005	15	13	67	33	4 (100)	0 (0)	0	4
	2005–2006	15	53	67	33	2 (100)	0 (0)	0	2
	2006–2007	15	40	33	67	6 (100)	0 (0)	0	6
	2007–2008	16	13	79	21	3 (100)	0 (0)	0	3
DM815	2004–2005	3	33	50	50	1 (100)	0 (0)	0	1
	2005–2006	3	33	50	50	1 (100)	0 (0)	0	1
	2006–2007	3	0	33	67	2 (100)	0 (0)	0	2
	2007–2008	2	0	100	0	0 (100)	0 (0)	0	0
DM816	2006–2007	25	12	50	50	11 (100)	0 (0)	0	11
	2007–2008	25	36	36	64	9 (100)	0 (0)	0	9
DM817	2006–2007	16	25	25	75	9 (100)	0 (0)	0	9
	2007–2008	31	36	75	25	5 (100)	0 (0)	0	5
DM818	2006–2007	4	25	50	50	1 (100)	0 (0)	0	1
	2007–2008	18	89	100	0	0 (0)	0 (0)	0	0
DM819	2007–2008	1	0	100	0	0 (100)	0 (0)	0	0
DM820	2004–2005	22	55	100	0	0 (0)	0 (0)	0	0
	2005–2006	22	59	13	88	7 (100)	0 (0)	0	7
	2006–2007	22	73	60	40	2 (100)	0 (0)	0	2
	2007–2008	34	44	47	53	10 (100)	0 (0)	0	10

TABLE 22 Unit 21D moose hunter residency and success, regulatory years 1990–1991 through 2007–2008

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	131	223	60	0	414	116	101	54	0	271	685
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	105	167	26	0	298	145	231	63	0	439	737
2002–2003	108	171	47	0	326	133	171	19	1	324	650
2003–2004	115	159	45	3	322	222	169	49	5	445	767
2004–2005	127	88	11	1	227	334	166	44	1	545	772
2005–2006	109	92	15	2	218	288	170	29	9	496	714
2006–2007	114	82	15	0	211	252	129	10	1	392	603
2007–2008[b]	112	79	13	1	205	235	116	22	2	375	580

[a] Unit 21D and Ruby residents only.
[b] Preliminary data.

TABLE 23 Unit 21D moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2007–2008

Regulatory year	Harvest chronology percent by month/day				
	8/22–8/31	9/1–9/14	9/15–9/25	2/1–2/10	*n*
1996–1997	0	53	43	3	419
1997–1998	0	59	38	3	414
1998–1999	0	50	50	1	387
1999–2000	0	49	46	5	441
2000–2001	7	41	47	5	334
2001–2002	3	27	62	8	263
2002–2003	4	30	61	5	313
2003–2004	4	43	47	6	313
2004–2005	2	40	58	0	212
2005–2006	1	37	61	0	209
2006–2007	10	32	58	0	204
2007–2008[a]	7	36	57	0	196

[a] Preliminary data.

TABLE 24 Unit 21D moose harvest percent by transport method, regulatory years 1990–1991 through 2007–2008

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
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	3	0	89	1	7	0	1	0	298
2002–2003	5	0	87	0	4	1	1	2	326
2003–2004	4	0	88	0	6	0	1	1	322
2004–2005	3	0	81	2	3	2	6	3	227
2005–2006	1	1	92	1	1	2	1	1	209
2006–2007	5	0	90	2	0	1	1	1	211
2007–2008[a]	6	0	88	4	0	1	2	1	201

[a] Preliminary data

WILDLIFE

MANAGEMENT REPORT

Alaska Department of Fish and Game
Division of Wildlife Conservation
(907) 465-4190 P.O. BOX 115526
JUNEAU, AK 99811-5526

MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

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 snowmachines provide hunters with easy access to suitable moose habitat (Machida 1997). Annual harvests reported from 1969 through 2004 ranged from a low of 44 moose in 1972 to a high of 408 moose in 1986 (Table 1). However, in recent years, declining moose populations prompted the Board of Game to implement restrictions intended to reduce harvest in many parts of Unit 22. Unit residents account for the majority of the annual reported harvest.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The following population objectives and bull:cow ratios are the current management goals for Unit 22:

- Unit 22 unitwide: maintain a combined population of 5100–6800 moose.
  - Unit 22A: maintain a population of 600–800 moose.
  - Unit 22B West: increase and stabilize the population at 1000–1200 moose.
  - Unit 22B East: insufficient data exists to develop a specific management goal, however increased recruitment rates and population growth are desired.
  - Unit 22C: maintain a population of 450–525 moose.
  - Unit 22D: increase and stabilize the population at 2000–2500 moose.
  - Unit 22E: increase and stabilize the population at 200–250 moose.
- 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 Alaska Department of Fish and Game (ADF&G, the department) was adopted by the Board of Game in November 2001. This objective was revised downward slightly from our previous management goal of 5700–7300 moose, which may be slightly larger than habitat can support. In Units 22A, 22B, and 22D our goal is to increase and stabilize the population from a period of steady decline in moose numbers. In Unit 22C, the goal was revised slightly upward (from reduce and maintain a population of 450–475 moose) based on results of a 2004 habitat survey and is intended to maintain a population within winter browse carrying capacity. In Unit 22E our goal is to reduce the population to the upper threshold of our management goal of 250 moose. 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 of 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 3-year 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

During the report period, we conducted aerial surveys in the spring and fall to estimate sex and age composition and short yearling recruitment in portions of Unit 22. Composition and recruitment surveys were completed using helicopter (Robertson R44) or fixed-wing (Piper PA12, PA18 and Cessna 185) aircraft. Geospatial population estimation (GSPE) techniques were used in March 2006 and March 2007 to estimate abundance of moose in Units 22D/22E and Unit 22C, respectively (J. VerHoef, ADFG, pers. comm.). Population estimates from this reporting period are comparable to previous geospatial census efforts completed in Units 22B and 22C (March 2004) and Unit 22A (March 2005). We summarized harvest reports returned by hunters and harvest data collected during big game harvest surveys in St. Michael, Shaktoolik, and Unalakleet. The department administered registration moose hunts in the most heavily hunted areas along the Nome road system in Units 22B, 22C, and 22D. Public meetings were held in Unit 22A to discuss declining moose populations and to form recommendations to the Board of Game for changes to hunting regulations.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Summary results for population censuses completed in Units 22C, 22D, and 22E are discussed below, respectively, and are presented in Table 2.

Population Size

In Unit 22C, a 2007 census estimated 620 moose (90% C.I. ±18.0%) and showed a 17% increase since the previous census completed in 2004 (Table 2). The Unit 22C moose population has been above the area's management goal of 450–525 moose since 1995 despite bull: cow ratios consistently below 30 bulls:100 cows (Table 3) and annual harvest rates of 8%. The department implemented an antlerless hunt in 2000 that allowed up to 20 cows to be taken each fall in an attempt to slightly reduce and stabilize the population.

In Unit 22D a census was completed between 23 February and 21 March 2006. An estimate was generated for the combined Kuzitrin and Agiapuk River drainages (2881 mi.^{2}) and separate estimates were obtained for the Kuzitrin River drainage (1610 mi.^{2}) and for the Agiapuk River drainage (1271 mi.^{2}). The combined area of Unit 22D had an estimated 1565 moose (90% C.I. ±22.8%; range 1208–1922 moose). The calf:adult ratio was 24 calves:100 adults (90% C.I. ± 18.8%), yielding a recruitment rate of 19%. Since 1988 the annual rate of change in population

has decreased approximately 3% (Table 2); however, recent composition data shows increases in calf: adult ratios suggesting stabilization of the population (Table 3).

Within sub-areas of Unit 22D, the Kuzitrin River drainage yielded an estimate of 966 moose (90% C.I. ± 28.9%; range 687–1246 moose), where the calf:adult ratio was 18 calves:100 adults (90% C.I. ± 27.3%)) and the recruitment rate was 15%. In the Agiapuk River drainage we estimated 599 moose (90% C.I. ± 29.9%; range 420–778 moose), where the calf: adult ratio was 35 calves: 100 adults (90% C.I. ± 26.1%). and the recruitment rate was 26%.

The number of moose estimated in the entire Unit 22D census area in 2006 is similar to 2002 when 1594 moose were estimated. The point estimate for the Kuzitrin drainage indicates a slight decline (not statistically significant) and the estimate for the Agiapuk drainage shows a slight increase (also not statistically significant). A slight decline in moose numbers in the Kuzitrin is not surprising given calf:cow ratios of 9–15 calves:100 cows found on composition surveys in the Kuzitrin during November 2002–2004. Composition surveys have not been flown in the Agiapuk since the 2002 census, but calf:cow ratios were consistently higher in the Agiapuk drainage during fall surveys prior to the 2002 census and calf:adult ratios were higher than in the Kuzitrin in both the 2002 and 2006 censuses.

In Unit 22E a census, completed during 15–23 March 2006, estimated 587 moose (90% C.I. ± 18.2%; range 481–695 moose). The calf:adult ratio was 22 calves:100 adults (90% C.I. ± 23.5%), and the recruitment rate was 18%. The current population remains well above the management goal of 200–250 moose (Table 2).

In this census, a computer modeling approach, called ‘desktop stratification’, was applied to all but the northeast portion of the census area. In the modeling process, the classification of strata likely to be occupied by moose was based on previous knowledge or distribution and not based on current survey observations. Standard GSPE procedures resulting in aerial coverage of 187 sample units were used in the northeast portion where pothole lake habitat makes moose distribution and abundance unpredictable. Overall, the entire census area contained 727 sample units, included 266 units classified as highs, and 461 classified as lows. We intensively searched 139 units, of which 87 had been designated as highs and 52 as lows. Of the 174 moose observed, 169 moose were in units classified as highs and 5 moose were in units classified as lows.

Compared to the previous Unit 22E census in 2003 (504 moose; 90% C.I. ±10%), the 2006 point estimate of 587 moose indicates a 16% increase in population size; however, the increase is not statistically significant at the 90% C.I. Considering additional local observations (through casual reports) and pre-2003 riparian survey data (which is not directly comparable to the recent census estimates), we believe population size and recruitment rates have shown an increasing trend since the late 1990s to early 2000s, when staff and local concerns about declining numbers of moose and calves led to season reductions and a bulls-only hunt. The increase observed in 2006 is probably influenced by a natal increase in population related to improved recruitment as well as the presence of non-migratory animals related to shallow snow-depth during the census period.

The relationship between Unit 22E moose numbers and snow depth has been shown in collaring studies in the 1980s where considerable movement of moose from Unit 22E into the

American/Agipuk drainages in Unit 22D occurred during winters of heavy snow accumulation. Migration of animals from Unit 22E into Unit 22D was substantially reduced in years of shallow snow depth, which is similar to the conditions experienced in both 2003 and 2006. To document and evaluate these potential annual variations, we altered our census schedule to allow censuses of Units 22D and 22E during the same winter, which we accomplished for the first time in 2006. The combined census efforts in Units 22D and 22E suggests stable populations since 2002 with improved calf:adult ratios. However, the importance of seasonal migration between the two areas is not fully understood and further comparative censuses in the same year are needed to determine the influence of this factor.

Population Composition

Fall. We completed fall composition surveys using Robertson R-44 helicopter, Cessna-185, and Piper PA-12 aircraft in several areas during the reporting period (Table 3). In both November 2005 and November 2006 we surveyed the Snake and Stewart river drainages in Unit 22C and portions of the Kuzitrin River drainage in Unit 22D. Helicopter surveys have greatly improved detection of moose when snow cover is minimal and were used whenever funds allowed.

Unit 22C. The November 2005 moose composition survey completed in the Snake and Stewart river drainages classified 110 moose yielding summary data of 27 bulls:100 cows, 39 calves:100 cows, and 24% calves. The composition survey completed in November 2006 classified 122 moose yielding summary data of 14 bulls:100 cows, 20 calves:100 cows, and 18% calves (Table 3).

Unit 22D. In November 2005 we flew a composition survey in a portion of the Kuzitrin drainage, classified 145 moose and found 20 bulls:100 cows (n=145) and 21% calves. (Table 3). In November 2006 we repeated the survey, classified 192 moose and found 22 bulls:100 cows, 17 calves:100 cows, and 12% calves.

Spring. Results of short yearling recruitment surveys completed in several areas of Unit 22 during the reporting period are found in Table 4.

Unit 22A. In 2006 a spring survey was completed in the central portion of Unit 22A including the Unalakleet, Old Woman, Ten mile, Chiroskey, South, Golsovia, Egavik, and North rivers. Some small coastal drainages were also flown. Complete snow cover made sightability excellent and staff classified 137 adults and 27 short yearlings and found 20 calves:100 adults and a 16% recruitment rate. The 164 moose counted represents the upper threshold of the 2005 census estimate of 123 moose (90% C.I. ± 33.8%; range 81 to 164 moose).

In spring 2007, we completed a survey covering the central portion of Unit 22A, although lack of snow made sightability poor because moose and their tracks were difficult to see from the air. We classified 82 adults and 15 short yearlings and found 18 calves:100 adults and a 15% recruitment rate.

Unit 22B. In 2006 a spring survey was completed in Unit 22B, west of the Darby Mountains including portions of the Niukluk and Fish rivers. Staff classified 189 adults and 19 short yearlings and found 10 calves:100 adults and a 9% recruitment rate. During the period 1991

through 2006, recruitment rates have shown little change and have remained low at 7%-10%, annually.

In 2007 a partial survey was completed in Unit 22B west of the Darby Mountains because strong winds prohibited aircraft coverage of the Niukluk and Fish river drainages. During this abbreviated effort, staff classified 83 adults and 3 calves and found 4 calves:100 adults and a 3% recruitment rate.

Unit 22D. In 2007 we completed a spring recruitment survey in a portion of the Kuzitrin River drainage and found 298 adults and 25 calves and an 8% recruitment rate. Recruitment rates have ranged between 6%-18% in spring surveys completed since 1991.

Distribution and Movements

No studies were undertaken during this reporting period to evaluate distribution or movements of moose in Unit 22. However, we did document dispersal of 3 moose originally captured and marked with ear tags as 10-month-old calves in a calf weight study project. A male moose, originally captured in the Snake River drainage near Nome, was harvested near Solomon, Alaska at a distance of approximately 30 air miles east of the capture site. The second male moose was captured in the Nome River drainage near Nome and was harvested near mile 62 on the Nome-Teller highway, approximately 40 air miles northwest of the capture site. The third male moose was captured in the Nome River drainage near Nome and was harvested approximately 5 miles away in the Nome River drainage.

MORTALITY

Harvest

Seasons and Bag Limits. Changes were implemented in Unit 22A, 22B, and 22D during the reporting period.

2005–2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22A, that portion north of and including the Tagoomenik and Shaktoolik River drainages Residents: 1 bull	1 Aug–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 22A, that portion in the Unalakleet River drainage and all drainages flowing into Norton Sound north of the Golsovia River drainage and south of the Tagoomenik and Shaktoolik River drainages	15 Aug–25 Sep	

2005–2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Residents: 1 bull		
Nonresidents:		No open season
Remainder of Unit 22A Residents: 1 bull; or 1 antlered bull	1 Aug–30 Sep 1 Dec–31 Dec	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Sep–30 Sep
Unit 22B, that portion east of the Darby Mountains, including the drainages of the Kwiniuk, Tubutulik, 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 by registration permit only; or 1 antlered bull by registration permit only	10 Aug–23 Sep 1 Jan–31 Jan	
Nonresidents:		No open season
Unit 22C Residents: 1 bull by registration permit only; or 1 antlerless moose by registration permit	1 Sep–14 Sep 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		

2005–2006 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
the Kougarok, Kuzitrin and Pilgrim River drainages		
Residents: 1 antlered bull by registration permit only; or	1 Sep–14 Sep	
1 antlered bull by registration permit only	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Unit 22D Southwest, that portion west of the Tisuk River drainage, west of the west bank of the unnamed creek originating at the unit boundary opposite the headwaters of McAdam's Creek to its confluence with Tuksuk Channel		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 bull by registration permit only	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Remainder of Unit 22D		
Residents: 1 antlered bull or 1 moose; however antlerless moose may be taken only from 1Dec through 31 Dec; a person may not take a cow accompanied by a calf	10 Aug–14 Sep 1 Oct–31 Jan	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side, by registration permit only		1 Sep–14 Sep
Unit 22E		
Residents: 1 antlered bull	1 Aug–31 Dec	
Nonresidents:		No open season

2006–2007 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
Unit 22A, that portion north of and including the Tagoomenik and Shaktoolik River drainages		
Residents: 1 bull	1 Aug–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 22A, that portion in the Unalakleet River drainage and all drainages flowing into Norton Sound north of the Golsovia River drainage and south of the Tagoomenik and Shaktoolik River drainages		
Residents: 1 bull	No open season	
Nonresidents:		No open season
Remainder of Unit 22A		
Residents: 1 bull; or	1 Aug–30 Sep	
1 antlered bull	1 Jan–31 Jan	
Nonresidents: 1 bull with 50-inch antlers or with 4 or more brow tines on at least one side		1 Sep–14 Sep
Unit 22B, that portion east of the Darby Mountains, including the drainages of the Kwiniuk, Tubutulik, Koyuk and Inglutalik Rivers	1 Aug–30 Sep	
Residents: 1 bull	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 by registration permit only; or	1 Sep–14 Sep	

2006–2007 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
1 antlered bull by registration permit only	1 Jan–31 Jan	
Nonresidents:		No open season
Unit 22C		
Residents: 1 bull by registration permit only; or	1 Sep–14 Sep	
1 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 by registration permit only; or	1 Sep–14 Sep	
1 antlered bull by registration permit only	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Unit 22D Southwest, that portion west of the Tisuk River drainage, west of the west bank of the unnamed creek originating at the unit boundary opposite the headwaters of McAdam's Creek to its confluence with Tuksuk Channel		
Residents: 1 bull by registration permit only; or	1 Sep –14 Sep	
1 bull by registration permit only	1 Jan–31 Jan (Season may be announced by emergency order)	
Nonresidents:		No open season
Remainder of Unit 22D		
Residents: 1 antlered bull or	10 Aug–14 Sep	

2006–2007 Units and Bag Limits	Resident/Subsistence Hunters	Nonresident Hunters
1 moose; however antlerless moose may be taken only from 1Dec through 31 Dec; a person may not take a cow accompanied by a calf	1 Oct–31 Jan	
Nonresidents: 1 bull with 50–inch antlers or with 4 or more brow tines on at least one side, by registration permit only		1 Sep–14 Sep
Unit 22E		
Residents: 1 antlered bull	1 Aug–31 Dec	
Nonresidents:		No open season

Board of Game Actions and Emergency Orders (EO).

In November 2005 the Board made changes in moose regulations in Units 22A, 22B, and 22D, effective in regulatory year 2006–2007. The season was closed in the central portion of Unit 22A in response to the area's declining moose population. In southern Unit 22A seasons were adjusted to account for changing weather patterns and winter travel conditions in the area.

In Unit 22B east of the Darby Mountains a nonresident drawing hunt with a harvest quota was established in response to the increased nonresident effort and harvest from the area.

In Unit 22B remainder, that portion of Unit 22D within the Kougarok, Kuzitrin, and Pilgrim river drainages, and Unit 22D Southwest the resident moose season was shortened to 1–14 September to align all seasons along the Nome road system. People hunting in all areas along the Nome road system need a registration permit valid in 4 hunt areas: Unit 22C, western Unit 22B, the Kuzitrin drainage in Unit 22D, and Unit 22D Southwest.

In July 2005, the department closed the 2005–2006 resident moose season within the central portion of Unit 22A which includes the Unalakleet River drainage and all drainages flowing into Norton Sound north of the Golsovia River drainage and south of the Tagoomenik and Shaktoolik River drainages. The season closure was later made permanent during the November 2005 BOG meeting.

In September 2005, the department issued an EO that closed fall registration moose hunt RM840 in the Kuzitrin River drainage in Unit 22D. The registration hunt had a harvest quota of 33 bull moose which was close to being reached with several days left in the season. The EO was issued to prevent over harvest.

In September 2005, the department issued an EO that closed fall registration moose hunt RM840 in Unit 22C. The registration hunt had a harvest quota of 40 bull moose which was close to being reached with several days left in the season. The EO was issued to prevent overharvest.

In November 2005, the department issued an EO that closed the 1–31 December resident moose season in southern Unit 22A (referred to in regulation as Remainder of Unit 22A) and announced a 1–31 January resident moose season with an antlered bull bag limit.

In September 2006, the department issued an EO that closed fall registration moose hunt RM840 in Unit 22B remainder. The registration hunt had a harvest quota of 18 bull moose which was close to being reached with several days left in the season. The EO was issued to prevent over harvest.

In September 2006, the department issued an EO that closed fall registration moose hunt RM840 in Unit 22C. The registration hunt had a harvest quota of 40 bull moose which was close to being reached with several days left in the season. The EO was issued to prevent overharvest.

In November 2006, the department issued an EO that opened registration permit moose hunt RM849 in the portion of Unit 22D in the Kougarok, Kuzitrin and Pilgrim River drainages and in Unit 22D Southwest. The winter registration moose season was 1–31 January and had a harvest quota of 4 antlered bull moose in Unit 22D in the Kougarok, Kuzitrin and Pilgrim River drainages and 4 antlered bull moose in Unit 22D Southwest.

In January 2007, the department issued an EO that closed winter registration permit hunt RM849 in Unit 22B, west of the Darby Mountains and Unit 22D in the Kougarok, Kuzitrin and Pilgrim River drainages. The registration hunt areas each had harvest quotas of 4 bull moose that were met with several days left in each season. The EO was issued to prevent overharvest.

Hunter Harvest. During the 2005–2006 season, harvest report data shows that 544 hunters harvested 164 moose (154 males, 8 females, and 2 unknown). A harvest of 175 moose (159 males and 16 females) was reported taken by 520 hunters during the 2006–2007 season (Table 1).

Compared to previous reports, moose harvests in the current reporting period have decreased slightly to an average hunter success rate of approximately 32%. Moose harvest remained well below harvest levels seen in the 1980s and 1990s. Declining numbers of moose have resulted in shortened seasons with harvest quotas in many parts of the unit, which have reduced harvest in recent years.

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 initiated in April 1999 to obtain more accurate big game harvest data from Unit 22 villages. Kawerak Inc. was able to survey 12 villages during 2005–2006 and visited from 37.9%–95.9% of households in each village (Kawerak, Inc. 2005–2006). The village-based harvest surveys found the following total moose harvests in Unit 22 villages: 9 in Shishmaref, 3 in Wales, 7 in Brevig Mission, 4 in Teller, 11 in White Mountain, 20 in Elim, 24

in Koyuk, 2 in Unalakleet, 11 in St. Michael, 10 in Stebbins, 0 in Gambell, and 0 in Savoonga. Cow harvest was reported in Brevig Mission (1) and St. Michael (1).

Permit Hunts. Two registration permit hunts for antlerless moose are administered in Unit 22C. Hunt RM850 occurs in the Nome and Snake River drainages, with up to 5 available permits. RM852 occurs in the remainder of Unit 22C, and up to 15 permits may be available. During this reporting period all permits were issued for both hunts. In 2005, 2 cows were harvested in RM850, and 6 cows were harvested in RM852. In 2006, 4 cows were taken in RM850 and 12 cows were harvested in RM852 (Table 5).

Since 2002 registration moose hunts with harvest quotas have been in place in the heavily hunted portions of Units 22B and 22D along the Nome road system. In 2005 a total of 450 people were issued permits in RM840 and 92 bull moose were harvested (Table 5). In Unit 22B West, hunters harvested 17 bulls out of a 23 bull quota. In Unit 22C, hunters harvested 39 bulls out of a 40 bull quota. In Unit 22D, Kuzitrin, hunters harvested 31 bulls out of a 33 bull quota. In 22D SW hunters harvested 5 moose out of an 8 bull quota.

In 2005, winter registration moose hunt RM849 was administered in Unit 22B west of the Darby Mountains. Hunters harvested 5 antlered bulls of the 7 antlered bull quota. The winter hunt utilizes a portion of the total harvest quota from Unit 22B west of the Darby Mountain as recommended by the Northern Norton Sound Advisory Committee.

In 2006, a total of 474 people were issued permits in RM840 and 93 bull moose were harvested (Table 5). In Unit 22B west, hunters harvested 18 bulls out of the 18 bull quota. In Unit 22C, hunters harvested 36 bulls out of a 40 bull quota. In Unit 22D Kuzitrin, hunters harvested 35 bulls out of a 39 bull quota. In 22D SW hunters harvested 4 moose out of an 8 bull quota.

In 2006, winter registration hunt RM849 was administered in Unit 22B west of the Darby Mountains, Unit 22D Kuzitrin drainage, and Unit 22D southwest. Hunters' harvested 4 out of the 5 antlered bull bag limit in Unit 22B west, and 2 of 4 antlered bull moose and 0 of 4 antlered bull moose in Unit 22D Kuzitrin and Unit 22S southwest, respectively.

In 2005, nonresident registration hunt RM842 was administered in Unit 22D Remainder. Eight permits were issued, 8 nonresidents hunted and 6 bulls were taken. In 2006, nonresident registration hunt RM842 was administered in Unit 22D Remainder. Eleven permits were issued, 10 nonresidents hunted and 8 bulls were taken (Table 5).

The registration hunts with harvest quotas require reporting within 3 days of harvesting a moose and hunters must turn in the lower jaw for aging and tooth analysis. Reporting by people who hunt but fail to harvest a moose has typically been lax in the past, but increased emphasis on the need to report has increased the reporting rate in the registration hunts.

Hunter Residency and Success. Unit 22 residents accounted for 90% of the harvest in 2005–2006 and 85% of the harvest in 2006–2007 (Table 6). From 1994–2004 the proportion of harvest attributable to local residents remained between 69%–74%, but since 2005 local resident harvest has been higher, between 78%-90%. The 2002 regulatory changes that closed nonresident seasons in large parts of the unit and established harvest quotas likely discouraged visiting

hunters from flying to Unit 22, and are probably responsible for the decrease in nonlocal harvest. The nonresident portion of the harvest accounted for 9% of the harvest in 2005 and 10% in 2006.

Harvest Chronology. Shortened season lengths have consolidated much of the harvest into the months of August and September in most parts of the unit (Table 7). Previously long seasons that ran from August through January in many parts of the unit and through March in Unit 22E allowed harvest to occur over a period of up to 8 months. During this reporting period most of the hunter effort and reported harvest occurred during September (79%), and August (9%).

Transport Methods. During this reporting period 42% of successful moose hunters used four wheelers (three-wheelers not used in reporting period), 24% used boats, 13% used highway vehicles and 10% used snowmachines (Table 8). Only 2% of the harvest was by hunters using airplanes.

Other Mortality

No surveys were attempted to determine natural mortality rates of Seward Peninsula moose. 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 in most parts of the unit. 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 predation (Persons 1998). During years when deep, soft snow persists well into May, bear predation on adult moose may be significant; however, during this reporting period winter conditions in most parts of the unit appeared to be fairly easy on moose. 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

In 2004 we began conducting moose browse surveys in Unit 22 as a first step to help determine whether habitat limitations are contributing to the long-term decline of moose populations in parts of the unit. Habitat surveys use transects to: 1) categorize shrub architecture to estimate the proportion of shrubs that exhibit a “broomed” growth form caused by repeated heavy browsing; and 2) categorize shrub health to estimate the proportion of the plants that have more dead stems than live biomass. The percentage of browsed plants that are broomed (“brooming index”) can be compared to percentages obtained from moose ranges in other parts of Alaska where correlations have been made between the brooming index and forage removal, moose density, and productivity (twinning rates) for the purpose of assessing resource limitation (Seaton et al. *In Press*).

In September 2006 we conducted browse transect surveys in the Agiapuk River drainage located in Unit 22D, and in April 2006 we surveyed portions of the Fish and Niukluk rivers located in Unit 22B (Paragi 2004). Results from browse transect surveys are summarized in Table 9. Surveys completed since 2004 show moose have influenced shrub architecture on the central

Seward Peninsula but shrubs appear to be sustaining a compensatory response to browsing pressure without substantial shrub mortality.

The broomed index calculated from 2006 surveys was 70.0 in Unit 22D and 56.0 in Unit 22B. The broomed index has ranged from 46.7 (22B) to 70.0 (22D) from all surveys completed in Unit 22. The central Seward Peninsula range is clearly more affected by moose browsing than areas of Unit 18 (lower Yukon and Kuskokwim rivers), where brooming indices were 0–28 among 4 sampling areas with relatively low moose density (Paragi 2002). Seward Peninsula brooming indices were less than those found for the Tanana Flats and foothills of central Unit 20A (77 [73–81]), where forage removal was 42.5% (40.8–44.1) and twinning rate averaged only 6% (Seaton et al. *In Press*), signaling resource limitation. Brooming indices found on the Seward Peninsula were most comparable to the eastern portion of Unit 19D (64 [60–68]), where forage removal was 18.9% of current annual growth, moose twinning rates were 45% (Seaton et al. *In Press*) and resource limitation is not considered to be a significant limiting factor for moose.

During April 2006 department staff weighed 10-month old moose calves to further assess nutritional health of Unit 22 moose populations. Calf weights are considered along with moose browse biomass surveys, twinning rates, and parturition rates of cow moose to assess nutritional health of interior moose populations (Boertje et al 2007). Research completed on Interior Alaska moose populations found short yearling weights less than 385 lbs. can be an indication moose are resource limited. A sample of 29 moose weighed during April 2006 in Units 22B and 22C found average weights of 417 lbs and 411 lbs respectively. Males averaged 419 lbs and females averaged 410 lbs.

Enhancement

There were no habitat enhancement activities conducted in Unit 22 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

There were no nonregulatory management needs reported during the reporting period.

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. Survey and inventory projects during this reporting period show populations stabilizing in Unit 22D and statistically significant population increases in Units 22C and Unit 22E.

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 abundant in the area, and bear predation on calves is probably the most significant factor in calf

mortality. Additionally, during the last 10 years wolf numbers have increased on the Seward Peninsula since Western Arctic herd caribou began wintering there.

Moose browse surveys suggest current browse availability and condition are unlikely to be limiting the unit's moose population. However, browse transect data alone is insufficient evidence to discount the possibility that habitat limitations may be a factor. If funding permits, we recommend that other indices of resource limitation, such as obtaining additional weights of short-yearlings, and determining browse removal rates or twinning rates be applied in Units 22B, 22C and 22D.

Unit 22C is the only portion of Unit 22 where consistently high recruitment rates have allowed the population to exceed our management goal. Two antlerless moose hunts in Unit 22C were initiated in 2000 to help stabilize the population and prevent over-utilization of the limited winter habitat. Harvest has been below antlerless harvest objectives and harvest reports show hunters experienced a 69% success rate since 2000. Additional effort should be made to harvest antlerless moose to help slow population growth in Unit 22C. The 2007 moose census showed the population grew to 620 moose and is above our management goal of 450–525 moose.

The department has amended the spring census schedule in response to declining moose populations in Unit 22. A stratified moose census is completed in each of the units once every 3 years and future censuses are scheduled as follows: 2009 – Units 22B/C, 2010 – Units 22D/E, 2011 – Units 22A, and 2012– Units 22B/C.

Compliance with regulations and harvest reporting is thought to be reasonably high in the Nome area and has improved as a result of education efforts associated with the new registration hunts. 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 data has been essential in providing the Board of Game with a realistic picture of moose harvest and timing in Unit 22 and has greatly influenced the board in its regulatory decisions. If funding allows, this program should be continued and expanded to provide ongoing estimates of moose harvest and subsistence use of moose by village residents.

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KAWERAK, INC., NORTH PACIFIC RESEARCH BOARD, ALASKA DEPARTMENT OF FISH & GAME, 2005-2006. Comprehensive Subsistence Harvest Survey, Bering Strait/Norton Sound Region

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Table 1 Unit 22 historical moose harvest by sex, hunter effort, and success rate for regulatory years 1969–1970 through 2006–2007

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	35
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
2001–2002	119	8	0	127	421	30
2002–2003	160	12	0	172	563	31
2003-2004	182	12	2	196	587	33
2004-2005	179	13	0	192	530	36
2005-2006	154	8	2	164	544	30
2006-2007	159	16	0	175	520	34

[a]Minimum known number of hunters.

Table 2 Summary of Unit 22 spring moose censuses, 1987–2007

Area	Year	Size (mi^2)	Census estimate (Nr.)			Density ($Nr./mi^2$)		Calves per 100 Adults	Percent calves	Census method
			Adults	Calves	Total[a]	Adult	Total			
Unit 22A Unalakleet Drainage	1989	1124	273	52	325	0.24	0.29	19	16	Gasaway
Unit 22A Unalakleet Drainage	2003	2000	71	11	75	0.04	0.04	15	15	Geostatistical
Unit 22A Unalakleet Drainage	2005	2400	113	10	123	0.05	0.05	9	8	Geostatistical
Unit 22B West	1987	2105	1676	218	1894	0.80	0.90	13	11.5	Gasaway
Unit 22B West Reduced area	1992	859	603	95	698	0.70	0.81	16	14	Mod. Gasaway
Unit 22B West	1999	2105	749	49	797	0.36	0.38	7	6	Geostatistical
Unit 22B West Reduced area	1999	859	448	28	476	0.52	0.58	6	6	Geostatistical
Unit 22B West	2004	2400	529	53	586	0.22	0.24	10	9	Geostatistical
Unit 22C	1990	1368	322	85	407	0.24	0.30	26	21	Gasaway
Unit 22C	1995	1368	394	85	479	0.29	0.35	22	18	Mod. Gasaway
Unit 22C	2001	1368	413	139	557	0.30	0.41	34	25	Geostatistical
Unit 22C	2004	1368	442	102	530	0.32	0.39	23	19	Geostatistical
Unit 22C	2007	1368	533	87	620	0.39	0.45	16	14	Geostatistical
Unit 22D Kuzitrin Drainage	2006	1610	821	145	966	0.51	0.60	18	15	Geostatistical
Unit 22D Kuzitrin Drainage	2002	1456	911	114	1028	0.63	0.71	13	11	Geostatistical
Unit 22D Kuzitrin Drainage	1988	1456	1673	278	1951	1.14	1.34	17	14	Gasaway
Unit 22D Kuzitrin Drainage Reduced	1993	856	943	153	1096	1.10	1.28	16	14	Mod. Gasaway
Unit 22D Kuzitrin Drainage	1997	1456	1019	232	1251	0.70	0.86	23	19	Mod. Gasaway
Unit 22D Agiapuk Drainage	1988	1041	782	159	941	0.75	0.90	20	17	Gasaway
Unit 22D Agiapuk Drainage Reduced	1993	723	406	77	483	0.56	0.66	19	16	Mod. Gasaway
Unit 22D Agiapuk Drainage	1997	1041	451	127	578	0.43	0.56	28	22	Mod. Gasaway
Unit 22D Agiapuk Drainage	2002	1041	485	82	567	0.47	0.54	17	14	Geostatistical
Unit 22D Agiapuk Drainage	2006	1271	443	156	599	0.35	0.47	35	26	Geostatistical
Unit 22E	1991	NA	208	18	226	NA	NA	9	8	Riparian Survey
Unit 22E	1996	NA	164	32	196	NA	NA	20	16	Riparian Survey

Area	Year	Size (mi^2)	Census estimate (Nr.)			Density ($Nr./mi^2$)		Calves per 100 Adults	Percent calves	Census method
			Adults	Calves	Total[a]	Adult	Total			
Unit 22E	2001	NA	157	12	169	NA	NA	8	7	Riparian Survey
Unit 22E	2003	4500	408	96	504	0.09	0.11	23	19	Geostatistical
Unit 22E	2006	4500	481	106	587	0.11	0.13	22	18	Geostatistical

[a] Totals may not equal the sum of adults and calves. Each census estimate column is an independent computer-generated estimate using the census method noted in the census method column.

Table 3 Unit 22 aerial moose composition surveys, fall of 1992, 1994, and 2000–2006

Survey area	Year	Bulls per 100 cows	Calves per 100 cows	Total calves	Percent calves	Total adults	Total moose
Unit 22A							
Unalakleet River	2003	69	20	7	10	59	68
Golsovia River	2003	50	67	8	31	18	26
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
Koyuk River	2004	12	0	0	0	56	56
Unit 22C							
Snake River	1992	11	30	11	21	41	52
	1994	14	32	12	22	42	54
	2000	10	25	16	19	69	85
Snake/Stewart Rivers	2001	25	21	24	15	140	164
	2002	24	43	32	26	93	125
	2004	11	31	28	22	101	129
	2005	27	39	26	24	84	110
	2006	14	20	18	15	104	122
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
	2003	26	15	24	10	208	232
	2004	30	9	5	7	68	74
	2005	20	33	31	21	114	145
	2006	22	17	23	12	169	192

Agiapuk	2000	44	23	43	14	275	318
	2001	30	6	5	4	107	112
	2003	24	27	40	18	183	223

Table 4 Unit 22 short yearling recruitment surveys, spring 1991–2005

Survey area and survey year	Nr. calves	Nr. adults	Total	Percent Calves
Unalakleet, main stem (Unit 22A)				
2000	7	77	84	8
2003	3	16	19	16
Shaktoolik, main stem (Unit 22A)				
2000	5	40	45	11
2003	2	11	13	15
Ungalik, main stem (Unit 22A)				
2000	1	28	29	3
2003	0	1	1	0
Golsovia drainage (Unit 22A)				
2000	4	11	15	27
2003	6	23	29	21
Pikmiktalik main stem (Unit 22A)				
2000	2	4	6	33
2003	6	11	17	35
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
2003	6	59	65	9
Koyuk River (Unit 22B)				
1999	21	208	229	9
2000	19	223	242	8
2004	12	54	66	18
2005	13	89	102	13
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

Table 4 continues next page

Table 4 Unit 22 short yearling recruitment surveys, spring 1991–2003 (continued)

Survey area and survey year	Nr. calves	Nr. adults	Total	Percent calves
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
2003	32	180	212	15
Kuzitrin/Noxapaga River (Unit 22D)				
1991	23	191	214	11
1994	16	71	87	18
2000	14	203	217	6
2003	52	276	328	16
Kuzitrin Below Bridge (Unit 22D)				
2000	17	271	288	6
2003	16	87	103	15
American River (Unit 22D)				
1995	51	248	299	17
Agiapuk/American (Unit 22D)				
2003	74	246	320	23

Table 5 Unit 22 Registration moose hunt statistics for regulatory years 2005–2006 and 2006-2007

Reg Year	Hunt	Total moose killed	Males killed	Females killed	Unknown killed	Total permittees reporting	Hunted	Did not hunt
2005	RM850	2	0	2	0	5	4	1
2005	RM852	6	0	6	0	15	13	2
2005	RM840	92	92	0	0	450	365	85
2005	RM849	6	6	0	0	22	21	1
2005	RM842	6	6	0	0	8	8	0
2006	RM850	5	0	4	1	5	5	0
2006	RM852	12	0	12	0	16	15	1
2006	RM840	93	93	0	0	474	391	83
2006	RM849	7	7	0	0	26	20	6
2006	RM842	8	8	0	0	11	10	1

Table 6 Residency and success of moose hunters in Unit 22, regulatory years 2005–2006 and 2006–2007

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
2005–2006										
22A	7	4	2	1	14	5	4	2	0	11
22B	30	2	4	0	36	87	14	0	0	101
22C	43	4	2	0	49	117	8	3	1	129
22D	46	4	6	0	56	84	6	3	0	93
22E	7	1	0	1	9	12	0	0	0	12
22 unknown	0	0	0	0	0	26	6	0	0	32
Total	133	15	14	2	164	331	38	8	1	378
2006–2007										
22A	6	2	4	2	14	3	1	0	2	6
22B	25	4	4	3	36	54	10	2	5	71
22C	46	5	0	0	51	91	9	3	1	104
22D	47	11	10	0	68	82	20	3	0	105
22E	3	2	0	1	6	10	3	0	2	15
22 unknown	0	0	0	0	0	48	5	0	0	53
Total	127	24	18	6	175	288	48	8	10	354

[a] Resident of Unit 22

[b] Other Alaska resident

Table 7 Chronology of Unit 22 moose harvest, regulatory years 2005–2006 and 2006–2007

Regulatory year/ Unit	Month of harvest									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Unknown	Total
2005–2006										
22A	1	6	0	0	0	5	2	0	0	14
22B	5	21	0	3	0	5	0	0	1	35
22C	0	48	0	0	0	0	0	0	0	48
22D	0	46	9	0	0	1	0	0	0	56
22E	2	2	3	0	1	1	0	0	0	9
22 Unknown	0	0	0	0	0	0	0	0	2	0
Total	8	123	12	3	1	12	2	0	3	164
2006–2007										
22A	3	7	0	0	0	2	2	0	0	14
22B	0	22	0	10	0	4	0	0	0	36
22C	0	50	1	0	0	0	0	0	0	51
22D	5	52	5	0	0	2	0	0	1	65
22E	0	3	2	0	1	0	0	0	0	6
22 Unknown	0	0	0	0	0	0	0	0	30	0
Total	8	134	8	10	1	8	2	0	4	175

Table 8 Means of transportation reported by successful Unit 22 moose hunters, regulatory years 2005-2006 and 2006-2007

Regulatory Year/Unit	Aircraft	Horse	Boat	3 or 4 Wheeler	Snowmobile	Off-road vehicle	Highway vehicle	Air boat	Unknown	Total
2005–2006										
22A	0	0	5	5	4	0	0	0	0	14
22B	0	0	14	13	8	0	0	0	1	36
22C	0	0	10	19	0	3	16	0	1	49
22D	3	0	14	31	1	2	5	0	0	56
22E	0	0	1	2	1	2	0	0	3	9
Total	3	0	44	70	14	7	21	0	5	164
2006-2007										
22A	0	0	5	5	4	0	0	0	0	14
22B	0	0	14	13	8	0	0	0	2	36
22C	0	0	5	21	4	2	19	0	0	51
22D	3	0	14	31	3	10	5	0	2	65
22E	0	0	1	2	2	2	0	0	0	7
22 Unk	0	0	0	0	0	0	0	0	2	2
Total	3	0	39	72	21	14	24	0	6	175

Table 9 Categorization of browse shrub architecture and health of moose winter range in parts of Unit 22, 2004- 2006.

Area	Date	n[a]	% unbrowsed	% browsed by moose	Broom index[b]	% browsed by hare	% none dead	% less dead	% more dead	Average Nr. dead[c]
22A Unalakleet	Aug 2005	859	24.3	55.3	19.3	6.7	3.8	90.7	5.5	0.41
22C Nome/Snake/ Flambeau	Mar 2004	960	7.6	32.6	64.7	0	1.1	87.0	11.9	0.44
22B Fish/Niukluk	Jun 2004	531	8.7	47.5	46.7	2.2	0	96.4	3.6	0
22D Kuzitrin	Jun 2004	545	4.5	29.0	69.5	0.2	0.4	92.1	7.5	0
22D Agiapuk	Sep 2006	960	1.0	29.7	70.0	0	0	98.5	1.5	0
22B Fish/Niukluk	April 2006	900	3.0	42.7	56.0	0	0.2	94.5	5.3	0.03

[a]Number of shrubs categorized along linear transect, across all transects in count area.

[b]Index is proportion of shrubs receiving any browsing that were broomed ((broomed / [browsed + broomed])* 100), by respective herbivore.

[c]Average number of dead shrubs encountered during the course of getting 30 live shrubs to evaluate.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007

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 expanded their range to the Chukchi Sea coast by the mid- to-late 1940s (W. Uhl and L. Davis, personal communication). Moose currently rank second to caribou as a source of terrestrial meat for most residents of the unit. Moose are also avidly sought – mainly for recreation and secondarily for food – by Alaska resident (nonlocal) and nonresident hunters who live outside this unit. 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. Many adult moose starved, and at least 2 cohorts of calves appeared weak. These factors, combined with predation by grizzlies and wolves, likely caused moose populations to stabilize or decline throughout the unit. From the mid 1990s through this reporting period calf recruitment throughout most of the unit has been low and, as a result, moose density has reached low levels in large portions of the unit.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

- Maintain healthy age and sex structures of moose populations within Unit 23.
- Determine size, trend, and composition of Unit 23 moose populations.

MANAGEMENT OBJECTIVES

- Monitor the size and sex/age composition of moose populations in the Noatak, Kobuk, Selawik and Northern Seward Peninsula drainages through aerial surveys.

- Maintain a minimum November ratio of 40 bulls:100 cows and a minimum density of 0.5 moose/mi^2 in each major drainage within Unit 23.

METHODS

During this reporting period moose population trend and sex/age composition data were collected through aerial censuses using the geospatial technique (Kelly and DeLong 2006). No fall moose censuses were conducted during this reporting period because of poor survey conditions. Four spring moose censuses were conducted in Unit 23 since the last report was prepared:

1. That portion of the Kobuk River drainage below and including Kobuk Valley National Park (March 2006; cooperative project with NPS, USF&WS and BLM).

2. That portion of the Kobuk River drainage above and including the Shungnak and Pick River drainages (April 2006; cooperative project with NPS).

3. The entire Selawik and Kauk River drainages (March 2007; cooperative project with NPS, USF&WS and BLM).

4. That portion of the Noatak River drainage below and including Kaluktavik Creek, the area west of the Noatak River and south of the Kivalina River drainage, and that portion of the Squirrel River drainage above and including its North Fork (March and April 2008; cooperative project with NPS, FWS and BLM).

In defining geospatial moose census areas we excluded areas that were obviously not moose habitat such as high alpine areas typical of sheep habitat and very large lakes. We included large areas of open tundra as well as the headwaters of rivers and creeks even though such areas are often poor moose habitat. We did this because at densities higher than the present time, as occurred during the late 1980s, moose commonly used these marginal areas. Even now at lower densities a few moose still use these poor to marginal habitats. An inclusive census approach that covers geographically large areas (e.g., >4000 mi^2) 1) ensures that a broad range of moose habitat types and quality will be included; 2) reduces the effects of snow-induced movements of moose on census results; and 3) reduces the temptation to perpetually ‘adjust’ census boundaries through time to fit changing environmental conditions. For the lower Kobuk moose census in March 2006, we excluded sample units from the census area if >75% of the area was at >1500 ft. elevation. I report adult moose densities here versus total moose densities as a measure of abundance to avoid annual variation associated with calf production and survival.

In addition to quantitative moose censuses, I also classified moose in the western half of Unit 23 during October–early December in 2006 and 2007. However, the fall 2007 Board of Game meeting limited fall composition work that year. I began conducting fall composition surveys in fall 2004 to identify red flags regarding bull:cow ratios and to help classify areas for eventual

conversion to a geospatial approach to monitor fall composition. Fall weather is chronically poor in northwest Alaska and snow conditions are often not conducive to observing moose. As a result, we haven't conducted a fall moose census in Unit 23 since 1999. I did not employ a rigorous sampling technique to collect fall composition data because variable snow conditions, chronically poor weather and a shortage of survey planes would have seriously limited my ability to observe moose. However, as the percentage of a moose population sampled approaches 100%, ratio estimates should approach actual population levels regardless of how the moose are located. Therefore, I attempted to classify as many moose as possible between mid-October and early December. I covered a broad range of habitat types but moved quickly through areas where I saw few moose or little sign. I rarely spent >2 min/mi^2 on search intensity. In most years I searched the Noatak drainage below and including the Nimiuktuk drainage; the main stem of the lower Kobuk drainage; the main stem of the Squirrel drainage; the Kiana and Selawik Hills; the Selawik drainage below and including the western portion of the Purcell Mountains; and most drainages on the Northern Seward Peninsula. Each year I estimated the proportion of the total population classified during fall classification surveys using appropriate spring census results.

Harvest information was derived from statewide moose harvest ticket reports for nonlocal hunters. Community-based harvest assessments were used to estimate moose harvests by unit residents. The term "nonlocal hunter" refers to all hunters, including residents of Alaska and nonresidents, who reside outside Unit 23. "Local hunter" refers to residents of Unit 23.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Spring geospatial censuses indicate Unit 23 adult moose densities are currently $\geq$0.1–0.6 adult moose/mi^2 (Table 1). Adult density appears to be stable based on the 3 large geospatial census areas that have been censused at least twice (lower Noatak-upper Squirrel; northern Seward Peninsula; and upper Kobuk).

We have not applied a sightability correction factor (SCF) in any geospatial moose census conducted in Unit 23. Sightability of moose is probably high in those portions of this unit with open cover. Even so, we have undoubtedly underestimated densities to some degree even where trees are sparse (Boertje, unpublished data). Given the relatively low density of moose throughout Unit 23, management based on these slightly conservative estimates of moose affords a small measure of additional protection for these populations.

Even though we have likely underestimated moose densities in Unit 23 to some degree, the large disparity in density between Unit 23 and other portions of Alaska (Hicks 1998) and their consistency here through time suggest moose density is, in fact, low and not an artifact of conservative estimates. Of course, localized densities in preferred habitat can exceed 0.6 moose/mi^2, especially when moose are seasonally aggregated. The main stem of the Kobuk River below Kiana has the highest year-round density and proportion of calves in the unit (Tables 1 and 2). The Mulgrave Hills, upper Squirrel drainage and northern portion of the Selawik Hills also have high, localized densities of moose on a seasonal or even annual basis. This uneven distribution of moose within the unit is important in several ways. First, hunters and

commercial operators focus their efforts on high moose density areas during the fall hunting season so often have an inflated opinion of overall abundance of moose in the unit. Second, it is misleading to concentrate survey efforts on high-use areas as an index of overall abundance throughout the unit. Census areas should contain a mix of habitat types and qualities representative of the overall area. Finally, heavy, localized harvests of moose in fall concentration areas could affect moose sex and age ratios over much broader areas during other times of the year.

Population Composition

Spring calf:adult ratios were 10-18:100 during this reporting period (Table 1). Public reports and my opportunistic observations suggest parturition and twinning rates have been high since 1998; however, due to conflicts with other work we have been unable to conduct moose calving surveys in Unit 23.

Despite their shortcomings, moose classification flights conducted during late fall 2004–2007 suggest that there is no shortage of bulls in this unit (Table 2). The unitwide bull:cow ratio has been surprisingly consistent at 38–40:100 during the last 2 reporting periods, and spatial differences in this ratio have been consistent as well. Across all subpopulations sampled during 2004–2007, the mean proportion classified was 25% (SD=12) of the estimated population, far below anything approaching an actual census. I attempted to minimize bias in fall composition data by searching a broad range of habitat types each year. Given the weaknesses of this approach, trends in composition are probably more valuable than the ratios *per se*. Advantages of unstructured classification flights are: 1) a large air force is not required to classify a substantial number of moose – this minimizes the complexity of logistics, reduces dependency on charter operators and other agencies, and substantially reduces cost; 2) you see far more moose/hr of flight time compared to a rigorous sampling technique; 3) you have the flexibility to go where weather and snow conditions best allow so can take advantage of localized survey opportunities; 4) you can collect composition information in multiple drainages each year (in Unit 23, fall weather and snow conditions only rarely allow even a single large, rigorous census to be completed); 5) you can collect data even during very short (i.e., 1-day) periods of favorable weather (large censuses are usually not initiated until the forecast for favorable weather is $\geq$3-4 days long); and, 6) they provide other information relevant to wildlife management (e.g. the distribution of predators and other prey). Of course, there are serious disadvantages associated with unstructured classification flights as well: 1) they do not produce estimates of abundance; 2) they do not provide confidence intervals around ratio estimates; and, 3) they are vulnerable to bias from spatial variation in population composition and search effort.

Development of the Gasaway census technique in the mid 1980s (Gasaway et al. 1986) caused most biologists throughout the state to forgo less rigorous techniques, such as trend counts and classification surveys, to monitor moose populations. Subsequent experience showed that the 2000-mi^2 limitation on maximum size of Gasaway census areas was a serious shortcoming of this technique. Even now with the development of the geospatial technique, weather, availability of staff and airplanes, and funding often preclude conducting large-scale, rigorous censuses as frequently as we would like. For these reasons, no fall moose censuses have been conducted in Unit 23 since 1999. Even with all of its disadvantages, fall moose composition data from

unstructured flights is beneficial, especially given its low cost, as long as abundance can be estimated from spring censuses and caution is used when interpreting fall data.

Distribution and Movements

As moose densities declined in portions of Unit 23 during the late 1980s and early 1990s, moose almost disappeared from some localized areas. Examples of this are Aklumayak Creek and the Kaluktavik River, both small tributaries of the middle Noatak River that held many moose prior to this decline. In contrast, moose density in some locales, e.g. the Mulgrave Hills and the northeast portion of the Selawik Hills, appeared unaffected by this decline. This contraction of moose distribution is probably influenced by habitat quality and possibly by behavior of moose (e.g., movement to traditional rutting areas during fall and the tendency for moose to 'yard up' during periods of deep snow).

MORTALITY

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
2005-2006 and 2006-2007		
Unit 23 north of and including the Singoalik River drainage:		
1 bull with 50-inch antlers or antlers with 4 or more brow tines on 1 side	1 Sep–20 Sep (general hunt) (harvest ticket)	1 Sep–20 Sep (drawing permit only)
OR		
1 moose by registration permit only; however, antlerless moose may be taken only from 1 Nov–31 Dec; a person may not take a calf or a cow accompanied by a calf	1 Jul-31 Dec (registration hunt)	
Remainder of Unit 23:		
1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side	1 Sep–20 Sep (general hunt) (harvest ticket)	1 Sep–20 Sep (drawing permit only)
OR		

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
1 moose by registration permit only; however, antlerless moose may be taken only from 1 Nov–31 Dec; a person may not take a calf or a cow accompanied by a calf	1 Aug-31 Dec (registration hunt)	

Board of Game Actions and Emergency Orders. The board reauthorized antlerless moose seasons for the 2005–2006 and 2006–2007 regulatory years.

Hunter Harvest. Community-based harvest assessments indicate approximately 400-450 moose are harvested annually by residents of Unit 23 (Table 3). This number appears to have been stable since about 2000 and slightly exceeds the upper range of the Unit 23 'Amount Necessary for Subsistence' level of 325-400 moose annually (ADF&G Subsistence Division, unpublished data). The community-based estimate of moose harvest is substantially higher than the 63 and 86 moose unit residents reported through the statewide harvest ticket system in 2005–2006 and 2006–2007, respectively. Although establishment of RM880 appears to have improved compliance with licensing and reporting requirements for local moose hunters, community harvest data suggests compliance is still far from complete. We think harvest ticket and registration permit data are reasonably accurate for nonlocal hunters based on observations by Department of Public Safety staff during field observations. Combining harvest ticket data for nonlocal hunters (90 moose in 2005-2006 and 92 moose in 2006-2007) with community harvest assessments for local hunters (mean harvest of 440 moose annually) indicates the total annual moose harvest in Unit 23 was roughly 530 moose during each year of this reporting period.

All community-based estimates of moose harvests in Unit 23 were determined when caribou were abundant and generally available at least sometime during the year. If caribou availability decreases through spatial or temporal shifts in distribution or population decline, harvest of moose by local residents will almost certainly increase. Most unit residents explain the decline in local moose harvests during 1979–1994 (Fig. 3) as a result of increased caribou availability during that time.

There has been no trend in the total moose harvest from harvest ticket data since the late 1970s (Table 4; Fig. 1). In contrast, the total number of moose hunters generally increased from roughly 1980 through this reporting period (Fig. 1). Until the 2003–2004 regulatory year, most of this increase in hunters was due to visiting resident and nonresident hunters (Figure 2). However, after 2003–2004 the number of local moose hunters increased rapidly. This increase in local moose hunters may have been in response to establishment of the RM880 hunt increasing awareness of licensing requirements. Additionally, uncertain availability of Western Arctic Herd caribou in recent years may have caused local hunters to shift effort from caribou to moose. As overall hunter numbers in Unit 23 increased, success rates slowly declined (Fig. 3). As in the past, the reported harvest of female moose was small during 2005–2006 and 2006–2007 in terms

of absolute numbers (10 and 6 females, respectively; Table 4), and in relation to total harvest (7% and 4%, respectively).

Since the early 1980s, numbers of moose hunters and harvest levels have generally declined in the Noatak drainage and increased in the Kobuk and Selawik drainages (Fig. 4). No clear trends in harvests have been apparent in the other major drainages in the unit; however, hunter numbers in the Kobuk drainage have generally increased through time. Numbers of moose hunters and harvests remained low and stable in the Wulik/Kivalina drainages and in northern Seward Peninsula drainages.

Guide-outfitter (G-O) areas provide finer resolution to distributions of moose hunters and harvests throughout Unit 23. From 1983–1984 until 1993–1994, G-O areas 2 (middle Noatak drainage) and 6 (Squirrel, Aggy and Eli drainages) had the highest densities of hunters (1–2 hunters/mi^2). In 1994–1995 use of G-O area 2 began to decline and since 1999–2000 hunter density has been 0.2–0.6 hunters/mi^2. Use of G-O area 5 steadily increased from 1983–1984 through this reporting period and in 2006-2007 reached 2.3 hunters/mi^2. G-O areas 5 and 6 have been the most heavily used areas in Unit 23 since 1999–2000. Patterns of harvest density generally follow patterns of hunter density by G-O area.

Permit Hunts. During fall 2003, the BOG established 2 types of permit hunts for moose in Unit 23: an optional registration hunt for resident hunters and mandatory drawing permit hunts for nonresident hunters. These permit hunts, along with other changes in seasons and bag limits, were intended to incrementally reduce moose harvests in Unit 23 in response to low moose densities. The resident registration hunt was described by Dau (2006).

Drawing permit hunts for nonresident hunters were established during the 2005–2006 regulatory year. Seven hunt areas, each corresponding to a guide-outfitter area, were created and the number of permits available for each area was calculated using the mean nonresident harvest during 2000–2001 through 2004–2005. This regulatory change markedly reduced numbers of nonresident moose hunters but only moderately reduced their harvest levels.

During this reporting period, most local resident moose hunters (mean=84%) participated in RM880 (Table 5). In contrast, most nonlocal resident moose hunters (mean=76%) hunted under the general hunt. Patterns in moose harvest by hunt type were similar among local and nonlocal resident hunters (Table 5).

Hunter Residency and Success: Community harvest assessment data suggest compliance with licensing and reporting requirements in Unit 23 is poor for local residents. Harvest report data are probably useful only for showing temporal trends in moose hunting activity. Community harvest assessments appear to provide much more accurate estimates of harvest levels.

In 2005–2006 the overall number of moose hunters in Unit 23 dipped below levels in previous years (Figure 1). This was primarily due to the sharp reduction in nonresident hunters that resulted from establishing nonresident drawing hunts in the unit (Fig. 3). There was a slight reduction in the number of nonlocal Alaska resident hunters during 2005–2006 but this number increased during 2006–2007.

As in past years, nonresident hunters had a higher success rate than nonlocal resident hunters during both years of this reporting period. This may be because nonresident hunters are often highly motivated to take a moose after spending the money to come here, and because they are more likely to hire a guide than resident hunters.

Harvest Chronology. As in the past, during this reporting period most moose were harvested in September. Virtually all sport hunting occurs during this time because weather is mild and conducive to airplane and boat access, September entirely encompasses the nonresident season and resident general season, and bulls have completely developed antlers free of velvet. In 2005–2006, 73% of the reported harvest occurred during September, and in 2006–2007 this percentage was 75%. Twelve and 13% of the total harvest was taken during August during these regulatory years, respectively.

Transport Methods: Airplanes continued to be a primary mode of transportation for most hunters who reported hunting moose in Unit 23 (Table 6). However, as numbers of local residents who reported hunting moose have increased while numbers of nonlocal hunters have decreased, for the first time since the mid 1980s boat hunters equaled or exceeded airplane hunters during both years of this reporting period. Establishment of RM880 may have merely brought into the regulatory system some local hunters who did not report hunting moose in the past. If so, the actual shift in transport method may not be as dramatic as suggested by harvest report data. Alternatively, if uncertain availability of caribou caused local hunters to shift efforts to moose, this change in transport methods is probably real rather than an artifact of variable compliance with licensing and reporting requirements.

Other Mortality

Predation by brown bears, black bears and wolves certainly affect moose population dynamics in Unit 23; however, the relative importance of predators in relation to weather, snow, forage, disease and human harvests is unknown. Opportunistic observations suggest that bear predation on moose calves during May–June may be a significant mortality source at least in some portions of the unit. The localized high density and disproportionately high calf:cow ratio in the Kobuk River delta, an area almost devoid of large predators due to its location in relation to Kotzebue and primary human travel routes year round, further suggests that predators may be affecting moose in more remote portions of the unit.

HABITAT

Assessment

Moose habitat was not formally evaluated by the Alaska Department of Fish and Game in Unit 23 during this reporting period. In summer 2005 a department biologist with experience evaluating use of willow (*Salix* spp.) by moose floated and hiked extensively in the Squirrel drainage and reported willows did not appear to be overused by moose (T. Paragi, personal communication). In summer 2006, this same individual floated the upper Kobuk drainage from Walker Lake to Kobuk and reported similar findings.

Enhancement

There were no habitat enhancement activities for moose in Unit 23 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

Conflicts among local subsistence hunters, nonlocal hunters and commercial operators continued to escalate during fall 2005 but, for the first time in 20 years, seemed to diminish in fall 2006. The nature and reasons behind user conflicts have been previously described (Dau 2002).

CONCLUSIONS AND RECOMMENDATIONS

I recommend the department:

1. Monitor moose abundance by conducting spring censuses over large areas (4000–10,000 mi^2). Covering large areas minimizes the effects of moose movements on density estimates, and ensures the full range of habitat types and quality are included in census areas. Snow and light conditions are optimal for observing moose during spring. Specifically:
   A. Modify the lower Noatak-Wulik-Kivalina census area to remove that portion of the area in the Squirrel River drainage.
   B. Modify the lower Kobuk census area to include the entire Squirrel River drainage.
   C. Modify the upper Kobuk census area to abut the lower Kobuk census area (i.e., add the Ambler River drainage and appropriate portion of the main Kobuk River floodplain).
   D. Retain the Seward Peninsula and Selawik River drainage moose census areas as currently delineated.
   E. Create a census area in the upper Noatak River drainage to include everything above the lower Noatak River census area. Moose density in this area is very low and hunting pressure is very low partly because much of the area is within Gates of the Arctic National Park. This area may not need to be censused as frequently as the other census areas.
   F. There is no need to census moose in that portion of Unit 23 northwest of the Kivalina River drainage as habitat is poor and there are no resident moose in that area.
2. Rotate census areas to complete one area each spring to estimate population size. Incorporate trend information into annual census point estimates to improve accuracy.
3. Explore using a geospatial approach with established spring census areas to estimate sex and age composition of moose populations during October through early December. Fall composition surveys should not be conducted after December 7th to avoid problems with antler drop.
4. 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.
5. Begin browse surveys in coordination with federal monitoring programs.
6. Explore feasibility of conducting calving surveys during late May-early June to evaluate twinning rates and overall parturition rates.

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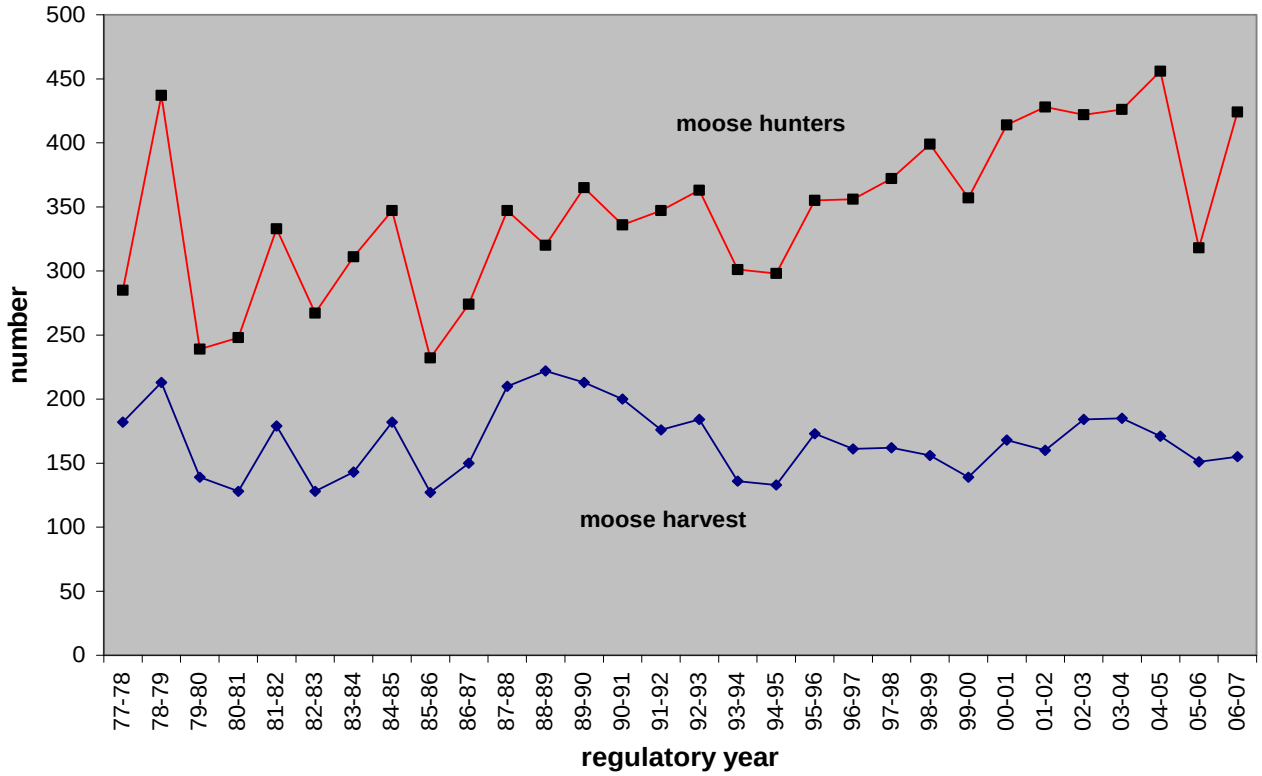

FIGURE 1 Unit 23 moose hunters and harvests reported through the statewide harvest ticket system, 1977–1978 through 2006-2007

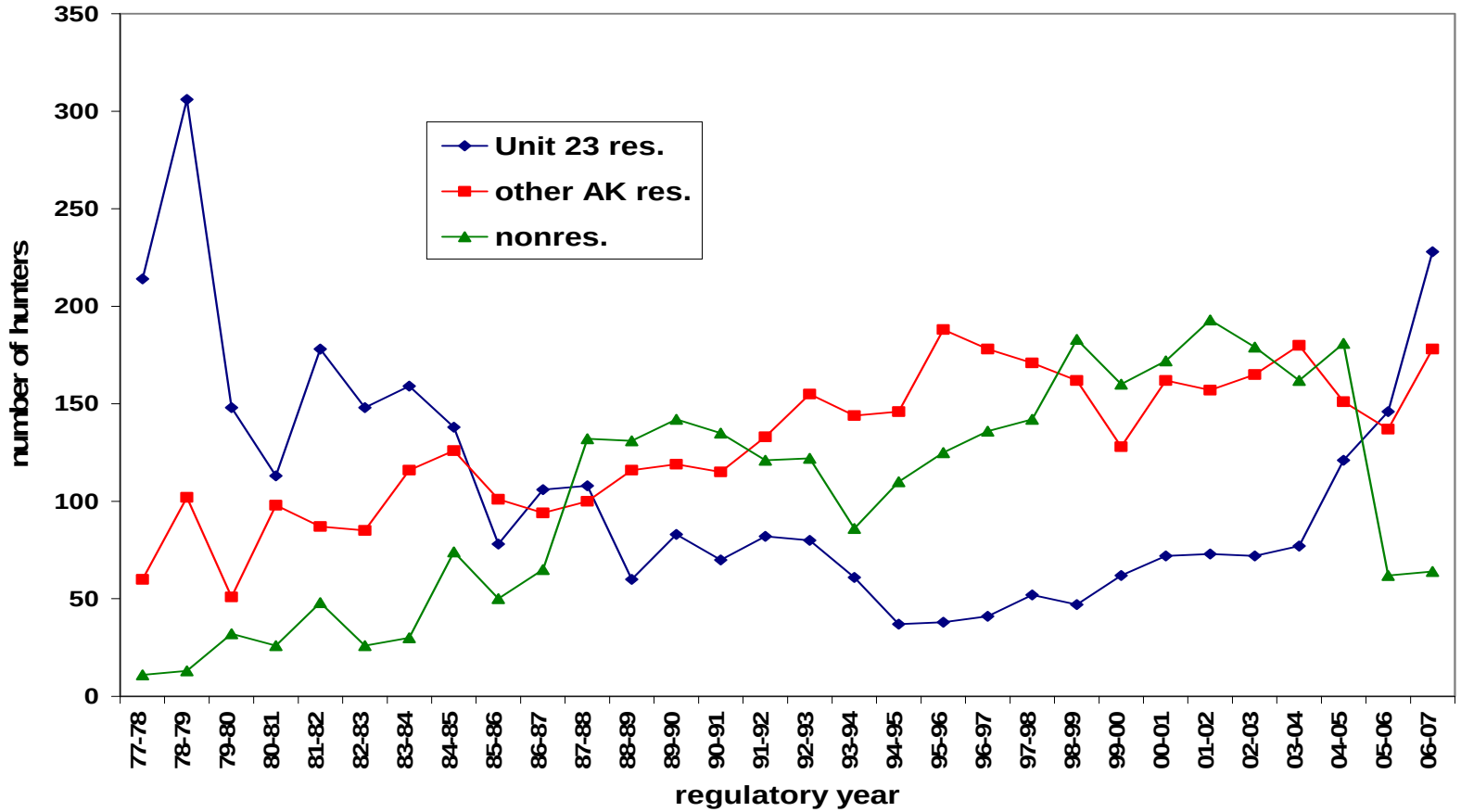

FIGURE 2 Numbers of moose hunters in Unit 23 by residency, 1977–1978 through 2006–2007

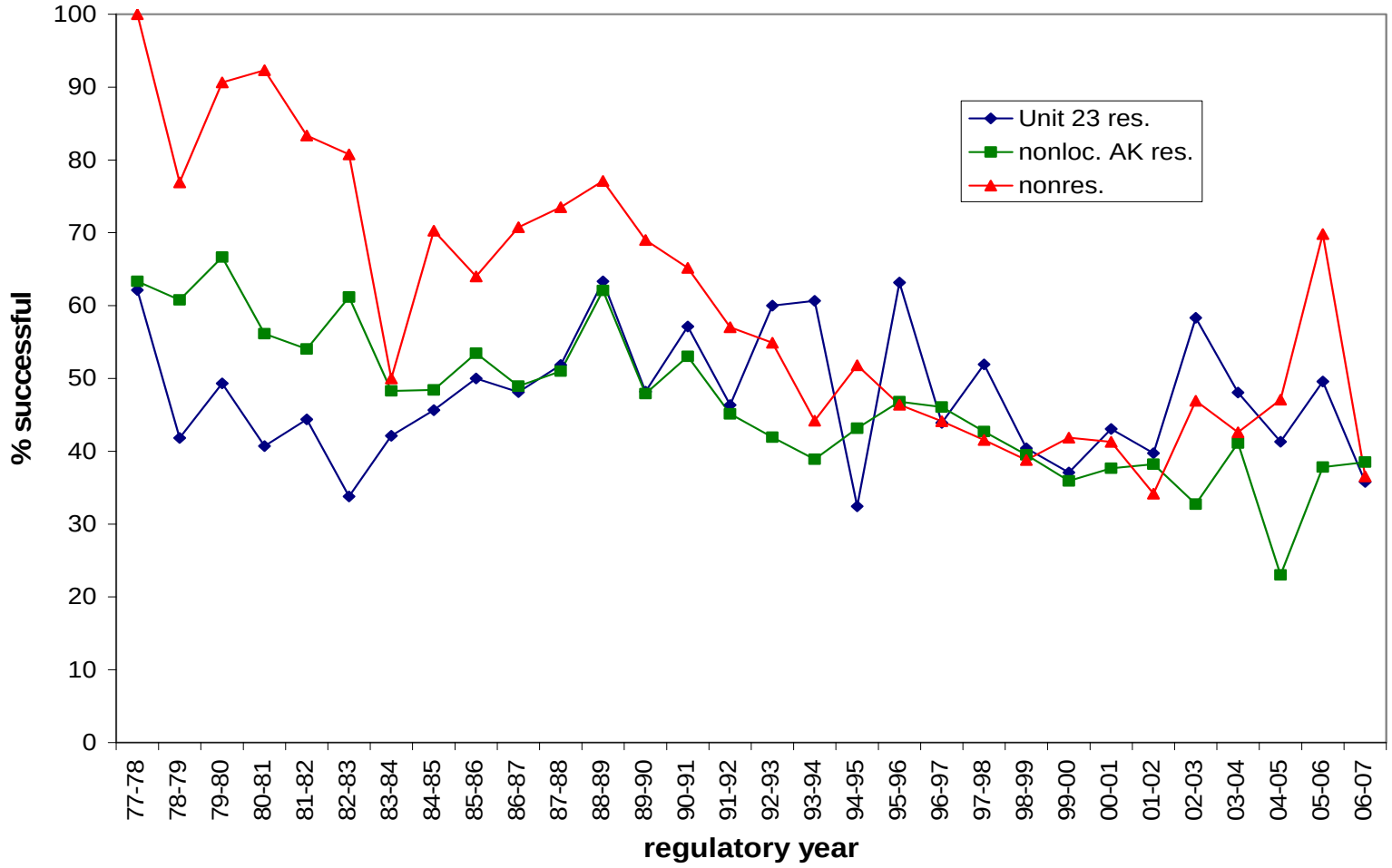

FIGURE 3 Unit 23 moose hunter success by residency (harvest and registration report data), 1977–1978 through 2006–2007

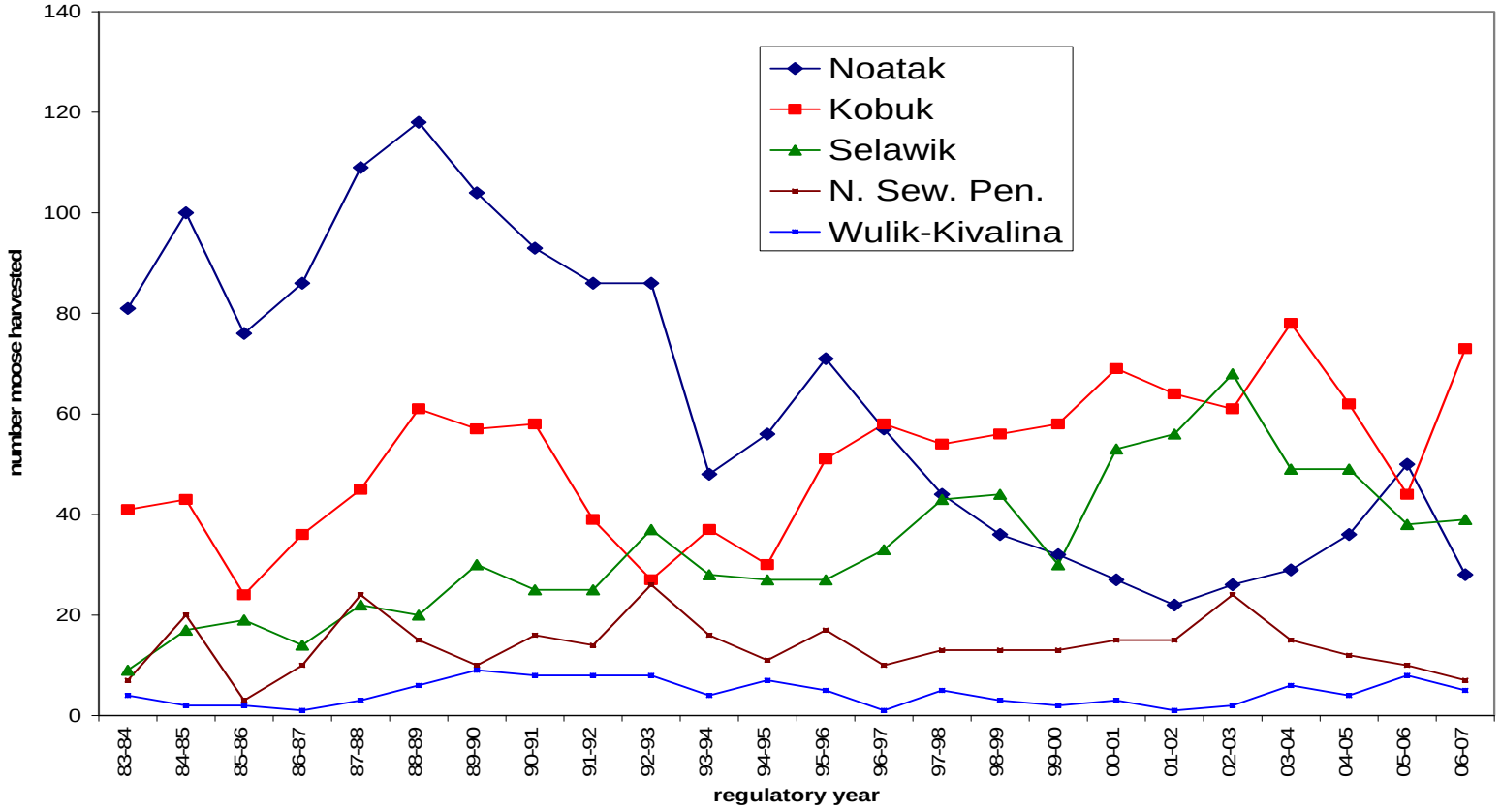

FIGURE 4 Unit 23 moose harvest by drainage (statewide harvest ticket data), 1983–1984 through 2006–2007

TABLE 1 Unit 23 spring geospatial moose census results, 1999–2008 (all censuses conducted cooperatively by ADF&G, NPS, USF&WS and BLM, except those conducted solely by ADF&G on the northern Seward Peninsula)

			Census estimate (Nr.)			Density (Nr./mi^2)		
Area	Year	Size (mi^2)	Adults	Calves	Total[a]	Adult	Total	Calves:100 Adults
Selawik	2007	6580.1	2137	204	2341	0.32	0.36	10
Lower Noatak	1999	2111.2	1126	65	1191	0.53	0.56	6
Lower Noatak	2000	2111.2	710	59	779	0.34	0.37	8
Lower Noatak	2001	2111.2	1325	130	1453	0.63	0.69	10
Lower Noatak-upper Squirrel	2001	5230.2	1580	151	1731	0.30	0.33	10
Lower Noatak-upper Squirrel	2005	5349.7	1630	208	1838	0.30	0.34	12
Lower Noatak-upper Squirrel-Wulik-Kivalina-Cape Krusenstern	2008	7161.6	2094	297	2388	0.29	0.33	13
N. Seward Pen.	2002	5888.5	576	38	614	0.10	0.10	7
N. Seward Pen.	2004	5882.9	724	86	810	0.12	0.14	12
Upper Kobuk	2003	4001.5	765	91	856	0.19	0.21	12
Upper Kobuk	2006	4001.5	653	96	737	0.16	0.18	15
Lower Kobuk-Lower Squrirel	2006	4870.5	2891	511	3398	0.59	0.70	18

[a] Totals may not equal the sum of adults and calves. Each census estimate column is an independent computer-generated estimate using the census method noted in the census method column.

TABLE 2 Late fall (October–early December) moose classification counts from western portions of Unit 23, 2004–2005[a] (approximate percentage of total estimated population reported in Table 1 that was classified shown in parentheses of 'Total' column)

Area	Sp-Fk bull	Med. bull	Large bull	C w/0 ca	C w/1 ca	C w/2 ca	C w/3 ca	Lone calf	Total (% of Pop.)	Total Est. Pop. (year)	Bulls: 100 Cows	Calves:100 Cows
2004												
Lower Noatak-upper Squirrel	21	62	99	358	37	5	0	0	629 (34)	1838 (2005)	46	12
N. Seward Peninsula	7	10	24	105	19	1	0	0	187 (23)	810 (2004)	33	17
Lower Kobuk-lower Squirrel	16	26	12	137	76	8	0	2	369 (11)	3398 (2006)	24	43
Selawik	25	45	36	227	30	4	0	0	405 (17)	2341 (2007)	41	15
Total	69	143	171	826	162	18	0	2	1589		38	20
2005												
Lower Noatak-upper Squirrel	16	83	81	316	41	8	0	0	602 (33)	1838 (2005)	49	16
N. Seward Peninsula	7	39	39	203	29	2	0	0	352 (43)	810 (2004)	36	14
Lower Kobuk-lower Squirrel	27	95	59	409	177	14	1	2	992 (29)	3398 (2006)	30	35
Selawik	31	73	57	326	61	6	0	1	628 (27)	2341 (2007)	41	19
Total	81	290	236	1254	308	30	1	3	2574		38	23

TABLE 2 continued

Area	Sp-Fk bull	Med. bull	Large bull	C w/0 ca	C w/1 ca	C w/2 ca	C w/3 ca	Lone calf	Total (% of Pop.)	Total Est. Pop. (year)	Bulls: 100 Cows	Calves:100 Cows
2006												
Lower Noatak-upper Squirrel	41	114	130	480	45	4	0	0	867 (47)	1838 (2005)	54	10
N. Seward Peninsula.	4	21	31	123	3	0	0	0	185 (23)	810 (2004)	44	2
Lower Kobuk-lower Squirrel	32	77	40	467	136	6	0	1	907 (27)	3398 (2006)	24	24
Selawik	21	89	42	334	70	5	0	0	641 (27)	2341 (2007)	37	20
Total	98	301	243	1404	254	15	0	1	2600		38	17
2007												
Lower Noatak-upper Squirrel	11	68	64	254	28	4	0	0	465 (23)	2008 (2008)	50	13
N. Seward Peninsula.	11	26	16	92	9	3	0	0	172 (21)	810 (2004)	51	14
Lower Kobuk-lower Squirrel	6	52	13	193	73	10	0	1	441 (13)	3398 (2006)	26	34
Selawik	1	0	0	1	1	0	0	0	4 (0)	2341 (2007)		
Upper Kobuk	0	2	2	8	0	1	0	0	15 (2)	737 (2006)		
Total	29	148	95	548	111	18	0	1	1097		40	22

[a] Ratios not reported when sample sizes are very small

TABLE 3 Estimated moose harvest in Unit 23 villages from community harvest estimates (Subsistence Division unpublished data, except as noted)

Village	Year of survey	Estimated village population in survey years	Mean number moose reported harvested	Per capita moose harvest	Estimated village population in 2007	Estimated annual moose harvest in 2006-2007[b]
Ambler	2002	295	11	0.04	277	10
Buckland	2003	404	17	0.04	461	19
Deering	1994	148	15	0.10	133	14
Kiana	1999, 2006	390	12	0.03	398	12
Kivalina	1982, 1983, 1992, 2007	427	11	0.03	398	10
Kobuk	2004	126	7	0.06	119	7
Kotzebue	1986, 1991	3165	150	0.05	3133	148
Noatak	1994, 1999, 2001, 2007	432	5	0.01	489	6
Noorvik	1996, 2002	583	47	0.08	636	51
Point Hope[a]	1992	685	14	0.02	787	16
Selawik	1999	772	64	0.08	828	69
Shungnak	1998	248	21	0.08	269	23
Total Unit 23					**7838**	**440**

[a] North Slope Borough, unpublished data
[b] Rounding errors associated with estimating per capita harvest rates affect all of these estimates

TABLE 4 Number of moose hunters by residency and success, and moose harvests by sex for Unit 23, 1982–1983 through 2006–2007

	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
1982–1983	148	85	26	8	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	182	165	52	162	17	3
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	0
1987–1988	108	100	132	7	347	210	137	61	194	15	1
1988–1989	60	116	131	13	320	222	98	69	207	15	0
1989–1990	83	119	142	21	365	213	152	58	200	11	2
1990–1991	70	115	135	16	336	200	136	60	185	14	1
1991–1992	82	133	121	11	347	176	171	51	143	33	0
1992–1993	80	155	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	146	110	5	298	133	165	45	127	6	0
1995–1996	38	188	125	4	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	47	162	183	7	399	156	243	39	146	8	2
1999–2000	62	128	160	7	357	139	218	39	127	11	1
2000–2001	72	162	172	8	414	168	246	41	157	11	0
2001–2002	73	157	193	5	428	160	268	37	150	9	1
2002–2003	72	165	179	6	422	184	238	44	172	11	1
2003–2004	77	180	162	7	426	185	241	43	174	11	0
2004–2005	121	152	172	11	456	171	285	38	171	0	0
2005–2006	146	137	62	0	345	153	192	44	143	10	0
2006–2007	213	173	62	0	448	168	280	38	161	6	1

TABLE 5 Numbers of resident Alaska moose hunters and harvests in Unit 23 by hunt type and location of residence

	General Hunt	RM880	Total
2005–2006			
Hunters:			
Residents of Unit 23	26	96	122
Nonlocal AK residents	87	26	113
Total	113	122	235
Moose harvest:			
Residents of Unit 23	10	48	58
Nonlocal AK residents	26	11	37
Total	36	59	95
2006–2007			
Hunters:			
Residents of Unit 23	27	177	204
Nonlocal AK residents	111	36	147
Total	138	213	351
Moose harvest:			
Residents of Unit 23	10	63	73
Nonlocal AK residents	31	20	51
Total	41	83	124

TABLE 6 Number of moose hunters by transportation type in Unit 23, 1987-1988 through 2006-2007

Year	Airplane	Boat	Snow machine	Horse/dog team	3- or 4-wheeler	Off-road vehicle	Highway vehicle	Airboat	Unk.	Total hunters
1987–1988	165	93	25	0	21	0	4	0	39	347
1988–1989	207	63	13	1	13	0	1	0	22	320
1989–1990	229	89	16	1	7	0	2	0	21	365
1990–1991	224	61	19	0	10	1	1	0	20	336
1991–1992	231	65	28	2	7	0	3	0	11	347
1992–1993	248	63	23	1	7	0	3	0	18	363
1993–1994	193	72	17	0	9	1	2	0	7	301
1994–1995	191	74	13	2	5	1	4	0	8	298
1995–1996	240	77	11	0	16	0	1	0	10	355
1996–1997	234	77	20	1	16	0	2	0	6	356
1997–1998	250	74	19	2	13	0	2	0	12	372
1998–1999	289	76	10	1	11	1	0	0	0	388
1999–2000	245	78	18	2	11	0	2	0	0	356
2000–2001	262	115	17	3	7	1	2	2	5	414
2001–2002	282	117	14	0	7	1	2	1	4	428
2002–2003	273	118	13	1	6	0	2	4	5	422
2003–2004	252	150	7	3	3	2	2	0	7	426
2004–2005	263	161	14	0	8	0	1	0	6	453
2005–2006	160	151	16	3	9	1	0	0	13	353
2006–2007	169	225	17	2	12	0	2	4	14	445

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNIT: 24 (26,068 mi^2) (24A = 4146 mi^2, 24B = 13,523 mi^2, 24C = 3049 mi^2, 24D = 5350 mi^2)

GEOGRAPHIC DESCRIPTION: Koyukuk River drainage above Dulbi River

BACKGROUND

Moose are broadly distributed throughout much of Unit 24, with local densities (0.25–2.0 observable moose/mi^2) 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, and 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 and aquatic vegetation in summer and fall. Lightning-caused fire is a frequent event and large areas of the burned uplands are productive browse communities. Based on habitat surveys, browse production is not limiting the size of the moose population in Unit 24.

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 River 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 was also 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

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

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, except for federally qualified rural residents. Access to portions of the unit increased with the opening of the highway in 1981.

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 state and federal regulations during December and March also provide hunting opportunity for residents of Alaska. A registration permit moose hunt was established in 1996 in the Koyukuk CUA, downstream from Huslia. Drawing hunts were established in the Koyukuk CUA in 2000, the DHCMA in 2002, and drainages around the Koyukuk CUA in 2004.

Annual reported harvest did not exceed 100 moose until 1980, and was highest in 1999 at 240 moose. Unreported harvests during this period probably were 160–300 moose per year (Woolington 1998). Local residents have become more aware of the importance of harvest reporting, resulting in increased compliance with reporting requirements.

MANAGEMENT DIRECTION

Management was directed according to the following management goals and objectives during the reporting period.

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 (NWR), 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). We also established TCAs using a grid system based on latitude and longitude coordinates to locate sample units (~5.7 mi^2 in size; Ver Hoef 2001, Kellie and DeLong 2006). Surveys were flown approximately 500 ft above ground level at ground speeds of 70–80 mi/hr in fall. Moose were classified as cows, calves, yearling bulls (<30" antler width and no brow tine definition), medium bulls (<50" antler width), or large bulls (≥50" antler width). Sample units of approximately 12 mi^2 each were searched in the TCAs at a rate of approximately 5 min/mi^2. Data were recorded on standard data forms, and moose locations were also recorded on 1:63,000 U.S. Geological Survey quadrangle maps or Global Positioning System (GPS) navigation devices. Surveys were typically 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. Surveys were not completed in the southern TCAs in 2002 or the northern TCAs in 2006 due to low snowfall.

We conducted a population estimation survey covering 8390 mi^2 (ADF&G files, Galena, 12 May 2000) in fall 1999 in the northern portion of Unit 24, a survey of 1949 mi^2 in the southern portion of Unit 24 in 2001 (Bryant and Stout 2003), and in 2004 surveys of 1843 mi^2 and 11,494 mi^2 in the southern and northern portions of Unit 24 respectively (Lawler et al. 2006). In 2007 we conducted surveys on the Kanuti NWR, the eastern portion of the Koyukuk NWR and in the Hogatza River drainage. Data from those surveys were analyzed using the geospatial population estimator method (GSPE; Ver Hoef 2001, Kellie and DeLong 2006). Survey techniques were modified from those outlined by Gasaway et al. (1986). An important change from the Gasaway methodology was that, instead of geographical land characteristics, a grid system based on latitude and longitude coordinates was used to locate sample units (~5.5 mi^2 in size), with search intensity of ~6 min/mi^2.

In 2007 we completed a GSPE survey on the Kanuti NWR in Unit 24B covering 2715 mi^2. Cost for contract flight time was $18,643, fuel costs were $8,477, and groceries and other costs were $892, for a total survey cost of $28,012 not including wages. The area was contiguous with

surveys in 1999, 2004, and 2005. We compared densities among all areas (Fig 1). Conditions (snow cover and visibility) for the Kanuti NWR survey were good to excellent. We based 4 survey planes and the stratification plane at the FWS and NPS facilities in Bettles. Using a Cessna 207, we stratified 508 sample units (SU) prior to intensive surveys (16.9 hr), of which 69 SUs were stratified as high density (H) and 439 SUs were stratified as low density (L). We intensively surveyed 136 SUs (63 H, 73 L) in 73.27 hours; however, an additional 40.75 hours were logged for ferry time and travel time between units (total time = 114.02 hr). We classified 276 moose, and estimated 588 moose in the survey block, not including a sightability correction factor (SCF), with an error on the estimate of ±21% at the 90% confidence interval (CI).

To obtain a moose population estimate for RY05–RY06 in the 18,046 mi^2 area including Units 24A and 24B and a 378-mi^2 portion of Unit 24C, I used the 2007 Kanuti NWR GSPE estimate and extrapolated a 13% decline observed there since the 2004 survey to the 8779 mi^2 of the remainder of Units 24A and 24B area not completed in 2007. I did not include the 2672-mi^2 portion of Unit 24C that was surveyed in 2007. Therefore, for Units 24A, 24B, and 378-mi^2 portion of Unit 24C (total = 18,046 mi^2), I estimated 3270 ±980 moose, not including a SCF.

In 2007 we completed a GSPE survey for most of Unit 24C and eastern Unit 24D on the Koyukuk NWR. The entire survey area covered 4295 mi^2, and the survey conditions (snow cover and visibility) were good to excellent for the entire survey. We based 3 survey planes and their respective survey teams at the U.S. Fish and Wildlife Service (FWS) administrative cabin near the mouth of the Hogatza River, where we cached 300 gallons of aviation fuel the previous summer. The 3 Hogatza River cabin survey teams worked mostly north of the cabin in Unit 24C, while 4 survey teams based out of Galena surveyed primarily to the south in Unit 24D.

The survey area included 794 SUs, of which 63 were stratified as high density and 732 were stratified as low density. Of the 732 low density SUs, 121 of the northern most SUs were assigned a low density stratification by default because weather early in the survey prevented us from accessing those SUs. The remaining 674 SUs were stratified from a fixed-wing airplane according to methods previously described. The stratification survey required 16.97 hours of flight time. We intensively surveyed 196 SUs during 17–24 Nov, and classified 787 moose in 96.6 hours of surveying. The eastern Koyukuk NWR survey block was 1623 mi^2, and contained 296 SUs (39 H, 257 L), of which 82 SUs were intensively surveyed (39 H, 43 L). The Hogatza River survey block was 2672 mi^2, and contained 498 SUs (23 H, 475 L), of which 114 SUs were intensively surveyed (23 H, 91 L). Aerial survey expense was $40,983 (283.7 hr, including ferry time and logistics), fuel expense was $10,540 (1589 gal), and groceries and other costs were $1,220 for a total survey cost of $52,743, not including wages.

Composition data used were from aerial surveys conducted in cooperation with FWS staff from the Koyukuk NWR, Kanuti NWR, and staff from the Bureau of Land Management.

Twinning surveys were flown in May to determine the proportion of moose calf twins among all cows with calves 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 were flown when approximately 50% of the cows observed had calves. We flew at

this time to avoid early mortality factors such as black bear predation, which could lead to underestimating twinning rates when bears kill 1 calf among twins.

Hunter harvest was monitored through mandatory 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 reporting system using harvest tickets, registration permits, drawing permits, and door-to-door subsistence surveys. General season hunters were sent 1 reminder letter to return their harvest reports. Hunters who had harvest permits (drawing and registration hunts) were sent 2 reminder letters, and called via telephone between letters. Names of hunters who possessed drawing and registration permits were withdrawn from the following year's drawing permit and registration 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., RY05 = 1 Jul 2005–30 Jun 2006).

Habitat monitoring was conducted in RY06 in Units 24B and 24C. Spatial sampling was allocated among GSPE sample units used in moose surveys, with past information on density category used to assign samples randomly between high density (60%) and low density sample units (40%). Plot sampling measurements included biomass of production and browse removal, and were estimated respectively by measuring diameter at current annual growth (CAG) scars on leaders and the diameter at point of browsing by moose. We also inferred browsing history by recording whether shrub growth forms were unbrowsed, had some browsing, or were broomed (>50% of CAG production the result of lateral stems caused by prior browsing) to estimate the proportion of plants with a history of browsing that have heavy use (index = # broomed / [# browsed + # broomed]) (Seaton 2002).

Predation was evaluated using interviews with trappers, field observations, and aerial wolf reconnaissance surveys conducted in cooperation with FWS.

We discontinued the planning effort 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. 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, Fairbanks) that was submitted to the Alaska Board of Game during its 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 Board of Game at its winter 2001 meeting. Public meetings were hosted by the department in January 2004 and October 2005 to update interested individuals concerning the status of activities related to the moose management plan.

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. Most often, population size is described using generalities, and trends are discernible only for the few areas surveyed. However, since 2004 we have completed GSPE aerial surveys on 18,046 mi^2 of Unit 24, which is 69% of the 26,068-mi^2 game management unit.

During RY05–RY06, moose were numerous in the Koyukuk River lowlands in the southern third of the unit (Unit 24D). Based on recruitment parameters, the population probably began to stabilize beginning around 2003–2004 from previous high levels in the Dulbi Slough, Huslia River Flats, and Treat Island areas observed in the mid 1990s (Tables 1–3). Recruitment parameters were generally higher after RY03; the yearling bull:cow and calf:cow ratios improved from previous surveys but only to levels indicative of population stabilization, not population growth. Further upriver, in the Kanuti Canyon, Henshaw–Peavey Creek, and Middle Fork TCAs, moose densities in RY04 were 0.41, 0.65, and 0.97 moose/mi^2 without SCFs (Tables 4–6). Trend area surveys were last conducted on Kanuti Canyon and Henshaw Creek TCAs in RY04, replaced by a GSPE population estimate on the entire Kanuti NWR. Since the first GSPE survey was conducted in 1999 on Kanuti NWR, population estimates were completed in 2004, 2005, and in 2007, providing composition data as well as statistically comparable population estimates.

Population Size

In the RY03–RY04 management report (Stout 2006), the Unit 24 population estimate of 8342 ±1000 moose (7342–9342) was based on population estimation surveys (Martin and Zirkle 1996, Huntington 1998, Woolington 1998, Stout 2004) and extrapolations (Dale et al. 1995, Lawler et al. 2003). Most of that information was collected over relatively small areas within Unit 24 during the early and mid 1990s, when the population was high. Recent surveys helped refine the overall estimate within Unit 24 (Tables 7–9).

The 2007 estimate of 588 moose (0.22 moose/mi^2) on the Kanuti NWR in Unit 24B indicates a decline of as much as 62% in Kanuti NWR since the peak estimate in 1993 (0.67 moose/mi^2; Fig. 1). For Units 24A, 24B, and the 378-mi^2 portion of Unit 24C (total = 18,046 mi^2), I estimated 3270 ±980 observable moose, not including an SCF.

We analyzed the data for the entire survey area with an error on the estimate of 11% (90% CI). We analyzed the data for the 2 smaller survey blocks of the eastern Koyukuk NWR with an interval error of 9% (90% CI), and the Hogatza River with an error of 23% (90% CI). Not including a SCF, we estimated 1545 (±163) moose in the survey area, of which 983 (±93) moose were in the eastern Koyukuk NWR survey block and 562 ±130 moose were in the Hogatza River survey block. Therefore, I estimated 5197 ±480 moose, without a SCF (Table 9) in Units 24C and 24D using the 2004 and 2007 surveys and estimating 0.25 moose/mi^2 in the 1884 mi^2 unsurveyed portion of Unit 24D.

Based on TCA recruitment parameters it appears that the population in Unit 24D began to stabilize about RY04 to RY05, while Units 24A and 24B continued to decline. Because of the similarity of habitat, environmental influences, and predation effects, I believe the moose

population in Unit 24C was probably declining similar to Units 24A and 24B. Therefore, the total Unit 24 population was estimated to be 8467 moose ±1460 (7007–9927) without an SCF at the end of RY06 (Table 9).

Population Composition

Results from composition surveys conducted through RY07 with staff from Koyukuk NWR, Kanuti NWR, and the Bureau of Land Management were highly variable.

Bull:cow ratios were generally high in the Huslia River Flats and Henshaw–Peavy Creek TCAs and on the Kanuti Refuge. However, in the Dulbi Slough, Treat Island, Kanuti Canyon, and Middle Fork TCAs bull:cow ratios were typically lower than the broader area (Tables 1–6), and is supported by the population estimation surveys (Tables 7–9). I believe this is mostly explained by the influence of hunting pressure in these relatively higher density moose areas. The higher density moose areas typically attracted higher levels of hunting pressure and are generally more accessible. Schwartz (1998) suggested a ratio of 20–30 bulls:100 cows is needed to ensure breeding of all available cows. Population estimation surveys indicated ratios of >30 bulls:100 cows throughout Unit 24. Therefore, breeding activity was likely normal even in southern Unit 24. Ratios for RY01–RY02 in the Middle Fork TCA were questionable due to small sample size but improved for RY03–RY07 (Table 6). In general, most ratios in the TCAs with counts of less than 100 moose tended to have larger annual variation that made interpretation difficult.

High bull:cow ratios (>30 bulls:100 cows; Tables 7–9) indicate the bull component of the population was not overharvested in any of Unit 24. During RY05–RY06, recruitment parameters for TCAs in Unit 24D (Tables 1–8) indicated the population was producing calves (3-yr $\bar{x}$ = 33 calves:100 cows) and recruiting yearlings (3-yr $\bar{x}$ = 11 yearling bulls:100 cows) in the range that would be consistent with a stable or increasing population. Trend count area recruitment parameters were consistent with population estimation data, and indicated the population declined through RY03 in Unit 24D, but began to stabilize in RY04–RY06, while Units 24A, 24B, and 24C continued to decline through RY06.

Calf twinning rates in spring 2005 suggested improved productivity in Unit 24 (Tables 10–13) in the Huslia Flats, Treat Island, and Dulbi Slough TCAs. I believe this improvement was related to the 3–4 prior consecutive mild winters and the corresponding length of the intervening snow-free seasons. I observed no dramatic changes in vegetative characteristics that would account for the apparent improvements in twinning rates. I do not believe a measurable density-dependent effect was acting on the population because twinning rates were only low in 2001, while the moose population maintained relatively high densities. The cause of the twinning rate decline in spring 2007 is not clear at this time. In spring 2007 we also surveyed 2 days each in the Hogatza River drainage and the Kanuti River Flats in an attempt to establish the level of twinning, but were unable to locate an adequate number of moose with newborn calves. Radio collars were deployed in March 2008, which will improve our ability to determine twinning rate, distribution and movements.

Distribution and Movements

Little data are available on movements of moose within Unit 24. Thirteen moose radiocollared in winter 1984–1985 in northern Unit 21D migrated into southwestern Unit 24 each summer. Generally, moose are found at treeline in the northern part of Unit 24 in early winter, utilizing

10- to 20-year-old burns, and move into the river bottoms during late winter and summer. In the southern portion of Unit 24, moose appear to occupy the broad riparian habitats year-round with much shorter seasonal migrations.

MORTALITY

Harvest

Seasons and Bag Limits.

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY05		
Unit 24, that portion west of the Hogatza River drainage and the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in Unit 24 outside the Koyukuk Controlled Use Area.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side, by drawing permit; up to 450 permits may be issued in Unit 24 outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Unit 24, that portion east of the Dakli River drainage and the Koyukuk Controlled Use Area, and west of the Kanuti Controlled Use Area, the Tanana–Allakaket winter trail and Alatna River drainage.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in Unit 24 outside the Koyukuk Controlled Use Area; or	5 Sep–25 Sep	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit; up to 450 permits may be issued in Unit 24 outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep
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–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 21D, that portion within the Koyukuk Control Use Area; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit; up to 80 permits may be issued in combination with Unit 21D, that portion of the Koyukuk Control 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.		
1 moose; however; antlerless moose may be taken only from 21 Sep to 25 Sep.	1 Aug–31 Dec	No open season

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24, that portion of the North Fork Koyukuk River drainage within the Gates of the Arctic National Park.		
1 moose; however; antlerless moose may be taken only from 21 Sep to 25 Sep; or	1 Sep–25 Sep	No open season
1 bull.	1 Dec–10 Dec	No open season
Unit 24, all drainages to the north of the Koyukuk River upstream from the Henshaw Creek drainage, to and including the North Fork Koyukuk River, except that portion of the John River and North Fork Koyukuk River drainages within Gates of the Arctic National Park.		
RESIDENT HUNTERS: 1 moose; however, antlerless moose may be taken only from 21 Sep to 25 Sep.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one 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 from 21 Sep to 25 Sep; or	1 Sep–25 Sep	
1 bull.	1 Dec–10 Dec	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Unit 24, that portion in the Dalton Highway Corridor Management Area, except that portion in the North Fork Koyukuk River drainage.		
RESIDENT HUNTERS: 1 bull by drawing permit; up to 70 permits may be issued in combination with Unit 25A, that portion within the Dalton Highway Corridor Management Area.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 70 permits may be issued in combination with Unit 25A, that portion within the Dalton Highway Corridor Management Area.		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 one side		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
RY06		
Unit 24A, that portion in the Dalton Highway Corridor Management Area.		
RESIDENT HUNTERS: 1 bull by drawing permit; up to 70 permits may be issued in combination with Unit 25A, that portion within the Dalton Highway Corridor Management Area.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 70 permits may be issued in combination with Unit 25A, that portion within the Dalton Highway Corridor Management Area.		5 Sep–25 Sep
Remainder Unit 24A.		
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 one side.		5 Sep–25 Sep
Unit 24B all drainages of the Koyukuk river upstream from the Henshaw Creek drainage, excluding the North Fork Koyukuk River drainage.		
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 one side.		5 Sep–25 Sep
Remainder Unit 24B.		
RESIDENT HUNTERS: 1 bull.	1 Sep–25 Sep 1 Dec–10 Dec	

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side.		5 Sep–25 Sep
Unit 24C, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	27 Aug–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk Controlled Use Area; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24D, those portions within the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Remainder of Unit 24C.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk Controlled Use Area.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 450 permits may be issued in combination with Unit 24D outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 24D, that portion within the Koyukuk Controlled Use Area.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	27 Aug–20 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 320 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk Controlled Use Area; or	5 Sep–25 Sep	
1 bull.	1 Dec–10 Dec (Subsistence hunt only)	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 80 permits may be issued in combination with Units 21D and 24C, those portions within the Koyukuk Controlled Use Area.		5 Sep–25 Sep
Remainder of Unit 24D.		
RESIDENT HUNTERS: 1 bull by registration permit only; or	5 Sep–25 Sep (Subsistence hunt only)	
1 bull by drawing permit only; up to 450 permits may be issued in combination with Unit 24C outside the Koyukuk Controlled Use Area.	5 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on one side by drawing permit only; up to 450 permits may be issued in combination with Unit 24C outside the Koyukuk Controlled Use Area.		5 Sep–25 Sep

Alaska Board of Game Actions and Emergency Orders. Drawing and registration permit hunts continue to be the predominant regulatory feature of Unit 24. Key issues that we attempted to manage with regulation changes were declining bull:cow ratios and even distribution of hunters in Unit 24D. The regulations were designed to improve distribution of hunters around the

perimeter of the controlled use area and to improve success rates of local hunters. It is important for local hunters to have high success rates during the fall hunting seasons so they can be less dependent on winter hunts. From RY02 to RY05, fall antlerless moose seasons were closed by emergency order due to continued declines in recruitment in Units 24B and 24C, as well as lack of growth in Unit 24D. At the 2006 Board of Game meeting, all antlerless hunts in Unit 24 were eliminated.

At the 2006 Board of Game meeting, the board subdivided Unit 24 into 4 units (Units 24A, 24B, 24C, and 24D) and adopted new intensive management objectives for these units. The primary reasons for subdividing Unit 24 were the improved knowledge of the moose population, landownership, the need to develop intensive management objectives that would reflect differences in the moose populations, and differences in hunting patterns in each of the 4 areas. Minor changes to moose regulations were also adopted to correspond to the new units and simplify regulations. Although the initial regulatory workload with the resulting game management unit boundary changes was expected, a substantial unexpected workload was incurred to review and update game management unit boundaries on maps in the hunting regulation book and online references, and to review Uniform Coding Units for the statewide harvest database coding.

Harvest by Hunters. Hunting seasons in Unit 24 were diverse and reflected various moose densities and consumptive use patterns. Annual reported harvest during RY97–RY06 averaged 183 moose (128–240, Table 14).

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 14). Moose taken during winter were rarely reported, even when the season was open. Some villages have never had a license vendor. This contributed to the problem of people hunting without licenses, harvest tickets or permits. Checkstation results, including the meat evaluation survey and the hunter viewing survey, can be found in the RY05–RY06 Unit 21D moose management report (Stout 2008).

Harvest Chronology. Over 95% of reported harvest occurred in the September seasons (Table 15). However, much of the unreported harvest probably occurred during October–March (Brown et al. 2004).

Permit Hunts. Beginning in RY00 in the Koyukuk CUA, drawing permit hunts DM827, DM828, DM829, and DM830 replaced the general registration permit RM830. Either subsistence registration permit RM832 or one of the drawing permits were required for the fall hunt in the Koyukuk CUA. The number of RM832 permits issued from RY00 through RY07 was consistent ($\bar{x}$ = 382; σ = 23.1; range = 349–411; Table 16). Reported use of the registration permit increased among Unit 21D and Unit 24 residents while other Alaska residents' use of the permit was down (Stout 2008). Nonlocal use of the RM832 is linked closely to the number of drawing permits. Increases in the number of Alaska resident hunters using the subsistence permit alternative and the potential to exceed the sustainable yield of the moose population has been a critical management issue. With implementation of the 6 drawing hunts in the Koyukuk CUA (DM823 and DM825 in RY05; DM827, DM828, DM829, and DM830 in RY00) and the 2

permit hunts outside the Koyukuk CUA (DM892, DM896; RY04), hunter numbers can be better managed (Table 17).

Within the DHCMA, drawing permit hunts DM920 and DM922 (RY02) resulted in a reduction of moose harvested compared to harvest under the general harvest ticket. Average rates for successfully drawing a DHCMA permit were relatively high in RY04–RY06, at 18.3% for DM920 and 42.3% for DM922. However, hunting success rates among the permitted hunters was low at an average of 16% north of Slate Creek (DM920) and 14% south of Slate Creek (DM922; Table 18). Hunter comments about the new permit hunts were positive in terms of the aesthetics of the hunt, but often negative among those hunters unable to successfully draw a permit.

Hunter Residency and Success. Based on harvest reports, the average annual number of moose hunters was 394 during RY97–RY06; most hunters were Alaska residents (Table 19). The number of hunters was probably underreported because Unit 24 residents often did not report unsuccessful hunt information, which became especially apparent beginning RY04 when Failure to Report (FTR) reporting requirements were initiated (Fig. 2). Harvest and hunter participation by Unit 24 residents was relatively constant, according to ADF&G–Division of Subsistence surveys (Brown et al. 2004). However, nonresident and nonlocal resident hunter participation that increased steadily beginning the late 1980s declined after RY01. The increase in nonlocal hunters created tension among user groups and was the impetus for creating the KWG.

The estimated annual harvest by residents of Unit 24 was 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. I estimated an additional 5 moose taken by Unit 24 residents not living in a village. Data reported by Anderson et al. (1998) and Brown et al. (2004) was similar to earlier results. Our estimated unreported harvest incorporated recent Subsistence Division data, less the reported harvest by Unit 24 residents (Table 14).

Local hunters reported they were unable to meet subsistence needs in the past 5–6 years, and have made several emergency requests for season extensions and additional seasons. Initially, these reports appeared to conflict with reported harvest, which has increased steadily since RY02. However, analysis of nonresident harvest may explain the deficit of local households, because many nonresident hunters donated most of their moose meat to local residents. Combined local resident and nonresident moose harvest indicated local demand increased about 4.6 moose/year from RY88 through RY00. However, meat donated by nonresident hunters decreased by about 5.1 moose per year from RY00 to RY07, suggesting a growing deficit of nearly 10 moose/year (4.6 moose + 5.1 moose = 9.7 moose) (Stout 2006).

Concern was expressed that increased demand was only a reflection of improved reporting rates by local hunters during the period of permit hunt implementations and the new statewide FTR enforcement regulations. However, analysis of harvest for the village of Huslia indicated improved reporting was primarily by unsuccessful hunters and it did not explain the 10 moose/year increased demand.

Huslia serves as an appropriate measure for reporting rates for Unit 24, because it represents as much as 50% of the total Unit 24 local resident harvest, and because Huslia residents were accustomed to the stringent registration permit system reporting requirements implemented in 1996. From RY01 to RY07, the number of FTRs declined by 9.4 hunters (Fig. 3), and it was a good indicator of the improved reporting response. However, the slopes of the successful and unsuccessful number of hunters were nearly equal (4.93 [50.3%] vs. 4.86 [49.7%]); this indicated that only about half of the reduction of the FTR decline could be attributed to harvested moose. Of the 10 moose/year increased demand indicated by combined local resident and nonresident moose harvest, only 0.78 moose/year could be explained by an increase in improved reporting while the remainder was due to additional harvest. Therefore, reported harvest for Huslia increased 29.6 moose from RY01 to RY07, of which 4.7 were due to improved reporting and 24.9 were due to an actual increase in harvested moose.

Clearly, more Huslia residents participated in the hunt, and the increase coincided with the decline in nonresident hunters. This provided additional evidence that reduced nonresident bull harvest, meat "receiving" rates by local residents in years of higher nonresident reported harvest, federal cow harvest, and exportation of federally authorized subsistence moose to nonlocal (non-federally qualified) residents that may be family or friends, are interrelated issues and have important management implications in Unit 24.

Transportation Methods. In RY05–RY06, boat 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 controlled use areas (Table 20). Highway vehicles were used only on the Dalton Highway where it crosses eastern Unit 24. Snowmachines were the main transportation method used during the winter, but are likely underreported because most of the unreported harvest occurs during winter.

The Dalton Highway was closed to the public at the Yukon River Bridge after construction was completed, but was opened to public use in 1981. The number of hunters and the moose harvest for hunters accessing Unit 24 by the Dalton Highway during RY05–RY06 were similar to previous years (Table 19).

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 Unit 24. 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 and northern portion of the unit.

HABITAT

Assessment

We visited 64 plots in Unit 24B and landed at 38 (59%) where browse was evident from the air. The browse removal index for sampled plants was 5.3% (95% CL: 4.3–6.3%, n = 231 shrubs). The removal index extrapolated to the shrub counts and species composition was 8.8% (6.8–10.8%, n = 231 shrubs). The brooming index was relatively low at 0.34 (95% CL: 0.28–0.40, n = 231 shrubs), and 51% of the plants had no evidence of past browsing by moose (T. Paragi, ADF&G, personal communication to G. Stout, 22 Jun 2007).

We visited 48 plots and landed at 29 (39%) in Unit 24C where browse was evident from the air. The browse removal index (based on biomass was averaged for CAG leaders across all shrubs and species to avoid extrapolation bias from shrub counts) was 5.5% (95% CL: 4.3–6.3%). The removal index extrapolated to all shrubs in a species across all sites sampled in Unit 24C was 8.5% (5.6–11.4%). Both these removal indices are the lowest estimated to date in Interior Alaska and are statistically similar to removal rates for adjacent Unit 24B. Unit 25D (Yukon Flats) has the next closest removal index for CAG leaders ($\bar{x}$ = 8.8%; 95% CL: 7.8–9.8%). The brooming index for Unit 24C was 16% (95% CL: 10–22%, n = 149 shrubs) and 70% of the plants had no evidence of past browsing by moose. These measures of browsing history indicate the least effect of moose on plant growth history to date in the Interior.

MANAGEMENT PLANNING

The KWG was disbanded in RY02, due to the turnover of advisory committee membership. 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 24 and nearby Unit 21B. Two public meetings were hosted by the department, one in January 2004 and the other in 2005, to provide an update on the status of management-related activities outlined in the moose management plan. Participants at the 2005 meeting recommended that the department extend the active period of the plan through 2007.

Approximately 1300 copies of the *Galena Area Moose Management News* were mailed out in late April 2007. Fifty-one questionnaires were returned by October 2007, a response rate of about 4%. Responses to the questionnaire indicate continued support for several of the most significant components of Galena management area moose management programs. Even though the overall response rate was not high, these results did provide additional insight on people's opinions on key management issues and we hope the newsletter and questionnaire provided useful information to those interested in Galena area moose management issues. A full summary of the questionnaire results is on file at the Galena ADF&G office and with the ADF&G–Division of Wildlife Conservation planner in Fairbanks.

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 in large areas of rural Interior Alaska. 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 RY05–RY06.

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. Without

current Subsistence Division survey data, it is uncertain whether Unit 24 residents met their wild food requirements, but public comments and regression analysis of harvest data suggest those needs are not being met. Hunting opportunities cannot be expanded for people living outside Unit 24 until moose numbers increase and bull:cow ratios in the Koyukuk CUA meet objectives of the *Koyukuk Moose Management Plan*. Where predators have been lightly harvested for long periods, predation seems to keep moose densities low (0.1–1.1 moose/mi^2 in areas >800 mi^2, Gasaway et al. 1992).

Completing population estimation surveys on the Hogatza River, Indian River (eastern Koyukuk NWR), and Kanuti NWR was a major accomplishment for this reporting period. However, we still need to obtain a population estimate for the upper Huslia River drainage. A population estimation survey should be undertaken in that area in cooperation with Koyukuk NWR when funding is available. A baseline population estimate for the entirety of Unit 24A should be conducted in cooperation with Bureau of Land Management, and low intensity (100 sample units) population estimates of the Kanuti NWR should be conducted annually in lieu of trend count surveys. High intensity estimation surveys (150–200 sample units) should be conducted every 5 years on the Kanuti NWR.

For the first goal concerning harvest within sustained yield principles, my estimate of 8467 moose ±1460 (7007–9927), not including a sightability correction factor, did not achieve the objective to maintain a population of 10,000–12,000 moose for the fourth consecutive reporting period. We achieved the objective to provide for an adequate moose harvest without exceeding 360 moose or a 5% harvest rate (RY06 estimated harvest rate = 3.4%). We also achieved the objective to provide for hunting opportunity that did not exceed 500 hunters.

The long-term objective of implementing at least 2 habitat enhancement activities was not achieved directly during RY05–RY06, but coordination with the FWS concerning monitoring and potential treatment is in progress. The objective of reducing spoiled meat was monitored in RY02–RY07. We continued the program at the Ella's cabin checkstation to establish baseline meat salvage data for fall hunters. We also continued the monitoring program to evaluate the number of people engaged in nonconsumptive activities. Results of the meat salvage and nonconsumptive activities are reported in the Unit 21D moose management report (Stout 2008).

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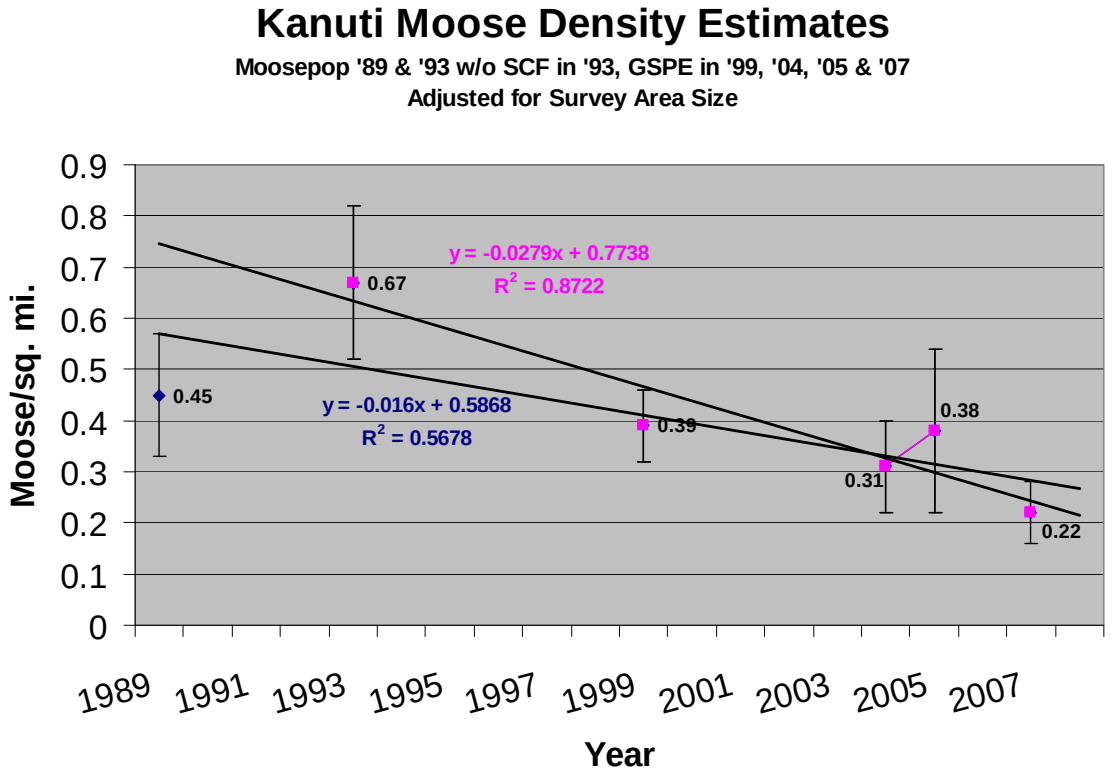

FIGURE 1 Unit 24 Kanuti National Wildlife Refuge moose density estimates and regression lines indicating population decline for regulatory years 1989–1990 through 2007–2008 (pink regression equation and line) and 1993–1994 through 2007–2008 (blue regression equation and line). Density estimates are used to adjust for different sized survey areas and sightability correction factors were eliminated from regulatory year 1993–1994 estimate, to standardize comparison.

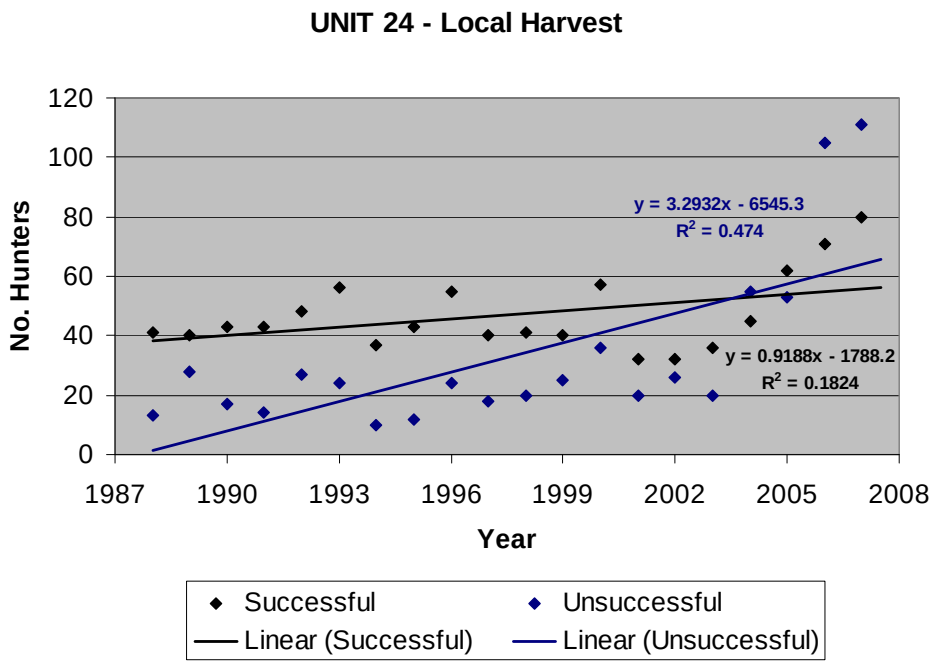

FIGURE 2 Unit 24 moose harvest reporting by successful and unsuccessful Unit 24 local resident hunters, regulatory years 1988–1989 through 2007–2008

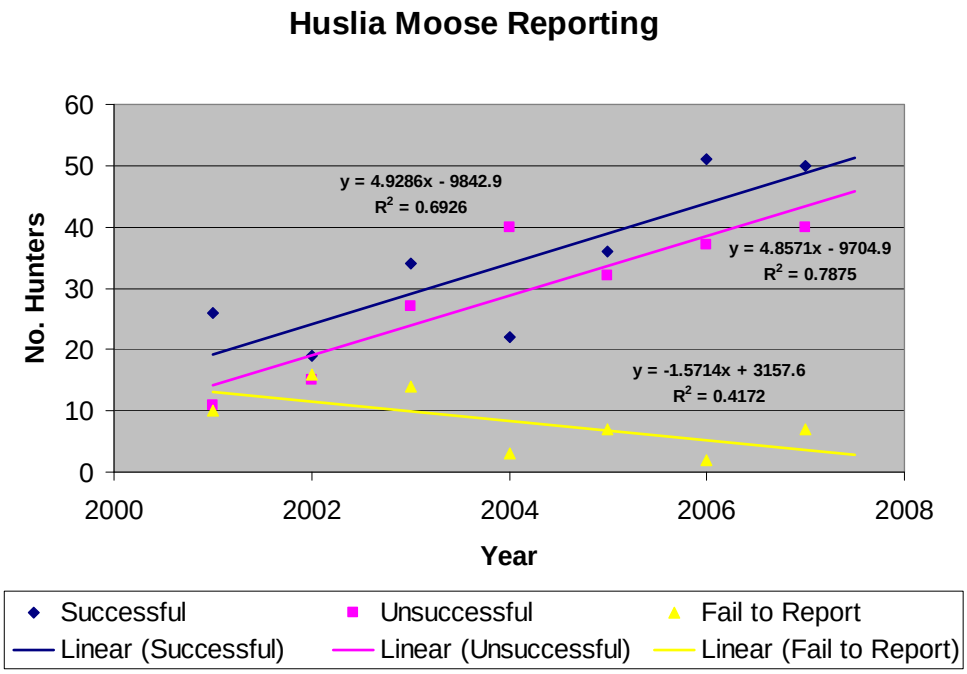

FIGURE 3 Unit 24 moose harvest reporting by residents of Huslia, regulatory years 2001–2002 through 2007–2008

TABLE 1 Unit 24D Dulbi Slough aerial moose composition counts, regulatory years 1982–1983 through 2006–2007[a]

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	132.8	24	8	28	0	18.2	280	2.1
2004–2005	132.8	28	16	40	11	23.7	389	2.9
2006–2007[b]	149.4	23	7	53	15	30.1	436	2.9

[a] Data reported prior to 2001 used Gasaway sample units, beginning in 2001 surveys used geospatial population estimator sample units.
[b] Low snow year.

TABLE 2 Unit 24D Huslia River Flats aerial moose composition counts, regulatory years 1983–1984 through 2007–2008[a]

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	125.9	38	9	16	0	10.0	603	4.8
2003–2004	136.8	36	10	29	4	17.7	623	4.6
2004–2005	142.3	38	16	33	7	19.1	768	5.4
2005–2006	142.3	31	14	23	4	15.0	752	5.3
2006–2007[b]	142.3	40	12	37	11	20.8	811	5.7
2007–2008	142.3	38	13	33	5	19.4	684	4.8

[a] Data reported prior to 2001 used Gasaway sample units, beginning in 2001 surveys used geospatial population estimator sample units.
[b] Low snow year.

TABLE 3 Unit 24D Treat Island aerial moose composition counts, regulatory years 1985–1986 through 2007–2008[a]

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	163.3	23	4	9	2	7.1	604	3.7
2003–2004	174.1	27	9	21	4	14.3	762	4.4
2004–2005	168.7	29	7	30	9	18.9	800	4.7
2005–2006	168.7	25	9	14	9	10.2	566	3.4
2006–2007[b]	168.7	35	8	30	5	18.2	740	4.4
2007–2008	163.3	29	11	22	10	14.4	711	4.4

[a] Data reported prior to 2001 used Gasaway sample units, beginning in 2001 surveys used geospatial population estimator sample units.
[b] Low snow year.

TABLE 4 Unit 24B Henshaw–Peavy Creek aerial moose composition counts, regulatory years 1991–1992 through 2004–2005

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
1991–1992	67	80		30		14	42	0.62
1992–1993	67	58	11	5		3	64	0.85
2000–2001	106	129	18	24	67	9	43	0.41
2001–2002	106	106	0	31	0	13	38	0.36
2002–2003	106	72	6	28	0	14	36	0.34
2003–2004	106	68	15	29	22	15	67	0.63
2004–2005	106	76	15	33	22	16	69	0.65

TABLE 5 Unit 24B Kanuti Canyon aerial moose composition counts, regulatory years 1988–1989 through 2004–2005

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
1988–1989	96	118		41		16	101	1.05
1992–1993	79	77	8	27		1	106	1.34
2000–2001	86	38	7	7	0	5	87	1.01
2001–2002	86	40	9	23	0	14	57	0.66
2002–2003	86	16	4	13	0	10	72	0.84
2003–2004	86	29	11	9	0	6	62	0.72
2004–2005	86	41	0	18	0	11	35	0.41

TABLE 6 Unit 24A Middle Fork aerial moose composition counts, regulatory years 1987–1988 through 2007–2008

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
1987–1988	78	49	5	21	0	13	104	2.16
2000–2001	77	13	0	43	10	27	62	0.81
2001–2002	77	36	9	18	0	12	34	0.44
2002–2003	77	0	0	33	0	25	24	0.31
2003–2004	113	23	9	24	0	16	104	0.92
2004–2005	113	38	6	22	0	14	110	0.97
2005–2006	113	33	5	14	0	11	86	0.76
2007–2008	113	41	5	25	15	15	101	0.89

TABLE 7 Unit B Kanuti National Wildlife Refuge population estimation surveys, regulatory years 1989–1990 through 2007–2008

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 (1372–2199)	0.76
1999–2000	2714	61	4.3	27.8	n/a	14.7	1188 (879–1497)	0.39
2004–2005	2710	62	8.6	46.0	n/a	20.7	842 (602–1083)	0.31
2005–2006[b]	2710	70	20.0	43.0	30.1	19.7	1025 (581–1470)	0.38
2007–2008	2715	60	13	53.0	22.3	24.7	588 (463–714)	0.22

[a] Martin and Zirkle 1996.
[b] Lawler et al. 2006.

TABLE 8 Unit 24C and 24D population estimation survey, regulatory year 2007–2008

Regulatory year/Area	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
2007–2008 Eastern Koyukuk NWR	1623	78	14	42	9.7	18.7	983 (890–1076)	0.61
2007–2008 Hogatza River	2672	70	16	45	16.5	20.7	562 (433–691)	0.21
2007–2008 Total Block	4295	75	14	43	12.3	19.4	1545 (1382–1708)	0.36

TABLE 9 Unit 24 population estimation survey summaries, regulatory years 1999–2000 through 2007–2008

Survey area	Area mi^2	Total sample units	Bulls:100 Cows	Calves:100 Cows	Population estimate without sightability correction factor
Unit 24A and 24B[a]					
1999 Survey block (upper Koyukuk)	8390	1585	65:100	28:100	3036±647 (90% CI)
2004 Survey block (upper Koyukuk and GAAR)	11,494	2204	65:100	35:100	2805±629 (90% CI)
2007 Estimated (13% decline since 2004)	8779				1929±550
2007 Survey block (Kanuti NWR)	2715	508	60:100	53:100	588±126 (90% CI)
Moose habitat Unit 24/North[b]	3402				595±200
Remainder Unit 24/North[c]	3150				158±100
Subtotal (2007)	18,046				3270±980
Unit 24C[a]					
2007 Survey block (Hogatza River)	2672	498	70:100	45:100	562±129 (90% CI)
Subtotal (2007)	2672				562±130
Unit 24D[d]					
2001 Survey block (lower Koyukuk)	1949	336	35:100	18:100	3642±572 (90% CI)
2004 Survey block (lower Koyukuk)	1843	336	33:100	34:100	3181±148 (90% CI)
2007 Survey block (eastern Koyukuk refuge)	1623	296	78:100	42:100	983±93 (90% CI)
Remainder Zone 1	1884				471±100
Subtotal (2007)	5350				4635±350
Unit 24 – Total	26,068				8467±1460

[a] Cumulatively, Units 24A (4,146 mi^2), 24B (13,523 mi^2), and 24C (3,049 mi^2) were formerly defined as Management Zone 2.
[b] The estimated area of Unit 24A and 24B that could potentially support moose year-round.
[c] The area remaining in Unit 24A and 24B with very little year-round moose habitat, primarily the high altitude mountainous portion within Gates of the Arctic National Park.
[d] Unit 24D (5,350 mi^2) was formerly defined as Management Zone 1.

TABLE 10 Unit 24D moose aerial twinning surveys in the combined areas of Huslia Flats and Treat Island trend count areas, regulatory years 2001–2002 through 2006–2007

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[a]	Yearlings	Date
2001–2002	--	17	2	11	3	29 May–1 Jun
2002–2003	144	53	22	29	41	28–30 May
2003–2004	58	55	23	29	34	29 and 30 May
2004–2005[b]	30	21	12	36	13	27 May
2005–2006	36	40	27	40	32	28 and 29 May
2006–2007	31	40	8	17	21	28 and 29 May

[a] Percent of cows with calves that had twins.
[b] Extensive flooding and early leaf-out, so survey flight path was "high-graded" to maximize observations.

TABLE 11 Unit 24D moose aerial twinning surveys in the Dulbi Slough trend count areas, regulatory year 2005–2006

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[a]	Yearlings	Date
2005–2006	16	18	16	47	10	29 May

[a] Percent of cows with calves that had twins.

TABLE 12 Unit 24C moose aerial twinning surveys in the Hogatza River, regulatory year 2006–2007

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[a]	Yearlings	Date
2006–2007	7	1	2	n/a	1	30 May–1 Jun

[a] Percent of cows with calves that had twins.

TABLE 13 Unit 24B moose aerial twinning surveys in the Kanuti–Alatna Rivers, regulatory year 2006–2007

Regulatory year	Cows w/o calves	Cows w/1 calf	Cows w/twins	Twinning %[a]	Yearlings	Date
2006–2007	4	3	1	n/a	0	30 and 31 May

[a] Percent of cows with calves that had twins.

TABLE 14 Unit 24 moose hunter harvest, regulatory years 1988–1989 through 2007–2008

Regulatory year	Harvest by hunters				Unreported harvest[a]	Total
	Bull	Cow	Unk	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	183	5	1	189	100	289
2002–2003	186	4	0	190	100	290
2003–2004	149	5	1	155	100	255
2004–2005	127	1	0	128	100	228
2005–2006	162	0	0	162	100	262
2006–2007	141	0	0	141	145	286
2007–2008[b]	178	0	0	178	145	323

[a] Unreported harvest based on Subsistence Division's door-to-door survey and other sources.
[b] Data preliminary.

TABLE 15 Unit 24 moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2007–2008

Regulatory year	Harvest chronology percent by month/day				
	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	37	60	2	2	179
2002–2003	43	55	0	2	174
2003–2004	48	48	0	5	145
2004–2005	46	54	0	1	123
2005–2006	34	66	0	0	152
2006–2007	44	56	0	1	128
2007–2008	38	62	0	0	176

TABLE 16 Units 21D, 24D and 24C within the Koyukuk Controlled Use Area moose harvest by permit hunt, regulatory years 1998–1999 through 2007–2008[a]

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
RM832	1998–1999	295	8	45	55	125 (77)	38 (23)	0	163
	1999–2000	356	9	49	51	127 (70)	54 (30)	1	182
	2000–2001	355	14	45	55	157 (93)	11 (7)	1	169
	2001–2002	403	15	62	38	126 (97)	3 (2)	1	130
	2002–2003	359	17	51	49	145 (100)	0 (0)	0	145
	2003–2004	401	12	55	45	155 (99)	0 (0)	2	157
	2004–2005	399	8	62	38	141 (100)	0 (0)	0	141
	2005–2006	411	9	63	37	132 (100)	0 (0)	0	132
	2006–2007	382	7	58	42	142 (99)	0 (0)	1	143
	2007–2008	349	8	59	41	131 (100)	0 (0)	0	131
RM830	1998–1999	330	5	45	55	159 (87)	23 (13)	0	182
	1999–2000	380	3	51	49	148 (79)	39 (21)	0	187
DM823	2005–2006	2	0	0	100	2 (100)	0 (0)	0	2
	2006–2007	2	0	50	50	1 (100)	0 (0)	0	1
	2007–2008	2	0	0	100	2 (100)	0 (0)	0	2
DM825	2005–2006	3	33	0	100	2 (100)	0 (0)	0	2
	2006–2007	4	0	0	100	4 (100)	0 (0)	0	4
	2007–2008	4	0	0	100	4 (100)	0 (0)	0	4
DM827	2000–2001	26	19	52	48	10 (100)	0 (0)	0	10
	2001–2002	26	19	68	32	5 (83)	1 (17)	0	6
	2002–2003	20	35	31	69	9 (100)	0 (0)	0	9
	2003–2004	26	19	63	37	7 (100)	0 (0)	0	7
	2004–2005	5	20	25	75	3 (100)	0 (0)	0	3
	2005–2006	3	33	0	100	2 (100)	0 (0)	0	2
	2006–2007	3	66	0	100	1 (100)	0 (0)	0	1
	2007–2008	3	66	0	100	1 (100)	0 (0)	0	1

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
DM828	2000–2001	103	51	22	78	38 (100)	0 (0)	0	38
	2001–2002	103	63	54	46	17 (100)	0 (0)	0	17
	2002–2003	79	56	45	55	17 (100)	0 (0)	0	17
	2003–2004	103	48	40	60	27 (100)	0 (0)	0	27
	2004–2005	20	55	43	57	4 (100)	0 (0)	0	4
	2005–2006	20	55	56	44	4 (100)	0 (0)	0	4
	2006–2007	20	50	40	60	6 (100)	0 (0)	0	6
	2007–2008	20	75	20	80	4 (100)	0 (0)	0	4
DM829	2000–2001	26	15	27	73	16 (100)	0 (0)	0	16
	2001–2002	26	15	50	50	8 (100)	0 (0)	0	8
	2002–2003	20	45	0	100	11 (100)	0 (0)	0	11
	2003–2004	26	12	38	62	13 (100)	0 (0)	0	13
	2004–2005	5	40	67	33	1 (100)	0 (0)	0	1
	2005–2006	2	50	100	0	0 (0)	0 (0)	0	0
	2006–2007	2	0	0	100	2 (0)	0 (0)	0	2
	2007–2008	2	0	0	100	2 (0)	0 (0)	0	2
DM830	2000–2001	103	41	25	75	45 (100)	0 (0)	0	45
	2001–2002	103	51	43	57	26 (100)	0 (0)	0	26
	2002–2003	79	38	16	84	41 (100)	0 (0)	0	41
	2003–2004	103	36	24	76	44 (100)	0 (0)	0	44
	2004–2005	20	60	43	57	4 (100)	0 (0)	0	4
	2005–2006	20	45	27	73	8 (100)	0 (0)	0	8
	2006–2007	20	32	53	47	9 (100)	0 (0)	0	9
	2007–2008	20	25	26	74	14 (100)	0 (0)	0	14
Total	1998–1999	625	7	41	59	284 (82)	61 (18)	0	345
	1999–2000	736	5	46	54	275 (75)	93 (25)	1	369
	2000–2001	613	25	39	61	266 (96)	11 (4)	1	278
	2001–2002	661	29	59	41	182 (97)	4 (2)	1	187

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters[b]	Percent successful hunters[b]	Bulls (%)	Cows (%)	Unk	Total harvest
	2002–2003	557	27	46	54	223 (100)	0 (0)	0	223
	2003–2004	659	22	50	50	246 (100)	0 (0)	2	248
	2004–2005	449	13	62	38	153 (100)	0 (0)	0	153
	2005–2006	461	15	60	40	150 (100)	0 (0)	0	150
	2006–2007	433	12	56	44	165 (100)	0 (0)	1	166
	2007–2008	400	15	54	46	158 (100)	0 (0)	0	158

[a] RM830 ended in regulatory year 2000–2001 and was replaced by drawing hunts DM827, 828, 829, and 830.

[b] Percent successful and percent unsuccessful were calculated using the total number of hunters who completed their report cards with enough information to determine whether they harvested a moose.

TABLE 17 Units 24C and 24D Huslia River and Hogatza River drainages moose harvest by permit hunt, regulatory years 2004–2005 through 2007–2008

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)		Cows (%)		Unk	Total harvest
DM892	2004–2005	32	72	11	89	8	100	0	0	0	8
	2005–2006	32	31	36	64	14	100	0	0	0	14
	2006–2007	32	53	40	60	9	100	0	0	0	9
	2007–2008	35	26	17	73	19	100	0	0	0	19
DM896	2004–2005	54	31	65	35	13	100	0	0	0	13
	2005–2006	54	57	52	48	11	100	0	0	0	11
	2006–2007	54	80	82	18	2	100	0	0	0	2
	2007–2008	60	65	57	43	9	100	0	0	0	9

TABLE 18 Unit 24A Dalton Highway Corridor Management Area moose harvest by permit hunt, regulatory years 2002–2003 through 2007–2008

Hunt	Regulatory year	Permits issued	Percent did not hunt	Percent unsuccessful hunters	Percent successful hunters	Bulls (%)	Cows (%)	Unk	Total harvest
DM920	2002–2003	20	30	100	0	0 (0)	0 (0)	0	0
	2003–2004	20	40	100	0	0 (0)	0 (0)	0	0
	2004–2005	20	45	91	9	1 (100)	0 (0)	0	1
	2005–2006	20	20	94	6	1 (100)	0 (0)	0	1
	2006–2007	20	55	67	33	3 (100)	0 (0)	0	3
	2007–2008	20	35	85	15	2 (100)	0 (0)	0	2
DM922	2002–2003	50	29	88	12	4 (100)	0 (0)	0	4
	2003–2004	50	54	86	14	3 (100)	0 (0)	0	3
	2004–2005	50	46	92	8	2 (100)	0 (0)	0	2
	2005–2006	50	42	79	21	6 (100)	0 (0)	0	6
	2006–2007	50	32	88	12	4 (100)	0 (0)	0	4
	2007–2008	50	24	97	3	1 (100)	0 (0)	0	1

TABLE 19 Unit 24 moose hunter residency and success, regulatory years 1988–1989 through 2007–2008

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	128	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	32	101	48	1	182	20	181	57	0	258	440
2002–2003	32	90	68	0	190	26	130	56	2	214	404
2003–2004	36	76	35	8	155	20	104	50	10	184	339
2004–2005	45	51	29	2	127	55	139	35	1	230	357
2005–2006	62	73	24	2	161	53	145	38	1	237	398
2006–2007	56	66	20	0	142	79	152	32	1	264	406
2007–2008	71	73	34	6	184	81	148	29	2	260	444

[a] Unit resident only.

TABLE 20 Unit 24 moose harvest percent by transport method, regulatory years 1988–1989 through 2007–2008

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Unknown	
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	19	1	62	2	3	0	14	0	182
2002–2003	18	1	69	1	2	0	7	2	190
2003–2004	19	1	69	1	5	0	5	1	155
2004–2005	19	0	59	2	1	0	17	2	127
2005–2006	7	1	75	1	0	0	13	4	161
2006–2007	9	3	69	1	1	2	11	4	142
2007–2008	17	1	74	2	0	2	5	1	184

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

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 the latter half of that century (Stephenson 2002). Moose density continues to be low compared with many other areas in Interior Alaska. In Unit 25D, a few population surveys were conducted 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. In the 1980s and 1990s trend count surveys and stratified random sampling were used by ADF&G and the U.S. Fish and Wildlife Service (FWS) to estimate population density. Estimates ranged from a low of 0.1 moose/mi^2 in the western Yukon Flats in 1984 to a high of 0.64 moose/mi^2 in the eastern Yukon Flats in 1989.

Unit 25D was divided into Unit 25D West and Unit 25D East in the early 1980s to allow the use of regulatory schemes that reflected differing 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 River. 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 primarily to residents of the area. In 1983, in Unit 25D West, a registration hunt with a bag limit of 1 bull moose was established, with 60 permits available to residents of Beaver (25 permits), Stevens Village (25 permits), and Birch Creek (10 permits). In 1984 the fall season was shortened and 2 winter hunting periods were added and by 1986 a harvest quota of 35 bull moose was established. In regulatory year (RY) 1990 (RY = 1 July through 30 June, e.g., RY90 begins 1 July 1990 and ends 30 June 1991) a Tier II permit hunt was established because the harvestable surplus was deemed insufficient to support all subsistence uses, and restrictions were thought to be necessary. During most of the 1990s, 125 permits and 3

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

hunting seasons were available. Also, beginning in 1990, the Federal Subsistence Board promulgated regulations for subsistence use on federal lands and 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. However, during RY93 through RY99, state Tier II permits were not recognized on federal land. During this period, a maximum of 30 federal permits and 125 state Tier II permits were issued. In 1999, discussions with local residents helped identify a number of steps that could improve moose management on the western Yukon Flats. These steps included revising the harvest quota for moose, reducing the maximum number of Tier II permits available, and aligning state and federal hunting seasons. In 2000, based on these discussions, the Alaska Board of Game lengthened the state season in Unit 25D West to 25 August–28 February (aligning it with the federal season), increased the harvest quota from 35 to 60 bull moose, and reduced the number of Tier II permits from 125 to 75 permits. 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 combined state and federal harvest quota of up to 60 bull moose.

In Unit 25D East, moose hunting remained under the general harvest ticket system for a take of 1 bull moose with a short fall season of 10–20 September and a short winter season of 1–10 December or 18–28 February. A nonresident hunt in the fall has been available and 50-inch antler restrictions were implemented in 1990–1991. In 2000 the board also approved a regulation that established a community harvest permit program for part of Unit 25D East. 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.

Other state regulations influenced moose hunting regulations in Unit 25D. In 1987 the Alaska Board of Game determined there was a positive customary and traditional use finding for moose in Unit 25D (5 AAC 99.025). The board identified 2 populations of moose for subsistence purposes in Unit 25D. Amounts reasonably necessary for subsistence uses (ANS) were established in Unit 25D West as 25–50 moose and Unit 25D East as 150–250. In 1992 the customary and traditional finding was reaffirmed. In 2002 the board revised the ANS to 50–70 moose for Unit 25D West and 150–250 for Unit 25D East.

Federal regulations have also influenced moose hunting in Unit 25D. Since 1990, dual management significantly affected regulations in Unit 25D and the cumulative effect of various annual permit application requirements, confusion over geographic boundaries, and other circumstances have resulted in low reporting and limited participation by local residents in the harvest management system.

State regulations for moose hunting have changed little over that past decade in Units 25A and 25B. In Unit 25A, seasons were either 1–20 September or 5–25 September with an any bull bag limit for residents and an antler restricted bag limit (50-inch antlers or at least 4 brow tines on one side) for nonresidents. For most of Unit 25B, the resident season was 5–25 September and 1–15 December with an any-bull bag limit for residents and an antler restricted bag limit for nonresidents (50-inch antlers or at least 4 brow tines on one side) during 5–25 September. In the upper Porcupine River drainage, the season was changed in 2003 from 20–30 September for residents and nonresidents to 10–25 September. A community harvest permit hunt (CM001) was

established in 2003 and occurred in most of Unit 25B with a bag limit of any bull and a season during 5–25 September and 1–15 December.

At the same time Unit 25D was divided for management schemes, separate survey areas have been conducted in Units 25D East and 25D West by ADF&G and FWS, respectively. Since 1999, population surveys have been conducted by ADF&G and FWS using geospatial population estimators (GSPE) described in Ver Hoef (2001, 2008) and in Kellie and DeLong (2006). From 1999 to 2006, estimated densities have ranged from 0.18 to 0.38 moose/mi^2. Survey data indicated that moose numbers were stable in the eastern Yukon Flats and declined in the western Yukon Flats. Both populations are at extremely low densities.

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 have declined and are currently at a low level. Periodic surveys in Unit 25A suggest that numbers have also declined in this area during the past decade, but no surveys have been conducted since 2002.

MANAGEMENT DIRECTION

During the early to mid 1990s, cooperative effort among ADF&G, FWS, and local residents of Unit 25D resulted in 2 educational videos on moose management in the Yukon Flats emphasizing the adverse effects of shooting cow moose. During this period it also became evident that there was substantial local 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. As a result, ADF&G initiated a cooperative effort in 2001 to develop a moose management plan for the Yukon Flats. By 2002 the Yukon Flats Cooperative Moose Management Plan (YFCMMP) was completed and endorsed by the Board of Game (ADF&G 2002). The plan was developed under the sponsorship of ADF&G–Division of Wildlife Conservation, in cooperation with the Yukon Flats Fish and Game Advisory Committee through the Yukon Flats Moose Management Planning Committee, an advisory group created specifically for the planning project. Other involved stakeholders included the Council of Athabascan Tribal Governments (CATG), individual tribal governments, FWS–Yukon Flats National Wildlife Refuge, FWS–Office of Subsistence Management, and other interested users of the Yukon Flats moose resource. This effort focused on community and agency initiatives that together could maintain or increase moose abundance, especially in key hunting areas near local communities, as well as the interest of nonlocal hunters and other interested parties. The YFCMMP was designed to promote moose population growth in the Yukon Flats through the following guidelines: 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 to improve recruitment, 4) inform hunters and others about the low moose population on the Yukon Flats and avenues people can take to help in the effort to increase moose abundance, and 5) use both scientific information and traditional knowledge to help make management decisions.

In March 2006 the board requested that ADF&G develop an intensive management plan for moose in the Yukon Flats in response to public proposals that requested predator control of

wolves and bears in Unit 25D to reduce predation on moose. In March 2008, ADF&G presented intensive management options to the board that explored a wide spectrum of management options to increase moose abundance in Yukon Flats. The presentation acknowledged the difficulty of implementing broad scale predator control on FWS lands and focused on the feasibility of increased wolf and bear harvest on smaller private lands surrounding villages. Intensive management objectives also included improved reporting by local residents and reduced illegal cow harvest. Many of the recommendations made in the intensive management plan mirrored those previously identified in the YFCMMP.

Recent management goals and objectives have been revised to reflect the goals and objectives in the YFCMMP and recent development of intensive management in Unit 25D.

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.

METHODS

POPULATION STATUS AND TREND

Unit 25D East Survey Area and Methods

The Unit 25D East survey area includes 2936 mi^2 of low elevation and some upland habitat adjacent to the Yukon, Porcupine and Black Rivers, in an area extending from near the mouth of the Chandalar River east to the vicinity of Chalkyitsik, and from Shuman House on the Porcupine River south to the Sucker River drainage and Mardow Lake area southeast of Fort Yukon. It includes the 115,000-acre Sheenjek River burn of 2005. This survey area encompasses the 1534-mi^2 area surveyed in 1995 and 1997 as well as trend count areas that were surveyed in the 1980s and early 1990s. The survey area includes 553 rectangular sample units, each defined by 2 minutes of latitude and 5 minutes of longitude, or approximately 5.3 mi^2. Sample units were classified as either high-density strata (>1 moose) or low-density strata (≤1 moose) and were originally based on a stratification survey conducted in October 1999 (Stephenson and Waggoner, ADF&G and Council of Athabascan Tribal Governments, 1999 unpublished eastern Yukon Flats moose population survey report). Since 1999, classification of strata has been modified annually to reflect count data from previous surveys (Stephenson and Thomas, ADF&G and Council of Athabascan Tribal Governments, 2006 unpublished eastern Yukon Flats moose population survey report).

In 2005 we surveyed 121 randomly selected sample units (83 high-density sample units and 38 low-density sample units) to estimate population size and composition. Search intensity averaged 23 min/unit or 4.3 min/mi^2. Snow coverage ranged from 6 to 10 inches and was about 1 week old. Light intensity was generally low to moderate with flat light due to overcast skies.

In 2006 we surveyed 117 randomly selected sample units (83 high-density units and 34 low-density units) to estimate population size and composition. Search intensity averaged 26.7 min/unit or 5.0 min/mi^2. Snow depth ranged from 6 to 10 inches and was about 1 week old. Light intensity was generally low to moderate and flat or bright.

In 2007 we surveyed 110 randomly selected sample units (76 high-density units and 34 low-density units) to estimate population size. An additional 17 non-random units from high-density strata were selected to increase sample size for composition estimates. Search intensity averaged 38.0 min/unit or 7.2 min/mi^2. Snow depth ranged from 6 to 10 inches and was

fresh to less than 1 week old. Frost coverage was extensive and significantly improved survey conditions. Light intensity and type varied from high to medium and from flat to bright.

In all years, survey data were analyzed using GSPE methods described in Ver Hoef (2001, 2008) with web-based software developed by ADF&G (DeLong 2006, Kellie and DeLong 2006). In 2007, separate data sets were used to analyze population size and composition. The former included only survey units that were randomly selected. Because relatively few moose were counted in randomly selected units, an additional 17 units were selected non-randomly to increase sample size for composition estimates. These additional units may bias population estimates because they were chosen based on logistical constraints and were concentrated in areas with higher moose densities. However, the additional units likely do not bias composition estimates and were only included in those analyses.

Unit 25D Birch Creek Survey Area and Methods

The Birch Creek survey area includes 3630 mi^2 of low elevation forest adjacent to the Yukon River, Birch Creek and Beaver Creek (includes portions of Unit 25D West and 25D East). Due to budget and time limitations the survey was limited to 87 sample units (51 high-density strata and 36 low density strata) and reduced search intensities. The area was initially stratified based on general familiarity with the habitat and anecdotal information from pilots and local residents regarding moose distribution. The stratification included 246 high-density sample units and 424 low-density sample units. In 2006 we spent 32.1 hours surveying 87 sample units (472 mi^2, $\bar{x}$ = 22.1 min/sample unit or 4.1 min/mi^2). Snow depth ranged from 6 to 10 inches and was less than 1 week old. Frost coverage on low vegetation also improved conditions. Light intensity ranged from low to medium and was generally bright. Survey data were analyzed using GSPE methods described in Ver Hoef (2001, 2008) and web-based software developed by ADF&G (DeLong, 2006, Kellie and DeLong 2006).

Unit 25D Venetie Survey Area and Methods

The Venetie survey area includes 2858 mi^2 of low elevation forest adjacent to the Christian and Chandalar Rivers and upland habitat north and east of Venetie. The survey area encompasses 2 large burns that occurred in 2004 (Pingo and Winter Trail) totaling 749,000 acres (1170 mi^2). Budget constraints limited survey effort in the central survey area, including most of the area used by the residents of Venetie. The area was stratified based on our general familiarity with the habitat and anecdotal information from local residents regarding moose distribution. The results of the first survey of this area were used to improve the stratification, and if funding is available an aerial stratification will be conducted in the future. The stratification included 237 units in the high-density strata and 313 in the low-density strata. In 2005 we spent 33.9 hours surveying 101 sample units (533 mi^2) and spent an average of 20 minutes in each unit (~3.8 min/mi^2). Survey conditions were generally moderate to poor due to 10–25 mph northeast winds. These conditions blew snow and frost from vegetation and made sightability of moose more difficult. Survey data were analyzed using GSPE methods described in Ver Hoef (2001, 2008) and web-based software developed by ADF&G (DeLong 2006, Kellie and DeLong 2006).

Unit 25D West Survey Area and Methods

The Unit 25D West survey area is 2269 mi^2 and extends from White Eye (near the lower mouth of Birch Creek), south to Mount Schwatka, and west to Stevens Village. This area is surveyed by

the Yukon Flats National Wildlife Refuge (Bertram and Vivion, FWS–Yukon Flats National Wildlife Refuge, 1999–2004 unpublished moose survey reports; Bertram, 2007 unpublished moose survey report). In November 2006 the FWS surveyed 97 (65 high-density strata and 32 low-density strata) randomly selected sample units to estimate population size and composition (Bertram, 2007 unpublished moose survey report). Search intensity averaged 5.7 min/mi^2. Survey data were analyzed using GSPE methods described in Ver Hoef (2001, 2008) and web-based software developed by ADF&G (DeLong 2006, Kellie and DeLong 2006).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Units 25A and 25B. No population surveys were conducted in RY05–RY07 in Units 25A and 25B. However, surveys were conducted in the Sheenjek and Coleen River drainages in eastern Unit 25A in fall 2000 and 2002 (FWS–Arctic National Wildlife Refuge, unpublished data). The survey area was identical to that used in 1989 and 1991, and survey conditions were excellent. About 50% fewer moose were observed in 2000 than in the 1989 and 1991 surveys and about 30% fewer moose were observed in 2002 than in 2000, suggesting that moose numbers may have declined during the last decade (Table 1). Reports from knowledgeable observers indicated moose numbers in southern Unit 25A also declined during this period. No surveys have been conducted in Unit 25B since 1987 (Table 1). Reports from hunters in Unit 25B indicated 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 southern Unit 25B and northern Unit 20E resulted in estimated densities of 0.34 observable moose/mi^2 in 1994 and 0.23 observable moose/mi^2 in 1997 and 1999 (Burch 1999). Total moose numbers are likely ≥20% in excess of observable moose numbers (Boertje et al. 2009; M. Keech, ADF&G, unpublished data).

Unit 25D East – Fort Yukon Survey. Density estimates for Unit 25D East have been extremely low (0.18–0.28 observable moose/mi^2) since GSPE survey methods were implemented in 1999. GSPE results were similar to results in prior years (Stephenson and Thomas, 2006 unpublished moose population survey report; Table 2). However, population estimates declined between 2005 and 2007 from 1008 (±20%) to 585 (±23%) moose, respectively, even with increased search intensity (4.3 min/mi^2 in 2005, 5.0 min/mi^2 in 2006, and 7.2 min/mi^2 in 2007). Long-term, estimates have been highly variable among years and it is unclear whether the current 2-year trend represents a recent decline in the moose population, the results of differing moose distribution, or sampling error. It is possible that fluctuations are real and typical of a population in low density dynamic equilibrium. Also, current survey techniques may not reliably detect annual changes in population size in this area of extremely low moose density. One to 2 additional population estimates are needed to determine whether the current trend represents an actual long-term population decline in the eastern Yukon Flats.

Birch Creek Survey. The area around Birch Creek in Unit 25D was surveyed for the first time in 2006. Moose density was estimated at 0.20 moose/mi^2, similar to estimates of other survey areas in Unit 25D (Table 2). Search intensity was low (mean = 4.1 min/mi^2), and total moose numbers were likely at least 20% higher.

Unit 25D East – Venetie Survey. The area around Venetie in Unit 25D was surveyed in 2004 and 2005. Estimated densities were 0.19 observable moose/mi^2 and 0.15 observable moose/mi^2, respectively, and were similar to density estimates in other portions of Unit 25D (Table 2). However, low search intensities (mean = 3.9 min/mi^2) and poor weather during surveys decreased sightability of moose.

Unit 25D West – FWS. Density estimates for Unit 25D West have been extremely low (0.18–0.30 observable moose/mi^2) since GSPE survey methods were implemented in 1999 and compare similarly to estimates in prior years based on other techniques (Table 2). U.S. Fish and Wildlife Service conducted a survey in fall 2006 but was unable to conduct surveys in 2005 and 2007. Fall population estimates declined from 862 (±19%) in 1999 to 418 (±21%) moose in 2006.

Unit 25D Totals. Based on extrapolation from the 2007 fall estimate in Unit 25D East and the 2006 fall estimate in Unit 25D West, the estimated observable population is 1600–2700 moose (0.15–0.25 moose/mi^2) in Unit 25D East and 900–1500 moose (0.14–0.22 moose/mi^2) in Unit 25D West. Combining estimates for Unit 25D East and West, the total observable moose population for Unit 25D is 2500–4200 moose (0.14–0.24 moose/mi^2). Assuming a minimum sightability correction factor of 1.23 for GSPE surveys conducted at 7–8 min/mi^2, we estimate the total moose population in Unit 25D at 3100–5200 moose (0.18–0.29 moose/mi^2).

Population Composition

Units 25A and 25B. No moose surveys were conducted in RY05–RY07 in Units 25A and 25B. Trend surveys conducted by FWS in Unit 25A in 1987, 1989, 1991, 2000, and 2002 showed high bull:cow ratios (63–91:100) and moderate calf and yearling survival (Table 1). Moderate to low harvests related to logistic limitations in this remote area suggest that hunting has had a minor effect on bull:cow ratios, although moose abundance appears to have declined. Surveys have not been conducted in northern Unit 25B in recent years. However, GSPE surveys were conducted in nearby Unit 20E in Yukon–Charley Rivers National Preserve in 2003 and 2006 (Burch 2003, 2006). Estimated moose densities remained the same between surveys (0.22–0.23 moose/mi^2) and indicate a stable low-density population. Bull:cow ratios were high (61–73 bulls:100 cows) and calf:cow ratios were moderate (25–33 calves:100 cows).

Unit 25D East and West. In Unit 25D East, estimates from fall surveys during 2005–2007 resulted in high bull:cow ratios (range: 60–80 bulls:100 cows) and high calf:cow ratios (range: 37–58 bulls:100 cows; Table 3). Yearling recruitment, also appeared to be robust, as indicated by high yearling bull:cow ratios (range: 12–22 yearling bulls:100 cows). In Unit 25D West, fall survey data resulted in a high bull:cow ratio (65 bulls:100 cows), a moderate calf:cow ratio (22 calves:100 cows) and robust yearling recruitment (18 yearling bulls:100 cows) in RY07 (Table 3). However, significant variation between years and poor precision in ratio estimates due to small sample sizes makes detection of trends in ratios difficult. Furthermore, given that harvest of cows is known to occur and a decline in the population trend has occurred, these ratio data for calves, yearling bulls, and adult bulls per 100 cows may be more indicative of a stable or declining cow population. For example, in some survey years, yearling recruitment is unexplainably high compared to fall calf production from the previous year (i.e., fall yearling recruitment appears to be greater than the prior years' fall calf recruitment). Causes of this

discrepancy may include measurement error, moose movement, and significant winter harvest of cow moose.

Distribution and Movements

Moose are distributed throughout Units 25A, 25B, and 25D in varying low densities. Large areas currently support densities of 0.1–0.3 moose/mi^2 and 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. Telemetry studies in Units 25D East and 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 in eastern Unit 25A to determine moose seasonal movements and distribution, fidelity to winter range, and relationship between fall moose concentrations and harvest. 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, as over 40 moose migrated to the Old Crow Flats in Yukon, Canada in spring and remained there until late August, when they began to move back into Alaska (Mauer 1998).

MORTALITY

Harvest

Seasons and Bag Limits during RY05–RY06.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
Unit 25A, within the DHCMA.		
RESIDENT HUNTERS: 1 bull by bow and arrow only, by drawing permit.	1 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side by bow and arrow only, by drawing permit.		1 Sep–25 Sep
Unit 25A, remainder.		
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 at least one side.		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.	10 Sep–25 Sep	
NONRESIDENT HUNTERS: 1 bull with 50-inch antlers or antlers with 4 or more brow tines on at least one side.		10 Sep–25 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 one 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 of Unit 25D).		
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 one side.		10 Sep–20 Sep

Alaska Board of Game Actions and Emergency Orders. There were no regulatory changes during RY05–RY06. However, in 2006, the Alaska Board of Game (board) requested that ADF&G present options at the March 2008 meeting for developing an intensive management plan for moose in Unit 25D. In March 2008, the board adopted an ADF&G proposal to clarify the boundary of the Tier II moose permit hunt in Unit 25D. We also presented options for developing an intensive management plan for moose in Unit 25D. In general, the plan focused on increasing wolf and bear harvest on private lands within Yukon Flats National Wildlife Refuge, reducing cow harvest, and improving reporting rates by local residents.

Harvest by Hunters. Reported moose harvest in Unit 25A was 53 in RY05 and 44 in RY06, similar to previous years (Table 4). Fewer moose were reported harvested in Unit 25B (26 and 35 animals) but harvest was similar to prior years (Table 5).

In Unit 25D East, reported harvest was 23 in RY05 and 16 in RY06 (Table 6).The reporting rate by residents of Unit 25D has historically been low. Actual harvest is likely significantly more than reported harvest. Efforts have been made to more accurately document moose harvest in Unit 25D. Surveys conducted by the CATG during 1993–2007 indicated that actual harvest varied greatly between years and ranged from 94 to 228 moose annually (CATG 2007). Although few cow moose were reported as a portion of the harvest, moose survey data and population modeling suggest a significant proportion of the harvest consisted of cows.

Permit Hunts. In RY05 and RY06, 53 and 75 TM940 permits were issued in Unit 25D West with a reported harvest of 7 and 2 moose (Table 7). Success rates were low (11–24%) and likely reflect low moose density in the area and harvest that may have occurred on a simultaneous federal permit hunt. In addition, most of the area encompassed by TM940 is federal land, closed to moose hunting except by federally qualified subsistence hunters. For those lands, a separate federal permit hunt allows for the harvest of moose by local hunters. The reported federal subsistence harvest in RY05 and RY06 was 14 and 10, respectively.

No moose have been reported taken on a Chalkyitsik community harvest permit since 2004. During 2000–2003, annual reported harvest on a community harvest permit ranged from 2 to 11 moose in Unit 25D and 1–9 moose in Unit 25B.

Hunter Residency and Success. In Unit 25A, ≥50% of moose hunters were Alaska residents during RY05–RY06, consistent with prior years (Table 8). Total hunters increased slightly in RY05 and RY06 (95 and 119) compared to the previous report period. Success rates (56% and 37%) remained similar to prior years.

In Units 25B and 25D, residents composed ≥83% of hunters, respectively, during RY05–RY06, consistent with prior years (Tables 9 and 10). In Unit 25B, total hunters and success rates also remained similar to prior years, with 74 and 100 hunters in RY05 and RY06, respectively, and 35% success in both years.In Unit 25D East there were 69 and 62 hunters, respectively, in each of the two years Success rates in this portion of the unit were 33% and 26%, higher than the previous 4 years (range 15–20%). However, the total number of hunters in Units 25B and 25D is likely underrepresented due to low reporting rates for local residents in these units.

Harvest Chronology. Most moose harvest in Unit 25 occurred during the second and third weeks of September in RY05–RY06 (Table 11). Although the hunting season opens on 1 September for residents and 5 September for nonresidents, few moose were harvested during the first week of September. The observed trend in harvest chronology has been consistent in recent years. However, harvest chronology has changed since RY96–RY03, when a larger proportion of the harvest occurred during the first week of September. In Unit 25B, moose harvest was well distributed across the last 3 weeks of September with few moose harvested during the first week of September (Table 12). Similar to Unit 25A, there appears to be a recent shift in harvest chronology from the first week of September to later in the season. In Unit 25D East, most moose harvest occurred during the second and third weeks of September, consistent with most years (Table 13). Historically, reporting for this unit has been low. Too few moose were reported in Unit 25D West to determine harvest chronology.

Transport Methods. Aircraft was the most common transport method in Unit 25A, used by 66% and 77% of successful hunters, respectively, in RY05 and RY06. Boats were used by most of the remaining successful hunters (Table 14). Transport methods remained consistent in Unit 25A during RY05–RY06 compared to RY96–RY04. Boats were used by 78% and 79% of successful hunters in Units 25B and 25D East, respectively, during RY05–RY06, consistent with prior years (Tables 15 and 16). The use of snowmachines and boats in Units 25B and 25D was probably underrepresented because relatively few harvest reports were submitted by local hunters. Too few moose were reported in Unit 25D West to determine transport methods, but boats were likely the most common method.

HABITAT

Assessment and Enhancement

Empirical observations and habitat surveys indicated that the upper Yukon River valley provides excellent moose habitat in Units 25A, 25B, and 25D. Moose in Unit 25D are well below carrying capacity and appear to be in excellent nutritional condition as indexed by relatively high pregnancy and twinning rates (Bertram and Vivion 2002, Boertje et al. 2007).

Habitat surveys in 2000 indicated that moose browsing intensity is low in both riparian and upland sites and a large amount of good to high quality forage is available. The occurrence of broomed plants (plants with growth forms as a result of multi-year browsing) is low compared to the Tanana Flats and other areas with high moose densities (C. T. Seaton, ADF&G, Fairbanks and C. Fleener, unpublished data). Feltleaf willow (*Salix alaxensis*) provides high quality food for moose, and is the most common shrub in riparian habitats. Limited moose browsing is reflected by the extensive stands of 6–50 foot tall feltleaf willows that show little or no evidence of branching due to browsing.

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*).

Extensive wildfires in the upper Yukon area have maintained early succession vegetation and created large areas of good habitat for moose. Between 2004 and 2006, 7 wildfires in excess of 100,000 acres occurred in the upper Yukon drainage, mostly in Unit 25D.

CONCLUSIONS AND RECOMMENDATIONS

UNIT 25D

Moose densities in the Yukon Flats have been historically low and are among the lowest population densities found among low density moose–bear–wolf systems (Gasaway et al. 1992). Sources and extent of adult moose mortality is poorly documented in the Yukon Flats. However, Bertram and Vivion (2002) observed 87% annual survival rates for radiocollared adult cows from 1998 to 2000. These estimates are similar to or lower than other studies of moose populations in Interior Alaska (Keech and Boudreau 2006, Boertje et al. 2009). Predation accounted for most sources of the mortality in all Interior Alaska studies. Recent survey data for the Yukon Flats indicate adult cow mortality remains higher than would be expected from

predation alone (ADF&G 2002). Recent efforts by local hunters, tribal and village governments, and state and federal agencies resulted in development and implementation of the YFCMMP, which emphasized the importance of reduced cow harvest and increased bear and wolf harvest. However, estimated moose densities in the Yukon Flats remain among the lowest in Interior Alaska. Also, ratio data for calves, yearling bulls, and adult bulls per 100 cows may be more indicative of a stable or declining cow population.

The Yukon Flats moose population has potential to grow, as indicated by the highest reproductive rates in Interior Alaska (Boertje et al. 2007). Bertram and Vivion (2002) observed mean pregnancy and twinning rates of 89% and 63%, respectively, during 1998 and 1999. High twining rates, low browse removal rates, and high browse production indicate habitat quality and moose nutritional status are excellent (Boertje et al. 2007). However, calf mortality, primarily from black and grizzly bear predation, limits annual recruitment and population growth (Bertram and Vivion 2002). It is likely that predation by wolves and bears and harvest of cow moose is significant and maintains this population at a low density dynamic equilibrium (Gasaway et al. 1992).

UNITS 25A AND 25B

Although few moose surveys have been conducted recently in Units 25A and 25B, moose densities are generally considered among the lowest in Interior Alaska. Anecdotal information suggests that the population may have declined over the past decade. Habitat quality is considered good and annual harvest is low due to remoteness. Although population dynamics for these areas are poorly understood, predation by wolves and bears likely maintains this population at low density dynamic equilibrium. Moose surveys need to be conducted to help determine current trend in moose abundance and distribution.

UNITS 25A, 25B, AND 25D

We did not meet our first management objective to double the size of the moose population in key hunting areas and, if possible, within the entire planning area, in the next 10 years (by 2012) or our secondary objective to increase the number of moose in Unit 25D from 4000 in 2002 moose to 8000 by 2012. The current moose population estimate is 3000–4500 moose. These objectives are likely unattainable and I revise them below.

We met our second objective to maintain a minimum of 40 bulls per 100 cows as observed in fall surveys. In RY05 and RY06, the ratio exceeded 40 bulls:100 cows in all surveys conducted.

We did not meet our third objective to attain a 90% or greater reporting compliance. It is not possible to measure whether we attained a 90% or greater reporting compliance and we revise this objective below by making it a goal.

We likely have not met our last objective to minimize cow moose harvest while the population is rebuilding. It is not possible to measure this objective, but the population is not rebuilding, indicating that high cow harvest likely continues. However, some local residents do feel there has been progress made toward reducing cow harvest. We eliminate this objective below, but continue to keep it as a goal.

Management direction for the next report period (RY07–RY08) is as follows:

MANAGEMENT GOALS

Unit 25 Overall

- Protect, maintain, and enhance the moose population and its habitat in concert with other components of the ecosystem while providing for maximum sustained harvest.

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.
- Improve moose harvest reporting.
- Minimize cow moose harvest, recognizing that some cows will probably be taken for ceremonial purposes when bull moose are in poor condition.
- Work with local communities to implement harvest strategies to increase bear and wolf harvest.

MANAGEMENT OBJECTIVES

- Increase the size of the moose population by 2–5% annually in key hunting areas near local communities in Unit 25D.
- With assistance of the Division of Subsistence, implement a systematic household harvest survey in Unit 25D to obtain 90% reporting.
- Reduce illegal and potlatch harvest of cow moose to less than 5% of total annual harvest.
- Maintain a minimum of 40 bulls per 100 cows as observed in fall surveys.

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, 1987–2002

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	38	20	14	130	150	
2002[b]	88	4	48	24	19	100	124	0.34
Unit 25B[e]								
1987	119	6	10	6	5	105	111	

Data source: F. Mauer and T. Wertz, Arctic National Wildlife Refuge.
[a] Upper Sheenjek River only.
[b] Includes upper Sheenjek (both forks above Double Mountain) 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 Chandalar River drainage around Arctic Village.
[e] The only early winter composition count in this area during 1986–2004.

TABLE 2 Summary of geospatial moose population estimates (GSPE)[a] in Unit 25D, 1999–2007

Location and survey year	Survey area (mi²)	Strata size (mi²) Low	Strata size (mi²) High	Area searched (mi²) Low	Area searched (mi²) High	Total search area (mi²)	No. of moose estimated by strata and total, and density (moose/mi²) Low	No. of moose estimated by strata and total, and density (moose/mi²) High	Total estimate @ 90% CI	Average density moose/mi²	No. of sample units counted
Eastern Unit 25D											
Fort Yukon Survey											
1999 GSPE	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	1612	1324	186	419	605	52/0.03	487/0.37	514±27%	0.18	115
Mar 2004 GSPE	2936	1649	1286	187	413	600	53/0.03	324/0.25	382±20%	0.13	113
2004 GSPE	2936	1607	1329	175	424	599	138/0.08	648/0.49	773±17%	0.26	113
2005 GSPE	2936	1548	1388	202	440	642	428/0.27	552/0.38	1008±20%	0.34	121
2006 GSPE	2936	1548	1388	181	440	620	206/0.13	593/0.43	799±17%	0.27	117
2007 GSPE	2936	1538	1398	181	403	584	178/0.12	408/0.29	585±23%	0.20	110
Birch Creek Survey											
2006 GSPE	3630	2295	1335	195	277	472	495/0.21	237/0.18	732±33%	0.20	87
Venetie Survey											
2004 GSPE	2858	1623	1235	109	204	313	105/0.06	413/0.33	551±60%	0.19	60
2005 GSPE	2858	1638	1219	115	418	533	71/0.04	280/0.23	423±32%	0.15	101
Western Unit 25D[b]											
Mar 1999 GSPE	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
Mar 2003 GSPE	2269	1682	587	194	264	458	156/0.09	383/0.65	508±29%	0.22	85
Mar 2004 GSPE	2269	1720	548	216	274	490	310/0.19	319/0.57	632±20%	0.28	91
2004 GSPE	2299	1569	700	151	350	501	198/0.13	298/0.43	511±25%	0.29	93
2006 GSPE	2269	1612	656	172	350	522	n/a	n/a	417±21%	0.18	97

[a] Population estimates are of observable moose and do not include a sightability correction factor. Surveys conducted in fall/early winter unless otherwise indicated.

[b] Data for western Unit 25D moose surveys provided by Fish and Wildlife Service–Yukon Flats National Wildlife Refuge (Bertram and Vivion, FWS–YFNWR, 1999–2004 unpublished moose survey reports; Bertram 2007, unpublished moose survey report).

TABLE 3 Estimated moose population composition based on fall GSPE surveys in Unit 25D, 1999–2007

Survey year and area (mi²)	Bulls:100 Cows	Yrlg bulls:100 Cows	Calves: 100 Cows
Eastern Unit 25D			
1999 (2936)	57	24	59
2000 (2936)	79	19	49
2001 (2936)	95	17	43
2004 (2936)	43	10	51
2005 (2936)	80	22	58
2006 (2936)	60	12	37
2007 (2936)	64	15	39
Venetie Survey			
2004 (2858)	75	24	41
2005 (2858)	44	4	58
Birch Creek Survey			
2006 (3630)	55	8	29
Western Unit 25D			
1999 (2269)	31	6	31
2000 (2269)	71	12	22
2001 (2269)	52	9	27
2004 (2269)	72	5	34
2006 (2269)	65	18	22

TABLE 4 Unit 25A reported moose harvest, regulatory years 1996–1997 through 2006–2007

Regulatory year	Reported[a] harvest			
	M	F	Unk	Total
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
2001–2002	41	0	0	41
2002–2003	49	0	0	49
2003–2004	36	0	0	36
2004–2005	29	0	0	29
2005–2006	52	0	1	53
2006–2007	44	0	0	44

[a] Source: moose harvest reports.

TABLE 5 Unit 25B reported moose harvest, regulatory years 1996–1997 through 2006–2007

Regulatory year	Reported harvest[a]			
	M	F	Unk	Total
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	40	0	0	40
2001–2002[b]	32	0	0	32
2002–2003[c]	34	0	0	34
2003–2004[d]	23	0	0	23
2004–2005	26	0	0	26
2005–2006	26	0	0	26
2006–2007	35	0	0	35

[a] Source: moose harvest reports.
[b] Includes 3 moose taken in Chalkyitsik community harvest permit hunt.
[c] Includes 1 moose taken in Chalkyitsik community harvest permit hunt.
[d] Includes 9 moose taken in Chalkyitsik community harvest permit hunt.

TABLE 6 Unit 25D East reported moose harvest, regulatory years 1996–1997 through 2006–2007

Regulatory year	Reported harvest[a]			
	M	F	Unk	Total
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[b]	21	0	0	21
2001–2002[c]	16	0	0	16
2002–2003[d]	24	0	0	24
2003–2004[e]	12	0	0	12
2004–2005	8	0	0	8
2005–2006	23	0	0	23
2006–2007	16	0	0	16

[a] Source: moose harvest reports.
[b] Includes 3 moose taken in Chalkyitsik community harvest permit hunt.
[c] Includes 2 moose taken in Chalkyitsik community harvest permit hunt.
[d] Includes 11 moose taken in Chalkyitsik community harvest permit hunt.
[e] Includes 9 moose taken in Chalkyitsik community harvest permit hunt.

TABLE 7 Unit 25D West moose harvest for permit hunt TM940 (Tier II) and federal subsistence permits, regulatory years 1996–1997 through 2006–2007

Regulatory year	Permits issued	Did not hunt (%)	Did not report (%)	Unsuccessful hunters (%)	Successful hunters (%)	Bulls (%)	Cows (%)	Unk	Tier II harvest	Federal permit harvest
1996–1997	91	32 (35)	18 (20)	31 (76)	10 (24)	10 (100)	0 (0)	0	10	7
1997–1998	36	23 (64)	0 (0)	11 (85)	2 (25)	2 (100)	0 (0)	0	2	13
1998–1999	40	21 (53)	1 (3)	11 (61)	7 (39)	7 (100)	0 (0)	0	7	20
1999–2000	92	55 (60)	0 (0)	24 (65)	13 (35)	13 (100)	0 (0)	0	13	17
2000–2001	75	41 (55)	4 (5)	21 (70)	9 (30)	7 (100)	0 (0)	2	9	7
2001–2002	34	15 (44)	6 (18)	9 (69)	4 (31)	4 (100)	0 (0)	0	4	14
2002–2003	49	23 (47)	6 (12)	16 (80)	4 (20)	4 (100)	0 (0)	0	4	7[a]
2003–2004	51	30 (59)	7 (14)	10 (71)	4 (29)	4 (100)	0 (0)	0	4	–[a]
2003–2004	51	31 (61)	7 (14)	10 (77)	3 (23)	3 (100)	0 (0)	0	3	26[b]
2004–2005	72	29 (40)	27 (38)	15 (94)	1 (6)	1 (100)	0 (0)	0	1	15[c]
2005–2006	53	22 (42)	2 (4)	22 (76)	7 (24)	7 (100)	0 (0)	0	7	14
2006–2007	75	56 (75)	0 (0)	17 (89)	2 (11)	2 (100)	0 (0)	0	2	10

[a] No federal harvest reports were received from Stevens Village.
[b] Includes 6 cows reported taken by Stevens Village hunters.
[c] Includes 5 cows reported taken by Stevens Village hunters.

TABLE 8 Unit 25A moose hunter residency and success, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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
2001–2002	2	15	24	0	41 (41)	2	34	22	1	59 (59)	100
2002–2003	2	20	27	0	49 (43)	3	33	29	0	65 (57)	114
2003–2004	2	9	25	0	36 (39)	5	24	27	0	56 (61)	92
2004–2005	2	7	17	2	28 (33)	3	26	27	1	57 (67)	85
2005–2006	3	24	26	0	53 (56)	3	24	15	0	42 (44)	95
2006–2007	3	20	21	0	44 (37)	3	34	38	0	75 (63)	119

[a] *Source*: moose harvest reports.
[b] Resident of Unit 25.

TABLE 9 Unit 25B moose hunter residency and success, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	0	25	4	0	29 (44)	1	34	2	0	37 (56)	66
2001–2002	3	21	5	0	29 (31)	5	54	5	0	64 (69)	93
2002–2003	1	29	3	0	33 (33)	4	60	2	0	66 (67)	99
2003–2004	5	16	1	1	23 (25)	6	54	9	0	69 (75)	92
2004–2005	3	18	5	0	26 (29)	6	48	10	0	64 (71)	90
2005–2006	12	13	1	0	26 (35)	9	29	10	0	48 (65)	74
2006–2007	13	14	8	0	35 (35)	11	42	11	1	65 (65)	100

[a] *Source*: moose harvest reports; does not include moose taken under the Chalkyitsik community harvest permit during regulatory years 2000–2001 through 2006–2007.

[b] Resident of Unit 25.

TABLE 10 Unit 25D East moose hunter residency and success, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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)	71
2001–2002	6	7	1	0	14 (20)	19	30	5	1	55 (80)	69
2002–2003	5	6	1	1	13 (16)	22	32	12	0	66 (84)	79
2003–2004	6	3	3	0	12 (16)	22	34	7	0	63 (84)	75
2004–2005	4	4	0	0	8 (15)	14	25	7	0	46 (85)	54
2005–2006	16	5	1	1	23 (33)	17	23	6	0	46 (67)	69
2006–2007	12	4	0	0	16 (26)	17	21	8	0	46 (74)	62

[a] *Source*: moose harvest reports; does not include moose taken under the Chalkyitsik community harvest permit during regulatory years 2000–2001 through 2006–2007.
[b] Resident of Unit 25.

TABLE 11 Unit 25A reported moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Harvest chronology percent by month/day					Unk	*n*
	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5[b]		
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
2001–2002	17	41	37	2	2[c]	0	41
2002–2003	16	47	31	4	0	2	49
2003–2004	0	26	44	24	6	0	34
2004–2005	0	14	55	28	3	0	29
2005–2006	8	40	40	8	0	6	53
2006–2007	0	41	48	9	0	2	44

[a] *Source*: moose harvest reports.
[b] No open season.
[c] Harvested out of season.

TABLE 12 Unit 25B reported moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Harvest chronology percent by month/day								
	Aug[b]	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Dec	Unk	*n*
1996–1997	0	25	35	15	5	0	10	10	20
1997–1998	0	5	5	29	29	19	10	5	21
1998–1999	0	10	32	39	10	0	6	3	31
1999–2000	0	8	32	27	11	0	0	22	37
2000–2001	0	27	11	35	16	0	8	3	37
2001–2002	0	10	28	38	24	0	0	0	29
2002–2003	0	12	36	36	15	0	0	0	33
2003–2004	0	9	36	18	14	9	14	0	22
2004–2005	0	0	12	23	50	15	0	0	26
2005–2006	4	4	38	27	23	0	4	0	26
2006–2007	3	3	23	43	23	3	3	0	35

[a] *Source*: moose harvest reports.
[b] No open season.

TABLE 13 Unit 25D East reported moose harvest chronology percent by month/day, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Harvest chronology percent by month/day							
	Aug[b]	9/1–9/7	9/8–9/14	9/15–9/21	9/22–9/28	9/29–10/5	Unk	*n*
1996–1997	0	7	50	29	0	0	14	14
1997–1998	0	0	5	47	37	11	0	19
1998–1999	0	17	57	22	4	0	0	23
1999–2000	0	6	50	31	13	0	0	16
2000–2001	0	5	56	33	0	0	5	18
2001–2002	7	0	43	43	7	0	0	14
2002–2003	0	0	31	46	15	0	8	13
2003–2004	0	0	0	50	42	8	0	12
2004–2005	0	0	14	57	28	0	0	7
2005–2006	4	9	43	35	9	0	0	23
2006–2007	6	13	19	63	0	0	0	16

[a] *Source*: moose harvest reports.
[b] No open season.

TABLE 14 Unit 25A moose harvest percent by transport method, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
1996–1997	69	28	2	0	0	0	0	0	0	39
1997–1998	65	6	26	0	0	0	3	0	0	31
1998–1999	68	15	17	0	0	0	0	0	0	47
1999–2000	64	20	16	0	0	0	0	0	0	25
2000–2001	77	6	16	0	0	0	0	0	0	31
2001–2002	80	5	10	0	0	2	2	0	0	41
2002–2003	71	10	18	0	0	0	0	0	0	49
2003–2004	83	8	8	0	0	0	0	0	0	36
2004–2005	69	17	10	0	0	0	0	0	3	29
2005–2006	66	15	11	2	0	0	0	2	4	53
2006–2007	77	2	14	2	0	0	0	0	5	44

[a] *Source*: moose harvest reports.

TABLE 15 Unit 25B moose harvest percent by transport method, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
1996–1997	15	5	75	0	0	0	0	0	5	20
1997–1998	14	5	71	0	0	0	10	0	0	21
1998–1999	13	3	81	3	0	0	0	0	0	31
1999–2000	8	3	73	5	3	0	3	0	5	37
2000–2001	11	3	81	0	3	0	0	0	3	37
2001–2002	3	0	93	0	0	3	0	0	0	29
2002–2003	12	0	82	6	0	0	0	0	0	33
2003–2004	9	3	83	3	0	0	0	0	0	23
2004–2005	15	0	69	4	0	0	0	0	12	26
2005–2006	12	0	85	0	4	0	0	0	0	26
2006–2007	20	0	71	11	3	0	0	0	0	37

[a] *Source*: moose harvest reports.

TABLE 16 Unit 25D East moose harvest percent by transport method, regulatory years 1996–1997 through 2006–2007[a]

Regulatory year	Harvest percent by transport method									
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Other ORV	Highway vehicle	Airboat	Unk	*n*
1996–1997	21	0	71	0	0	0	0	0	7	14
1997–1998	11	0	84	5	0	0	0	0	0	19
1998–1999	13	0	74	4	0	4	4	0	0	23
1999–2000	25	0	63	0	0	6	6	0	0	16
2000–2001	17	0	78	0	5	0	0	0	0	18
2001–2002	7	0	79	14	0	0	0	0	0	14
2002–2003	15	0	77	0	0	0	8	0	0	13
2003–2004	17	0	83	0	0	0	0	0	0	12
2004–2005	25	0	50	12	0	0	0	0	12	8
2005–2006	9	0	83	4	0	0	0	4	0	23
2006–2007	6	0	75	13	0	0	6	0	0	16

[a] *Source*: moose harvest reports.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

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, 1995, 1999, 2002, and 2005. The population increased steadily from a count of 1219 moose in 1970 to 1535 in 1991, declined to 757 in 1995 and 326 in 1999, then increased to 576 moose in 2002 and 1048 in 2005 (Trent, 1989; Carroll, 2006). The 1999 count indicated that the population had declined to about 21% of the 1991 population; then, numbers increased through 2005 (Carroll 2006).

The population decline was due to high adult mortality and poor calf survival. Fall composition surveys indicated that the parturition rate and/or summer survival were very low, as only 4%, 2%, and 0% calves were counted in 1993, 1994, and 1995. The decline appeared to be a combination of malnourishment, bacterial diseases, 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

[1] This unit report also includes data collected outside the reporting period at the discretion of the reporting biologist.

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 overbrowsing. 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.

Radiotracking surveys and trend area counts indicated that the population began to recover in 1996 due to increased adult and calf survival rates. The mortality rate among collared adults averaged about 7% per year from 1996–2003. Short yearling counts indicated recruitment ranged from 17% to 26% between 1997 and 2005. The trend area count increased from 152 moose in 1996 to 602 moose in 2005 (Carroll 2006).

Aircraft were used to transport moose hunters, gear, and moose parts in Unit 26A during all or part of the season from the early 1970s (Trent 1989) to 1995. Due to the population decline more restrictive regulations were instituted in the mid 1990s, including a ban on the use of aircraft to hunt moose between 1996 and 2005. As the population increased, regulations were liberalized; and, at its fall 2005 meeting, the Board of Game initiated a drawing permit hunt that allowed a limited number of hunters to use aircraft during moose hunts. 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 from 0 to 5 moose per year between 1996 and 2001 (Carroll 2002). From 2002–2006 hunters harvested from 5 to 11 moose (Carroll 2006).

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 3–5 years and yearly spring trend area counts 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 counts, 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 Bellanca Scout, and a Piper PA–18 aircraft to conduct census, trend area, and fall composition counts. During the census we attempted to survey all available moose habitat in Unit 26A. The trend count area included the Colville River valley from the mouth of the Killik River to the mouth of the Anaktuvuk River; the Chandler River below Sivugak Bluff; and the Anaktuvuk River below Table Top Mountain. During fall composition counts, we surveyed the trend count area, plus other selected areas, such as the lower Colville River and the Killik River. For all surveys we flew over suitable riparian habitat and attempted to locate all the moose in the survey areas. We determined short yearling recruitment and total number of moose during spring surveys and determined sex and age composition and estimated the antler size of bulls during the fall 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 and twinning rate surveys each year during the first 2 weeks of June. We obtained global positioning system locations for all moose observed during radiotracking surveys and noted whether females had 0, 1, or 2 calves. Most of the radiocollar batteries had expired by 2004, and in 2006 we flew twinning surveys by flying to calving areas, finding as many cows as possible, and recording whether they had 0, 1, or 2 calves.

We compiled harvest data from harvest reports submitted by hunters, from subsistence harvest surveys, and from talking to hunters.

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. The population then declined to 757 moose in 1995 and 326 moose in 1999, a 79% decline. More recent censuses indicate that the population increased to 576 moose in 2002 and 1048 moose in 2005 (Table 1). During all of these censuses we included moose counted on the Itkillik River, which is part of the Colville River drainage but is in Unit 26B. In 2005 there were 50 moose including 6 calves on the Itkillik River

Trend counts indicated that the number of moose in the trend area declined from 1991 (647 moose) until 1996 (152 moose), then increased steadily to 2005 (602 moose). This would indicate an increase of about 16% per year between 1996 and 2005. During the reporting period the number of moose within the trend count area was fairly stable with 602 moose counted in 2005, 539 moose in 2006, and 610 moose in 2007 (Table 2, Figure 1).

The increase in population after 1996 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 observers and 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 when 23% were observed, and continued high from 1998 through 2005 when between 17% and 26% short yearlings were counted. During the reporting period 23% were observed in 2006 and 22% in 2007 (Table 2, Fig. 1).

We began flying spring calving surveys of radiocollared moose during the first 2 weeks of June in 1996 and did this each year through 2004, when most of the collars had gone off the air. The number of calves per 100 collared cows ranged from 58 to 92. The number of twins per 100 collared cows ranged from 9 to 33. The twinning rate (number of sets of twins divided by the number of parturient collared females) ranged from 15% to 57%. In 2006 we flew calving surveys without using radiocollars and found 10 of 25 parturient cows had twins (40%). The twinning rate has generally been higher during the years of population recovery than it was during the years of low numbers (Table 3).

Fall composition surveys indicated much of the population decline from 1993–1995 was due to low parturition rates and/or summer survival, as only 6, 3, and 0 calves per 100 cows were counted. The population began to increase in 1996 when 44 calves per 100 cows were counted. During fall 2005 we observed 230 moose in the trend count area, including 75 bulls (66 bulls: 100 cows), 113 cows, and 42 calves (37 calves:100 cows). During 2006 composition surveys we observed 316 moose within the trend count area, including 93 bulls (59 bulls:100 cows), 159 cows, and 64 calves (40 calves:100 cows). In 2007 (after the reporting period) we observed 293 moose in the trend count area, including 92 bulls (63 bulls: 100 cows), 147 cows, and 54 calves (37 calves:100 cows). Fall bull:cow ratios can be quite variable because weather conditions influence how many bulls are in the survey area during fall counts. These counts continued the trend of increasing summer calf survival since 1996 compared to 1993–1995 (Table 4).

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:

Estimated bull antler widths in inches

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%
2002	15%	12%	16%	25%	32%
2003	10%	18%	17%	29%	26%
2004	24%	18%	10%	38%	10%
2005	19%	15%	19%	25%	22%
2006	18%	16%	19%	26%	21%
2007	21%	14%	17%	25%	23%

Distribution and Movements

By late winter most moose can be found along major rivers and tributary streams of the Colville River drainage system. During late April, with diminishing snow cover 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. Bull moose disperse widely during the summer months, ranging from the northern foothills of the Brooks Range 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 fall, as snow cover accumulates, moose move back into the riparian corridors of the large river systems.

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 collared 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 1 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 collared 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 1 was not found.

MORTALITY

Harvest

Season and Bag Limit.

2005-2006	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 26A: that portion in the Colville River drainage downstream from and including the Chandler River		
1 bull	1 Aug–14 Sep (General hunt with harvest ticket)	No open season
Unit 26(A), that portion west of 156° 00’ W. longitude and north of 69° 20’ N. latitude		
1 moose; a person may not take a calf or a cow accompanied by a calf;	1 Jul–31 Aug (General hunt with harvest ticket)	No open season
Or		
1 bull	1 Sep–14 Sep (General hunt with harvest ticket)	No open season
Remainder of Unit 26A		
1 bull	1 Sep–14 Sep (General hunt with harvest ticket)	No open season

Moose hunters may not use aircraft to transport hunters, hunting equipment, or parts of moose.

2006-2007	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 26A: that portion west of 156° 00' W. longitude and excluding the Colville River drainage		
1 moose; a person may not take a calf or a cow accompanied by a calf;	1 Jul–14 Sept (General hunt with harvest ticket)	No open season
Unit 26A: that portion in the Colville River drainage up-stream from and including the Anaktuvuk River drainage		
1 bull	1 Aug–14 Sep (General hunt with harvest ticket)	No open season
Or 1 bull	1 Sep–14 Sep (Permit Hunt DM992)	No open season
Or 1 moose; a person may not take a calf or a cow accompanied by a calf	15 Feb–15 Apr (General hunt with harvest ticket)	No open season
Remainder of Unit 26A	1 Aug–14 Sep (General hunt with harvest ticket)	No open season

Moose hunters may not use aircraft to transport hunters, hunting equipment, or parts of moose except for permit holders under DM992. Aircraft cannot be used to hunt moose on the Anaktuvuk River drainage.

Board of Game Actions and Emergency Orders During its November 2005 meeting the Board of Game continued to limit all Unit 26A moose hunts to residents, but made several other changes to moose regulations. In the portion of the Colville River drainage upstream from and including the Anaktuvuk River drainage the board: 1) initiated a hunt with up to 40 drawing permits for 1 bull that allows the use of aircraft for transporting moose hunters, gear, and moose parts; 2) initiated a winter hunt with a bag limit of 1 moose from 15 Feb–15 Apr; and 3) allowed a general hunt with a bag limit of 1 bull from 1 Aug–15 Sep. The board changed the area for the summer moose hunt to include the area west of 156° 00' W. longitude excluding the Colville River drainage, established a season of 1 Jul–14 Sep, and continued the bag limit of 1 moose. They established a 1 Aug–14 Sep season with a bag limit of 1 bull for the rest of Unit 26A. The board also closed the Anaktuvuk River drainage to the use of aircraft to hunt moose.

Hunter Harvest. Hunter harvest reports indicate 9 bulls and 2 cow moose were harvested during 2005–2006, and 8 bulls and 3 cows in 2006–2007 (Table 5). Antler sizes in 2005–2006 were: 1 from 20-29 inches, 1 from 30-39 inches, 3 from 40–49 inches, 3 from 50–59 inches, and 1 was 60 inches or greater. Antler sizes in 2006–2007 were: 2 less than 20 inches, 1 from 30-39 inches,

2 from 50–59 inches, and 3 were unknown (Table 6). Antler size was apparently not requested on the hunter report cards for drawing hunt DM992 and this will be remedied in the future.

Permit Hunts. Seventeen permits were issued and 3 bull moose were harvested under DM992.

Hunter Residency and Success. During 2005–2006, 9 successful hunters were local residents and 2 were nonlocal residents. Among total hunters there were 11 local residents and 3 nonlocal residents. The success rate was 79%.

During 2006-2007, 8 successful hunters were local residents and 3 were nonlocal residents. Among total hunters there were 10 local residents and 5 nonlocal residents. The success rate was 69%.

Harvest Chronology. During 2005–2006, 9% of reported moose were harvested in August., 73% during 1–7 September, and 18% during 15 Februrary-15 April. During 2006–2007, 36% of reported moose were harvested in August., 36% during 1–7 September., 18% during 8–14 September, and 10% during 15 February-15 April.

Transport Methods. During 2005–2006, 82% of hunters used boats to harvest moose and 18% used snowmachines, primarily for the winter hunt. During 2006–2007, 64% of hunters used boats to harvest moose; 9% used snowmachines; and, with the initiation of the drawing permit hunt, 27% used aircraft.

Other Mortality

Trend area counts and censuses indicate that the Unit 26A moose population declined by approximately 77%–79% between 1991 and 1996. A variety of factors may have contributed to the decline 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, 11.9% for 1999–2000, 7.25% for 2001–2002, and 13% for 2002–2003 for an average of about 6.7% mortality per year. Because no moose have been collared since 1997, the mortality rate of these collared moose is considered to be only a rough indicator for the entire population. Calf mortality has also decreased substantially since 1996. The percentage of short yearlings counted during spring surveys increased from an average of 2% from 1994 through 1996 to 22% from 1997 through 2007 (Table 2).

Mortality due to wolf predation probably decreased substantially during the mid 1990s but may currently be increasing. 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. However, we counted 35 wolves during the 2007 fall composition moose survey, indicating a considerable increase in wolf numbers over past years.

Since we have not observed moose that appear to have died of starvation and most of the moose now appear to be in good condition, this indicates that the vegetation has 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 due to low adult mortality and high recruitment. The census count, which is done every 3 years, increased from 326 in 1999 to 1048 in 2005. The annual trend count indicated an increase of moose in the core habitat area from 152 in the spring of 1996 to 602 in 2005, an increase of 16% per year. During 2005, 2006, and 2007 we counted 602, 539, and 610 moose, indicating that population numbers may be leveling off in the trend count area. The total population count could still go up if numbers of moose are increasing in the upper drainages, which are outside of the trend count area. This will be determined by the next census, which is scheduled for 2008.

There are several possible reasons that the population has increased. Vegetation may have recovered from overbrowsing when the population was at high numbers in the 1980s and early 1990s. The presence of bacterial diseases that were prevalent in the population is probably reduced. Some “specialist” bears that preyed on moose calves during the summer may have died or left the area. Wolf predation is probably reduced due to lower wolf density in the area. Weather factors may 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. As the population has increased, the board has incrementally liberalized the regulations. In 2001 the hunt area and season were expanded. In 2003 a summer hunt for moose of either sex that disperse into western Unit 26A was added. In 2005 the board implemented an expansion of the hunt area and season for the general hunt and the summer hunt. In addition, a winter hunt for either sex moose and a limited drawing hunt that allowed the use of aircraft were added. The restrictions on the use of aircraft for all other hunts remained and the hunts continued to be restricted to residents only. These regulation changes are designed to provide more hunting opportunity but allow for continuing recovery of the population.

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TABLE 1 Number of adult and calf moose from Unit 26A censuses, April 1970–2005

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
1999	274	52	326	16
2002	502	74	576	13
2005	863	185	1048	18

*Includes moose counted on the Itkillik River which is part of the Colville River drainage but is in Unit 26B. In 2005 there were 50 moose including 6 calves on the Itkillik River.

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, April, 1970, 1974–1981, and 1983–2007

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	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	10
1990	617	543	74	12
1991	647	516	131	20
1992	510	416	94	18
1993	504	424	80	16
1994	407	396	11	3
1995	307	302	5	2
1996	152	151	1	<1
1997	180	139	41	23
1998	206	153	53	26
1999	210	174	36	17
2000	325	245	80	25
2001	333	251	82	25
2002	307	267	40	13
2003	413	309	104	25
2004	522	407	115	22
2005	602	481	121	20
2006	539	413	126	23
2007	610	475	135	22

TABLE 3 Calving surveys of radiocollared cows with twinning rate, June, 1996–2006.

Year	Total cows	Calves:100 Cows	Pairs of Twins	Twins:100 Cows	Percent Twins*
1996	23	91	3	13	17%
1997	44	66	4	9	16%
1998	43	58	5	12	25%
1999	40	92	13	33	54%
2000	35	69	8	23	50%
2001**	18	83	2	11	15%
2002	28	82	6	21	35%
2003	25	92	7	28	44%
2004	16	68	4	25	57%
2006***	83	42	10	12	40%

* Number of sets of twins/number of parturient females
** Incomplete survey
*** No radiocollars were used due to expired batteries

TABLE 4 Unit 26A fall aerial moose composition trend area counts, November, 1983–2007

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	114
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	69	30	15	258	304
2002	52	49	24	253	334
2003	75	57	25	217	288
2004	60	37	19	255	313
2005	66	37	18	188	230
2006	59	40	20	252	316
2007	63	37	18	239	293

[a] Partial counts due to incomplete snow cover and wide dispersal of moose.

TABLE 5 Unit 26A moose harvest, 1985–2007

	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
2002-2003	10	0	10
2003-2004	5	0	5
2004-2005	4	1	5
2005-2006	9	2	11
2006-2007	8	3	11

TABLE 6 Number of bull moose harvested in antler width categories (inches) in Unit 26A, 1996–2007

Regulatory year	Unknown	<20	20–29	30–39	40–49	50–59	60+	*N*
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
2002-2003	1	0	0	1	5	3	0	10
2003-2004					1	2	2	5
2004-2005	1				1	2		4
2005-2006			1	1	3	3	1	9
2006-2007	3	2	0	1	0	2	0	8

TABLE 7 Moose hunter residency and success, Unit 26A, 1985–2007

	Successful hunters						Total hunters				
Regulatory year	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	63	40	20	39	0	99
1988–1989	–	–	–	–	57	68	12	30	37	5	84
1989–1990	9	13	21	1	44	65	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
2002–2003	8	2	0	0	10	53	11	8	0	0	19
2003–2004	4	1	0	0	5	56	6	3	0	0	9
2004–2005	5	0	0	0	5	38	9	4	0	0	13
2005–2006	9	2	0	0	11	79	11	3	0	0	14
2006–2007	8	3	0	0	11	69	10	5	1	0	16

[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 8 Percent chronology of moose harvest, Unit 26A, 1996–2007

Regulatory year	Harvest periods						
	July	Aug	1-7 Sep	8-14 Sep	15 Feb-15Apr	Unknown	*N*
1996–1997*	–	–	–	–	–	–	0
1997–1998*		100	–	–	–	–	2
1998–1999*		100	–	–	–	–	5
1999–2000*		100	–	–	–	–	2
2000–2001*	–	–	–	–	–	–	–
2001–2002*		100	–	–	–	–	–
2002–2003		20	80				
2003–2004		20	80				5
2004–2005	20	40	20	20			5
2005–2006		9	73	-	18		11
2006–2007		36	36	18	10		11

* Season open only in August

TABLE 9 Percent transport methods for moose harvest in Unit 26A, 1987–2007

	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	–	–	–	–
2002–2003		100				
2003–2004		100				5
2004–2005		80			20	5
2005–2006		82		18		
2006–2007	27	64	-	9		11

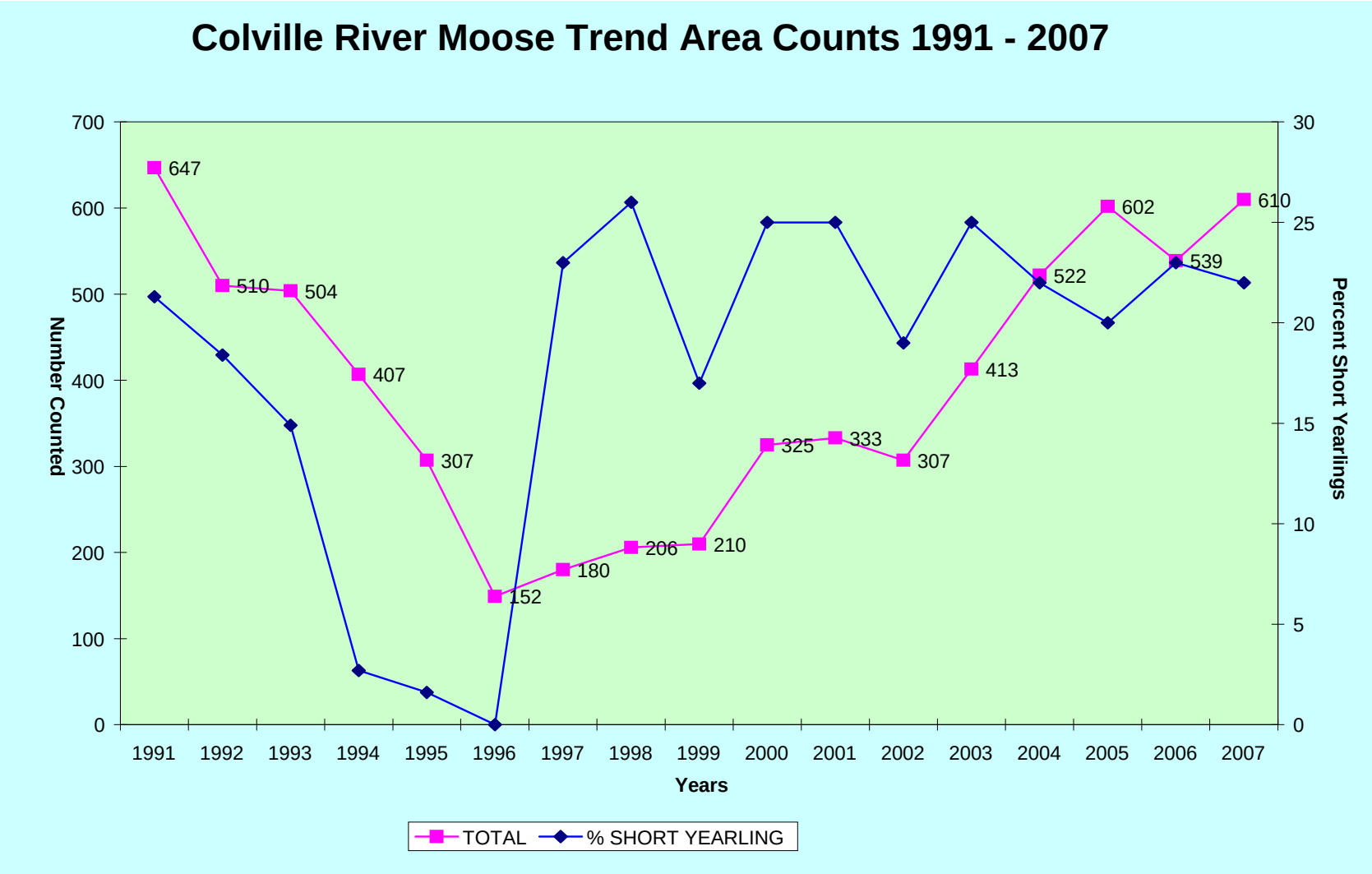

FIGURE 1 Unit 26A moose trend counts and percentage of short yearlings: Colville River between the mouths of Anaktuvuk and Killik Rivers, Anaktuvuk River from the mouth to Sivugak Bluff, Chandler River from the mouth to Table Top Mountain, 1991–2007.

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MOOSE MANAGEMENT REPORT

From: 1 July 2005
To: 30 June 2007[1]

LOCATION

GAME MANAGEMENT UNITS: 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 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.

The total number of moose in Units 26B and 26C probably peaked during the late 1980s at approximately 1250–1350 moose. The highest numbers of moose observed in Unit 26B East (east of the east bank of the Sagavanirktok River and including the Canning River in Unit 26C) were 629 in fall 1988 and 600 in 1989 (Mauer 1997, Lenart 2006). In Unit 26B West (west of Unit 26B East), moose numbers appeared to be relatively stable during the late 1980s at approximately 200 moose (150 in the Kuparuk and Toolik Rivers and 45 in the Itkillik River). Beginning in fall 1990, the number of moose observed in Unit 26B East declined markedly to 381 moose and continued to decline to 141 moose by fall 1996 (Lenart 2006). In 1999, surveys were conducted in the spring and 149 moose were observed (Table 1). Similarly in Unit 26B West, only 80 moose were observed in spring 1999 (Lenart 2006). Fewer surveys were conducted in Unit 26C; but moose numbers in eastern Unit 26C were substantially lower in 2002 (227) compared to 1991 (406).

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

The decline in moose numbers in the early 1990s appeared to be widespread on the eastern North Slope, including Unit 26A (Carroll 1998). Calf survival was very low during 1993–1996. In Unit 26B East, during fall 1994 and 1995, when the number of moose observed had declined dramatically, the proportion of calves in the population was 4% and 5%, respectively; compared to 14% and 13% in the early 1990s (Lenart 2006). In addition, in summer 1995 carcasses of adult moose were found along the Colville River and its tributaries in Unit 26A (G. Carroll, ADF&G, personal communication, Barrow).

Necropsies revealed that wolves and bears had not killed these moose. Disease may have been a factor. 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 poor environmental conditions increased vulnerability to disease during the early 1990s. Winters were long in 1993–1994 and 1994–1995, resulting in shorter growing seasons. Also, in summer 1995 there were numerous reports of intense harassment of moose 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. 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. Quick population decline and subsequent recovery from overbrowsing is unlikely, so overbrowsing was likely not a major factor causing the decline in moose numbers. In addition, twinning rates of moose in portions of Unit 26A were moderate in the mid to late 1990s, which indicated that nutritional status of the general population was not poor (Boertje et al. 2007). In Unit 26B the moose population began to slowly increase during the 2000s.

Regulations varied somewhat prior to closure of the hunting season in RY96. The following is a review of previous regulations and regulatory changes. The regulatory year (RY) begins 1 July and ends 30 June (e.g., RY00 = 1 Jul 2000 through 30 Jun 2001). During RY90–RY94 the season for Units 26B and 26C was 5–15 September for both residents and nonresident hunters, 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 north of the Alaska Range to a bull with antlers at least 50 inches or 4 or more brow tines on one side. During RY90–RY94 there was also a winter season of 1 November–31 December open to residents with a bag limit of 1 bull with antlers at least 50 inches or 4 or more brow tines on one side. In RY95 the season remained the same for Unit 26B and the Canning River drainage in Unit 26C. The RY95 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.

In response to the dramatic decline in moose numbers, moose hunting seasons were closed during RY96–RY05. When moose hunting was opened, hunting with firearms was prohibited within the DHCMA. The DHCMA extends 5 miles from each side of the Dalton Highway from

the Yukon River to the Prudhoe Bay Closed Area. Big game, small game, and fur animals could be taken by bow and arrow and 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.

Bull:cow ratios were below the previous management objective of 50:100 during fall 1991 (39) and 1994 (47; Lenart 2006). Reduced bull:cow ratios during the decline suggested that adult bull mortality was higher than adult cow mortality. Bull:cow ratios exceeded 60:100 during fall 1995–1997 (Mauer 1997; Lenart 2006) and the hunting season was closed in fall 1996. Fall surveys have not been conducted since 1997.

Kaktovik and Nuiqsut are the only communities within or near the area, and residents took 2–6 moose annually prior to the season closure in 1996. Local harvest was small because moose were 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

POPULATION STATUS AND TREND

Population Size and Composition

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 the fall 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 (Mauer 1997, Lenart 2006). Beginning in 1999, surveys in Unit 26B were conducted during 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. Beginning in spring 2003, all surveys were conducted using a Piper PA-18 aircraft. Surveys in central Unit 26C were conducted by Arctic National Wildlife Refuge (ANWR) staff during April using a Cessna 185 or 206 flown at 95–120 mph, at altitudes of 300–600 feet above ground level. Moose were classified as short yearlings (11-month-old calves) and adults. In 2002, spring surveys were conducted in early May when early antler development on males had initiated. Moose in this year were classified as bulls, cows, and short yearlings. The number of bulls identified was likely lower than those present because we probably misclassified young bulls with little early antler development as females.

The west bank of the Canning River is the boundary between Units 26B and 26C. However, Unit 26B East (east of the Sagavanirktok River) survey data includes moose counted in the Canning River portion of Unit 26C. Surveys in Unit 26B West include the area west of the east bank of the Sagavanirktok River. Moose inhabit different terrain in Unit 26B East and Unit 26B West. In 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.

Survey data are reported as Unit 26B East, Unit 26B West, Itkillik River drainage, and the 3 areas combined. In some years additional drainages or portions of drainages were surveyed to determine extent of redistribution and these data are also reported. Areas were analyzed and reported separately based on historical data collection to provide comparisons over a longer period of time. Recently, data was also combined because methods were standardized across all of Unit 26B.

Unit 26B East. ANWR conducted surveys during 1999–2001 and in previous years not included in this report (Lenart 2006). The Alaska Department of Fish and Game (ADF&G) conducted the surveys since spring 2002. 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. In 2002 the survey was conducted in early May and we were able to obtain a minimum estimate of bull:cow and calf:cow ratios. In 2006 we surveyed the upper portion of the Canning River.

Unit 26B West. ADF&G conducted spring moose surveys in Unit 26B West in April 1996 and during 1999–2008. 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 68°52'W latitude to the White Hills. In addition, parts of the Itkillik River have been surveyed periodically since 1981, but because of incomplete surveys during 1996–2004, these data were treated separately. In 2006 we surveyed a portion of the upper Canning River, upstream of Eagle Creek. In 2006 and 2008 we surveyed portions of the Sagavanirktok River, upstream of Happy Valley, to determine if moose had redistributed to the upper Sagavanirktok. In 2007 and 2008 we surveyed No Name Creek, located across the highway from Happy Valley.

Twinning Surveys

In early June 2007, twinning rates were estimated along riparian willow habitat in Unit 26B in the west and middle fork of Kuparuk River, No Name Creek, Ivishak and Lupine Rivers, Gilead, Juniper, and Fin Creeks and parts of the Sagavanirktok River. 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 was calculated as the proportion of cows with twins or triplets in the sample of all cows with calves.

Habitat Reconnaissance

We conducted habitat reconnaissance in Unit 26B East during the last week of April 1994 in cooperation with ANWR and the 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.

HARVEST

Harvest and hunting pressure were monitored using harvest reports and drawing permits (beginning in 2006) submitted by hunters. Reminder letters were sent to hunters who did not report. Population surveys, total harvest, residency and success, chronology, and transportation data were summarized by regulatory year. 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. During the report period, (RY05–RY06) the Unit 26B moose population appeared to stabilize, but the overall trend since 1999 was a gradual increase from the population decline in the 1990s (Tables 1, 2, 3, and 4).

Unit 26B East. In spring 1999 the number of moose observed in Unit 26B East was low (149) and had not recovered from the decline during the 1990s (Lenart 2006). It remained relatively stable for a few years and by 2002, the population began to increase. It increased slowly to 335 moose in RY05, and 308 in RY06 (Table 1). In RY07 we observed 309 moose, indicating 300–350 moose were in Unit 26B East. During recent surveys the highest concentrations of moose were found along the Echooka, Kavik, and Canning Rivers.

Unit 26B West (excluding the Itkillik River). Surveys conducted during 1996–2002 indicated a stable population of 50–70 moose (Lenart 2006). This followed the same trend observed in Unit 26B East. However, in spring 2003 we observed a substantial increase to 160 moose in Unit 26B West (excluding the Itkillik River drainage). This may have been related to changes in distribution or increased sightability because we used a Piper PA-18 after 2002 compared to a Cessna 185 during 2002 and prior years. Nonetheless, during this same time period, we also

observed a gradual increase in the number of observed moose in Unit 26B East. During the report period, we observed 150 and 175 moose in spring 2006 and 2007 in Unit 26B West (Table 2). In spring 2008 we observed 140 moose, a slight decline compared to the previous 3 years (Table 2). Most of the moose observed in Unit 26B West were in the Kuparuk drainage. An increase in the number of moose was also observed in Unit 26A since 2003 (Carroll 2006).

Itkillik River. Spring surveys along the lower Itkillik River during 1999–2004 indicated moose numbers were low, ranging 9–27 moose (Table 3). Beginning in 2005, we included the upper Itkillik River in our survey and observed 50 moose. During RY05–RY06, we observed 66 and 52 moose during spring 2006 and 2007. In spring 2008 we observed 63 moose. Thus, moose in the Itkillik drainage have stabilized at 50–70 during the past 4 years.

All Unit 26B. Overall, the moose population has increased slowly in Unit 26B. Combined survey data for Units 26B East, 26B West, and the Itkillik River drainage count areas indicated a gradual increase from approximately 400 to 550 moose during 2004–2008 (Table 4). Lower numbers of moose were observed in 2008, but this may have been related to poor sightability due to lack of snow cover.

In some years, additional portions of drainages were surveyed to determine the extent moose occupied these drainages. In 2006 and 2008, we surveyed the upper Sagavanirktok River and observed 37 moose. Additionally in 2006, the upper Canning River was surveyed and 18 moose were observed. The total number of moose observed in spring 2006 in Unit 26B (including the Canning River) was 606 moose. In 2007 we surveyed No Name Creek and a small portion of the upper Sagavanirktok River and observed 27 and 7 moose, respectively. A total of 569 moose were observed in 2007, and in 2008, 570 moose were observed (including the upper Sagavanirktok and No Name Creek). We estimate the moose population in Unit 26B at 550–650 moose.

Unit 26C. In central Unit 26C (drainages east of the Canning River and the lower Kongakut below Drain Creek), ANWR staff observed 52, 47, and 59 moose in April 2003, 2005, and 2007. The moose populations in Units 26A (Carroll 2006) and 26B increased during the 2000s, while moose numbers in central Unit 26C remained stable.

In spring 2006, ADF&G staff surveyed the valleys of the Sadlerochit Mountains and 9 adult moose were observed.

No surveys were conducted in eastern Unit 26C in the upper Kongakut and Firth Rivers and Mancha Creek area since 2002. Fall surveys completed by ANWR in 2000 (157) and 2002 (227) indicated that moose numbers were lower than in 1991 (406; Table 5). Lower numbers in the 2000s may reflect changes in distribution or density. Moose numbers were higher in 2002 than 2000, but sightability may have been lower in 2000 because a Cessna 185 was used to survey part of the area. A large proportion of the moose in these areas migrate south and east to the Old Crow Flats in Canada during spring and summer (Mauer 1998).

Population Composition

Unit 26B East. Beginning in 1999, surveys were conducted in spring, rather than fall. Historical data between fall and spring surveys is not directly comparable, but both provide information on recruitment (Lenart 2006). The proportion of 11-month-old calves (short yearling) in the population during RY99–RY06 varied, ranging 6–22% (Table 1). The proportion of short yearlings during the report period was moderate to good at 18% and 13% in spring of 2006 and 2007, respectively. In spring 2008 we observed 15% short yearlings.

Bull:cow ratios exceeded 60:100 during fall 1995–1997 (Mauer 1997, Lenart 2006). The hunting season was closed in fall 1996 and fall surveys have not been conducted since 1997. We observed a high bull:cow ratio of 72:100 during a May 2002 survey. This is likely conservative because we probably misclassified young bulls with little early antler development. Bull:cow ratios were not available during RY03–RY06 because surveys were conducted after bulls had shed antlers and prior to early antler development.

Unit 26B West. In Unit 26B West, excluding the Itkillik drainage, the proportion of short yearlings in the population was variable during 1999–2005, ranging 7–25%. The proportion of short yearlings during the report period was moderate to good at 17% and 22% in spring 2006 and 2007, respectively. In spring 2008 we observed 14% short yearlings (Table 2).

During the May 2002 survey we observed a conservative bull:cow ratio of 34:100 in Unit 26B West. 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. The overall bull:cow ratio in Unit 26B was 57:100. Bull:cow ratios were not available in Unit 26B West during RY03–RY06 because surveys were conducted after bulls had shed antlers and prior to early antler development.

All Unit 26B. The proportion of short yearlings in Unit 26B East, Unit 26B West, and Itkillik River drainage survey data combined was 12–18% during RY03–RY07, and averaged 15% the past 3 years (meeting our management objective; Table 4). The proportion of short yearlings for all moose observed was 17% in 2006, 16% in 2007, and 14% in 2008, similar to proportions observed when the areas were analyzed separately.

Unit 26C. No data on the proportion of short yearlings in central Unit 26C was available because moose were not classified.

In eastern Unit 26C in the upper Kongakut (above Drain Creek) and the Firth–Mancha drainages, fall surveys in 2000 and 2002 indicated high bull:cow ratios and modest proportions of calves and yearlings in the population (Table 5). As in other areas, bull:cow ratios in northwestern Unit 26C were not available during RY03–RY06 because surveys were conducted after bulls had shed antlers. In addition, short yearlings were not identified during the spring surveys.

Twinning Rates

In June 2007, in portions of Unit 26B, we observed 9 cows with single calves and 1 cow with twins. Sample size was too small to estimate twinning rate, but twinning surveys will continue.

Habitat Reconnaissance

In April 1994, reconnaissance of the moose habitat east of the Dalton Highway in Unit 26B 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. Quality of browse was not determined, but *S. alaxensis* is among the highest quality browse species and the one often favored by moose in Alaska.

Distribution and Movements

Moose were generally associated with narrow strips of shrub communities along drainages, except during calving and 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. Moose movements have not been intensively studied, but recent surveys indicate there may be extensive movements within or between North Slope drainages. Telemetry studies show that many moose that winter in the upper Kongakut River migrate south and east to summer on the Old Crow Flats in Canada (Mauer 1998), and that moose in the Colville River area in Unit 26A are resident, rather than seasonally migratory (Carroll 2004).

MORTALITY

Harvest

Season and Bag Limit. There was no open season for moose in Units 26B during RY96–RY05 or in Unit 26C during RY96–RY07.

Units and Bag Limits	Resident Open Season	Nonresident Open Season
RY06–RY07		
Unit 26B, excluding the Canning River drainage.		
RESIDENT HUNTERS: 1 bull by drawing permit; up to 30 permits may be issued,	1 Sep–14 Sep	No open season
or		
1 bull.	To be announced; up to 14-day season; 15 Feb–15 Apr	

Alaska Board of Game Actions and Emergency Orders. In RY96 the hunting season was closed in Units 26B and 26C. The season was closed in Unit 26B through RY05 and remains closed in Unit 26C. During the March 2000 meeting, the Alaska Board of Game determined that a harvest of 60–80 moose was necessary to satisfy subsistence needs in Unit 26. In March 2006 the Alaska Board of Game authorized 2 moose seasons to begin fall 2006 in Unit 26B, excluding the Canning River drainage. These seasons were opened to resident hunters only and include up to 30 drawing permits for bulls during 1–14 September and up to a 14-day general season for bulls

to be announced during 15 February–15 April. In November 2007, the board revised the amounts reasonably necessary for subsistence in Unit 26 to 21–48, including 15–30 in Unit 26A.

The Federal Subsistence Board established a federal registration hunt in 2004 for residents of Kaktovik that applies to federal public lands in Units 26B and 26C, with a harvest quota of 3 moose. No more than 2 bulls may be harvested from Unit 26C. Three permits are issued annually to residents of Kaktovik, with an open season of 1 July–31 March. Federal public lands in these units were closed to the taking of moose by other hunters except in 2007, when the federal season was opened in Unit 26B to coincide with state regulations.

Harvest by Hunters. No moose were reported harvested under the general moose season during RY06 and RY07. The number of moose harvested in DM966 was 7 and 3, respectively. Fifteen permits were available and issued in both years and all reports were returned. Thirteen hunters hunted in RY06 and 11 hunted in RY07 (Table 6).

Prior to the 1996 closure, the reported moose harvest in Unit 26B was relatively stable during the early 1990s, ranging from 24 to 37, except in RY92, when harvest was 45 (Table 6). In RY95 harvest declined to 17 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 (63–85), but harvest declined (range = 17–37) to previous levels, probably reflecting the declining moose population.

There has been no open state season in Unit 26C since 1996. During RY90–RY95, harvest was 3–6 moose by 5–12 hunters (Table 7). The relatively small number of hunters who reported hunting in Unit 26C probably resulted from the lack of airstrips near moose habitat and the small number of moose in the area during fall. Most moose hunting in Unit 26C occurred in the Canning River drainage.

Hunter Residency and Success. The moose season in Unit 26B was open only to Alaska residents in RY06 and RY07. Success rates were 54% in RY06 and 27% in RY07 in the DM966 permit hunt (Table 8).

Prior to the 1996 closure (RY90–RY95), Alaska residents living outside the area represented all but a few of the resident hunters in Units 26B and 26C (Table 8). Hunter success rates in Unit 26B were ≥50% during RY90–RY92 and declined below 50% beginning in RY93, probably due to the declining moose population. Too few moose were harvested in Unit 26C to analyze data. Nonresidents reported a higher success rate than Alaska residents, probably because many nonresidents benefited from guide–outfitter services.

Harvest Chronology. In RY06 and RY07, all moose were harvested within the first week of September in the DM966 permit hunt (Table 9).

Prior to the 1996 closure (RY90–RY95), most moose harvested in Units 26B and 26C were taken during the first 2 weeks of September (Table 9). The concentration of hunting activity in early autumn was likely due to early onset of winter in the region.

Transport Methods. In RY06, aircraft was the most common method of transport for successful hunters (71%), with highway vehicle and airboat representing the remainder (14% each). In RY07, sample size was very small (3) and successful hunters used an airplane, a highway vehicle, and an airboat (Table 10).

Prior to the 1996 closure (RY90–RY95), aircraft was used by more than 70% of successful moose hunters (Table 10).

Natural Mortality

No intensive studies of the causes of moose mortality were conducted in the eastern Arctic. The decline in the early 1990s was probably due to a combination of acute mortality factors unrelated to humans, as indicated above.

There is evidence that mortality rates for adult female moose have been low in the eastern Arctic during recent years. Among radiocollared moose in Unit 26A along the Colville River, the average annual mortality rate was 6.7% during 1996–2003 (Carroll 2004).

CONCLUSIONS AND RECOMMENDATIONS

The moose population in Units 26B and 26C declined dramatically during the early 1990s, probably due to a combination of factors including disease, weather, increased predation by wolves and grizzly bears, and possibly insect harassment. In Unit 26B, the population gradually increased during the 2000s, and we currently estimate the population consists of 550–650 moose. Moose numbers in central Unit 26C remained stable at approximately 50–60 moose during the 2000s. Including eastern Unit 26C, I estimate over 200 moose in all of Unit 26C, recognizing that the eastern portion has a migratory component to its population.

It is interesting to note that the moose population on the eastern North Slope increased substantially and rapidly in Unit 26A (Carroll 2006), gradually and steadily in Unit 26B, but remained stable in central Unit 26C. Habitat in Unit 26C is more limiting than the remainder of the eastern North Slope. There is concern that moose across the eastern North Slope may exhibit some nutritional differences, particularly during herd growth and decline. In Unit 26A, biologists initiated a study in spring 2008 to examine nutritional status of moose. Because the population in Unit 26A grew rapidly, they wanted an independent estimate of nutritional status, other than herd growth. Twenty–two 11-month-old calves were weighed in mid April after an unusually cold winter. Blood samples were collected to test for copper deficiency and bacterial diseases brucellosis and leptospirosis (L. Parrett, ADF&G, personal communication, Fairbanks). Preliminary data indicated that Unit 26A calves weighed much less than calves from Unit 20A (a nutritionally stressed population) in Interior Alaska, but the 2008 weights may be unusually low for Unit 26A calves. In addition, among 15 moose (12 calves, 3 adults) found dead during capture operations, percent of fat in bone marrow was very low (12%), indicating starvation (20% or less; L. Parrett, personal communication). These low calf weights and low bone marrow fat were unexpected (L. Parrett, personal communication). A similar study to weigh 11-month-old calves during mid April should be initiated in Units 26B and 26C to compare paired data from Unit 26A. The decline in the 1990s occurred quickly and hunting seasons may be closed if poor nutrition persists.

There is little information on moose movements on the North Slope. A radiotelemetry study in the Colville River drainage concluded that radiocollared moose are residents of the Colville drainage, suggesting that observed increases in numbers did not result from immigration from adjacent areas. Although moose in the Colville drainage remained residential, some moose in eastern Unit 26C, in the Firth–Mancha and upper Kongakut drainages were migratory (Mauer 1998). Recently, residents of Kaktovik have proposed higher harvest quotas of moose in the Federal hunt. They expressed concerns that some of the central Unit 26C moose could be migratory and may be vulnerable to harvest outside Unit 26C. ANWR is initiating a movement study using GPS collars to help address this question. I recommend ADF&G cooperate in this study. Additionally, moose surveys in central Unit 26C have been conducted by ANWR using a Cessna 185 or 206 to determine trend of the population. ANWR recognizes that sightability is less using the Cessna; but notes that results of the surveys indicated a stable population rather than an increasing population and are managing conservatively because the population has not increased. I recommend ADF&G cooperate with ANWR in spring 2009 or 2010 to conduct surveys using a Piper PA-18 to obtain better estimates of moose numbers and the proportion of short yearlings.

MEETING GOALS AND OBJECTIVES

I 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 recovered and our management objectives were met. I met our second goal of providing an opportunity to harvest moose because we opened a moose season in Unit 26B in RY06. Moose were available for viewing and photographing, our third goal.

During RY06–RY07 we met our first and second population objectives of at least 200 moose in Unit 26B East and 75 moose in Unit 26B West with ≥15% 11-month-old calves. These objectives were first met in RY05 and RY06. The third population objective was to maintain a posthunting sex ratio of 35 bulls:100 cows for Units 26B and 26C. Based on the high bull:cow ratios observed in early May 2002 (57:100), and little hunting pressure in RY06 and RY07, we believe our bull:cow ratios exceeded 35.

RECOMMENDATIONS

I recommend initiating a study of nutritional status in Units 26B and 26C comparable to the Unit 26A study. I also recommend cooperating with ANWR to determine moose movements in Units 26B East and 26C and conducting a spring survey using PA-18s in 2009 or 2010. We will issue 20 permits for the DM996 hunt in fall 2008 because harvest rate was low. The following objectives will be in place for the next reporting period:

Management Objectives and Activities

- In Unit 26B, maintain a population of ≥300 moose with a 3-year mean proportion of ≥15% short yearlings in the population.

  Activity: Maintain an open moose season when the objective is met

- In Unit 26C, maintain a population of ≥150 moose with a 3-year mean proportion of ≥15% short yearlings in the population.

  Activity: Maintain an open moose season when the objective is met

- Maintain a bull:cow ratio of ≥35:100 when hunting seasons are open.

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TABLE 1 Unit 26B East (east of the Sagavanirktok, including Canning River) aerial moose composition counts, regulatory years 1998–199 through 2007–2008[a]

Regulatory year	Adults	Short yearlings[b] (%)	Unknown	Moose observed	Search time (hr:min)
1998–1999	129	20 (13)	--	149	n/a
1999–2000[c]	151	14 (8)	--	165	n/a
2000–2001	--	-- --	--	146	n/a
2001–2002	148	22 (13)	--	170	n/a
2002–2003	183	41 (18)	--	224	8:19
2003–2004	219	15 (6)	--	234	8:30
2004–2005	226	62 (22)	--	288	9:12
2005–2006	275	60 (18)	--	335	11:08
2006–2007	267	41 (13)	--	308	10:07
2007–2008[d]	262	47 (15)	--	309	13:50

[a] Data source for 1998–1999 through 2000–2001: F. Mauer, US Fish and Wildlife Service, Arctic National Wildlife Refuge, Fairbanks.
[b] Short yearlings are 11-month-old calves.
[c] Moose were not circled and examined closely, so some short yearlings may have been identified as adults.
[d] Longer search time because sightability was not good due to low snow cover.

TABLE 2 Unit 26B West, excluding the Itkillik River drainage, spring aerial moose surveys, regulatory years 1998–1999 through 2007–2008

Regulatory year	Adults	Short yearlings[a] (%)	Unknown	Moose observed	Search time (hr:min)
1998–1999	50	6 (11)	--	56	n/a
1999–2000	34	10 (23)	--	44	n/a
2000–2001	65	5 (7)	--	70	2:35
2001–2002[b]	56	11 (16)	--	67	n/a
2002–2003	119	40 (25)	1	160	2:59
2003–2004	96	21 (18)	--	117	3:30
2004–2005	133	19 (13)	--	152	3:04
2005–2006	125	25 (17)	--	150	3:12
2006–2007	136	39 (22)	--	175	3:55
2007–2008[c]	121	19 (14)	--	140	6:00

[a] Short yearlings are 11-month-old calves.
[b] The Sagavanirktok River was not surveyed.
[c] Longer search time because sightability was not good due to low snow cover.

TABLE 3 Unit 26B, Itkillik River drainage[a] spring aerial moose surveys, regulatory years 1998–1999 through 2007–2008

Regulatory year	Adults	Short yearlings[b] (%)	Unknown	Moose observed	Search time (hr:min)
1998–1999	26	1 (4)	--	27	2:01
1999–2000	3	0 (0)	--	3	n/a
2000–2001	3	0 (0)	--	3	1:05
2001–2002	6	3 (33	--	9	n/a
2002–2003	11	2 (18)	--	11	1:07
2003–2004	19	8 (30	--	27	1:03
2004–2005	44	6 (12	--	50	1:39
2005–2006	60	6 (9)	--	66	2:25
2006–2007	47	5 (10)	--	52	2:05
2007–2008[c]	59	4 (6)	--	63	3:06

[a] Regulatory years 1998–1999 through 2003–2004 included the portion below Itkillik Lake to the mouth. In regulatory year 1998–1999 and since regulatory year 2004–2005, the area includes the headwaters of the Itkillik River to the mouth.
[b] Short yearlings are 11-month-old calves.
[c] Longer search time because sightability was not good due to low snow cover.

TABLE 4 Unit 26B East, Unit 26B West, and Itkillik River drainage spring aerial moose surveys, regulatory years 2003–2004 through 2007–2008

Regulatory year	Adults	Short yearlings[a] (%)	Unknown	Moose observed	Search time (hr:min)[b]
2003–2004	334	44 (12)	--	378	13:03
2004–2005	403	87 (18)	--	490	13:55
2005–2006	461	90 (16)	--	551	16:45
2006–2007	443	84 (16)	--	527	16:07
2007–2008	442	70 (14)	--	512	22:56

[a] Short yearlings are 11-month-old calves.
[b] Beginning in 2005–2006, search time in the upper Itkillik drainage increased. In 2007–2008, search time increased because sightability was not good due to low snow cover.

TABLE 5 Unit 26C, Kongakut (above Mount Greenough; 199 mi^2) and Firth Rivers and Mancha Creek (372 mi^2) early winter aerial moose composition, regulatory years 1991–1992 through 2002–2003[a]

Regulatory year	Bulls:100 Cows (*n* bulls)	Yearling bulls:100 Cows (*n* yearling bulls)	Calves:100 Cows (*n* cows)	Calves	Percent calves	Adults	Moose observed
1991–1992	84 (140)	21 (36)	38 (167)	63	15	343	406
2000–2001	92 (57)	26 (16)	35 (62)	22	14	135	157
2002–2003	92 (88)	21 (20)	24 (96)	23	10	204	227

[a] *Data source*: Compiled from U.S. Fish and Wildlife Service data.

TABLE 6 Unit 26B reported moose harvest, regulatory years 1990–1991 through 2007–2008[a]

Regulatory year	Reported harvest M (%)	F (%)	Unk	Total	Hunters (% success)
1990–1991	24 (100)	0 (0)	0	24	45 (53)
1991–1992	28 (100)	0 (0)	0	28	49 (57)
1992–1993	45 (100)	0 (0)	0	45	90 (50)
1993–1994	30 (100)	0 (0)	0	30	84 (36)
1994–1995	37 (100)	0 (0)	0	37	85 (43)
1995–1996	17 (100)	0 (0)	0	17	63 (27)
1996–1997 through 2005–2006[b]					
2006–2007	7 (100)	0 (0)	0	7	13 (54)
2007–2008	3 (100)	0 (0)	0	3	11 (27)

[a] General harvest ticket during regulatory years 1990–1991 through 1995–1996; includes DM996 since regulatory year 2006–2007.
[b] No open season.

TABLE 7 Unit 26C reported moose harvest, regulatory years 1990–1991 through 2007–2008

Regulatory year	Reported harvest M (%)	F (%)	Unk	Total	Hunters
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 2007–2008[a]					

[a] No open season.

TABLE 8 Units 26B and 26C moose hunter residency and success, regulatory years 1990–1991 through 2007–2008[a]

Regulatory year	Successful					Unsuccessful					Total hunters
	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	Local[b] resident	Nonlocal resident	Nonresident	Unk	Total (%)	
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	4	17	0	21 (28)	1	33	17	0	51 (72)	72
1996–1997 through 2005–2006[c]											
2006–2007	0	7	n/a	0	7 (54)	0	6	n/a	0	6 (46)	13
2007–2008	0	3	n/a	0	3 (27)	0	8	n/a	0	8 (73)	11

[a] *Source*: General moose harvest reports during regulatory years 1990–1991 through 1995–1996; includes DM966 since regulatory year 2006–2007.
[b] Residents of Units 26B or 26C.
[c] No open season.

TABLE 9 Units 26B and 26C moose harvest chronology percent by time period, regulatory years 1990–1991 through 2007–2008[a]

Regulatory year	Harvest chronology percent by time period								
	9/1–9/8	9/9–9/15	9/16–9/22	9/23–9/28	9/29–10/5	Oct	Mar	Dec/Jan	*n*
1990–1991	41	52	0					7	27
1991–1992	53	41						6	34
1992–1993	63	37							49
1993–1994	59[b]	35	3					3	34
1994–1995	61	36	3					2	41
1995–1996	39	56	0				5		18
1996–1997 through 2005–2006[c]									
2006–2007	100	0	n/a	n/a	n/a	n/a	n/a	n/a	7
2007–2008	100	0	n/a	n/a	n/a	n/a	n/a	n/a	3

[a] *Source*: General moose harvest reports during regulatory years 1990–1991 through 1995–1996; includes DM966 since regulatory year 2006–2007.
[b] One moose reported taken in August.
[c] No open season.

TABLE 10 Units 26B and 26C moose harvest percent by transport method, regulatory years 1990–1991 through 2007–2008[a]

Regulatory year	Harvest percent by transport method								*n*
	Airplane	Horse	Boat	3- or 4-wheeler	Snowmachine	Airboat	Highway vehicle	Unknown	
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	86	0	0	0	0	0	14	0	21
1996–1997 through 2005–2006[b]									
2006–2007	71	0	0	0	0	14	14	0	7
2007–2008	33	0	0	0	0	33	33	0	3

[a] *Source*: General moose harvest reports during regulatory years 1990–1991 through 1995–1996; includes DM966 since regulatory year 2006–2007.
[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.

Photo by Don Young, ADF&G